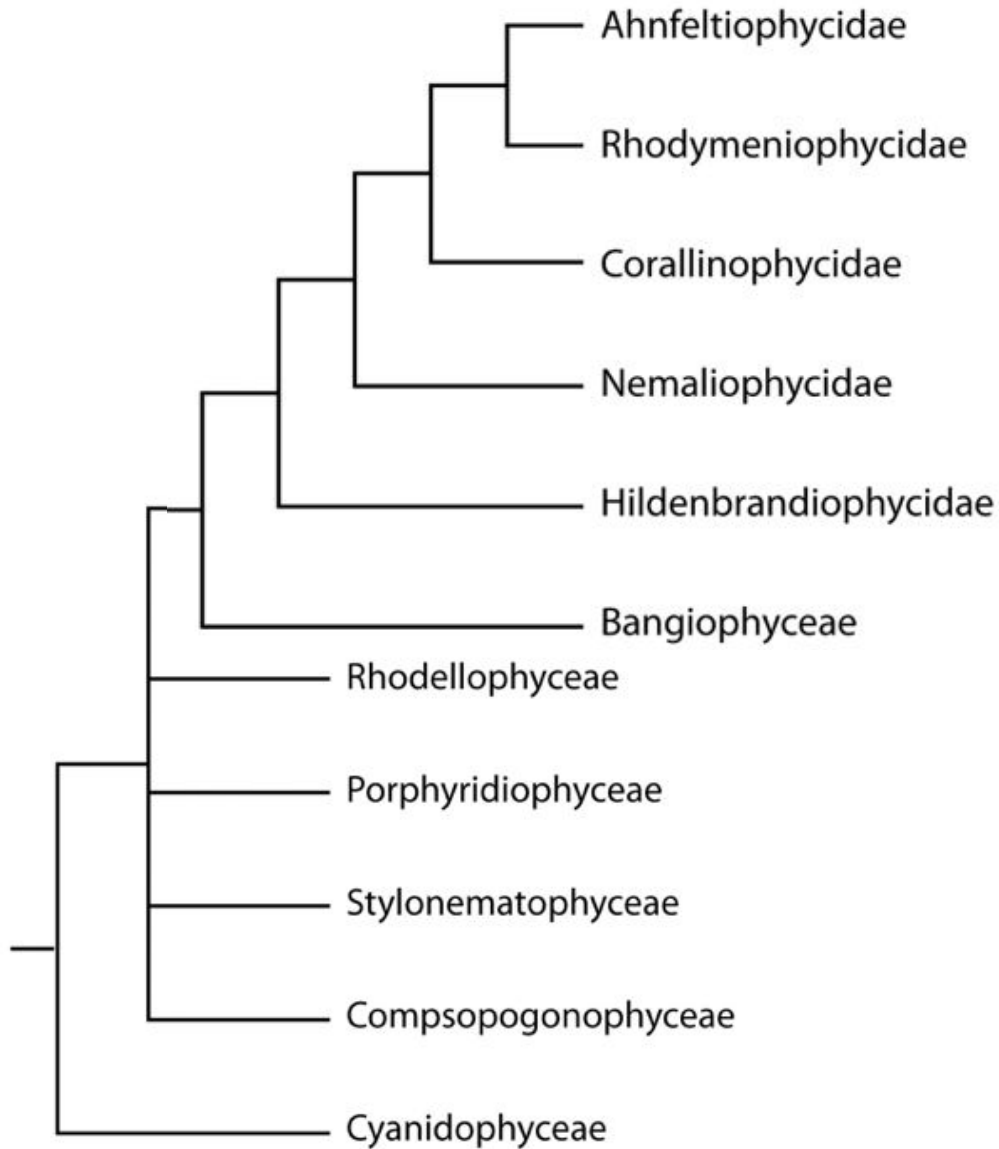


FLORIDEOPHYCEANS or FLORIDEANS



- Morphology: filamentous to pseudoparenchymatic thalli
- Growth is usually Apical
- Plastids usually many per cell, no pyrenoids!
- Life cycle usually triphasic (biphasic in some)
- Reproductive structures well differentiated, carpogonium & trichogyne
- Pit connections always present (several types of pit plugs)
- Floridean algae are a monophyletic group

