CHAPTER -3
ALGAE: AN INTRODUCTION

General Characters, Range of Thallus Organization, Reproduction, Classification, Morphology and Life Cycle of some Genera & Economic Importance

INTRODUCTION (father of algology :F.E. Fritsch)

The general term "algae" includes prokaryotic organisms — cyanobacteria, also known as blue-green algae — as well as eukaryotic organisms (all other algal species).

Algae are diverse group of relatively simple, chlorophyll containing, photo-autotrophic and oxygen evolving aquatic **thalloid** (without differentiation into true roots, stems, leaves or leaf like organs) organisms.

- The word algae has its origin from Latin, where alga means **seaweed**.
- The term algae was first used by **Carolous Linnaeus** in 1753.
- Most of them are photo-autotrophic but few are mixotrophic and myzotrophic (sucking through special feeding structure)
- Study of algae is known as **phycology** (GK. Phykos- seaweed; logos= discourse or study) or **algology**.
- Professor **M.O.P. Iyenger, (Mandayam Osuri Parthasarthy Iyengar)** is regarded as the **father** of Indian **Algology of Phycology**.
- He discovered the terrestrial alga *Fritschiella tuberosa.*

ECOLOGY AND DISTRIBUTION

Algae are mostly aquatic but they are present almost every available ecological habitat on this earth.

They are thus **ubiquitous** in their distribution.

On the basis of their habitat they are:

1. Aquatic Algae
2. Terrestrial Algae
3. Parasitic algae
4. Symbiotic Algae
5. Algae with some special habitats

AQUATIC ALGAE: most of algae are aquatic found in fresh water (lakes, ponds, rivers, ditches, tanks, streams, etc.) or sea (marine environment).

Bottom dwelling organism are called **benthophytes** (benthic algae or benthos) or may be present on the surface of water bodies are called **Phytoplanktons**.

- Phytoplanktonic algae are called **euplankton** (*Chlamydomonas, Cosmarium, Scenedesmus*) if they are free floating from the beginning or as tychoplankton (*Cladophora, Oedogonium, Zygnema*) if attached in the beginning but later got detached and became free floating.
- Sometimes planktonic algae show extensive growth in the water bodies and impart greenish colour to water. This is known as **water bloom or algal bloom** e.g. *Chlamydomonas, Chlorella, Scenedesmus, Microcystis* etc.
- **Fresh water forms** such as *Volvox, Hydrodictyon, Chlamydomonas* etc grow in stagnant water while *Cladophora, Oedogonium, Ulothrix* etc. prefer to grow in slow running water. Algae grow in running water is called lotic algae while in stagnant water is known as lentic alage.
- Some of marine algae are known as **Kelps,** may reach up to more than 70m (*Macrocystis pyrifera*) in length.

FRESH WATER PLANKTONIC ALGAE: *Chlorella, Chlamydomonas, Scenedemus, Volvox, Eudorina, Microcystis, Oscillatoria*.

FRESH WATER BENTHIC ALGAE: *Chara, Cladophora* (Chlorophyceae) *Bodanella, Pleurocladia* (Phaeophyceae) *Batrachspermum* (Rhodophyceae).

MARINE PLANKTONIC: *Chlamydomonas, Cyclotella, Trichodesmium*,

MARINE BENTHIC ALGAE :*Acetabularia, Caulerpa, Ulva* (Chlorophyceae) *Ectocarpus, Fucus, Laminaria, Sargassum* (Phaeophyceae) *Chondrus, Gelidium , Polysiphonia Porphyra* (Rhodophyceae).

TERRESTRIAL ALGAE OR EDAPHOPHYTES

Algae which grow on or inside the moist soik are known as terrestrial algae, e.g. *Vaucheria, Botrydium, Oedogonium, Fritschiella* etc. grows on the soil surface are known as ***saphophytes***

A few spp. *Anabaena and Nostoc* (BGA) grow inside the soil surface and are known **as cryptophytes**.

PARASITIC ALGAE: Algae which grow on some plants and cause plant diseases. E.g. *Cephaleuros virescence* parasite on tea leaves and causes red rust disease in them.

Harveyella mirabilis are obligate parasite and lack pigmentation.
Rhodochytrium, Phyllosiphon, etc are other examples of parasitic algae.
Polysiophonia lanosa is a semi parasite on brown alga *Ascophyllum*.

SYMBIOTIC ALGAE

Show association with different groups

ALGAE: Rhizosolenia forms association with green algae Calothrix sp.

FUNGI: Many green algae and BGA live in symbiotic with fungi and form new group lichens.

Green algae *Trebouxia* is the most common **photobiont** (previously known as phycobiont) in lichen. Other green algae are *Cocomyxa, Trentipohlia* etc.

BGA are *Nostoc, Scytonema, Stigonema, Gloecapsa* etc.

BRYOPHYTES: Nostoc lives in the mucilage filled chambers of *Anthoceros* and *Notothyllus* (Hornworts) thalli.

PTERIDOPHYTES: *Anabaena* inhabits leaves of water fern *Azolla*. The latter is used as a bio fertilizer in paddy fields

GYMNOSPERMS: *Nostoc* and *Anabaena* live in symbiotic association in the coralloid roots of *Cycas*.

ANGIOSPERMS: *Nostoc* inhabits papillose outgrowth of ***Gunnera*** near the base of their leaves.

SPECIAL HABITATS

1)THERMAL ALGAE (THERMOPHYTES): They grow in hot water springs at a temperature range of 65-85^{0}C, where ordinary plant life is not possible. Only BGA like *Mastigocladus ,Phormidium* and *Oscillatoria brevis etc.*

2)CRYOPHYTES : such algae grow in polar regions on ice and snow. E.g. *Chalamydomonas* sp. and *Scottiella* sp. among green algae and *Nostoc* among BGA algae. *Haematococcus nivalis* causes red snow ball in alpine region. *Anclyclonema nordenskioldii* impart brown colour.

3)EPIPHYTES: Algae growing on the surface of other plant parts are called epiphytes e.g. species of *Oedogonium, Ulothrix* etc., other examples are *Coleochaete nitellarum* grows on *Nitella and Chara*. Some algae , such as *Trentepohlia, Rhodochytrium*, grows on the surface of angiosperms leaves, called **epiphyllophytes**. Some algae such as *Pleurococcus* sp. grow on barks called **epiphloeophytes**.

4)ENDOPHYTIC ALGAE: Some algae grows within the tissue of other plants, e.g. *Nostoc* grows inside thalli of *Anthoceros.*

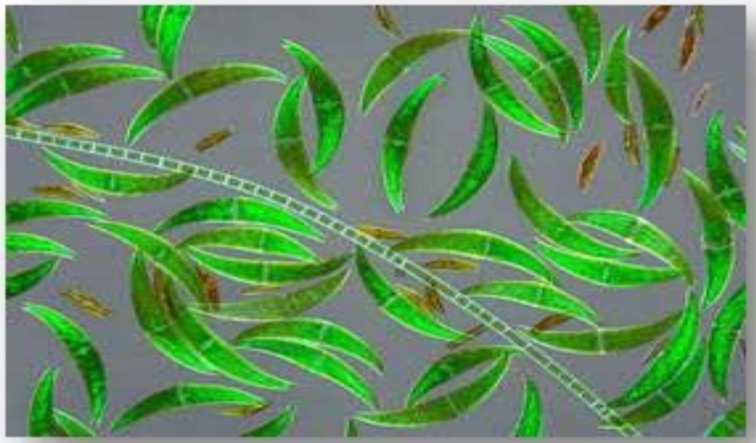
5)EPIZOIC ALGAE OR EPIZOOPHYTES :which grown on the surface of other animals, e.g. *Cladophora* on snails, *Cyanoderma* (red algae) and *Trichophilus* (Green algae) on the scales or outer hairs of Sloth.

6)ENDOZOIC ALAGE OR ENDOZOOPHYTE: Algae growing inside animals, e.g. Chlorella within the tissue of Hydra and sponges

7)LITHOPHILIC ALGAE: Which grows on rocks e.g. *Polysiphonia, Ectocarpus* etc.

8) OTHER ALGAE some algae like *Dunaliella, Chlamydomonas chrenbergii* grows in water with high salt concentration (**Halophilic algae**). *Fritchiella* grows on acidic soil while *Oscillatoria sp* , *Nostoc* etc. grow on alkaline soil.

