

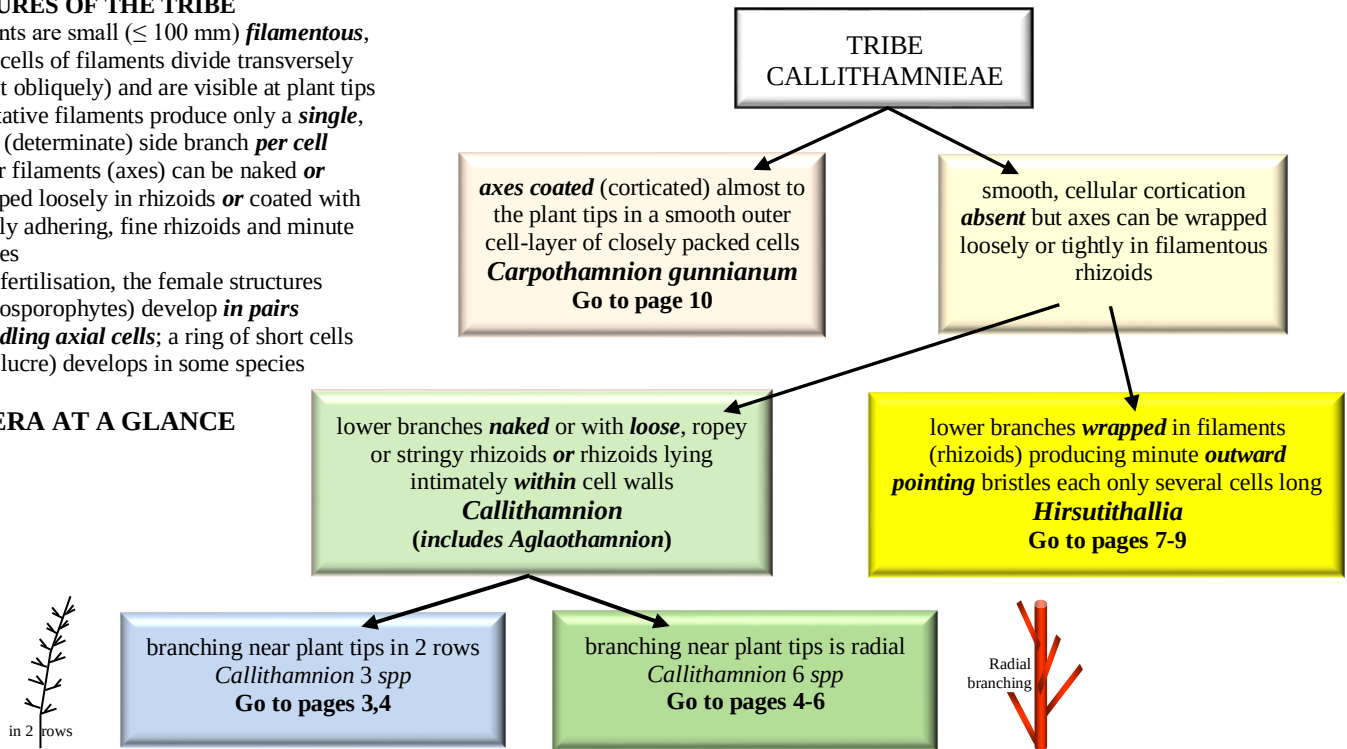
FILAMENTOUS RED ALGAE PART XIII: TRIBE CALLITHAMNIEAE OF THE FAMILY CERAMIACEAE

- This guide** Formal classification of algae relies on investigating microscopic reproductive features in detail. Often a complete set of reproductive stages is unavailable in the specimens to be investigated, making identification very difficult if the technical systematic literature is used. Fortunately some algae grow in specific places and some have recognisable shapes that allow them to be sorted directly into the level of Genus or Family and so shortcut a systematic search through intricate and often unavailable reproductive features. The materials below use this **artificial** way of searching for a name. Then you can proceed to the appropriate fact sheets or keys to refine your identification.
- Limitations** Unfortunately, to use this search strategy, microscopic investigation of specimens will be needed. Also, this guide overlaps somewhat with “**filamentous red algae: Part I**” and species may appear in more than one step of the key in order to capture those that may have variable shapes.
- Images used below** Unless acknowledged otherwise, all images come from pressed specimens or the extensive slide collection of the algal unit, State Herbarium of S. Australia, collections generated by the late Professor Womersley and his workers over some 60 years. Images with dark backgrounds have been taken using phase contrast or interference microscopy to highlight transparent structures. Other images may be stained dark blue.
- Scale** The coin used as a scale is 24 mm or almost 1” across.
- Names** Scientific names and means of sorting the species follow that found in Womersley, H B S. (1984-2003). *The Marine Benthic Flora of southern Australia*, as it continues to provide the most comprehensive and accessible account. Recent name changes from the Website **Algaebase** have been added.

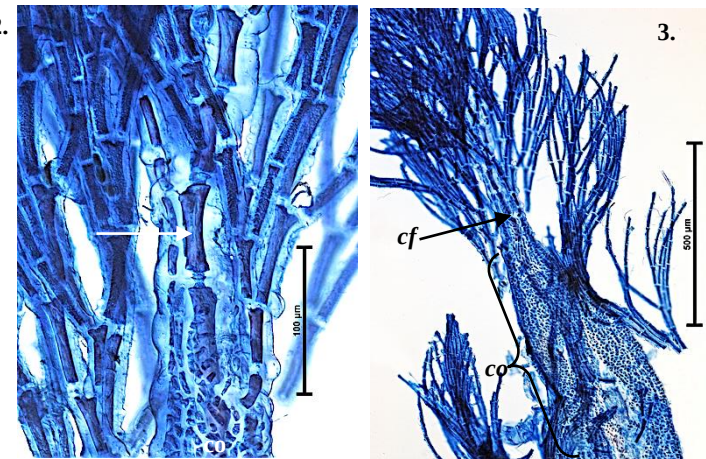
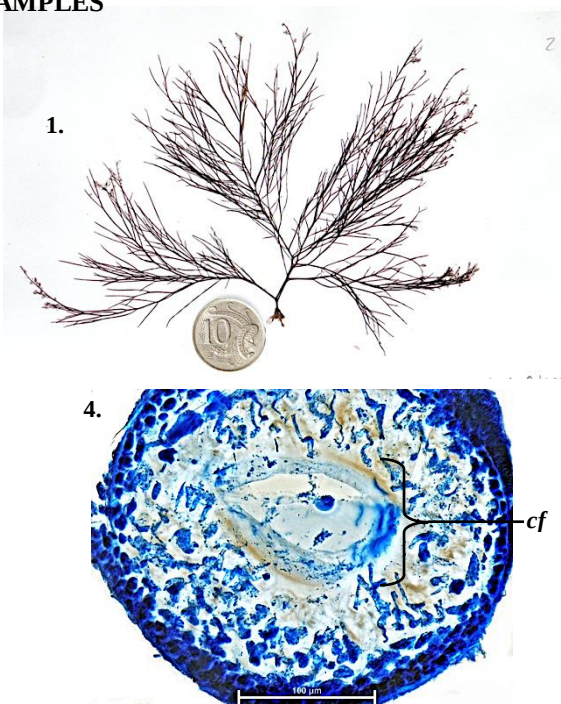
FEATURES OF THE TRIBE