Evolution of Red Algae

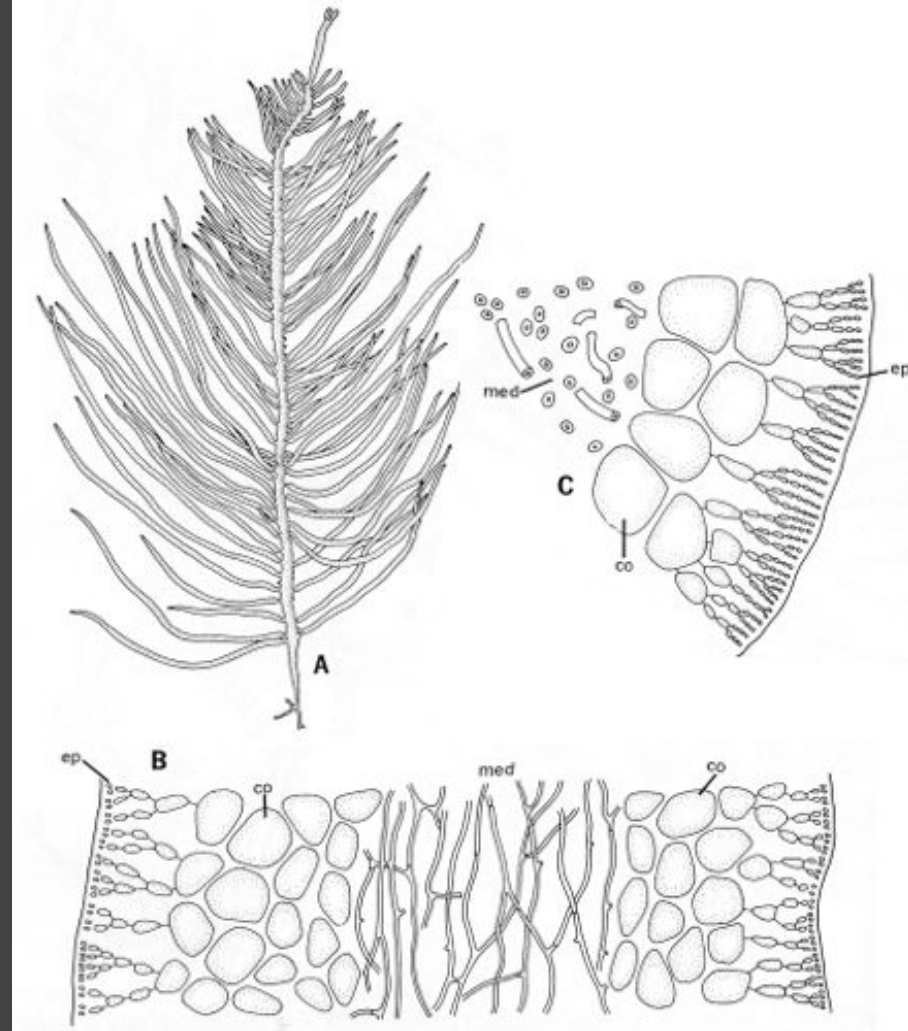


Florideophyceae

FLORIDEANS

Morphology

Thalli in florideans are Uniaxial or Multiaxial



Crustose thalli



Peyssonnelia



Lithothamnion



Petrocelis



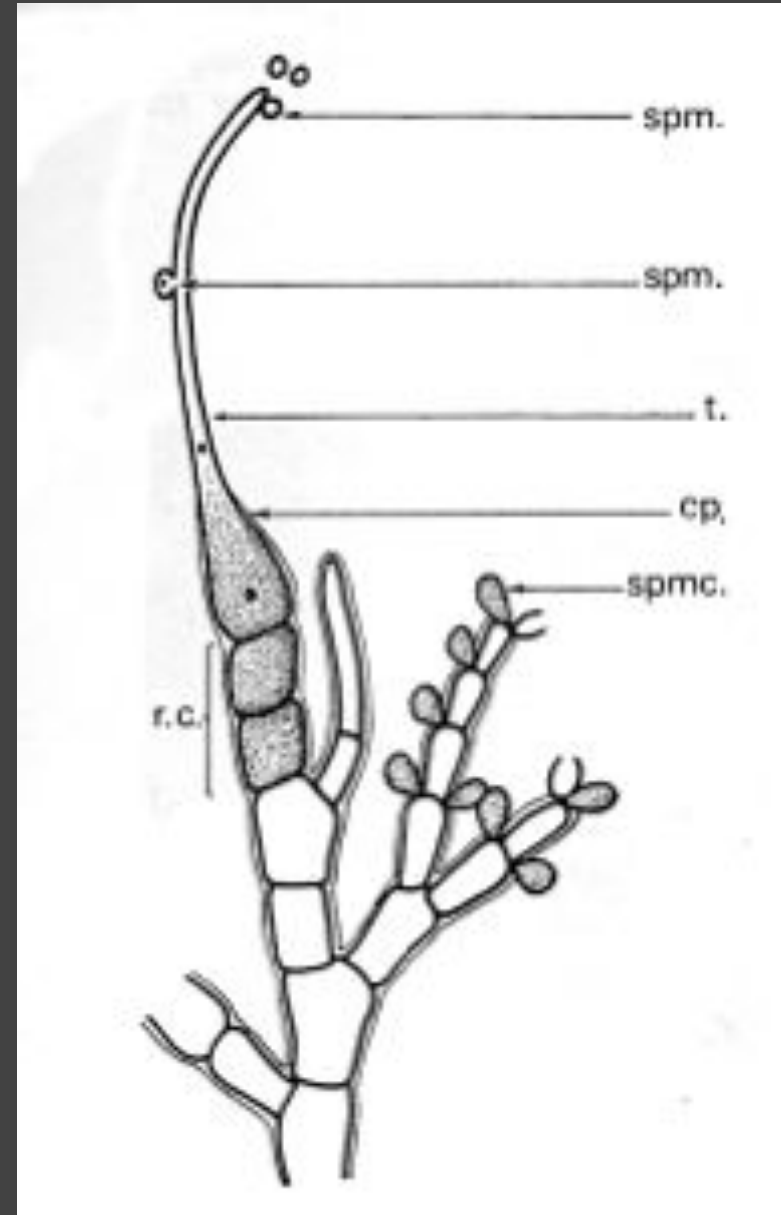
Melobesia

Sexual Reproduction in Florideophyceans

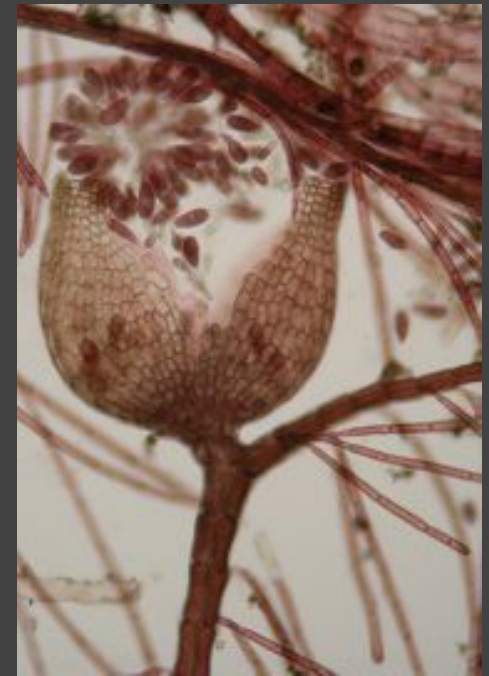
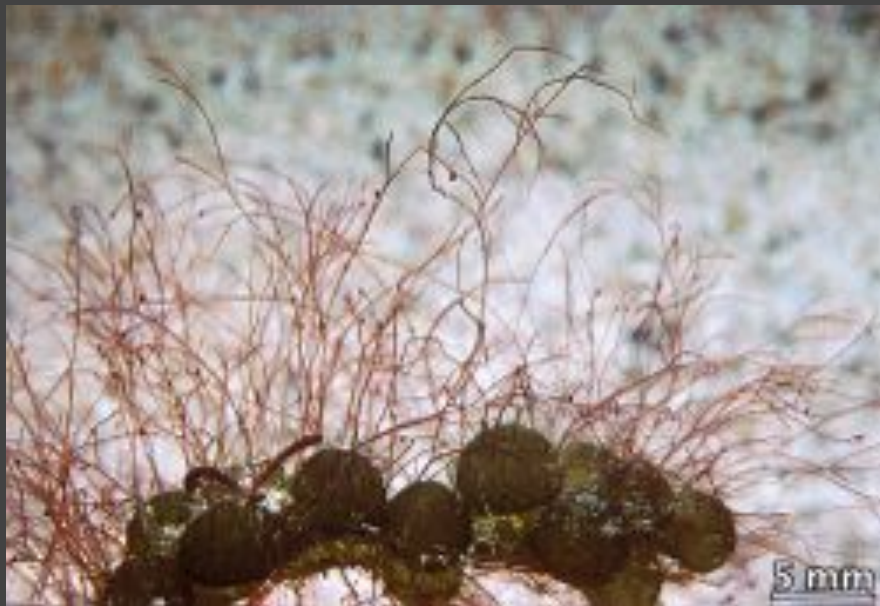
Trichogamy: Sexual reproduction with a female gamete **Carpogonium** bearing an elongated hair the **trichogyne**.