ALGAE: THALLUS DIVERSITY

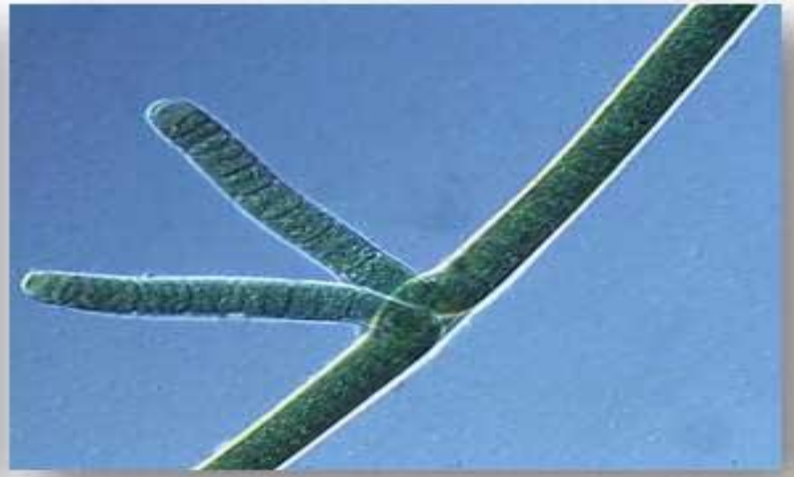


Desmids

Cladophora

Oscillatoria

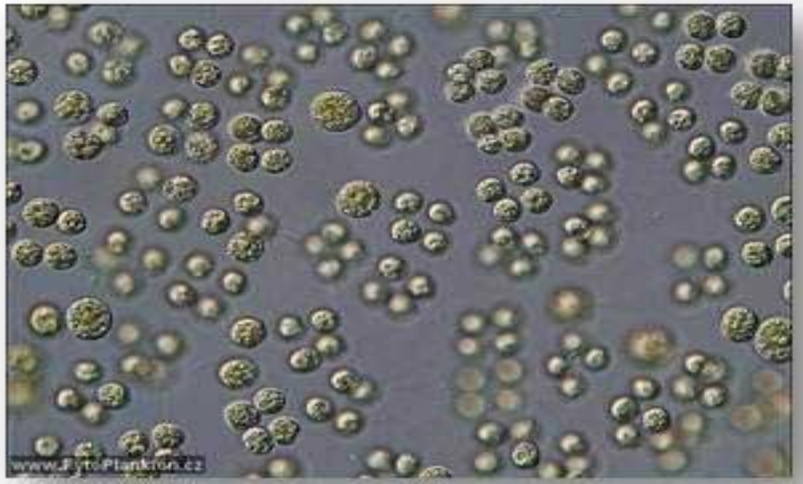
Spirogyra



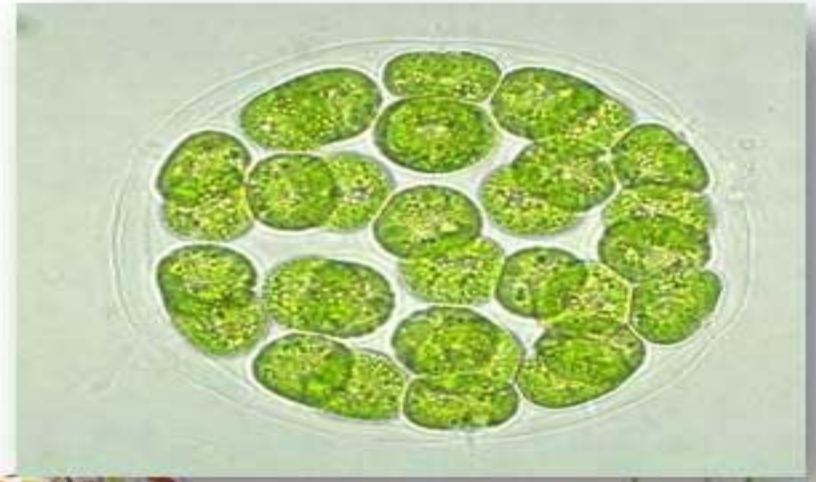
Scytonema

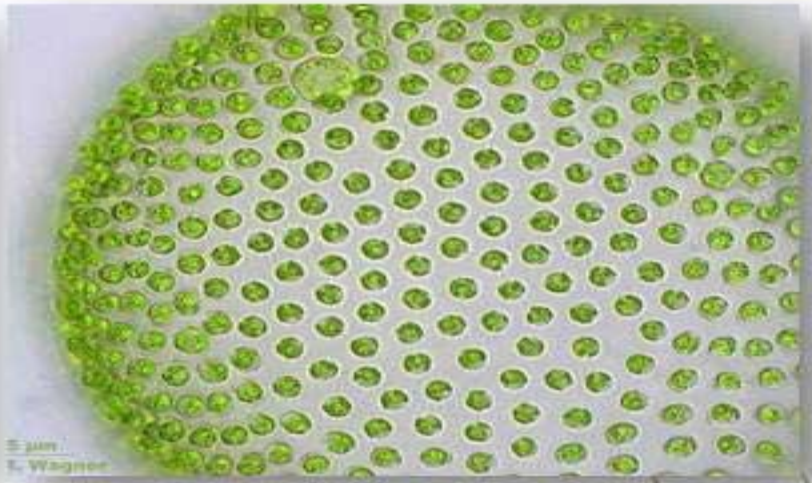
Cladophora

ALGAE: THALLUS DIVERSITY

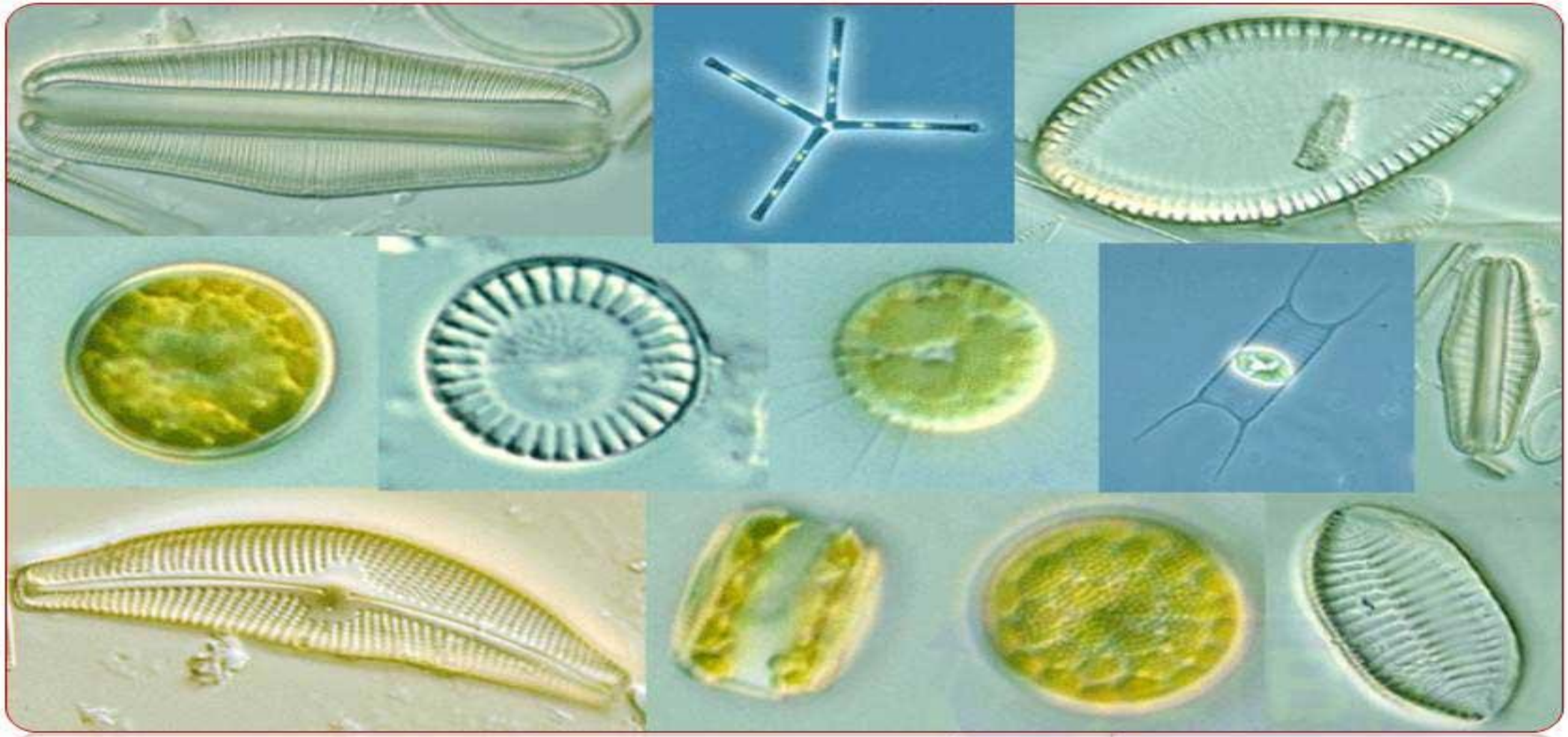


Colonial Forms





ALGAE: THALLUS DIVERSITY



Diatoms

RANGE OF THALLUS ORGANIZATION

Algae exhibits variety in their thallus organization and can be divided into the following broad categories

1. Unicelllular Thallus
2. Colonial thallus
3. Siphonaceous thallus
4. Filamentous thallus
5. Parenchymatous thallus

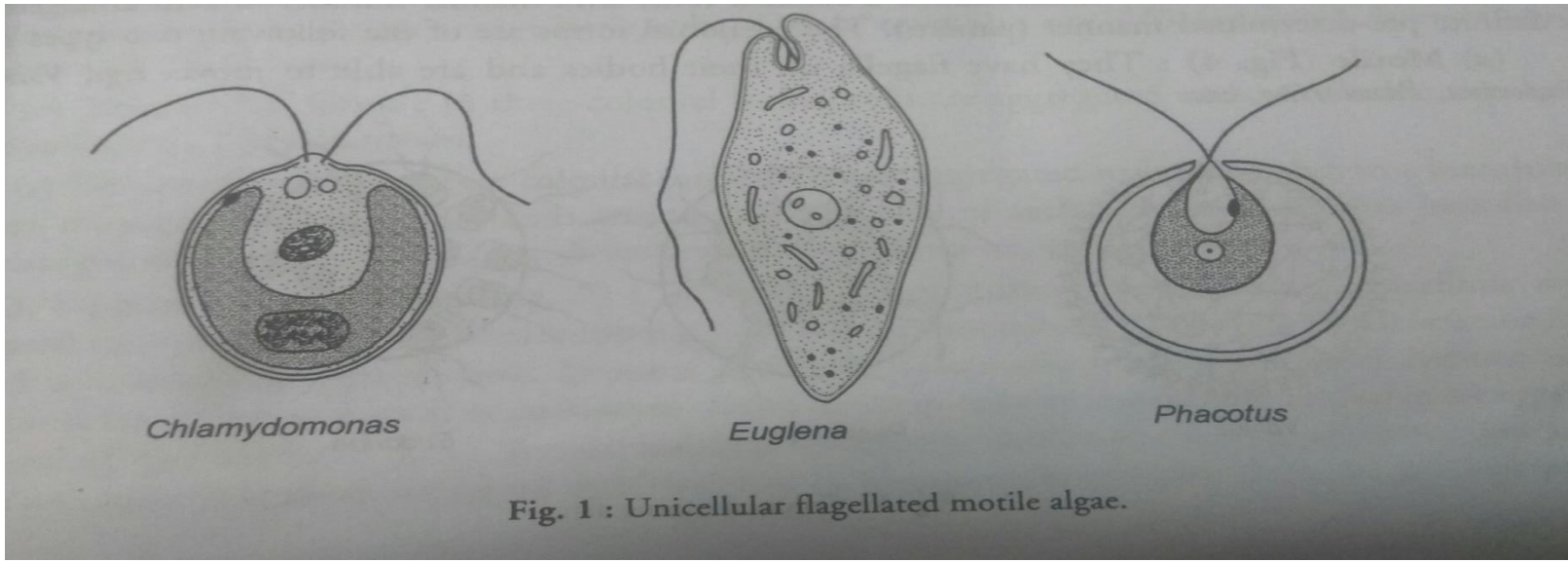


Fig. 1 : Unicellular flagellated motile algae.

UNICELLULAR FORMS

The plant body is made up of single cell. Which may be motile or non motile. Unicellular form are absent in **Charophyta and Phaeophyta**)

i)MOTILE FORMS : show presence of flagella or due to presence of periplastic nature.

a) **FLAGELLATED MOTILE FORMS:**

e.g. *Chlamydomonas, Phacotus, Chlorochromonas*.

b) PERIPLASTIC FORMS: etc.

They have soft cell wall and possesses fine protoplasmic projections known as rhizopodia, which helps in amoeboid movement e.g. *Rhizochloris, Chrysamoeba*

ii) **NON-MOTILE FORMS:** Lack flagella,e.g. *Diatoms, Chlorella, Chlorococcum, Porphyridium* and BGA (*Gloeocapsa, Anacystis, Spirullina*).

2. **COLONIAL THALLUS:** In this form daughter cells which arise as a result of cell division, remain loosely held together in common gelatinous mass. These forms are of two types

i) **COENOBIAL FORMS:** colonial form with definite number of cells arranged in definite manner. Coenobium are of two types

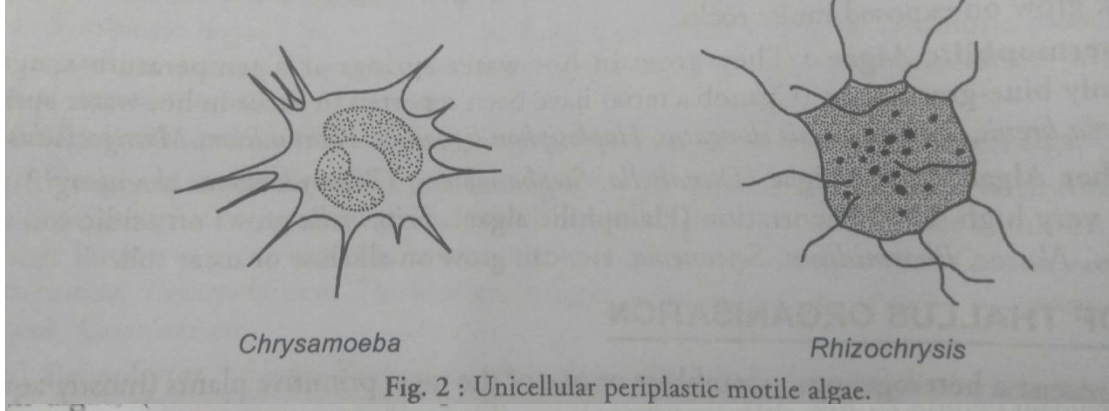


Fig. 2 : Unicellular periplastic motile algae.

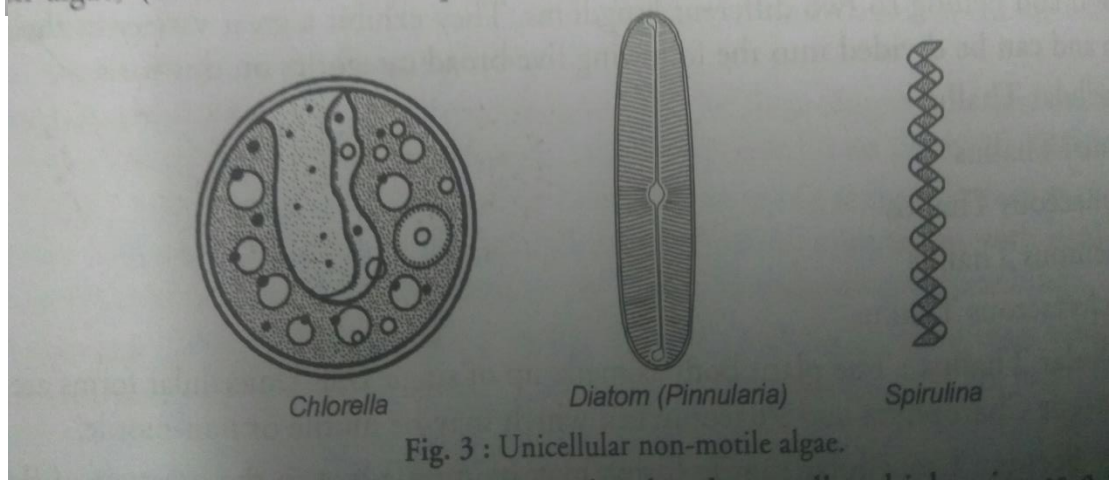


Fig. 3 : Unicellular non-motile algae.

a) MOTILE: They have flagella on their body and are able to move e.g. *Volvox, Eudorina, Pandorina* etc.

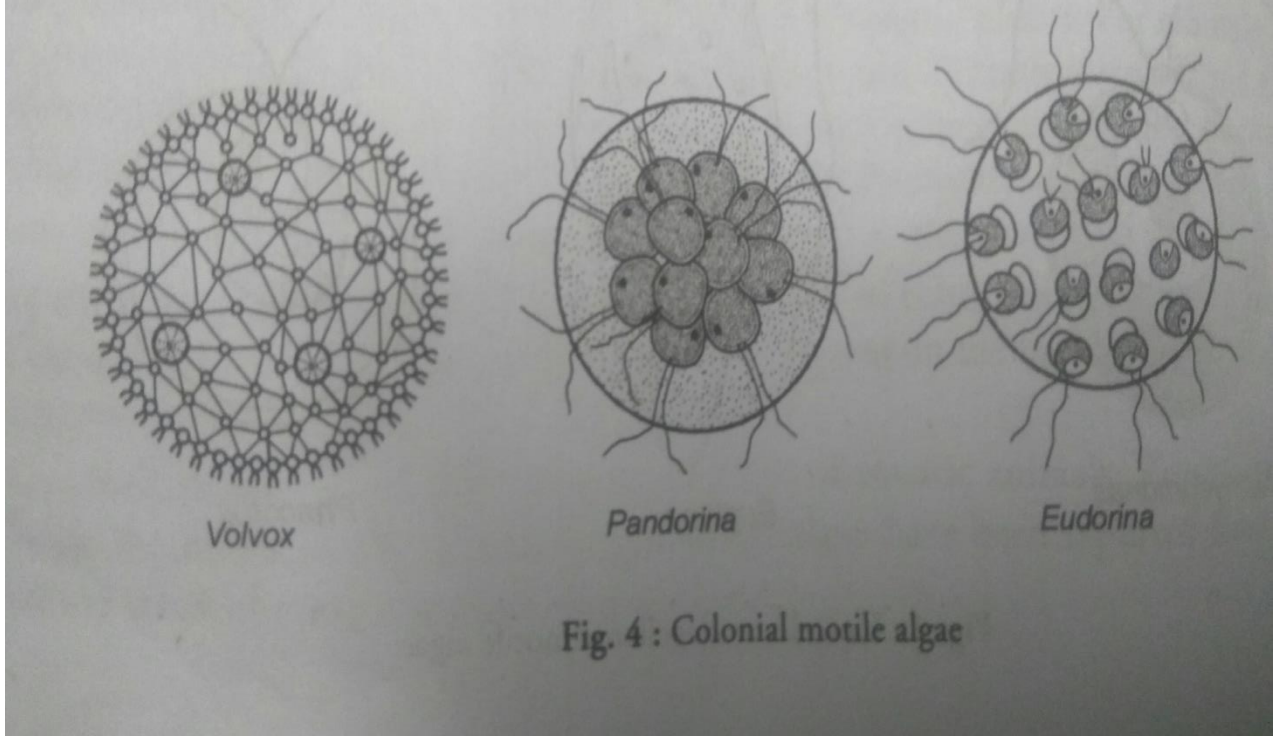


Fig. 4 : Colonial motile algae

a) NON-MOTILE: They lack flagella e.g. *Hydrodictyon, Pediastrum, Scenedemus, etc.*