- plants are small (≤ 100 mm) **filamentous**, tip cells of filaments divide transversely (not obliquely) and are visible at plant tips
- vegetative filaments produce only a **single**, short (determinate) side branch **per cell**
- major filaments (axes) can be naked **or** wrapped loosely in rhizoids **or** coated with closely adhering, fine rhizoids and minute bristles
- after fertilisation, the female structures (carposporophytes) develop **in pairs straddling axial cells**; a ring of short cells (involucre) develops in some species

GENERA AT A GLANCE



EXAMPLES



Carpothamnion gunnianum

- Fig. 1. whole plant, **surfaces smooth**, filaments exposed only at tips
- Fig. 2. upper parts; central filament exposed (arrowed) above, below, covered by rhizoids and small cells (cortication, **co**) forming
- Fig. 3. plant tip, central filament (**cf**) initially exposed but **rapidly covered** (corticated, **co**) below
- Fig. 4. cross section; large central filament cell (**cf**) wrapped in rhizoids and small outermost cells

EXAMPLES (continued)



5.



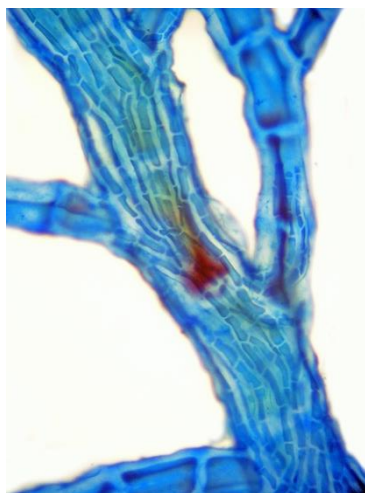
6.

Callithamnion

example: *C. circinnatum*

Fig. 5. whole plant, base ropey or stringy in this sp

Fig. 6. detail **naked upper branches** with spores and short side branches with **radial branching**



7.



8.

Callithamnion

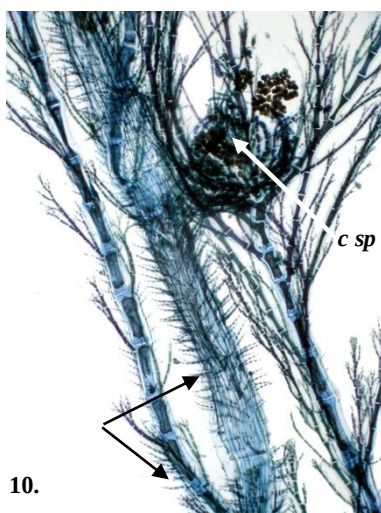
example: *C. pinnatum*

Fig. 7. lower axis cells with rhizoids running through the cell walls

Fig. 8. plant tips, short side branches in **2 rows** from each axial cell



9.



10.

Hirsutithallia example: *H. angustata*

see also **“some felty, ropey, stringy, furry, fuzzy, fluffy Red algae”**

Fig. 9. whole plant

Fig. 10. microscopic detail of branching pattern; fine, **closely adhering** rhizoids that produce **outward-pointing bristles** (arrowed); female reproductive structure (**c sp**) with ring of short branches (involucre) at the base

CALLITHAMNION AT A GLANCE (PAGES 3-6)

Of the 10 species in southern Australia, *Callithamnion circinnatum*, *C. confertum*, *C. pinnatum* and *C. propebyssoides* are considered rare. Fact Sheets for them can be found in this Website. They are included below for completeness, however.

Most the southern Australian species of *Callithamnion* have been placed in the genus *Aglaothamnion* in “Algaebase”.

Refer to the table on page 12 for these name changes



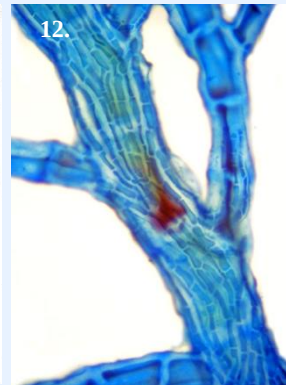
BRANCHING NEAR PLANT TIPS IS IN 2 ROWS

Callithamnion pinnatum

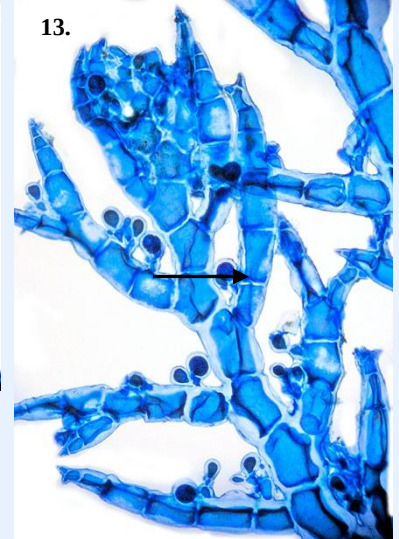
- plants pale red
- rhizoids at bases are **intimately pressed** against the large axial cells of the filament
- recorded for only 2 sites in Victoria



11.



12.

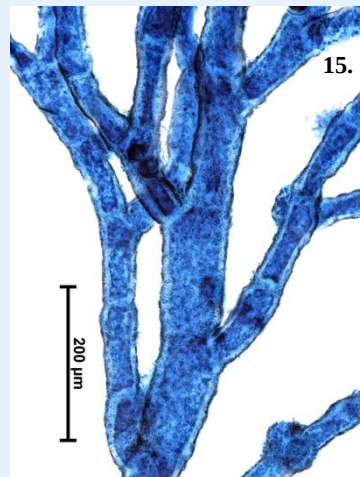
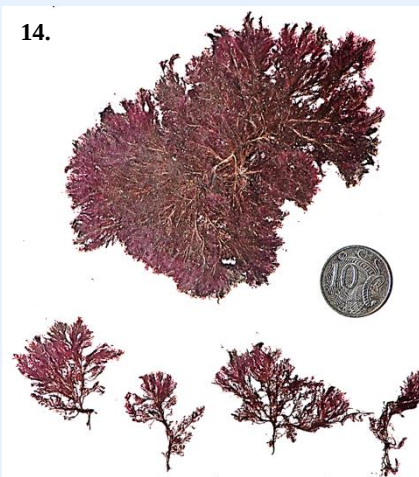


13.