Male gametes or **spermatia** are formed in male gametangia or spermatangia

There is no flagella in red algae, the spermatia are released and they found the way to get in contact with the trichogyne.



After fertilization the zygote will develop the next generation, the **Carposporophyte**, which grows parasitically *in situ* on the female gametophyte



The carposporophyte will form the **carpospores** by mitosis which germinates into a diploid **Tetrasporophyte**



Carpospores

The **carposporophyte** contains all or some of the following elements:

- a) The cells formed directly from the fertilized carpogonium
- b) The connecting filaments (sterile)
- c) The gonimoblastic filaments (fertile)

Frequently, the cells in the periphery of the **gonimoblast** (filaments that produce the carposporangia) are transformed in a protective envelope, the **pericarp** with a pore (ostiole)

Both, the pericarp (1N) and gonimoblast (2N), form the **Cystocarp**

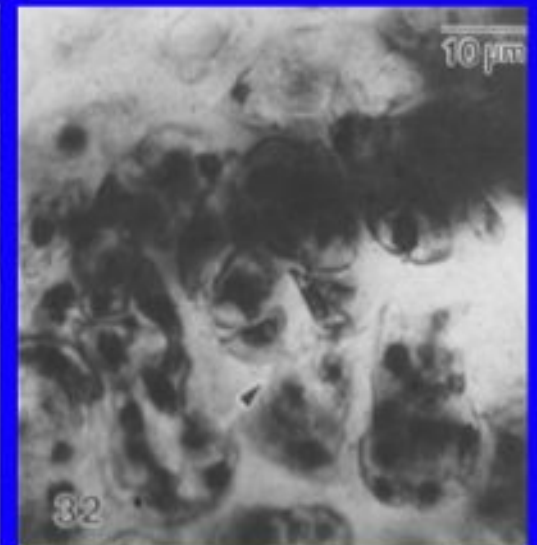
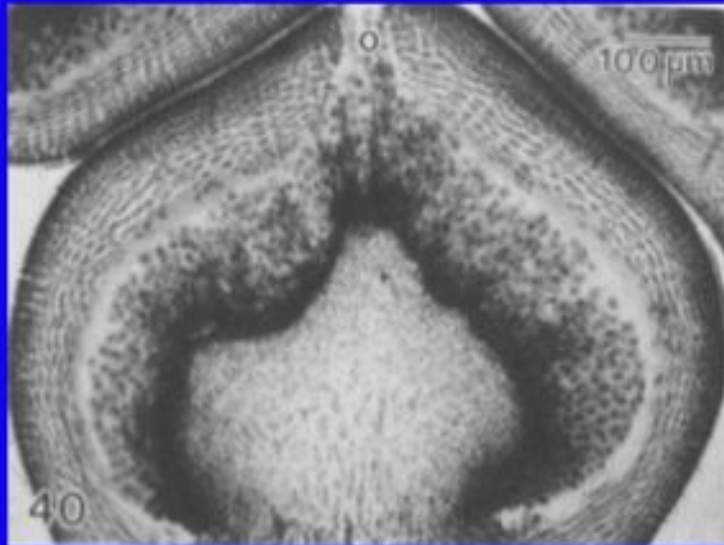


Once an interaction has taken place between a carposporophytic cell and a vegetative cell, the fruiting body is called a *cystocarp* rather than a carposporophyte

The great diversity of cystocarp types ranging from simple to very complex has traditionally formed the basis for the classification of red algae (Kylin, 1956)