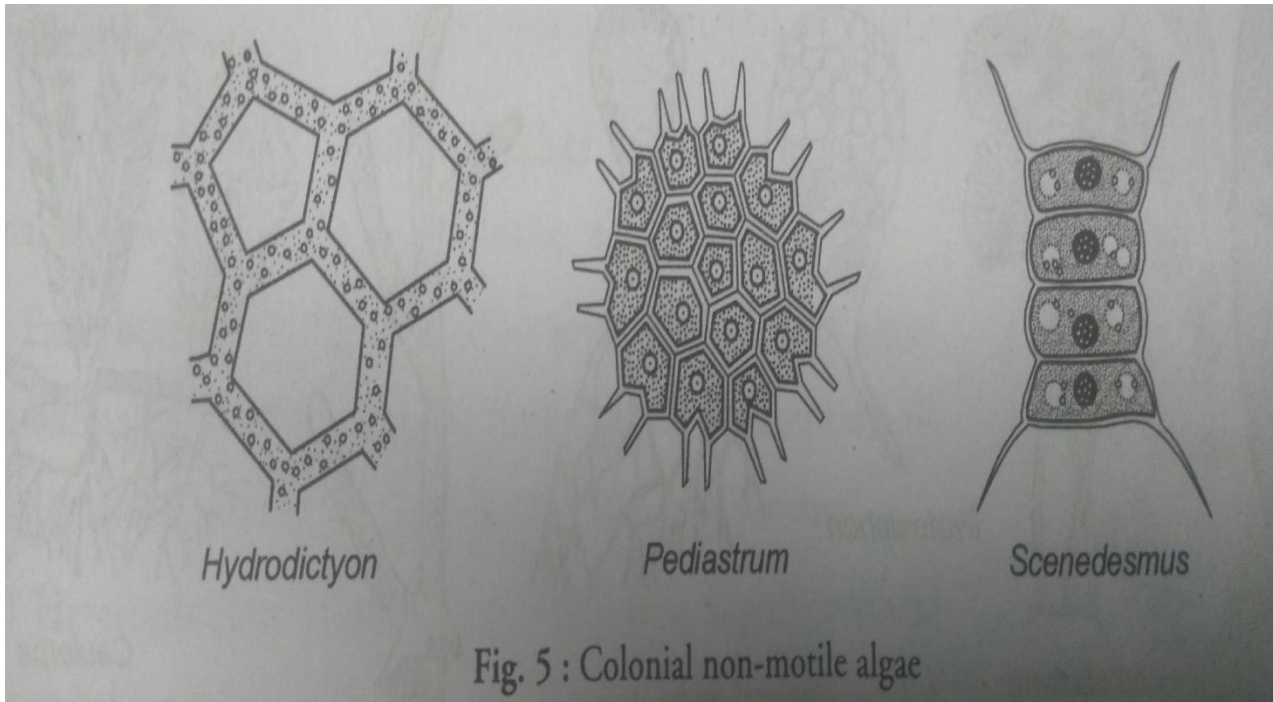


Fig. 5 : Colonial non-motile algae

II) CELL AGGREGATION: The daughter cells are not aggregated in a definite manner in the colony thus the colonies are not of constant size and shape. They are of following types

a) **PALMELLOID FORMS:** Cells remain irregularly arranged in a common gelatinous matrix. They function as independent entities.

These forms may be temporary (*Chlamydomonas*) or permanent (*Tetraspora)* other e.g. *Asterococcus, Aphanocapsa*.

b) **RHIZOPODIAL FORMS:** In these colonial forms, cells are aggregated with each other through rhizopdia e.g. *Chrysidiastrum*.

c) **DENDROID FORMS:** Cells are aggregated with each other in a branching pattern through mucilagenous strands arising from the base of each cell. Such colonies look like a microscopic tree. E.g *Ecballocystis, Chrysodendron* etc.

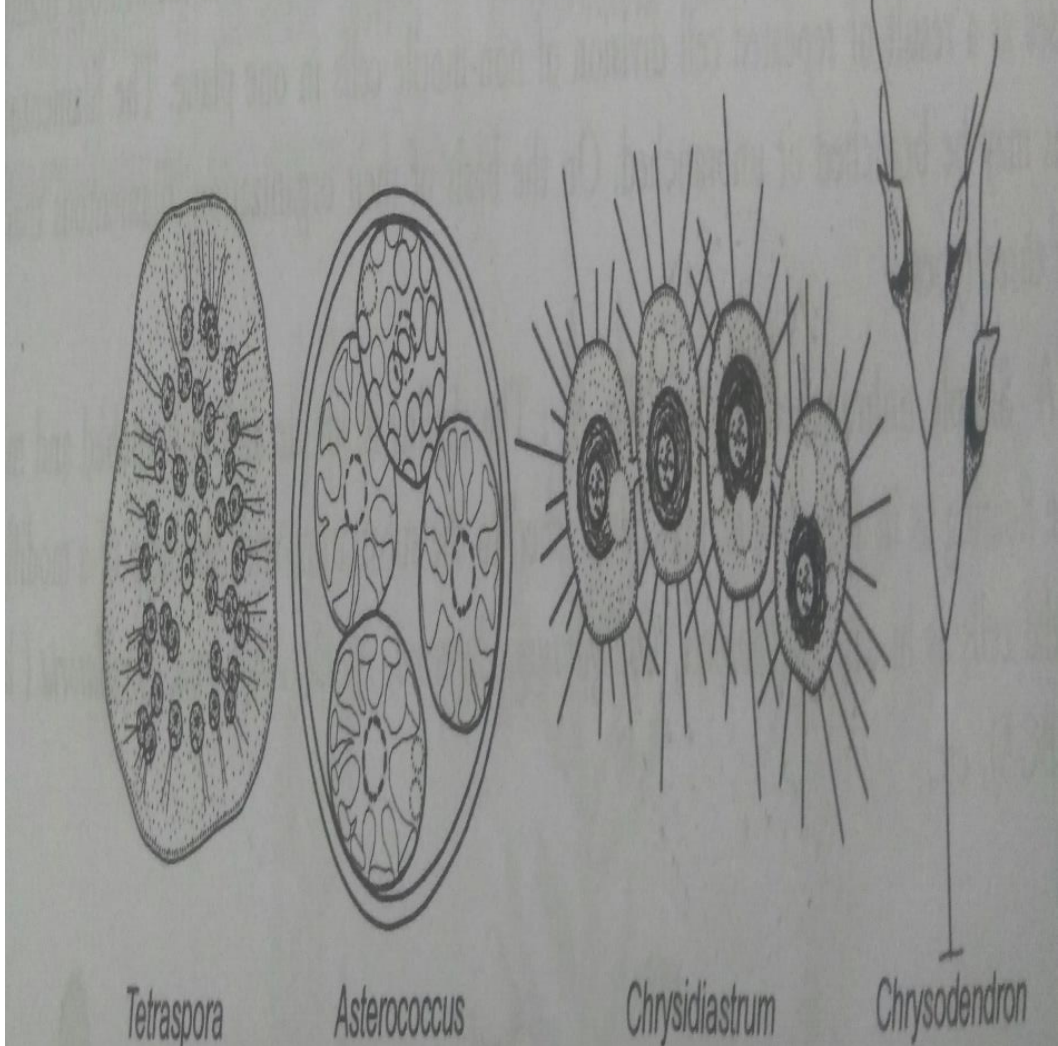


Fig. 6 : Cell aggregations

3. SIPHONACEOUS COENOCYTIC FORMS:

- Plant body is unicellular and elongated tubular structure (e.g. *Charium*) or umbrella shaped uni-nucleate body e.g. *Acetabularia*.
- In more advanced siphonaceous algae, thallus is aseptate and multinucleate structure known as **coenocyte.**
- Septa develop only to delimit the reproductive organs to seal off the damaged parts e.g. *Protosiphon Botrydium, Vaucheria, Caulerpa*.

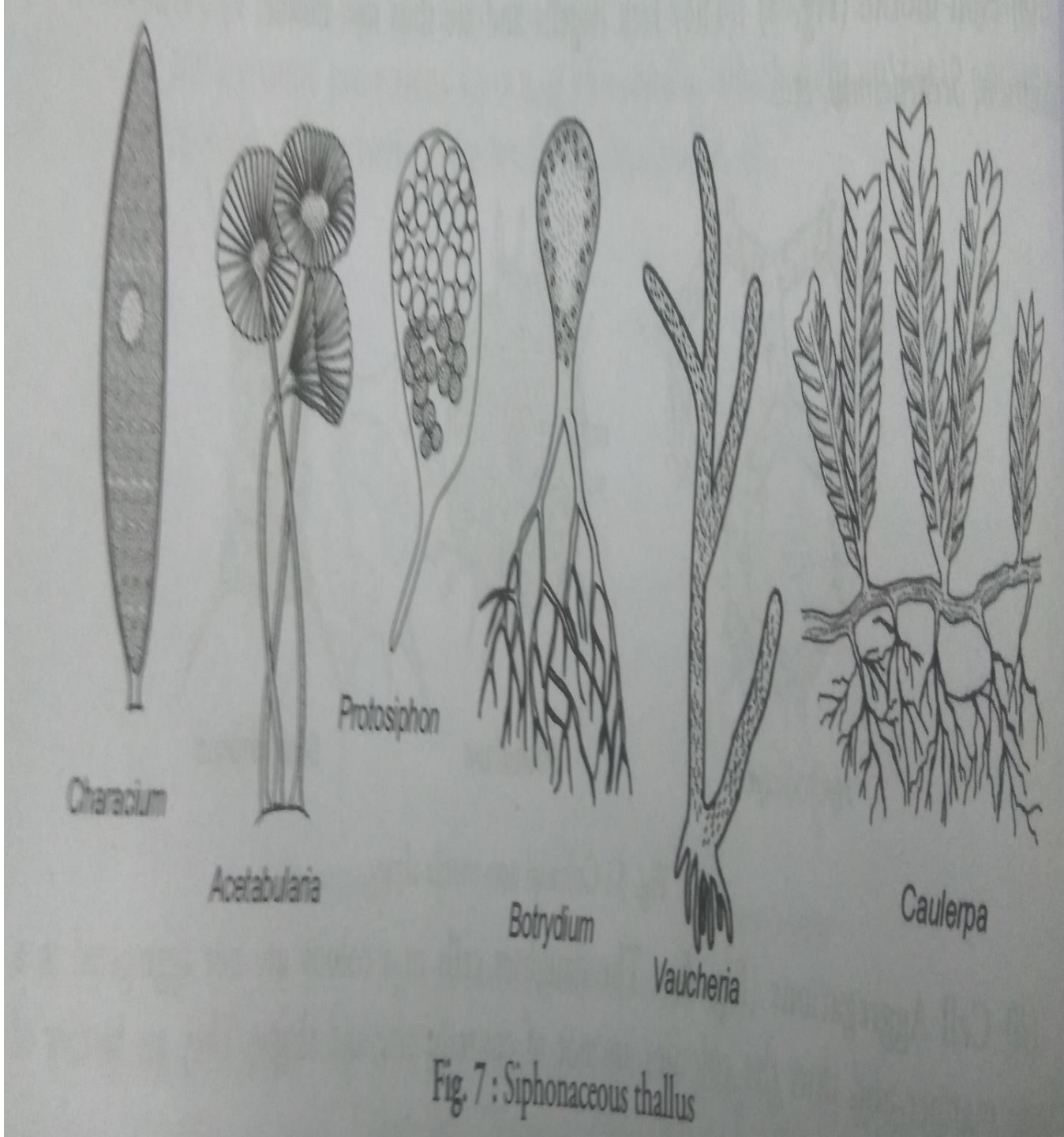


Fig. 7 : Siphonaceous thallus

4. FILAMENTOUS THALLUS: A thread like multi-cellular thallus is known as filamentous thallus. These are of following types:

i) **SIMPLE UNBRANCHED THALLUS**: The thallus is simple is simple and unbranced and may be free floating as in *Spirogyra* or may be attached to substratum with the help of rhizodial cells, e.g. *Ulothrix, Oedogonium, Zygnema, Nostoc, Anabaena, Oscillatoria* etc.

ii) **BRANCHED FILAMENTOUS THALLUS :** Thallus give rise to lateral outgrowth or branches which may be true or false branches.

a) **TRUE BRANCHES**: True branches arise as a result of occasional cell division in a second plane e.g. *Cladophora*.

b) **FALSE BRANCHES:** False branches arise in blue-green algae e.g. *Scytonema* due to breakage and resumption of growth by trichomes in mucilagenous sheath of filaments

iii) **HETEROTRICHOUS THALLUS:** Highly evolved filamentous habit where thallus is differentiated into creeping prostrate and upright erect systems, e.g. *Ectocapus, Fritscheilla, Stigoclonium, Coleochaete*.