- Fig. 11. whole plant, pale red
 Fig. 12. near the plant base; **closely adhering rhizoids** (arrowed) obscuring the large-celled axial filament beneath
 Fig. 13. tip displaying 2-sided branching pattern, spores in groups of 1-3, **on small stalks**

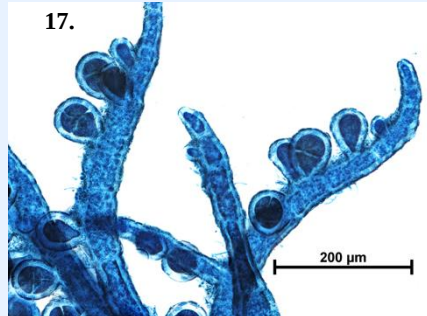


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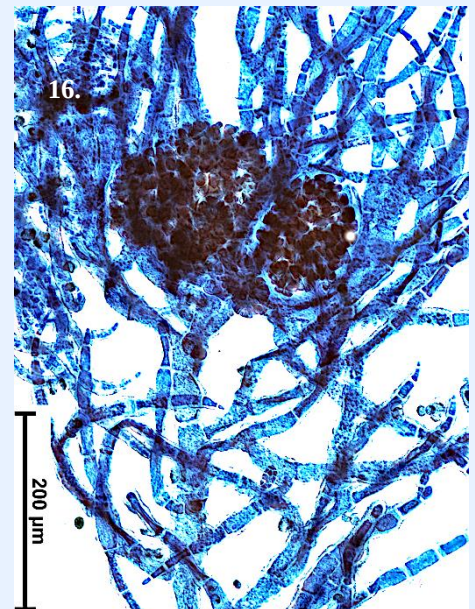


15.

- Fig. 14. whole plants
 Fig. 15. axis, free of rhizoids, basal cells of side branches $\frac{1}{2}$ width of axial cells
 Fig. 16. paired, **rounded**, female structures (carposporophytes)
 Fig. 17. stalkless spores on **inner side** of short branches



17.



16.

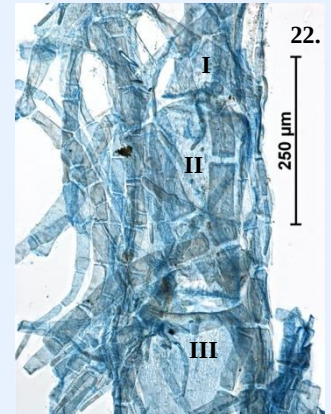
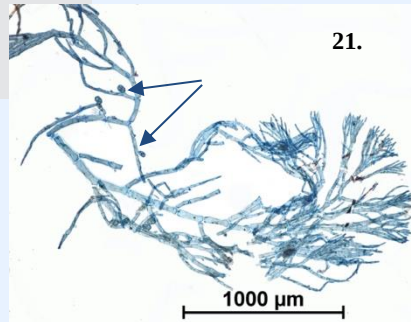
Callithamnion violaceum

(as *Aglaothamnion violaceum* in *Algaebase*)

- plants densely branched, dark red
- rhizoids **absent** or **loose**
- basal cells of the short side branch cells $\frac{1}{2}$ width of axial cells
- spores on **inner sides** (adaxial) of short branches

Callithamnion obstipum (as *Aglaothamnion obstipum* in *Algaebase*)

- plants only 10-20 mm tall
- axial cells wide (up to 250µm), **walls thick**
- in the middle of the plant, basal cells of side branches are only about ¼ the width of axial cells



Figs 18, 19. whole plants
 Fig. 20. lower axial cells, thick cell walls, short laterals with basal cells ¼ the width of axial cells, immature (undivided) stalkless spores on LHS branch tuft upper branches, stalkless spores present (arrowed)
 Fig. 21. basal cells (I, II, III), loosely surrounded by rhizoids

BRANCHING NEAR PLANT TIPS IS RADIAL

Callithamnion circinnatum

(as *Aglaothamnion circinnatum* in *Algaebase*)

- plants up to 120mm tall
- densely tufted
- side branches ending in a point, after 8-12 cells
- lower axes with **recurved** branches
- recorded for only 2 localities in S Australia

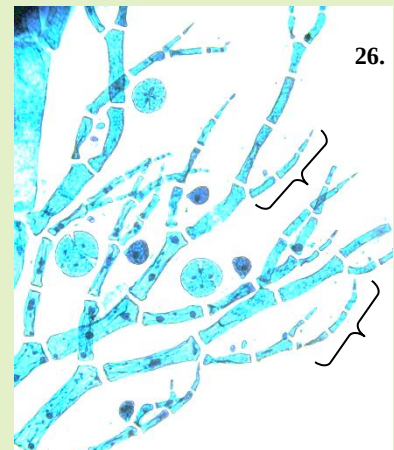
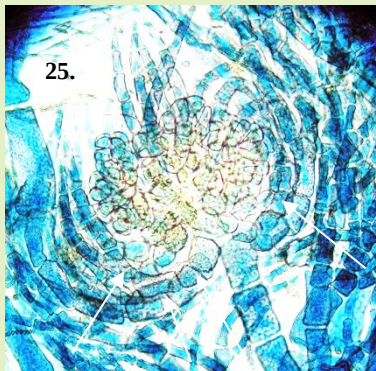
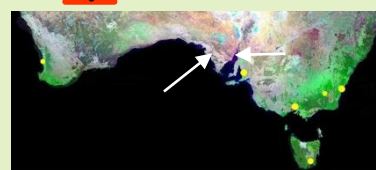


Fig. 23. whole plant
 Fig. 24. lower axial cells, recurved short side branches
 Fig. 25. female reproductive structure (cystocarp), short side branches at the base forming an involucre (arrowed)
 Fig. 26. tips of short side branches, ending in only a few cells (2 bracketed); stalkless spores present also

Callithamnion pseudobyssoides

(as *Aglaothamnion pseudobyssoides* in *Algaebase*)

- plants floppy, with dense, flat-topped apical tufts
- basal cells without a rhizoid coat
- axial cells narrow, about 50µm wide
- paired female structures (carposporophytes) with a cluster of short branches at the base



Fig. 27. dense flat-topped apical clusters base with

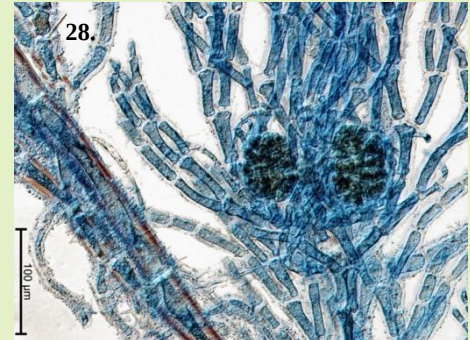


Fig. 28 paired carposporophytes; axis rhizoids but no rhizoidal coat

Callithamnion shepherdii

(as *Aglaothamnion shepherdii* in *Algaebase*)

- basal axial cells coated in rhizoids
- tip cells about 4µm wide, length/breadth ≈ 8
- cells **uninucleate**