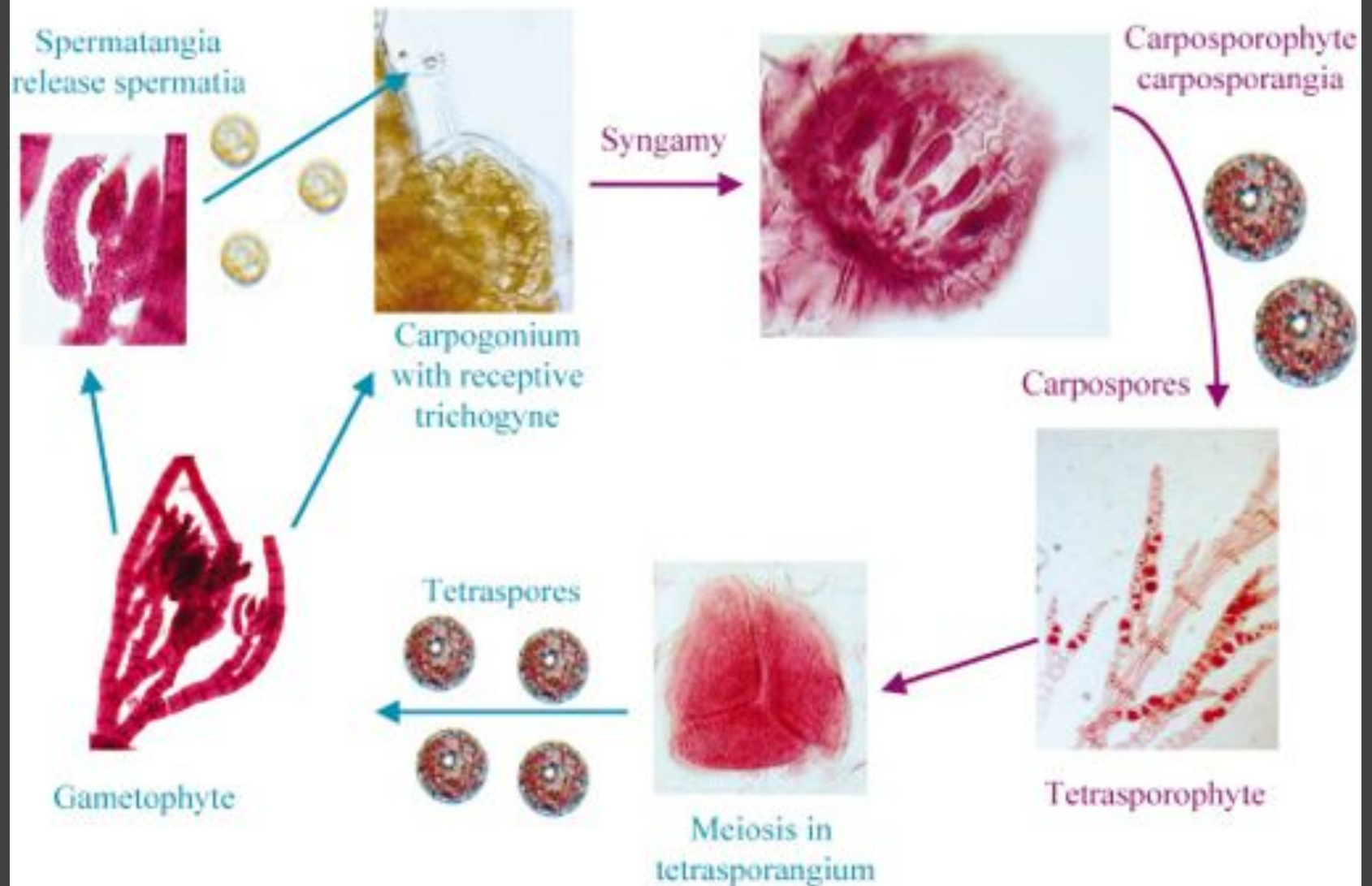
FRUITING BODY = CYSTOCARP

=morphological manifestation of nutrient-driven interaction between carposporophytic and gametophytic cells



The **Triphasic** life history of later-divergent florideophytes

“Typical” Florideophyte Life Cycle



Variations of the sexual reproduction in Florideophyceans

1) Origin of the carpogonium

- a) Vegetative cell transformation
- b) On a carpogonial branch

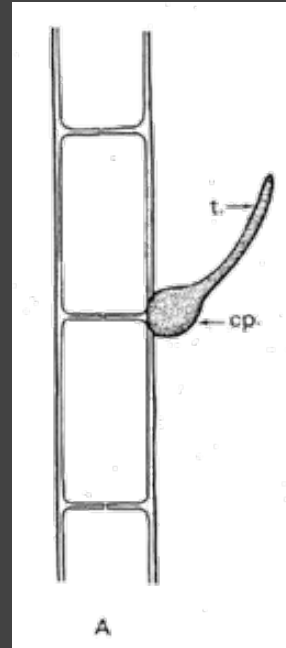
2) Development of the carposporophyte:

- a) Direct
- b) Indirect with auxiliary cells

3) The life cycle, which usually has 3 generations but sometimes variations occur.

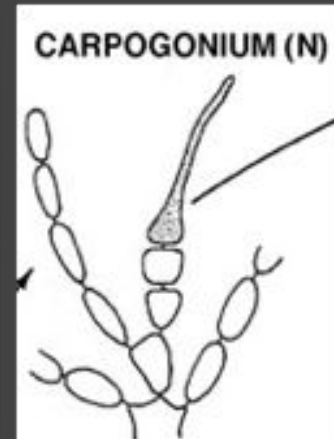
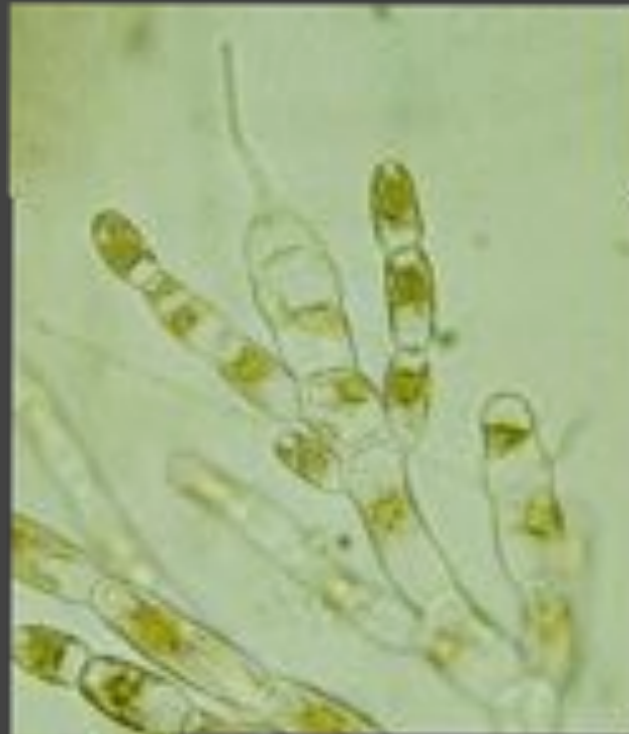
1. Origin of the carpogonium