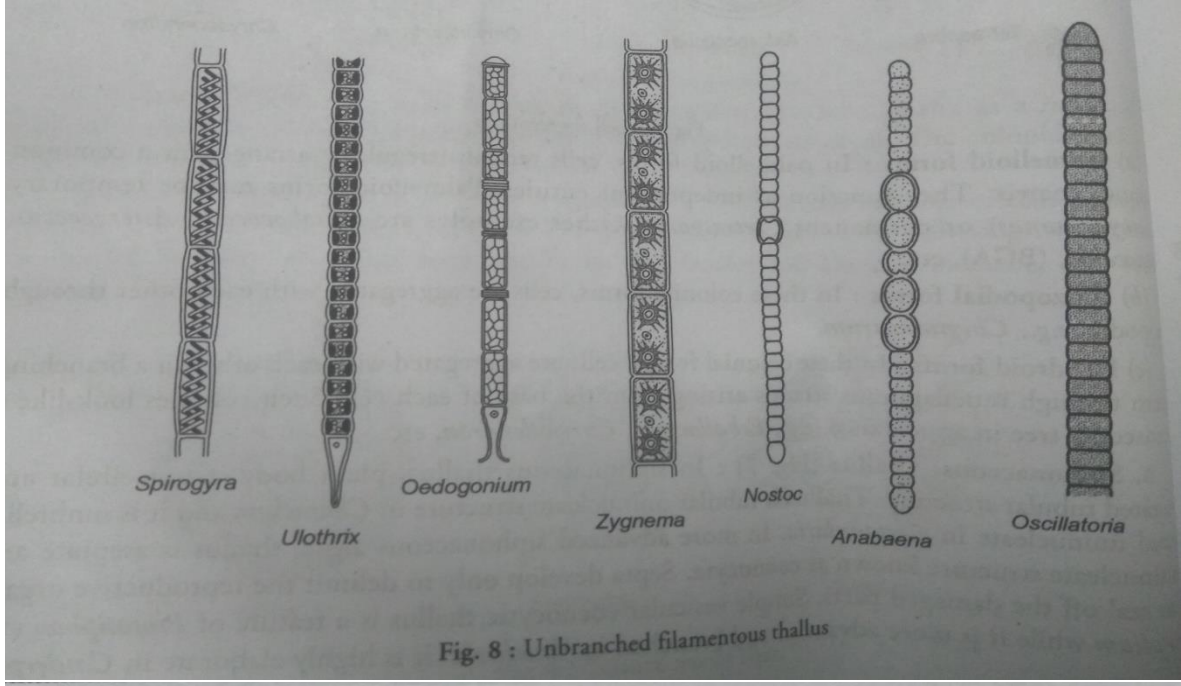


Fig. 8 : Unbranched filamentous thallus

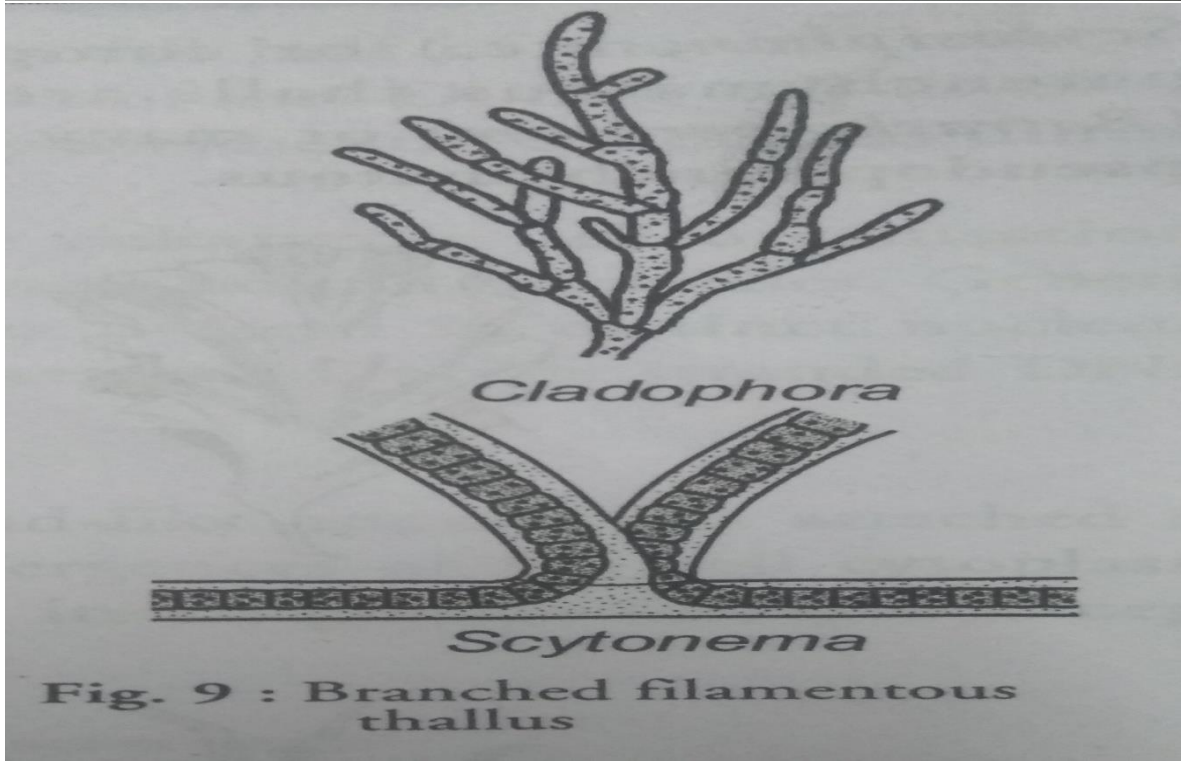


Fig. 9 : Branched filamentous thallus

5. PARENCHYMATOUS THALLUS:

- It is multicellular where cell division take s place in two or more planes.
- If cell division occur in one plane only, flat foliaceous structure are formed as in *Ulva.*
- If cell division takes place in more than two plane, tubular (in *Codium, Scytosiphon* etc.) or complex structure (as in *Sargassum*)may be formed.

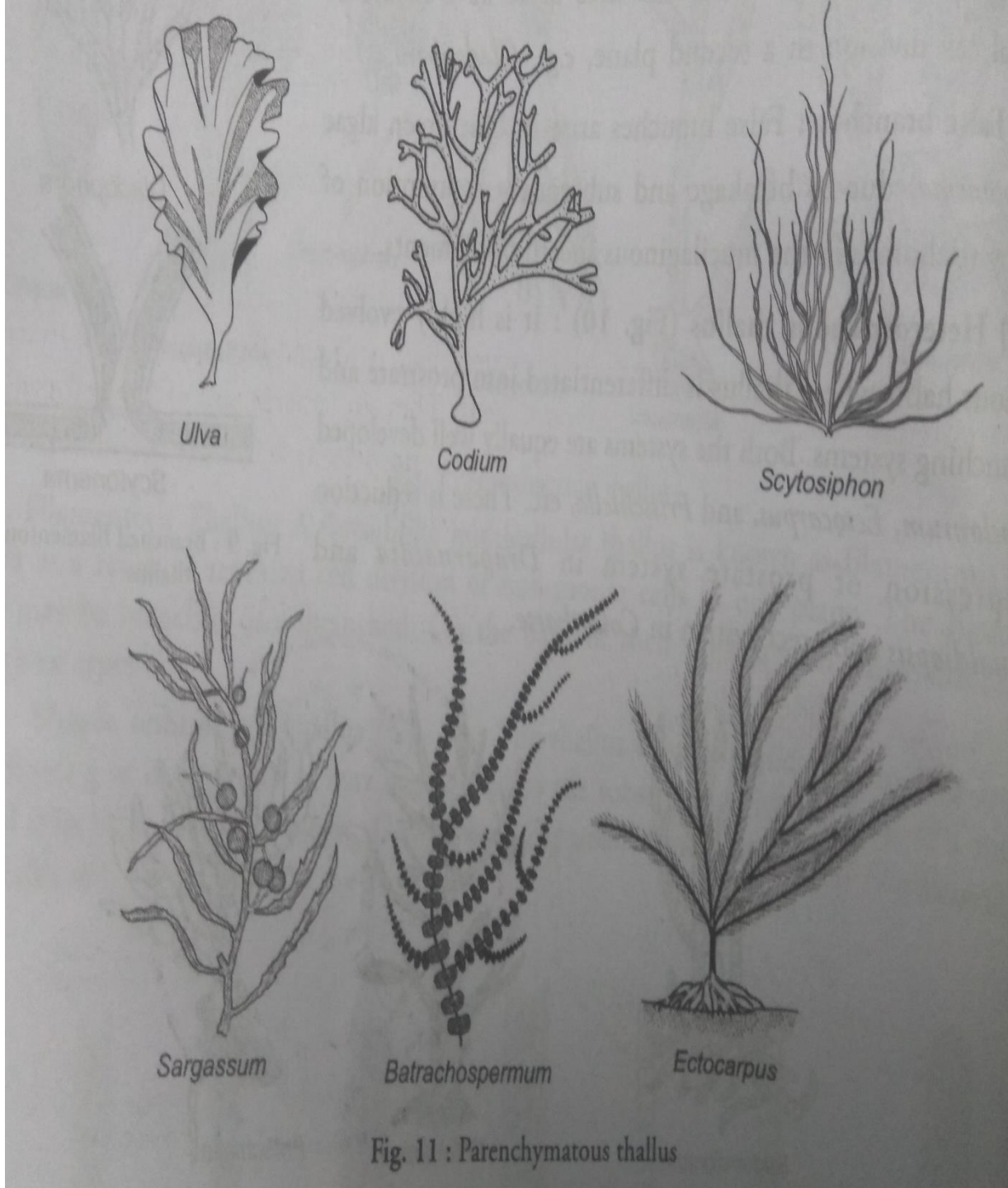
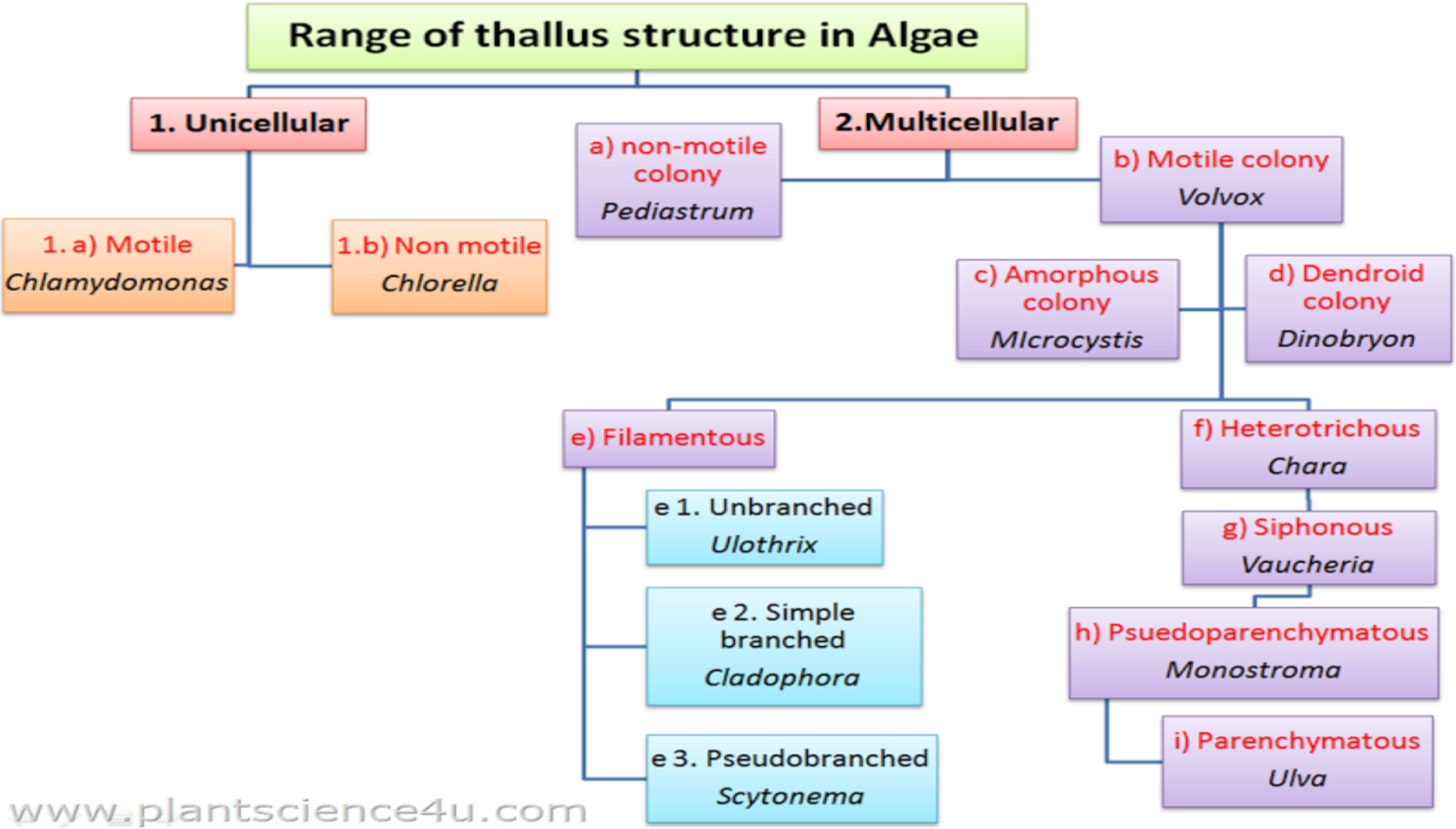


Fig. 11 : Parenchymatous thallus



REPRODUCTION IN ALGAE

REPRODUCTION

- Reproduction is the biological process by which new individual organisms "offspring" are produced from their "parents".
- Reproduction is a fundamental feature of all known life; each individual organism exists as the result of reproduction.
- There are three forms of reproduction.

TYPES OF REPRODUCTION

There are three common methods of reproduction found in algae.

1. VEGETATIVE REPRODUCTION
2. ASEXUAL REPRODUCTION
3. SEXUAL REPRODUCTION

1. VEGETATIVE REPRODUCTION

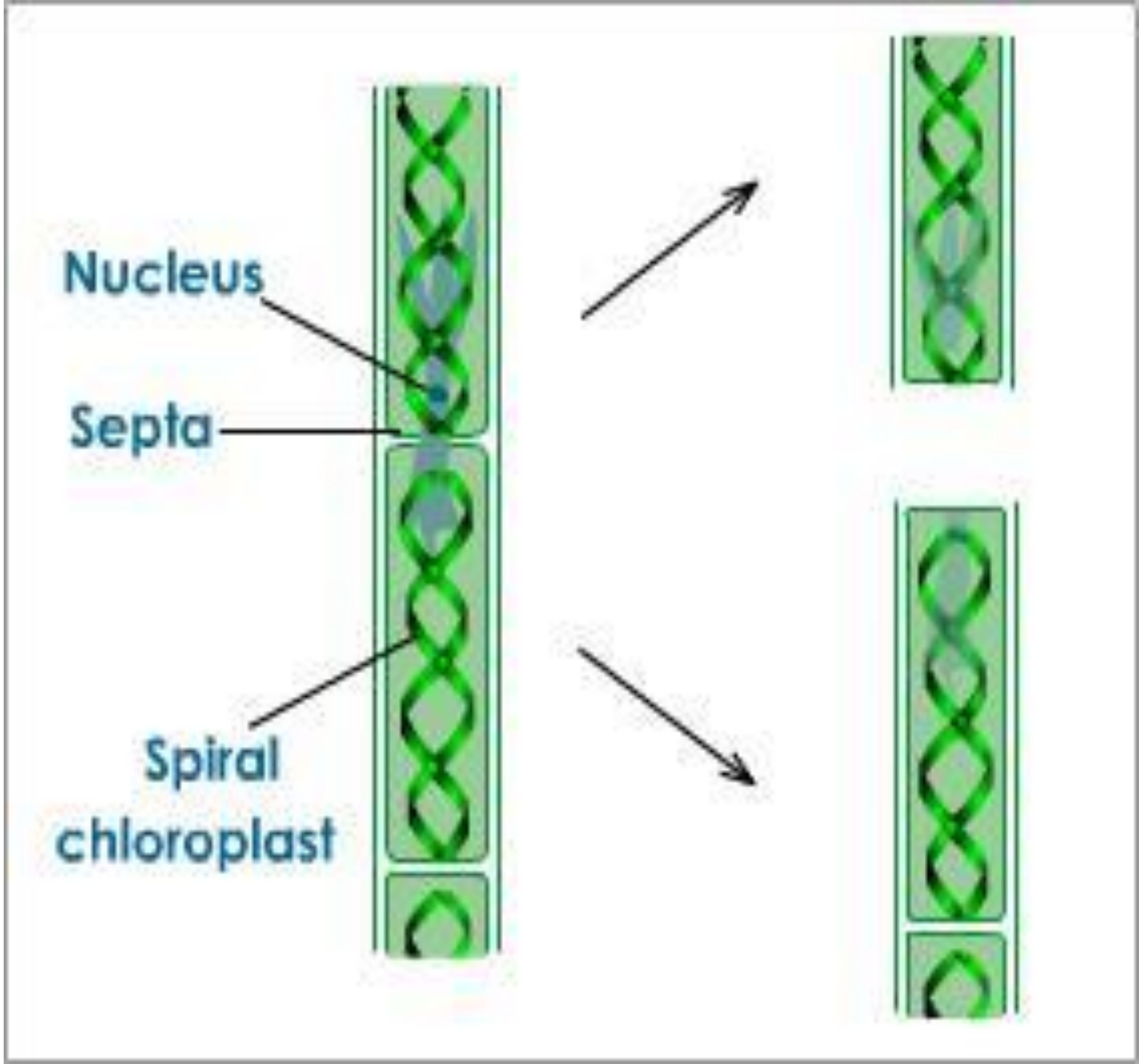
- The vegetative reproduction in algae includes those methods of propagation in which portion of the plant body become separated off to give rise to individuals.
- Process does not involve the meiosis, fusion of nuclei and production of spores.
- Very common mode of multiplication.
- Vegetative reproduction take place by different methods.

i) BY CELL DIVISION:

- The mother cells divide and the daughter cells are produced, which become new plants.
- It is sometime known as Binary Fission.
- This type of reproduction is found in ***Diatoms , Euglena.***

ii) **FRAGMENTATION**:

- The plant body breaks into several parts or fragments and each such fragment develops into an individual.
- This type of vegetative reproduction is commonly met within filamentous forms, e.g., ***Ulothrix, Spirogyra*** etc.
- The fragmentation of colonies also takes place in several blue green algae, **e.g.** ***Aphanothece, Nostoc*** etc.



iii) BUDDING:

Bud like structure has been reported to develop on the thalli of ***Protosiphon.***

iv) AMYLUM STARS: They are starch filled, star shaped, cell aggregates present on the lower node of member of Charophyceae. They germinate into new plant bodies.

v) TUBERS: Tuber like structure develop on the rhizoids of *Cladophora* and *Chara*. They accumulate food materials. When detached, germinate into new plants.