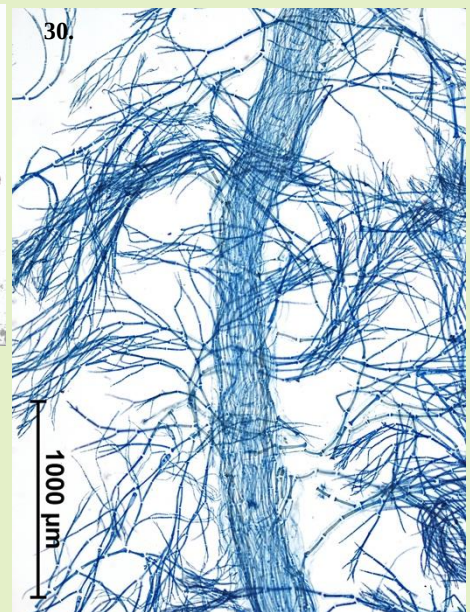
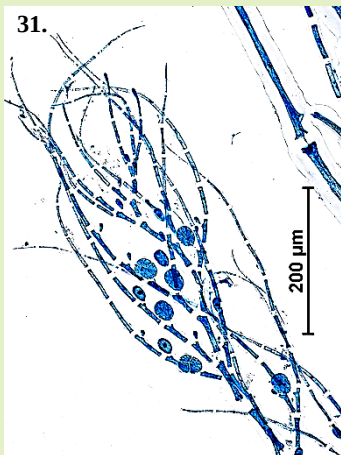


Fig. 29. whole plants on the red alga *Osmundaria*

Fig. 30. axis heavily wrapped in rhizoids

Fig. 31. elongate axial cells and side tuft with stalkless spores

Fig. 32. apical tufts with paired, rounded female structures (carposporophytes)

Callithamnion caulescens

- tip cells about 6µm wide, length/breadth ≈ 2 , often ending in a hair
- very similar to *C. shepherdii* (above), but cells **multinucleate** ⚠

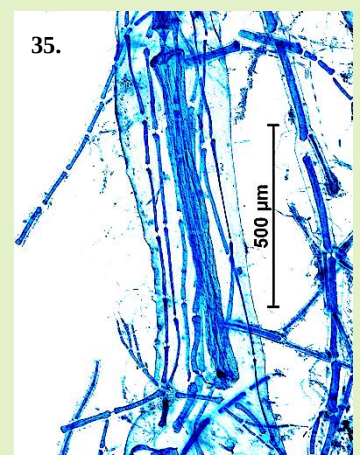
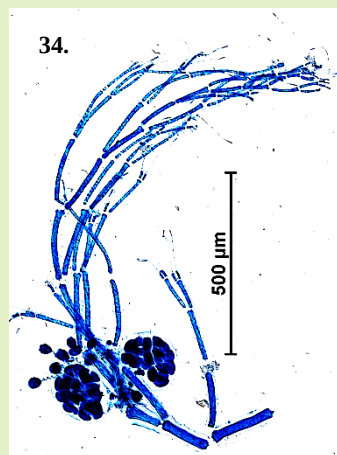


Fig. 33. whole plants

Fig. 34. apical tufts with paired, rounded female structures (carposporophytes)

Fig. 35. elongate axial cell near plant base, rhizoids within the cell wall

Callithamnion confertum

(as *Aglaothamnion confertum* in Algaebase)

- axial cells relatively short
- side tufts with crowded branches
- basal cells of short branches about 50µm wide
- female reproductive structures (carposporophytes) **rounded** ⚠
- found only at a single site? on other algae

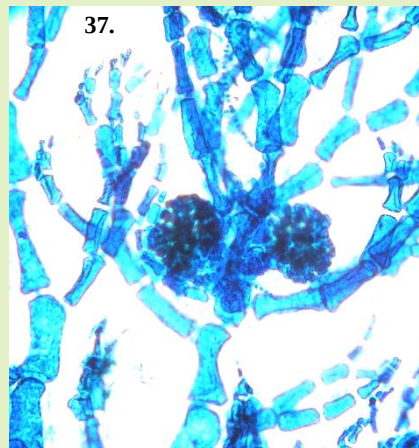


Fig. 36. whole plants originally growing on the Green alga, *Caulerpa brownii*

Fig. 37. stubby side branches, paired, **rounded** female reproductive structures (carposporophytes)

Fig. 38. dense side branches, radially arranged



Callithamnion propebyssoides as *Aglaothamnion propebyssoides* in Algaebase

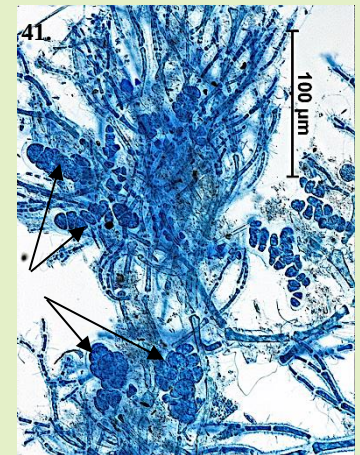
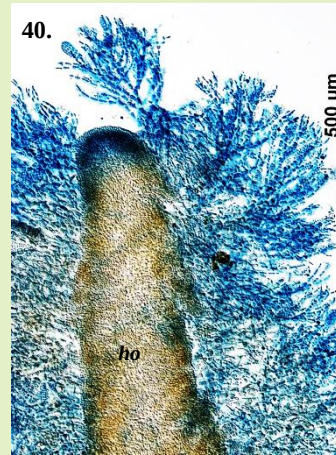
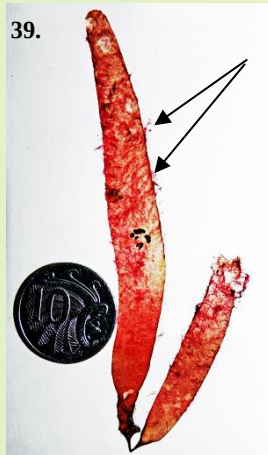
- only 5-15mm tall
- grows on gelatinous Red algae
- paired female reproductive structures (carposporophytes) **lobed**



Fig. 39. the Red alga, *Gloiosaccion*, with a surface "fuzz" of *C. byssoides* (arrowed)

Fig. 40. surface microscope view of the surface "fuzz" on the host (**ho**)

Fig. 41. axes and side branches similar, carposporophytes lobed (two pairs are arrowed)



Callithamnion propebyssoides (as *Aglaothamnion propebyssoides* in Algaebase)

- side branches are **short**, but obvious
- tip cells are **very small**, 6-9 µm long
- paired female spore-structures (carposporophytes) are **lobed**
- only known from Port Broughton, on the Brown alga, *Caulocystis* and very similar to *C. byssoides* ⚠