a) Transformation of a vegetative cell, I.e. *Acrochaetium*



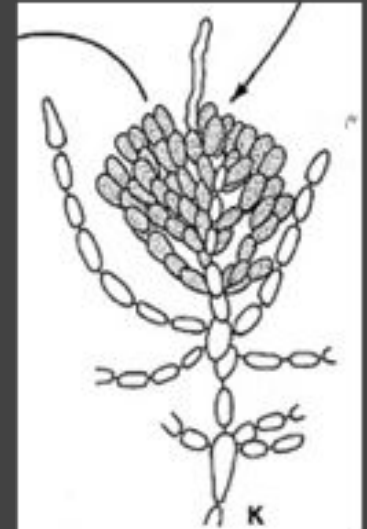
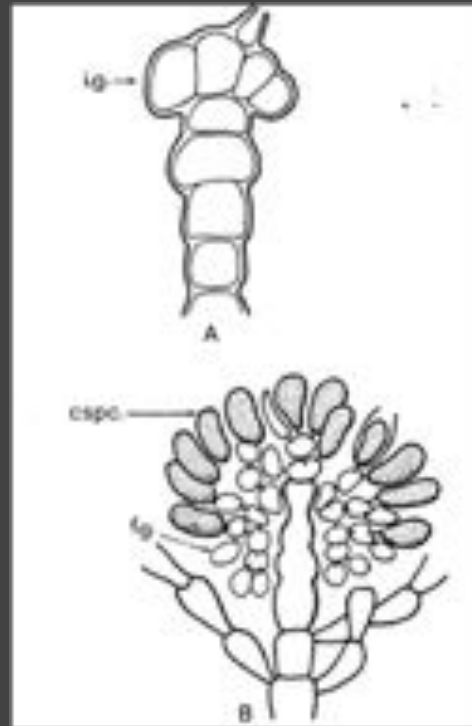
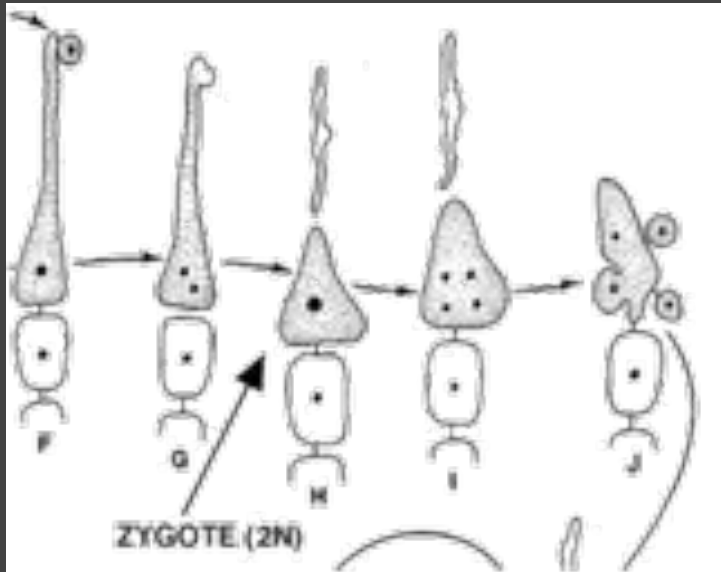
b) With a Carpogonial branch, I.e. *Nemalion*

Carpogonial branch: the uniseriate branch, two to several cells long, which bears the terminal carpogonium.

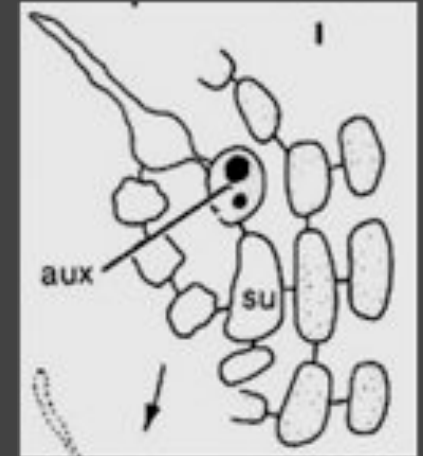
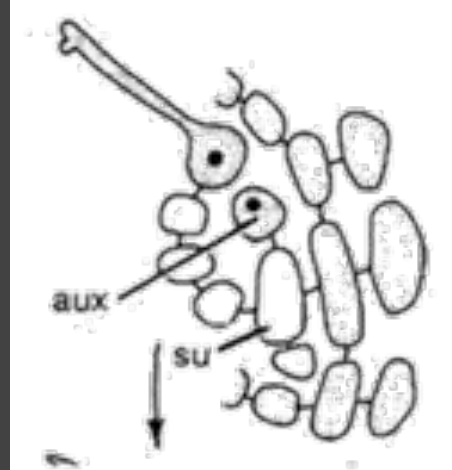
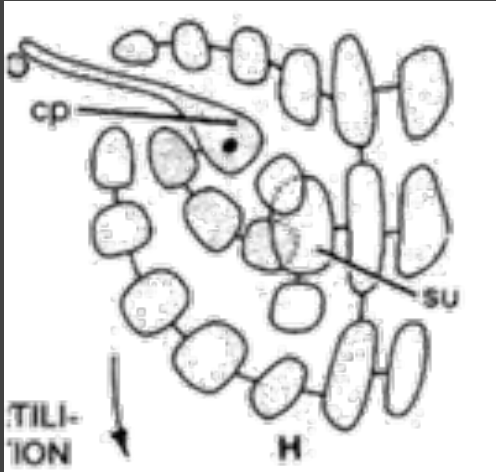


2. Development of the carposporophyte (gonimoblast)

- a) Directly from the fertilized carpogonium, I.e. *Acrochaetium*,
Nemalion (early divergent florideans)