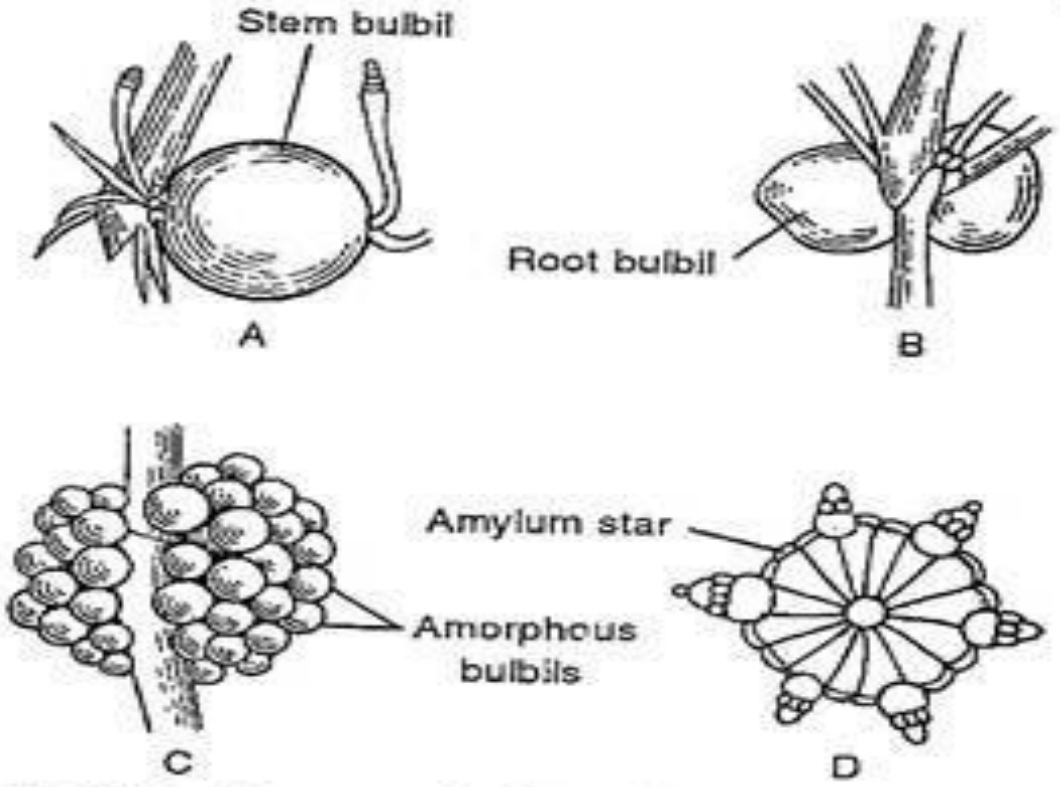
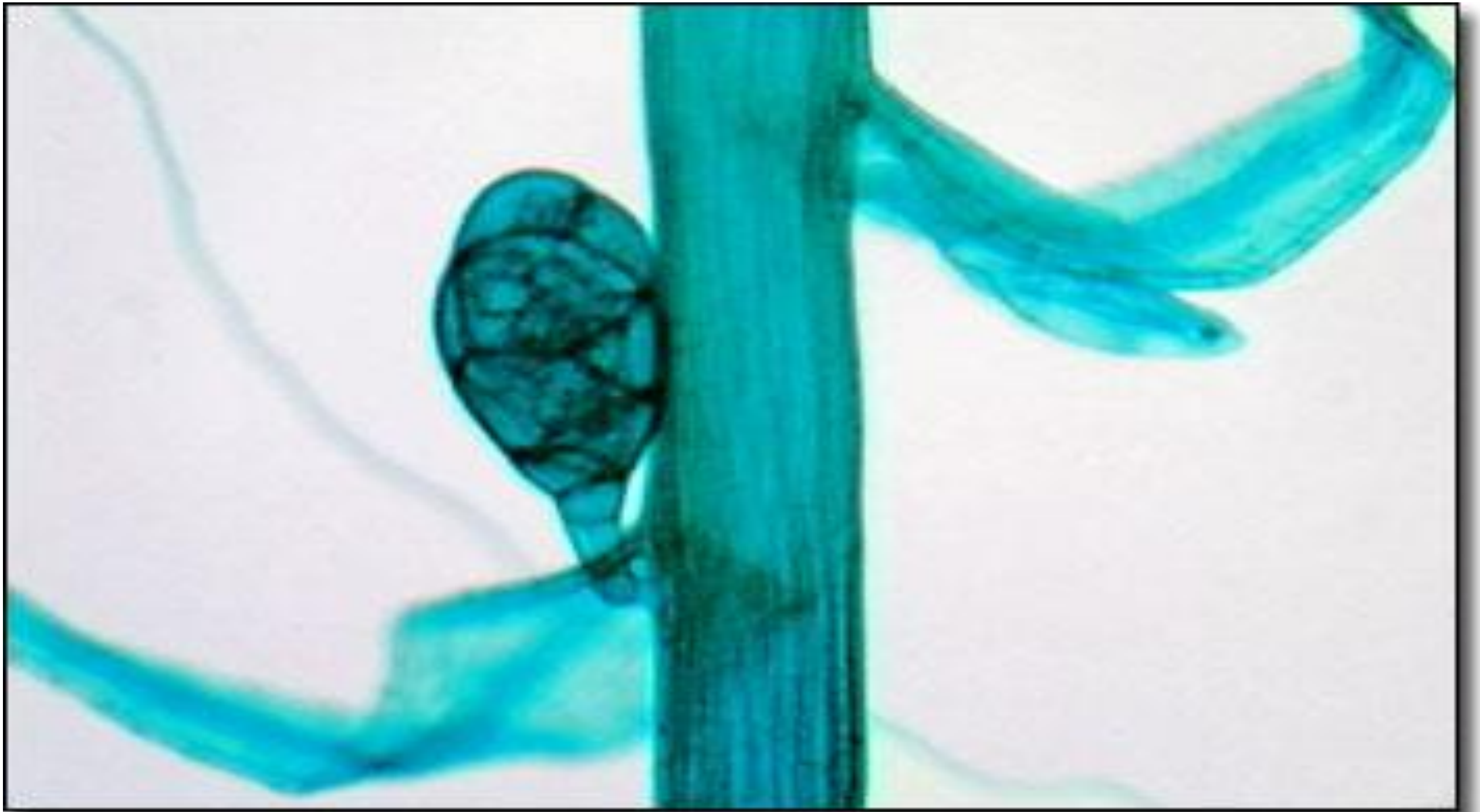


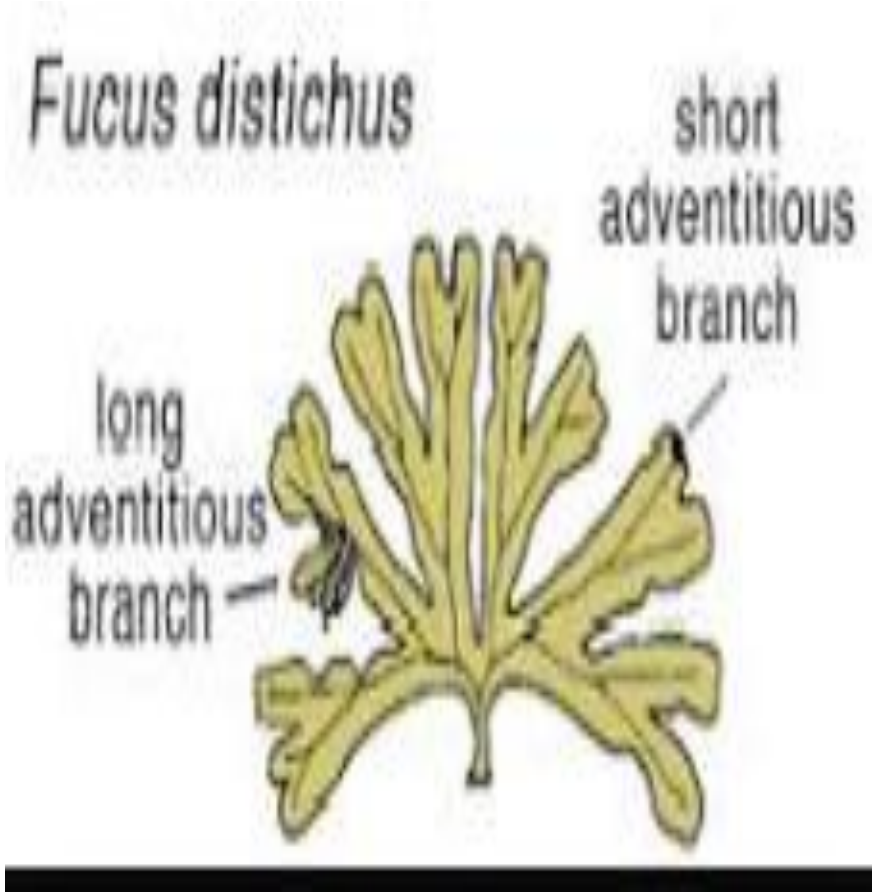
Fig. 3.93 : *Chara* sp. : A. Stem bulbil, B. Root bulbil, C. Amorphous bulbil, and D. Amylum star



VI) ADVENTITIOUS BRANCHES

- ✓Adventitious Branches are formed in some large thalloid forms of algae.
- ✓These branch when get detached from the parent thallus develops into new plant .
- ✓Adventitious branch like protonema formed on the internodes of *Chara* .
- ✓E.g ***Dictyota , Fucus .***

Adventitious Branches



vii) **Hormogone formation**:

- When the trichome's break in small pieces of two or more cells, such pieces are called 'hormogones'
- In some Blue green algae the fragments undergoes a gliding movement which are called 'Hormogones'.
- Each hormogone develops into a new plant, e.g., ***Oscillatoria, Nostoc*** **etc.**

2. ASEXUAL REPRODUCTION

- Asexual reproduction is a mode of reproduction by which offspring arise from a single organism, and inherit the genes of that parent only.
- it is reproduction which almost never involves ploidy or reduction.
- The offspring will be exact genetic copies of the parent, except in the specific case of automixis .
- It involves the rejuvenation of the protoplasts.
- Asexual reproduction occur through following methods.

i) **BY ZOOSPORES**:

❖These are motile and naked reproductive bodies developed inside special structures known as zoosporangia.

❖They possess two, four or many flagella and are able to swim in water.

❖Each zoosporangium may produce only one (*Oedogonium*), in multiple of four (*Ulothrix*) or many (*Cladophora*) zoospores inside them.

❖Flagella may be present at he interior end (green algae) or on the lateral side (brown algae).