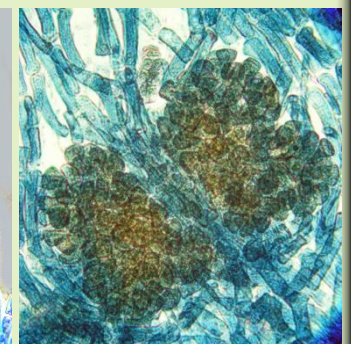
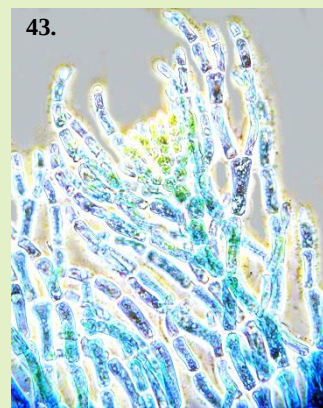
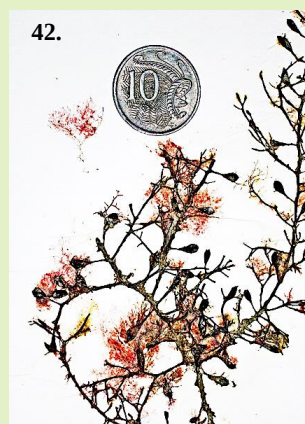
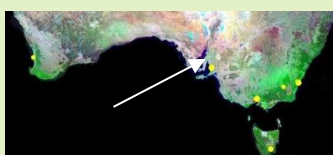


Fig. 42. plants on the Brown alga, *Caulocystis*

Fig. 43. plant tips with **small** tip cells

Fig. 44. paired female spore structures (carposporophytes, **ca sp**) are **lobed**

HIRSUTITHALLIA AT A GLANCE (pages 7-9)

Hirsutithallia mucronata

- tip cells pointed
- dense rhizoid coating practically to the plant tips
- plant grows on other algae



Fig. 45. whole plant

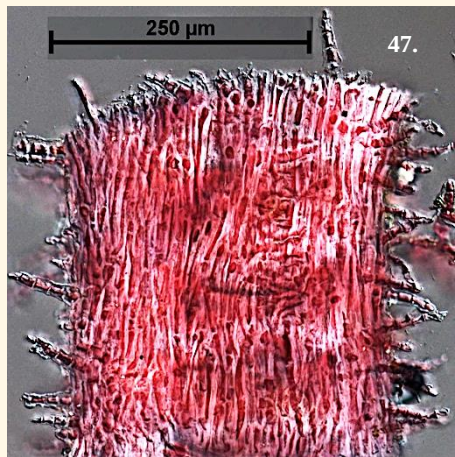
Fig. 46. dense, stiff short side branches

Fig. 47. axis from the plant base; dense rhizoids cover the underlying large axial cells and produce minute, outward-pointing bristles

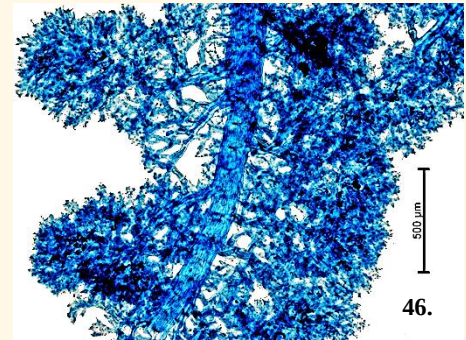
Fig. 48. detail of a short branch



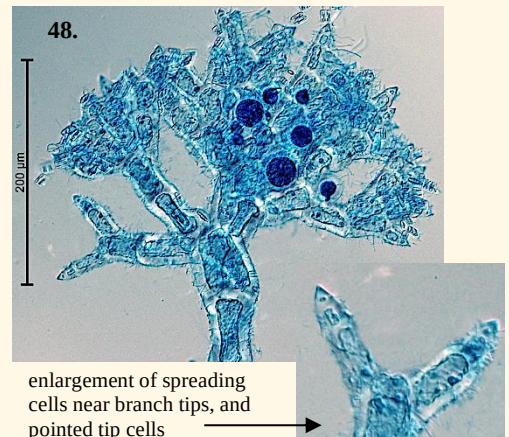
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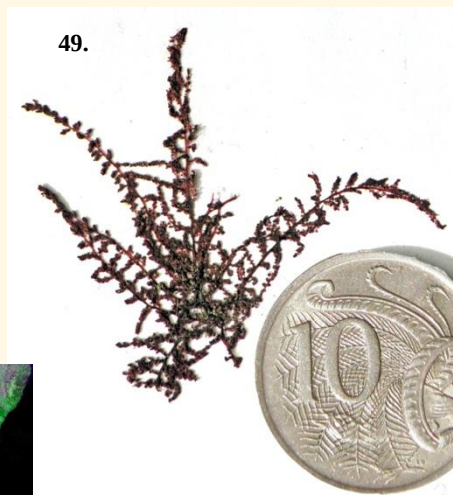
46.



enlargement of spreading cells near branch tips, and pointed tip cells

§ *Hirsutithallia laricina*

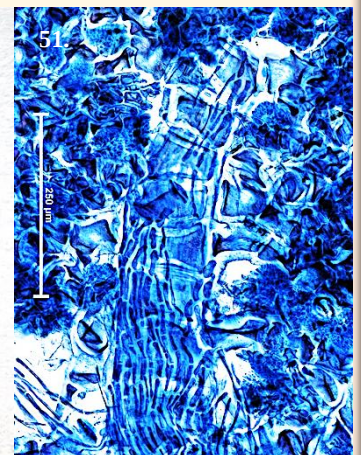
- tip cells rounded
- rhizoids coat axes practically to the plant tips
- cells of side branches about 250μm long
- side branches radially branched or branched on one side
- often grows on *Posidonia* sea grass



49.



50.



51.

Fig. 49. whole plant

Fig. 50. detail of branching pattern

Fig. 51. stubby axial cells visible beneath rhizoidal covering; side branches of small cells

§ an underwater image can be seen in Huisman, J.M. (2019). *Marine plants of Australia* Revised edition. Crawley Western Australia: UWA Publishing.

Hirsutithallia tinctoria

- minute, dense, outward-pointing bristles
- short side branches radially branched
- basal cells of side branches about 70 μm wide

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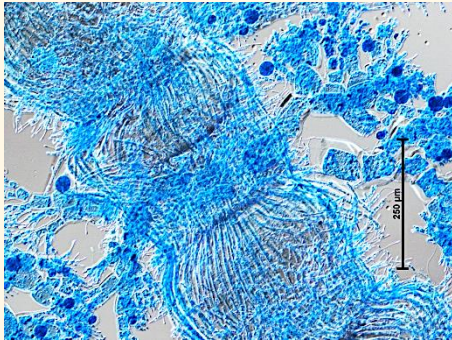