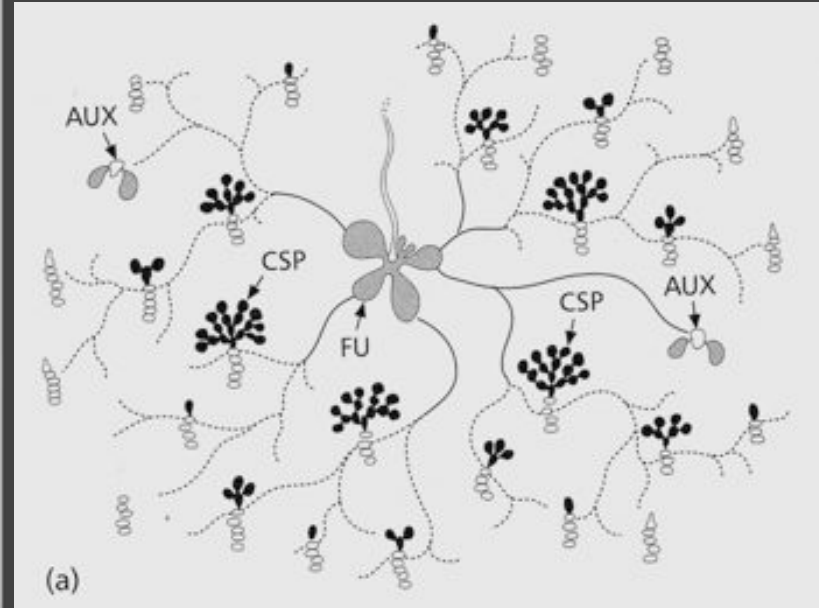
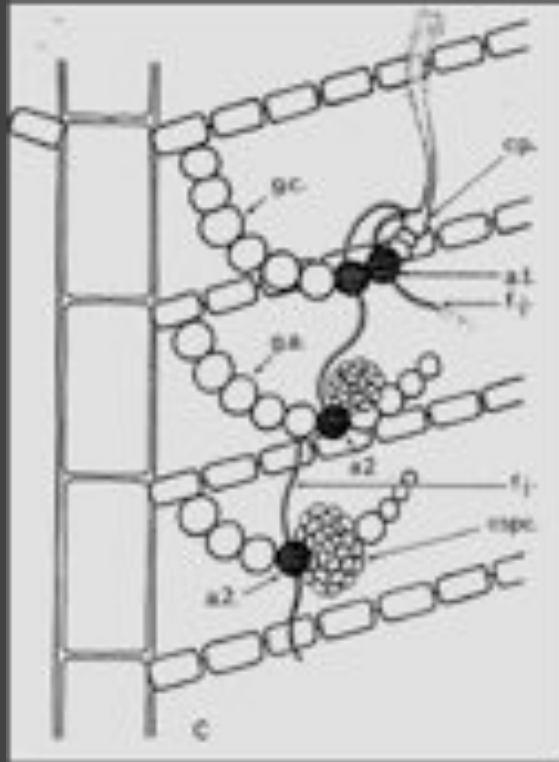
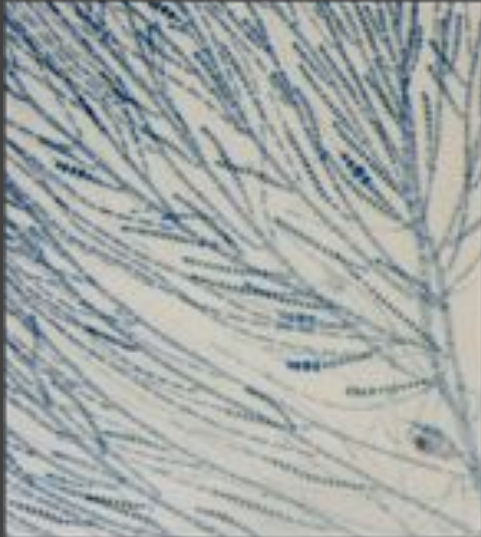
b) Indirectly with auxiliary cells, I.e. *Rhodymenia*, *Polysiphonia*
(more advanced florideans)



Auxiliary cells: a cell which produces the carposporophyte following transfer to it of the zygote nucleus or one of its diploid progeny.

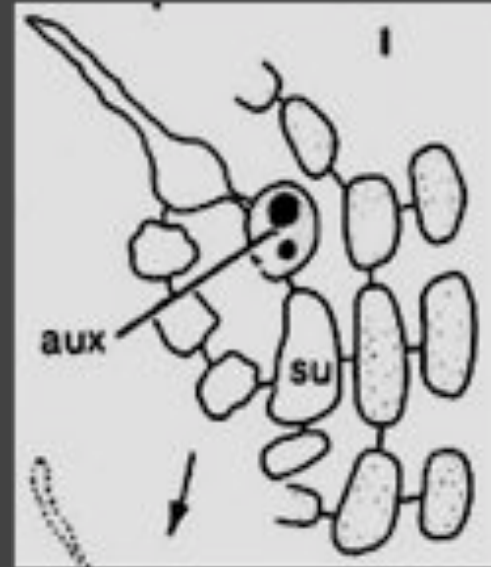
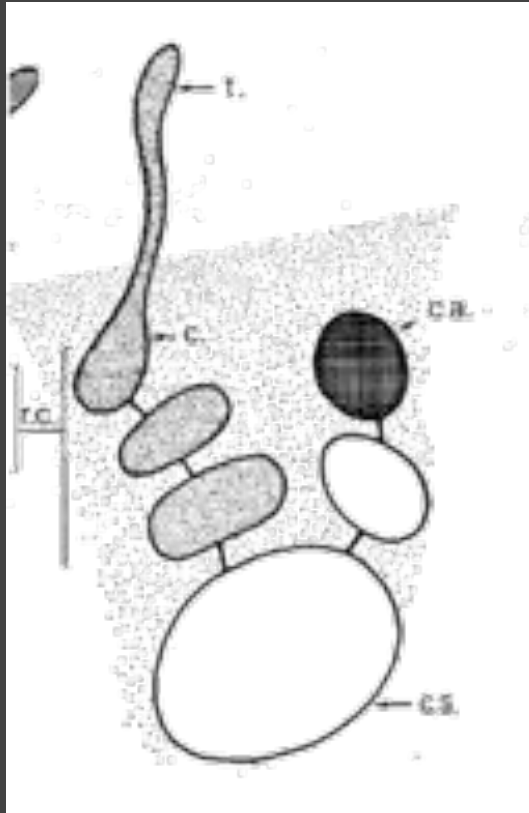
The auxiliary cells are important for the classification of orders in Rhodophyta:

- In some florideans the auxiliary cells are far from the carpogonium. In this case is common the presence of the **connectig filaments**, i.e. Gigartinales Complex



Connecting filaments: aseptated filament through which the zygotic nucleus is transfer from the carpogonium to the auxiliary cell.