❖They are always **formed in favourable conditions.**

❖The zoospores are always **motile.**

On the basis of number of flagella present on their bodies they are of following types

i) **Biflagellate:** Having two flagella, e.g. *Chlamydomonas, Ectocarpus*.

ii) **Quardiflagellate :** Having four flagella e.g. Macrozoospores of ***Ulothrix***

iii) **Octaflaellate:** Having eight flagella, e.g. *Polyblepharis*.

iv) **Multiflagellate:** having many flagella e.g. *Oedogonium, Synzoospore of Vaucheria.*

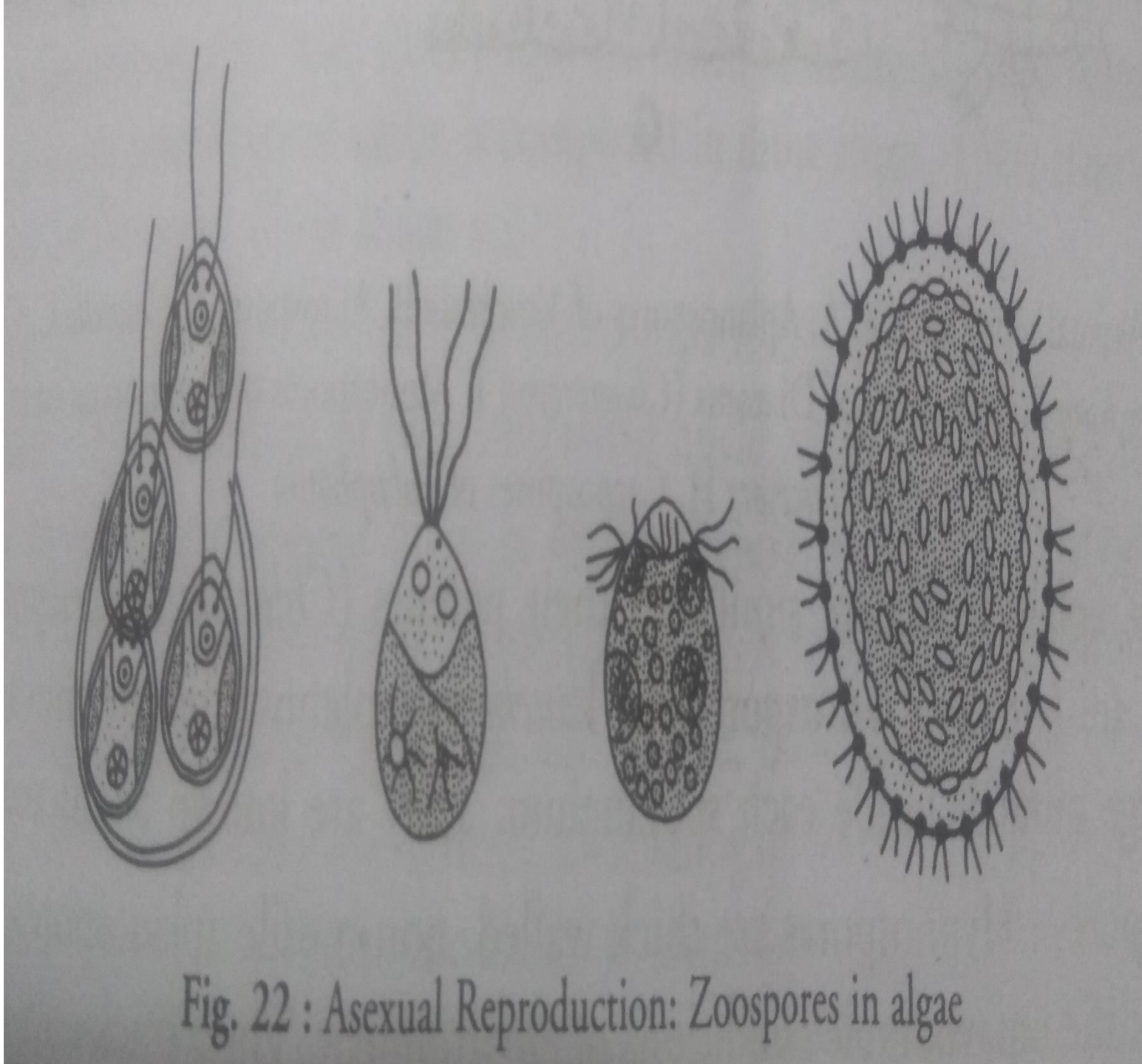


Fig. 22 : Asexual Reproduction: Zoospores in algae

2. APLANOSPORES :

- These are non motile spores produced inside sporangia.
- Mostly these are produced by terrestrial algae (e.g. *Vaucheria*) but also by ***Microspora*** and ***Ulothrix*** (aquatic forms)
- For their formation, protoplast of the cell rounds off and develop its own wall to become aplanospore, also considered as arrested zoospore.
- Sometimes aplanospores are similar to their parents (*Chlorella, Scenedesmus*) in all aspect except size and are known as **autospore**.
- ***Vaucheria*** produces minute size spore in large numbers inside sporangium, known as **microaplanospores**.

3. HYPNOSPORES: These are thick walled, non-motile aplanospores produced by some algae to tide over the unfavourable conditions, e.g. *Chlamydomonas nivalis, Pediastrum*, etc. on return of favourable conditions, hypnospore germinate into new plant bodies.

Chlamydomonas nivalis walls become red due to deposition of **haematochrome**, responsible for **Red Snow** phenomenon.

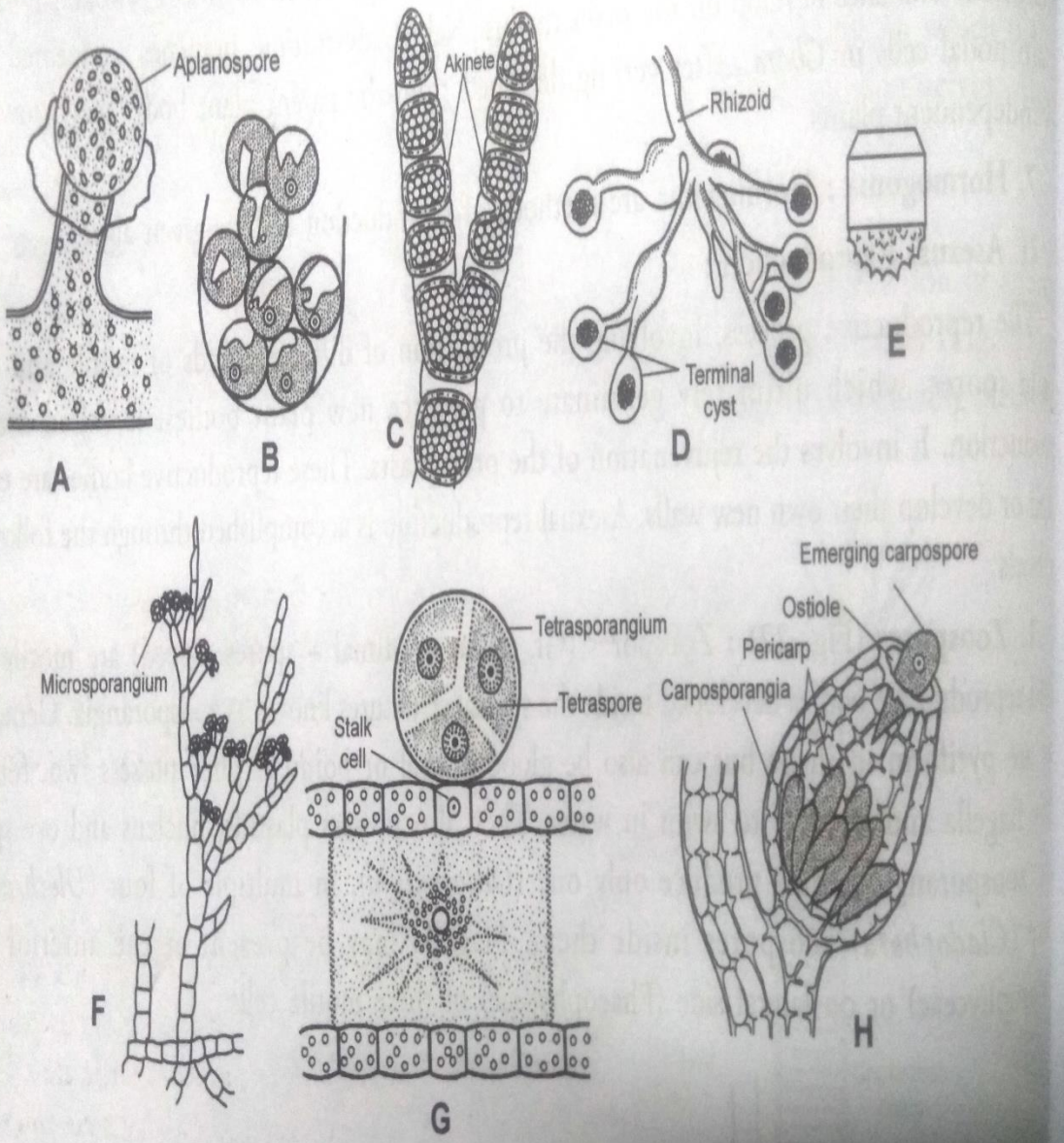
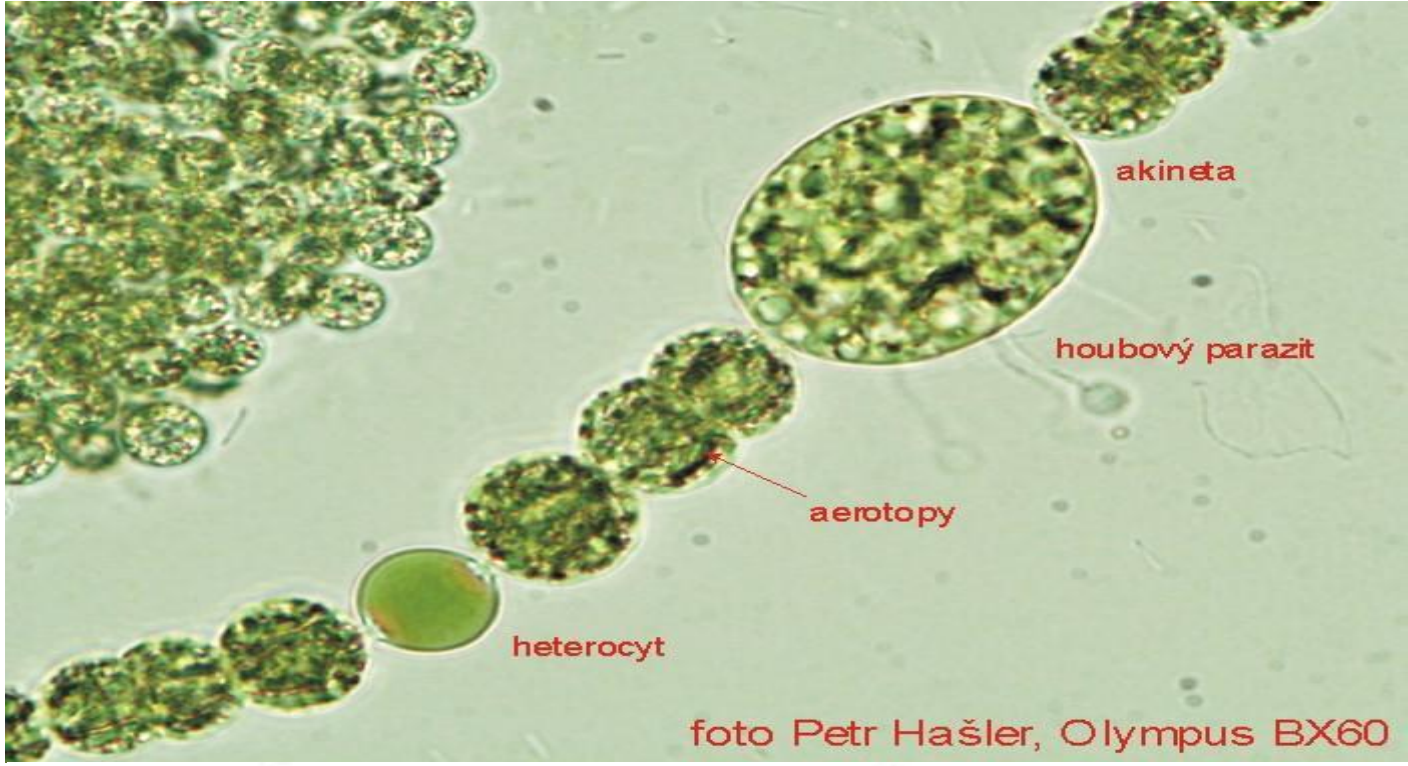


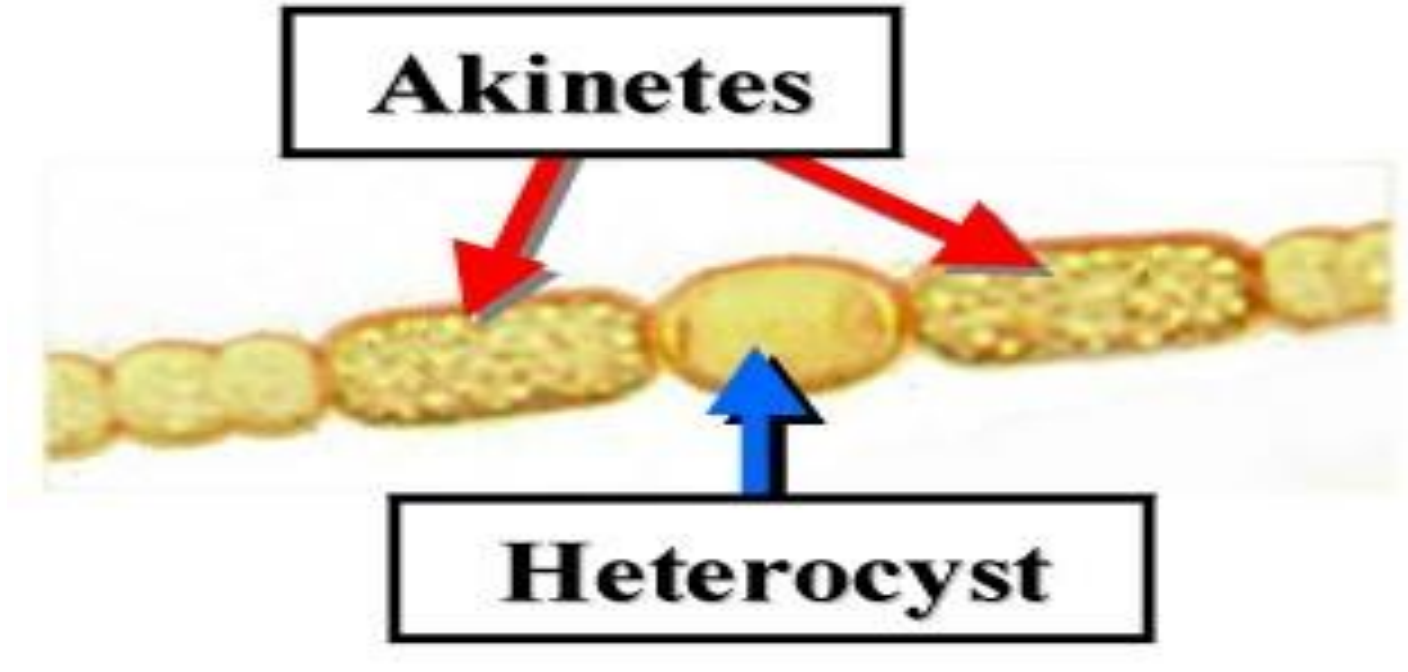
Fig. 23 : Asexual reproduction: A. Aplanospores of *Vaucheria* B. Autospores of *Chlorella* C. Cysts of *Vaucheria* D. Cysts of *Botrydium* E. Statospore of Diatoms (*Chaetoceros*) F. Monospores of *Batrachospermum* G. Tetraspores of *Dictyota* H. Carpospores of *Polysphonia*.


Chlamydomonas nivalis

4) AKINETES OR CYST:

- It is the types of reproduction very common in the blue green as well as green algae.
- These akinetes are **a type vegetative cell which is thick walled and will overcome the unfavourable condition.**
- Sometimes they are formed in chain.
- In *Protosiphon*, akinetes are formed multinucleate protoplast to form **coenocysts**. They are known as **statospore** in diatoms.





5.MONOSPORES: These are haploid, naked, non-motile and uninucleate spores produced singly inside the monosporangia during chantrantia stage in member of class Rhodophyceae. They are liberated after the rupturing of cell wall.