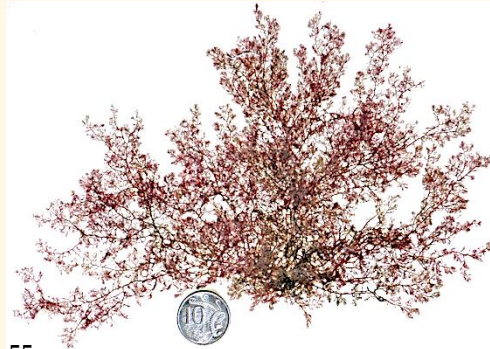
Fig. 52. whole plant

Fig. 53. branching pattern

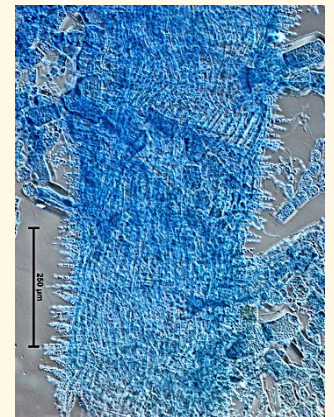
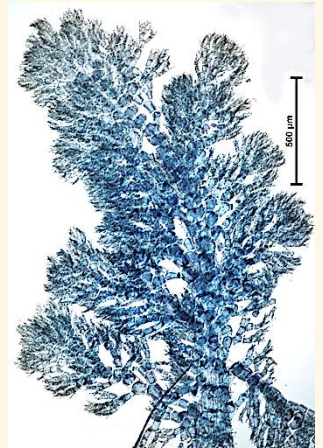
Fig. 54. bulging axial cells covered with rhizoids bearing outward-pointing bristles; densely stained sporangia

Fig. 55. spreading branching pattern in detail

Fig. 56. broad axial cells obscured by a coat of rhizoids bearing outward-pointing bristles



55.



Hirsutithallia abaxialis

- branch tufts of the short side branches tend to be on outer sides (abaxial)  diagnosis can be difficult
- basal cells of side branches are about 120 μm wide
- only known from 1 locality, on sea-grasses 



Fig. 57. whole plants on sea-grass leaves

Fig. 58. axis of box-shaped cells obscured by rhizoids, densely branched short side branches

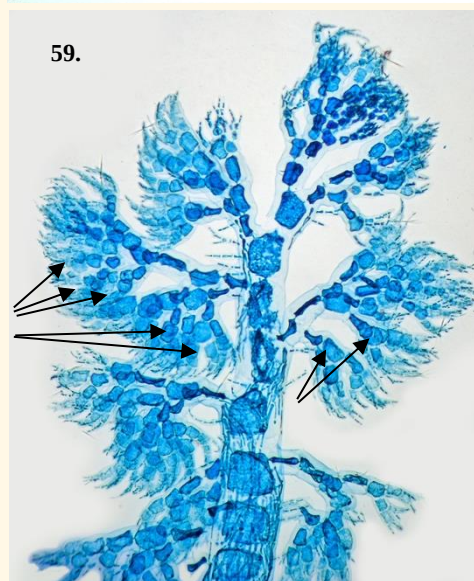
Fig. 59. branching pattern: 3 sets (arrowed) of tufts arising on the outer sides of short branches

Fig. 60. darkly stained, paired, lobed female structures (carposporophytes) (arrowed) lacking a basal ring (involucre) of branches

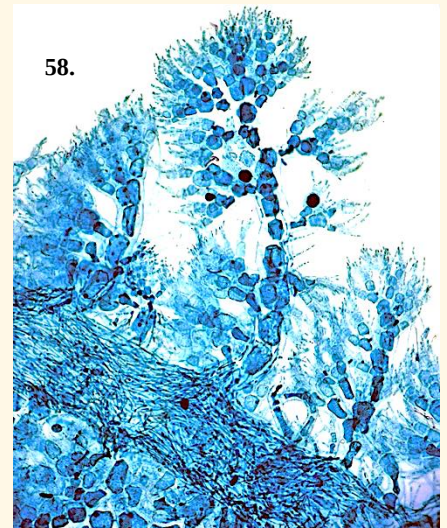
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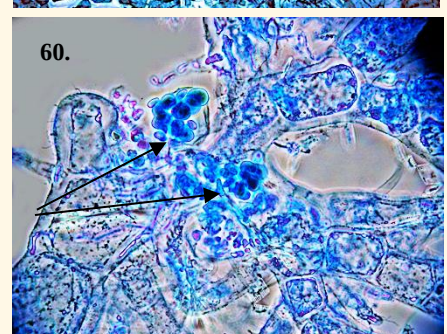
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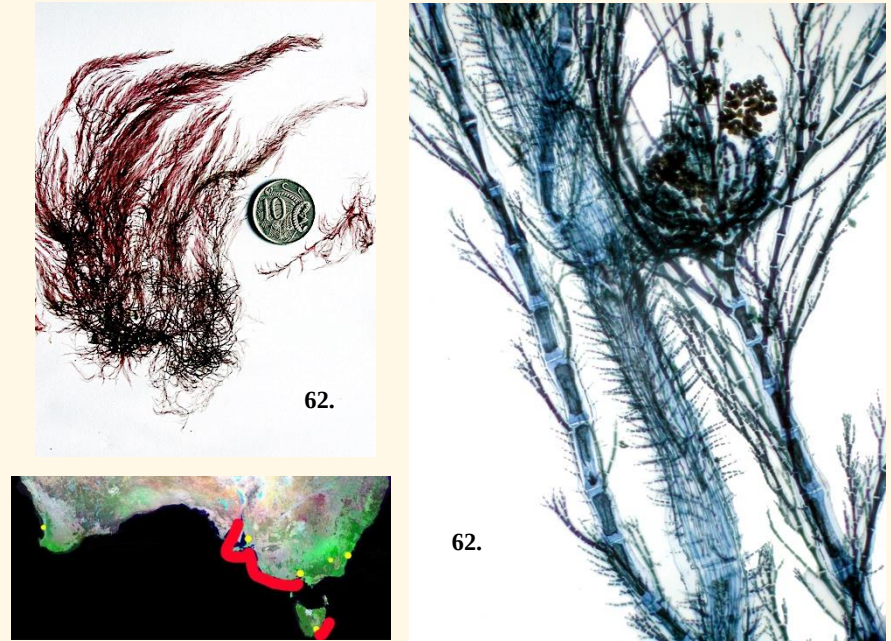
60.



Hirsutithallia angustata

- plant slender and floppy
- axis cells covered with rhizoids mainly at the plant base
- axial cells are elongate, > 5 times longer than wide in upper parts of plants
- the paired female structures (carposporophytes) have a basal ring of short branches (involucre)

Fig. 61. whole plant
Fig. 62. details of thin axes - one naked, one with a light covering of rhizoids bearing outward-pointing bristles, and an older axis covered in rhizoids and bristles; side branches are short; spores have exuded from the female structure (carposporophyte) exposing a basal ring of short branches