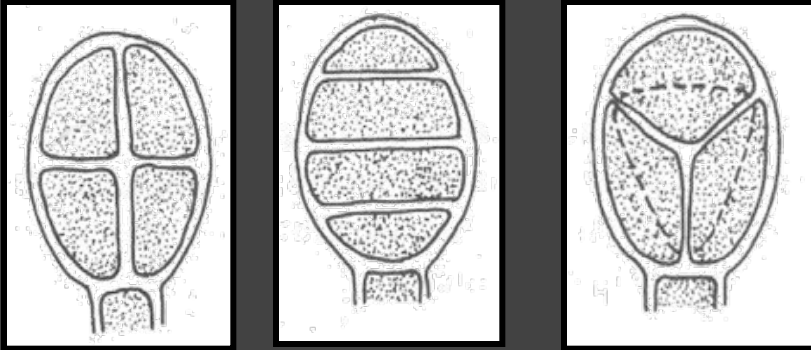
- In some florideans the auxiliary cells are very close to the fertilized carpogonium, these species are called **Procarpic**



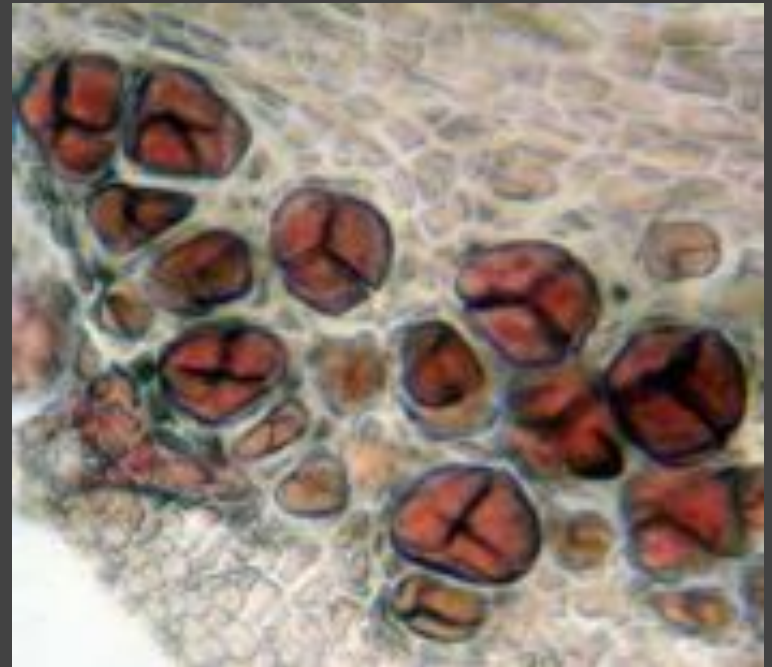
Procarp: close association of the supporting cell, carpogonial branch, and auxiliary cell in the one branch system, i.e. the orders Rhodymeniales and Ceramiales.

Development of the Tetrasterophyte

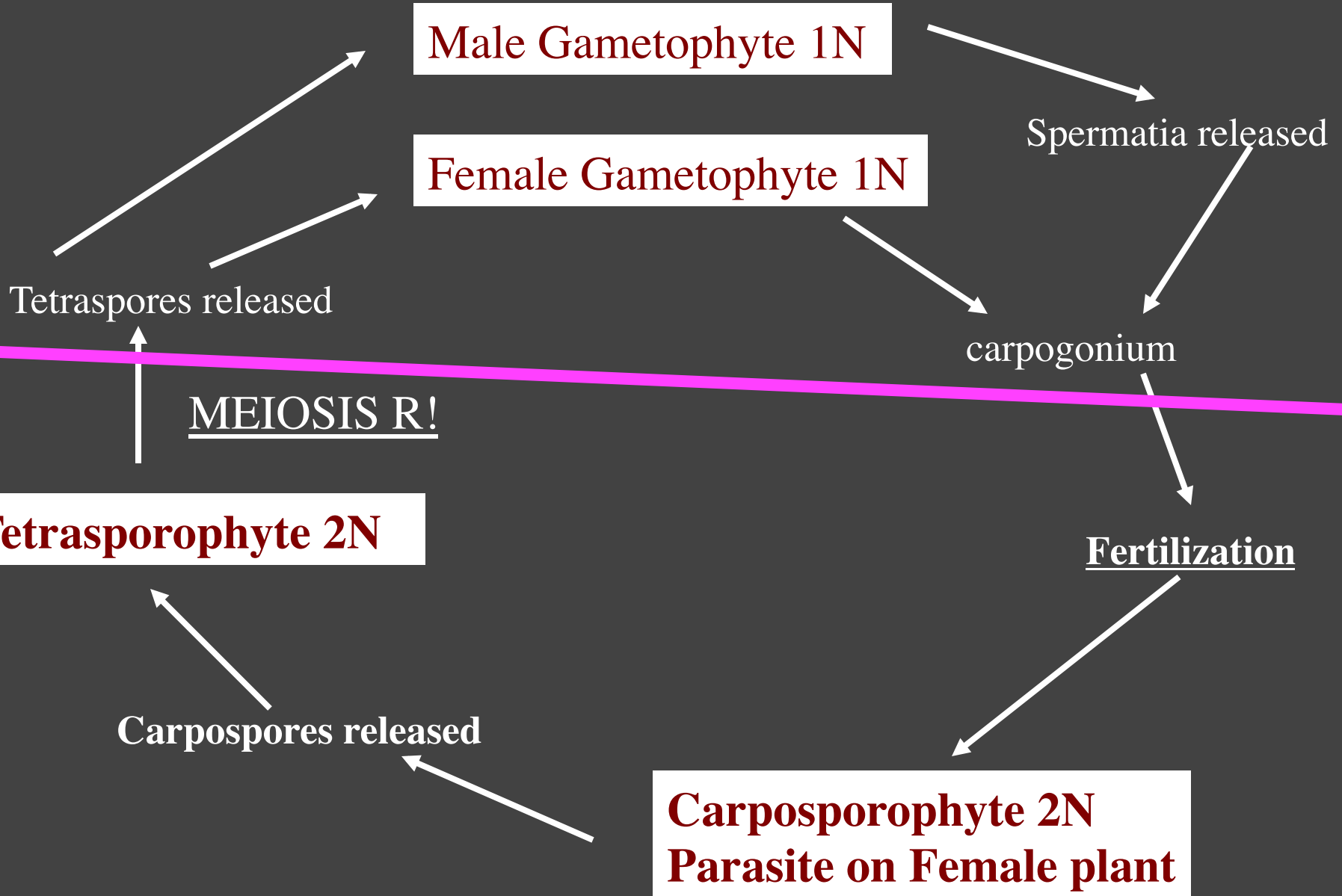
The diploid tetrasterophyte forms tetrasterporangia in which meiosis occurs. Each **tetrasterpore** germinates into a haploid female or male gametophyte