6.TETRASPORE: These are non-motile spores produced in groups of four, inside specialized cells known as tetrasporangia.

Tetraspores are sexual spores known as **gonospores and meiospores** produced after meiotic division in diploid nucleus of tetrasporangium.

found in **Phaeophyceae** and some member of **Rhodophyceae**

7.NEUTRAL SPORES: prouduced by direct transformation of the protoplast of a vegetative cell into a single spore, e.g. ***Ectocarpus***.

8.CARPOSPORES: (Karpos= fruit +Sporo= seed) are non- motile spores produced on short filament arising from carpogonium following fertilization. They are feature of red algae, e.g. ***Polysiphonia, Batrachospermum*** etc.

3. SEXUAL REPRODUCTION

Reproduction in Algae

Vegetative

1. Fragmentation: *Cyanophyceae, Ulotrichales*
2. Fission: *Diatoms*
3. Akinetes: *Pithophora, Oedogonium*
4. Tubers: *Chara*
5. Hormogonia: Myxophyceae
6. Adventitious thalli : in *Fucus*

Asexual

1. Zoospores: *Chlamydomonas, Cladophora*
2. Synzoospore: *Vaucheria*
3. Aplanospore: *Vaucheria, Chlamydomonas*
4. Hypnospore: *Vaucheria*
5. Autospores: *Chlorella*
6. Tetraspores: Rhodophyceae nad some Phaeophyceae

Sexual

1. Isogamy: *Spirogyra, Zygnema*
2. Anisogamy: *C.braunii*
3. Oogamy: *Volvox, Fucus*

Conditions for sexual reproduction:

(a) The sexual reproduction takes place after considerable accumulation of food material and the climax of vegetative activity is over.

(b) The bright light is the major factor for the production of the gametes.

(c) A suitable pH value is required.

(d) The optimum temperature is necessary.

Sexual reproduction is of following types:

i)Autogamy

ii) isogamy

iii) Heterogamy

- a)Anisogamy
- b) Physiological Anisogamy

iv) Aplanogamy or conjugation

v) Parasexuality

AUTOGAMY: Is the fusion of two sister gametes produced inside the same mother cell.

In this process, only karyogamy takes place.

It is important feature of **diatoms.**

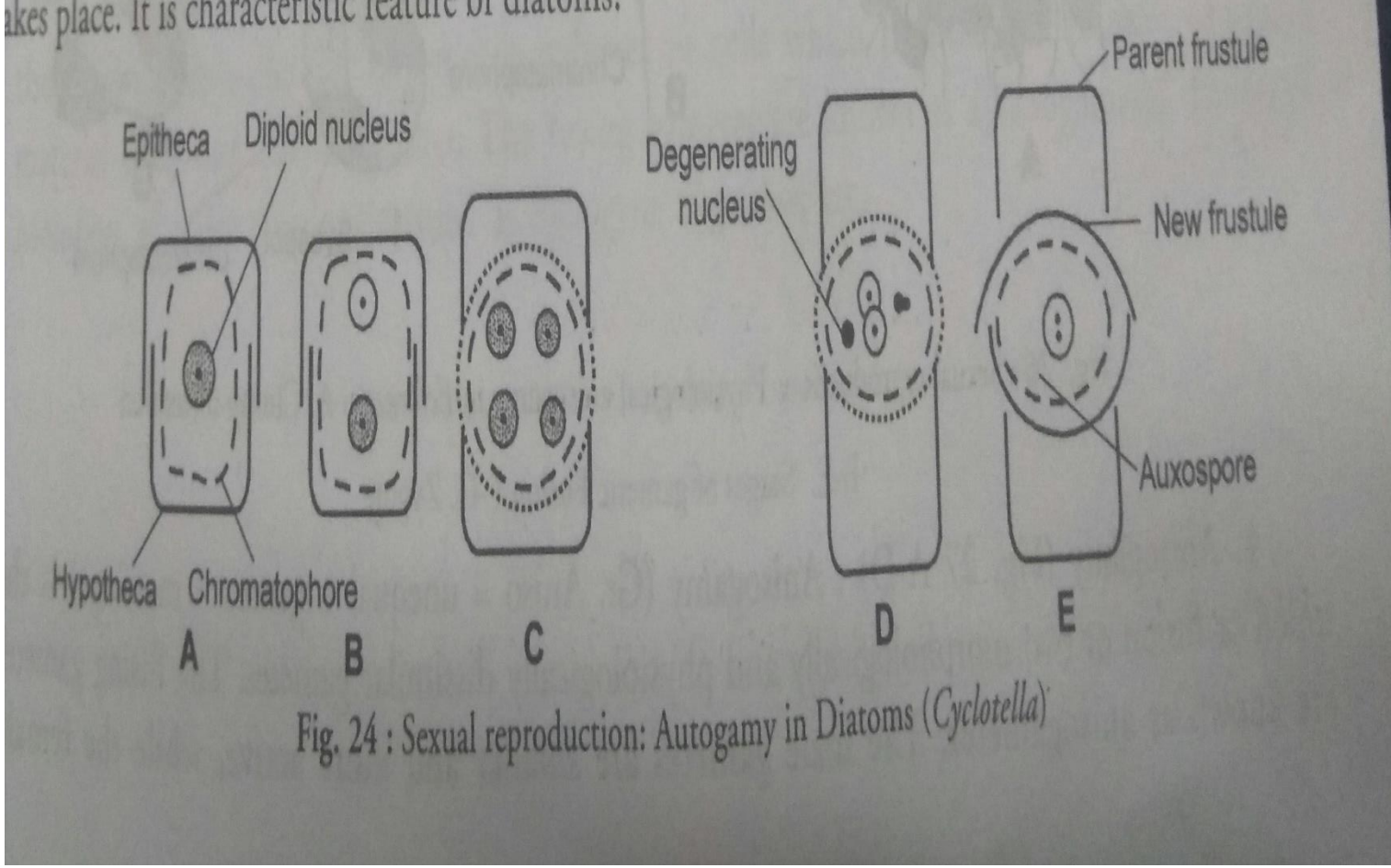
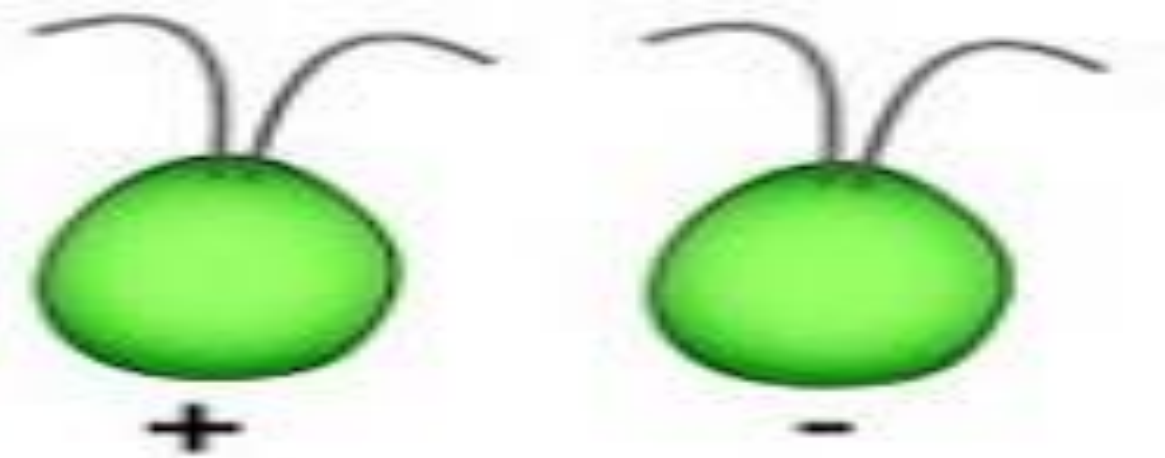


Fig. 24 : Sexual reproduction: Autogamy in Diatoms (*Cyclotella*)

(i) **Isogamy**:

- Isos=equal, alike, +gamos=marriage)is the fusion of two morphologically and physiologically similar gametes.
- Fusing gametes are known as isogametes.
- The fusion of similar motile gametes is found in many species.
- Usually the gametes taking part in fusion come from two different individuals or filaments, sometimes these gametes come from two different cells of the same filament.
- they cannot be classified as "male" or "female." Instead, organisms undergoing isogamy are said to have different mating types, most commonly noted as "+" and "-" strains, e.g. many spp. of ***Chlamydomonas spp., Ulothix*** etc.



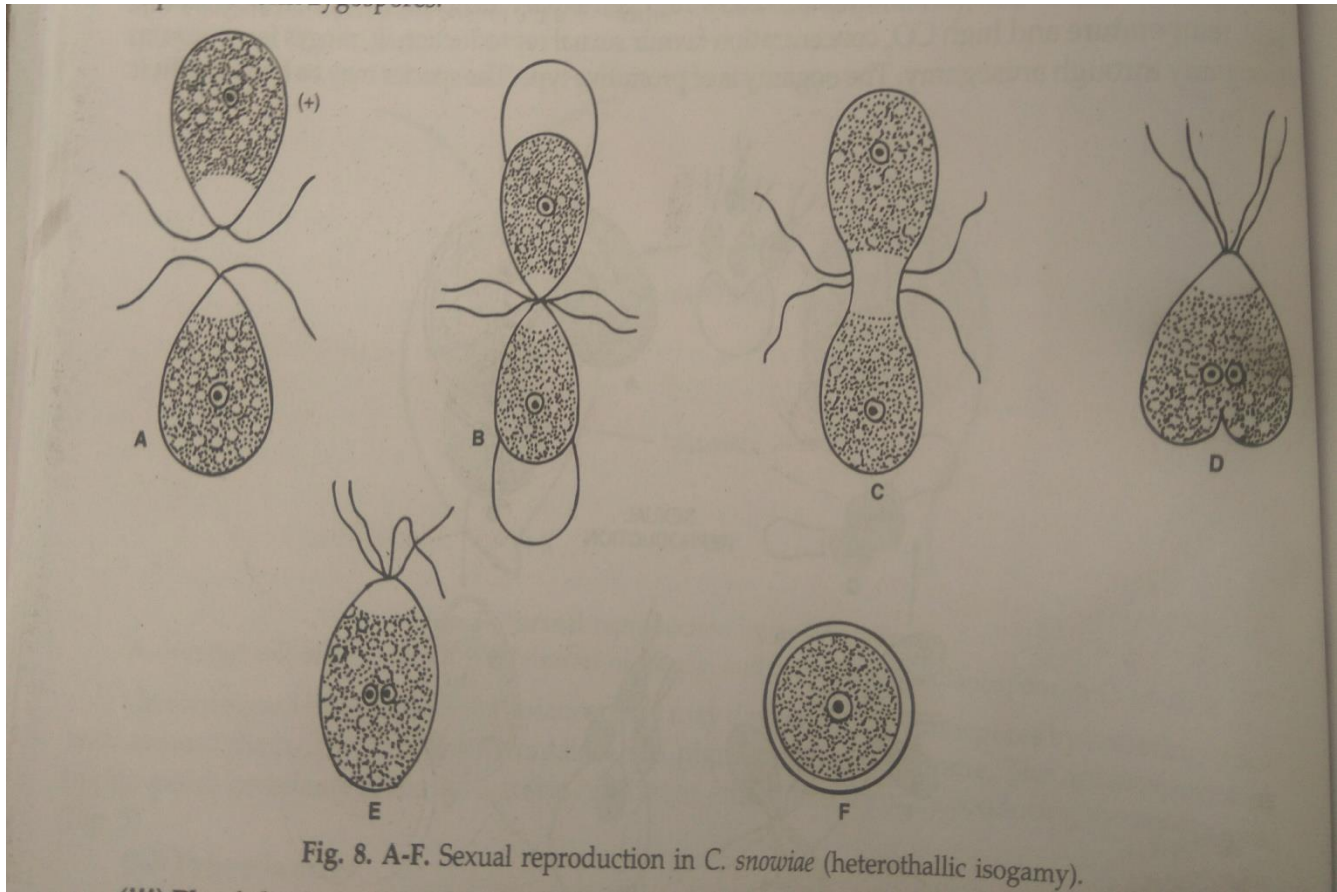


Fig. 8. A-F. Sexual reproduction in *C. snowiae* (heterothallic isogamy).

(ii) **HETEROGAMY**:

The fusion of dissimilar gametes is called heterogamy.

There are two main types :

(a) Anisogamy:

(b) Physiological Anisogamy

a) ANISOGAMY: (Gr. Aniso=unequal+gamos= marriage) is the fusion of two morphologically and physiologically dissimilar gametes.

✓Fusion gametes are known as anisogametes.

✓Male gametes are smaller and more active, while the female gametes are larger and less active, e.g. *Chlamydomonas braunii, Pandorina* etc.