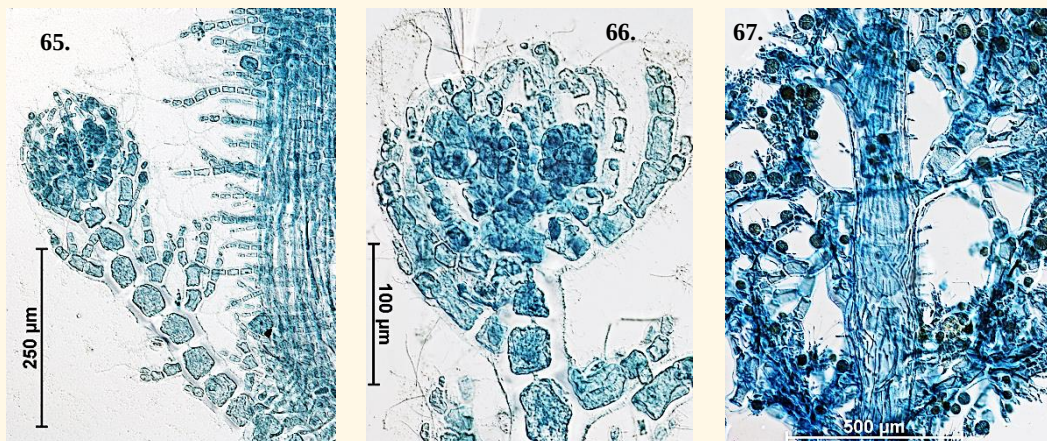
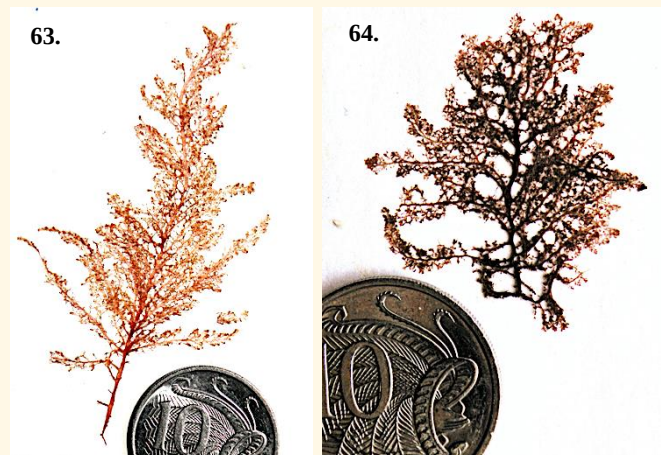


Hirsutithallia formosa

- plants are relatively robust and openly branched
- cells are about as long as broad
- axis cells covered with rhizoids are found mainly at the plant base
- the paired female structures (carposporophytes) are irregularly lobed and have a basal ring of short branches (involucre)



Figs 63, 64. two whole plants
Fig. 65. towards the plant base, short side branch tipped with paired carposporophytes ringed at the base by short branches (involucre)
Fig. 66. detail of paired carposporophytes
Fig. 67. axis lightly clothed in rhizoids, short side branches with densely staining spores



CARPOTHAMNION GUNNIANUM AT A GLANCE

- axes with a **central filament** of large cells, wrapped in a thick layer of filamentous **rhizoids** from near plant tips and **coated** (corticated) almost to the plant tips in a smooth, outer cell layer of **closely-packed cells**
- tufts** of naked, filamentous, radially-branched, short, side-branches occur; single cells arise from each of the main cells, a characteristic of the Tribe: Callithamnieae
- when tufts are denuded, a smooth, narrow-branched plant body remains, requiring a cross section in order to detect the central large-celled filament wrapped in numerous rhizoids and coated with closely-packed small cells that are diagnostic of the genus

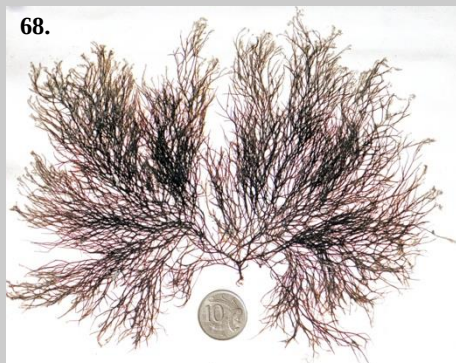


Fig. 68. whole plant



Fig. 69. detail of branched axes, denuded of short side tufts

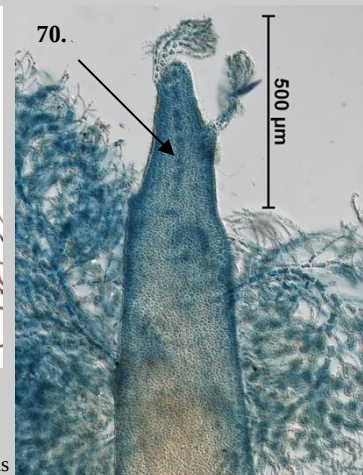


Fig. 70. microscope view of the plant tip with filamentous tufts intact; central large-celled filament still visible (arrowed) towards the tip before becoming covered by rhizoids and a coating of small cells



Fig. 71. details of filamentous short-branches

Fig. 72. at plant tip, central filament still exposed in the axis

Fig. 73. fully developed side branch

Fig. 73. upper part of a side branch, single branches arising from each of the main cells, a characteristic of the Tribe

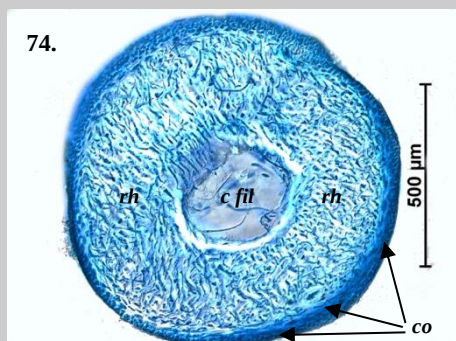


Fig. 74. cross section of an axis; central large filament cell (**c fil**), wide "wrapping" of filamentous rhizoids (**rh**) outer closely-packed layer of small cells (cortex, **co**)

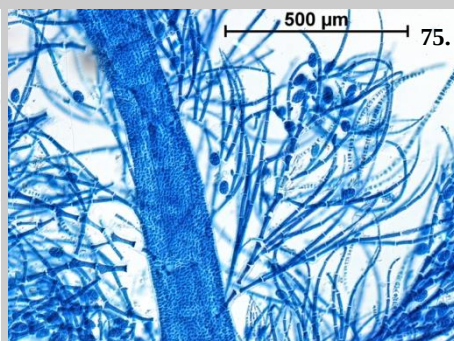
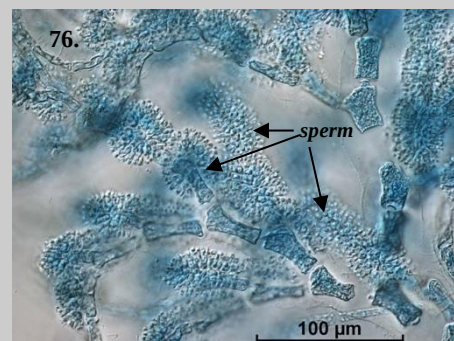


Fig. 75. axis and side-branches bearing deeply staining spores

Fig. 76. side branch bearing clusters of male spermatangia (**sperm**)



CALLITHAMNIEAE LOOK-ALIKES

Dasythamniella 5 spp

Tribe: Compsothamnieae

similarities:

- plants are filamentous
- axes are wrapped in rhizoids
- each axial cell of short (determinate) branches produces a single cell

differences

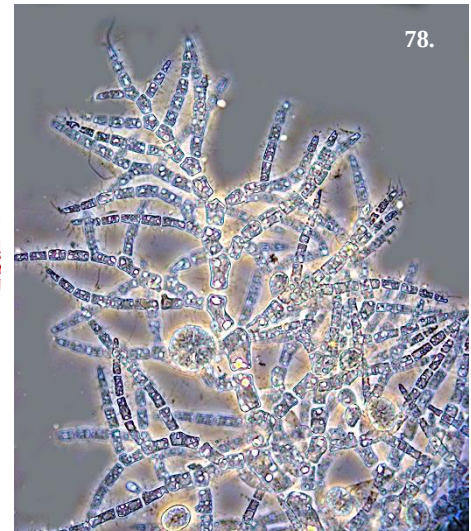
- plants are often larger
- carposporophytes are **not** twinned **nor** do they straddle axial cells, but several are formed sequentially on short fertile branches



EXAMPLE:

Fig. 77. whole plant of *Dasythamniella superbiens*

Fig. 78. Detail of branching of a short side branch; globular spores



Spongoclonium and *Lophothamnion*

Tribe: Spongoconieae

similarities:

- plants are filamentous
- axes are often wrapped in rhizoids
- axial cells produce short side branches (determinate branches)

differences

- plants are often larger
- carposporophytes are **not** twinned **nor** do they straddle axial cells, but appear to form at tips of short branches
- side branches may crowd over ("over-top") and obscure tips of plants
- spores may be divided into 4 or more parts; (polysporangia) are produced in *Lophothamnion*

EXAMPLE: SPONGOCLONIUM

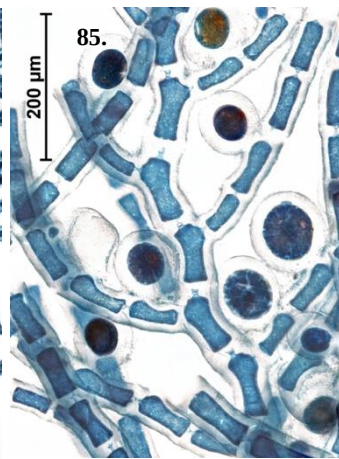
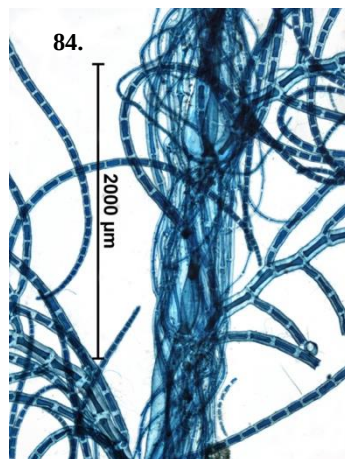
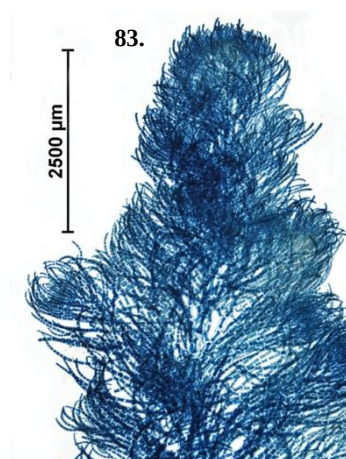
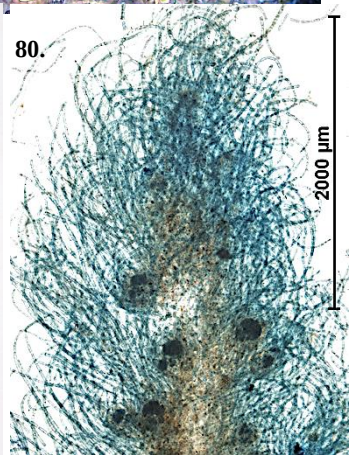
Fig. 79. pressed plant of *Spongoclonium conspicuum*

Fig. 80. detail of side branches overtopping the plant tip; dark masses of carposporophytes on short side branches

79.



80.



EXAMPLE: LOPHOTHAMNION

Fig. 81. pressed plant of

Lophothamnion hirtum

Fig. 82. dense branching at tips

Fig. 83. short branches

overtopping the plant tip

Fig. 84. axis wrapped in rhizoids

Fig. 85. short branches with polysporangia



ACKNOWLEDGEMENT

Thanks to Carolyn Ricci of the State Herbarium of South Australia who gave helpful advice and also edited the material.

LIST OF SPECIES ILLUSTRATED

species	author/s	page/s	name in <i>Algaebase</i>	author/s
<i>Callithamnion byssoides</i> (syn.)	Arnott ex Harvey	6	<i>Aglaothamnion tenuissimum</i>	(Bonnemaison) Feldmann_Mazoyer
<i>Callithamnion caulescens</i>	(J. Agardh) Womersley	5		
<i>Callithamnion circinnatum</i> (syn.)	Womersley	2, 4	<i>Aglaothamnion circinnatum</i>	(Womersley) Cormaci, G. Furnari & Alongi
<i>Callithamnion confertum</i> (syn.)	Womersley	6	<i>Aglaothamnion confertum</i>	(Womersley) Cormaci, G. Furnari & Alongi
<i>Callithamnion obstipum</i> (syn.)	(Cowling, Kraft & J.A.West) Womersley	4	<i>Aglaothamnion obstipum</i>	Cowling, Kraft & J.A.West
<i>Callithamnion pinnatum</i>	Womersley	2, 3		
<i>Callithamnion propebyssoides</i> (syn.)	Womersley	6	<i>Aglaothamnion propebyssoides</i>	(Womersley) Cormaci, G. Furnari & Alongi
<i>Callithamnion pseudobyssoides</i> (syn.)	P. Crouan & H. Crouan	5	<i>Aglaothamnion pseudobyssoides</i>	(P. Crouan & H. Crouan) Halos
<i>Callithamnion shepherdii</i> (syn.)	Womersley	5	<i>Aglaothamnion shepherdii</i>	(Womersley) Cormaci, G. Furnari & Alongi
<i>Callithamnion violaceum</i> (syn.)	Harvey	3	<i>Aglaothamnion violaceum</i>	(Harvey) Cormaci, G. Furnari & Alongi
<i>Carpothamnion gunnianum</i>	(Harvey) Kützing	1, 10		
<i>Dasythamniella</i>		11		
<i>Hirsutithallia abaxialis</i>	Wollaston & Womersley	8		
<i>Hirsutithallia angustata</i>	(Hooker f. & Harvey) Wollaston & Womersley	2, 9		
<i>Hirsutithallia formosa</i>	(Harvey) Wollaston & Womersley	9		
<i>Hirsutithallia laricina</i>	(Harvey) Wollaston & Womersley	7		
<i>Hirsutithallia mucronata</i>	Wollaston & Womersley	7		
<i>Hirsutithallia tinctoria</i>	Wollaston & Womersley	8		
<i>Lophothamnion</i>		11		
<i>Spongoclonium</i>		11		