Tetrasterpores types: cruciate,
zonate, and tetrahedral



In summary:



3. Life cycles in Florideophyceans

- Isomorphic
- Heteromorphic
- Tetrasporoblastic
- Direct type or Apomictic

Isomorphic alternation of generations: When gametophyte & tetrasporophyte individuals are morphologically similar (I.e. *Polysiphonia*)



Carposporophyte



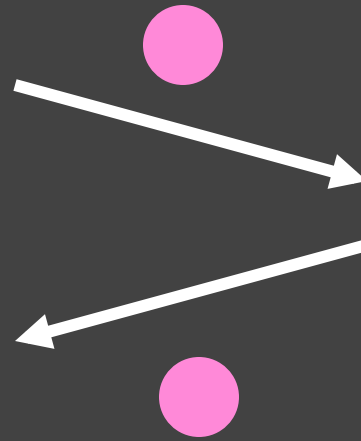
Gametophytes

Tetrasporophyte

Heteromorphic alternation of generations: in which gametophytes alternate with small free-living tetrasporophytes, often a crust which doesn't bear any morphological resemblance to the gametophyte (I.e. *Bonnemaisonia*, *Palmaria*)

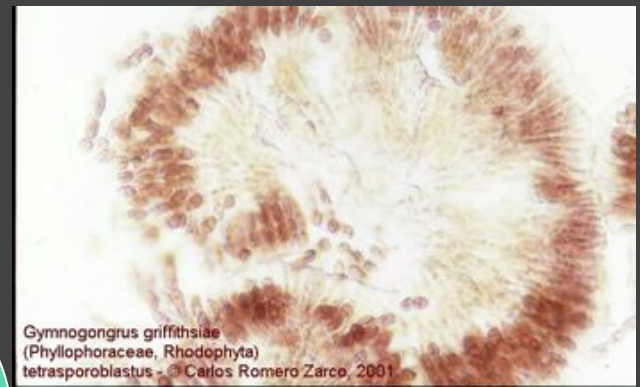


Bonnemaisonia-phase
Gametophyte

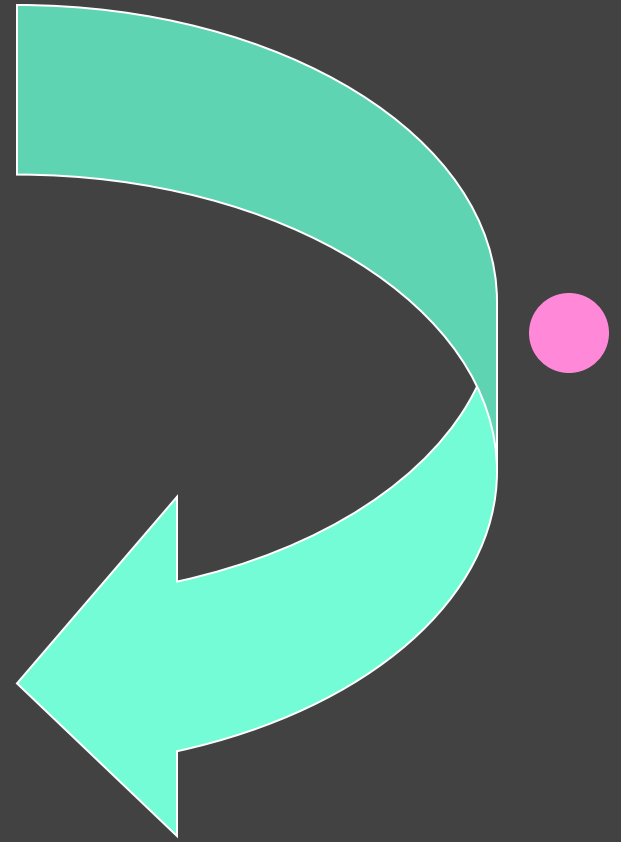


Trailliella-phase
Tetrasporophyte

• **Tetrasporoblastic:** When individuals lack carposporophytes but possess wart-like tetrasporophytes that are parasitic (tetrasporoblasts or carpotetrasporophytes) on the female gametophytes, the life history is biphasic with meiosis occurring in the tetrasporangia in the tetrasporoblasts (I.e. *Gymnogongrus*)



- **Direct type or Apomictic:** A fourth type is the direct type of life history involving only female gametophytes that apomictically produce carposporophytes (i.e. *Liagora tetrasporifera*)



Why all these complexity in the life cycles of red algae? Why an extra generation?

It has been argued that selection has favored the evolution of a **triphasic** life history in red algae as a **compensation** for an inefficient fertilization in the absence of motile gametes.

One fertilization → one zygote → many carposporophytes → lots of carpospores → many more tetrasporophytes → HUMONGOUS amount of tetraspores!