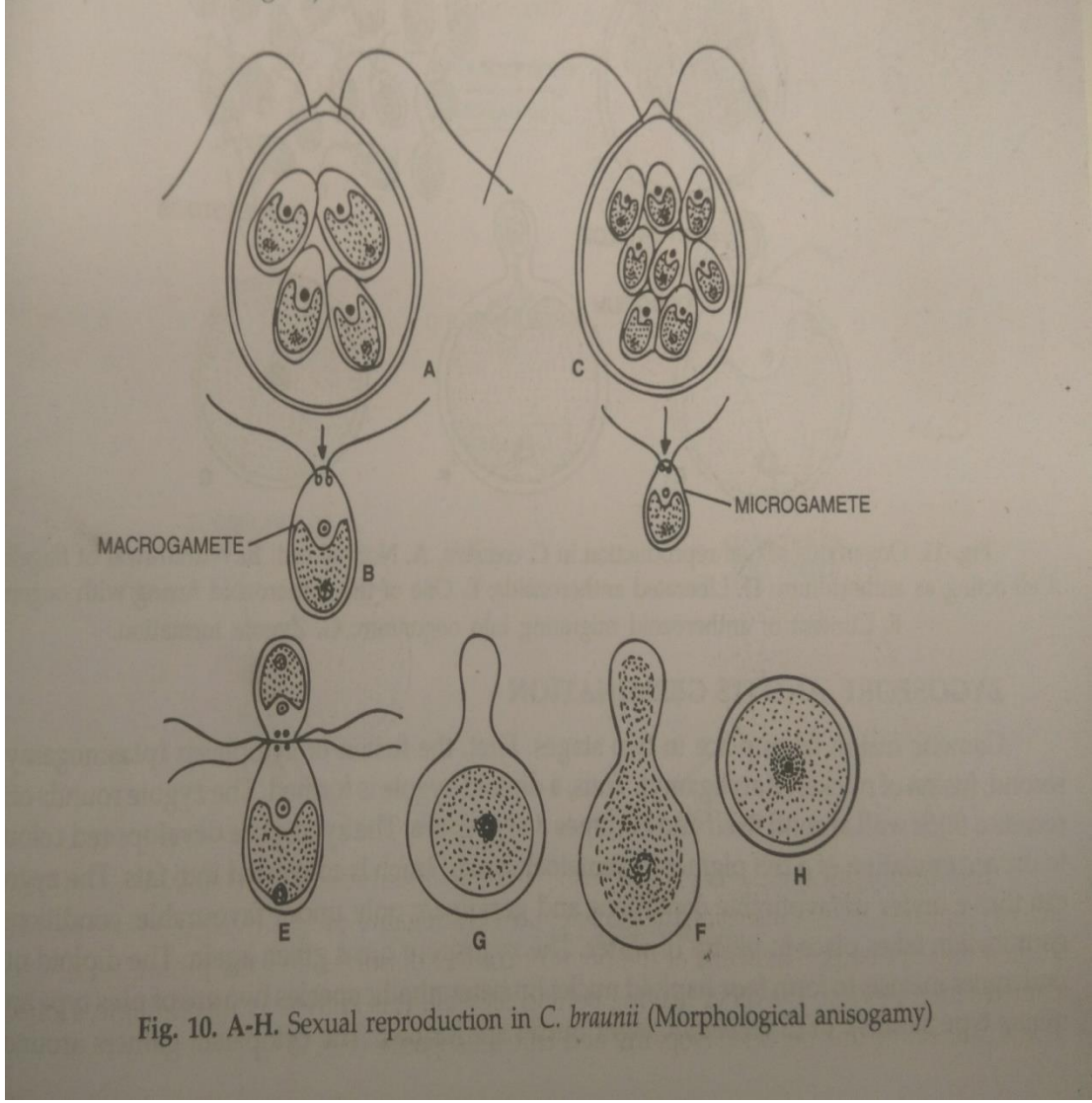


Fig. 10. A-H. Sexual reproduction in *C. braunii* (Morphological anisogamy)

(b) PHYSIOLOGICAL ANISOGAMY: when the fusing gametes are morphologically similar but exhibit different physiological behaviour, the sexual reproduction is known as phisiological anisogamy.

❖In this case one gamete is more active and other is sluggish e.g. *Chlamydomonas monoica, Spirogyra, Ectocarpus*.

❖In *E. siliculosus*, the sluggish (female) gamete is surrounded by a large number of more active (male) gametes this type of fusion is known as **clump formation**.

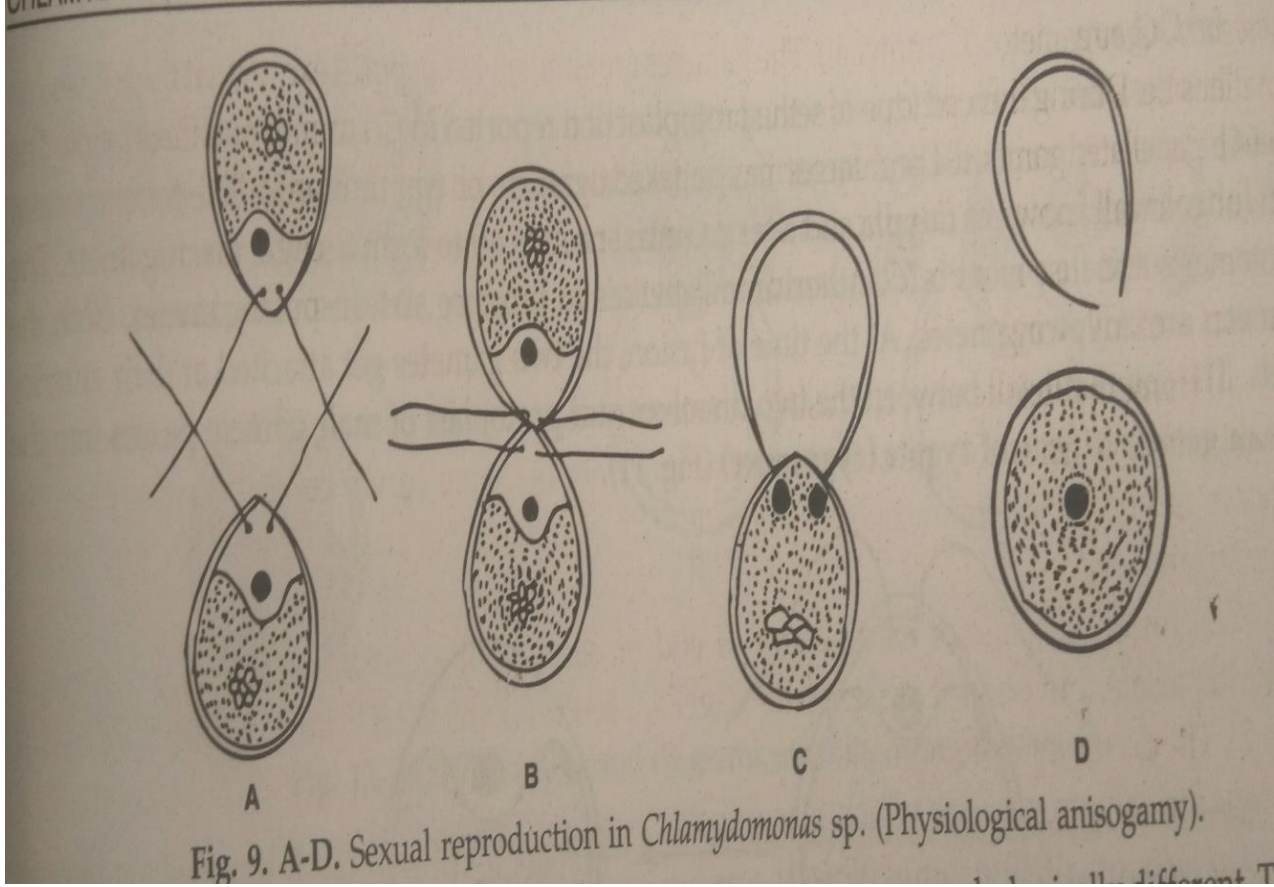


Fig. 9. A-D. Sexual reproduction in *Chlamydomonas* sp. (Physiological anisogamy).

iii)**Oogamy:** (Gr. Oion= egg + gamos = marriage) is the fertilization of a large, non-motile female gamete by small, motile male gamete.

- It is most advanced and highly evolved mode of sexual fusion and occur in highly evolved algae, e.g. *Chlamydomonas coccifera, C. ooganum, Volvox, Oedogonium, Chara, Fucus* etc.
- In red algae *Polysiphonia* and Batrachospermum where male gametes are also non- motile, oogamy is more specialized.
- Here male gametes are known as **spermatia** and female as **carpogonia**.

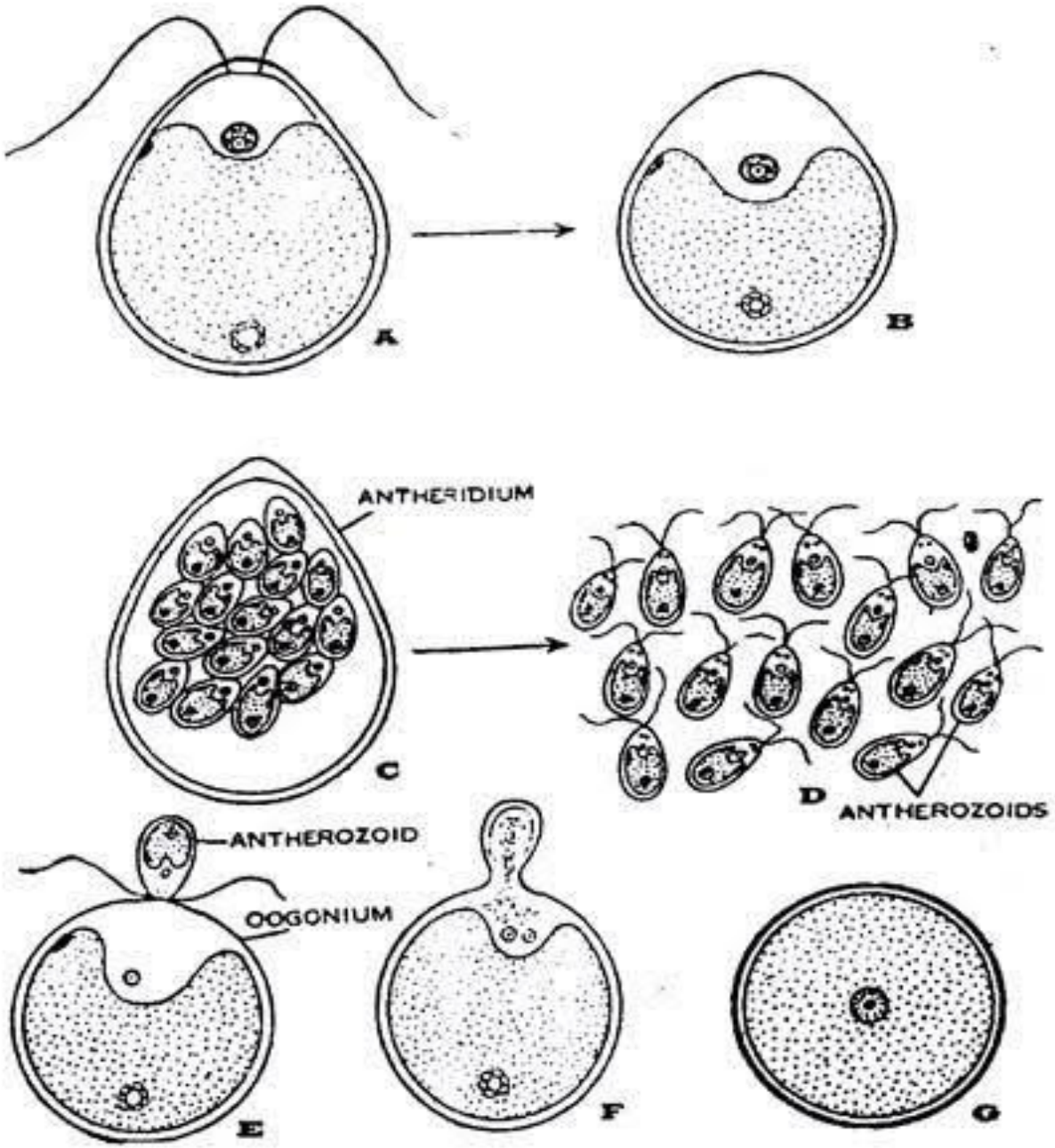


Fig. 12. *Chlamydomonas*. Oogamous reproduction

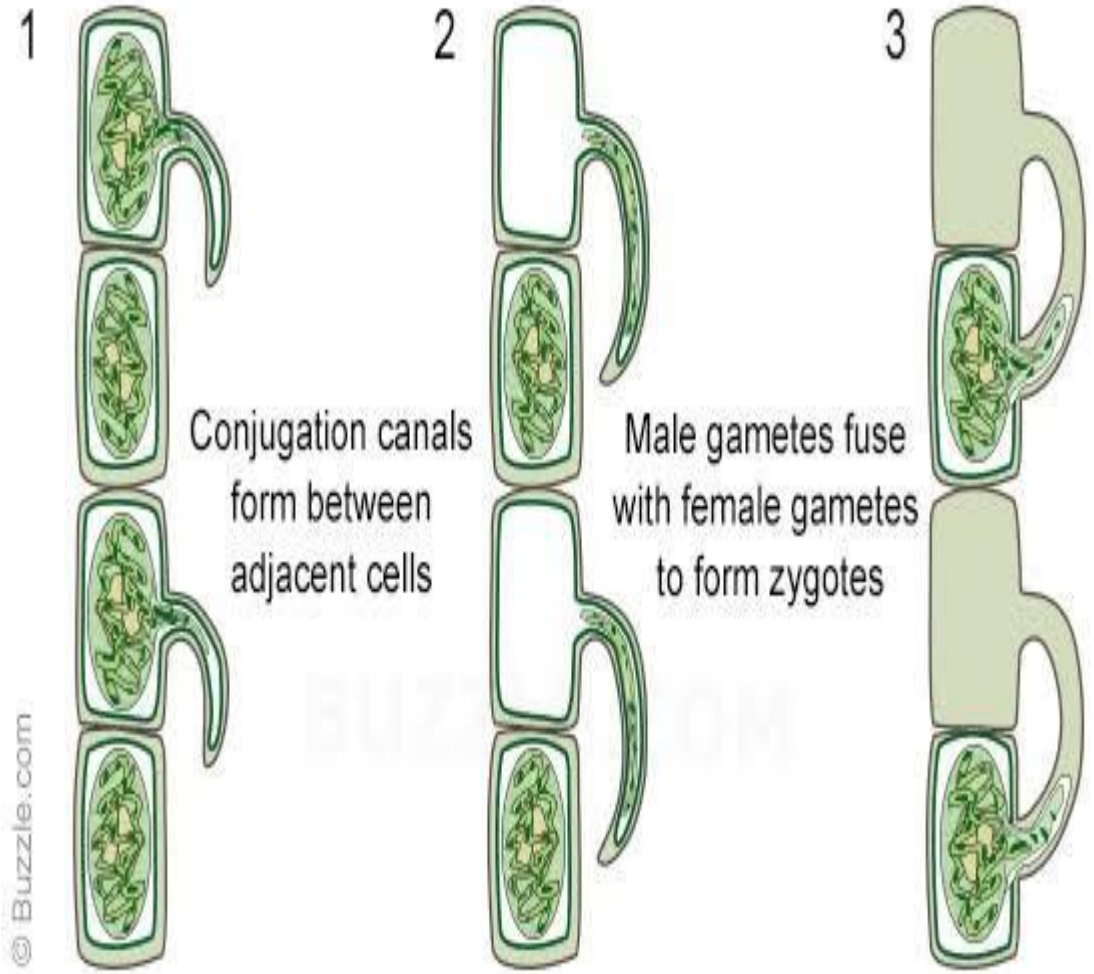
IV) CONJUGATION OR APLANOGAMY: is the fusion of two similar, non-motile gametes or cells which facilitate the transfer of genetic material from one cell to another.

The fusing gametes are known as **aplanogametes.**

e.g. *Spirogyra, Zygnema* etc.

V) PARASEXUALITY: The genetic recombination without the involvement of sexual reproduction is known as parasexuality

e.g. *Anacytis, Anabaena* and *Cylindrospermum.*



LIFE CYCLES IN ALGAE

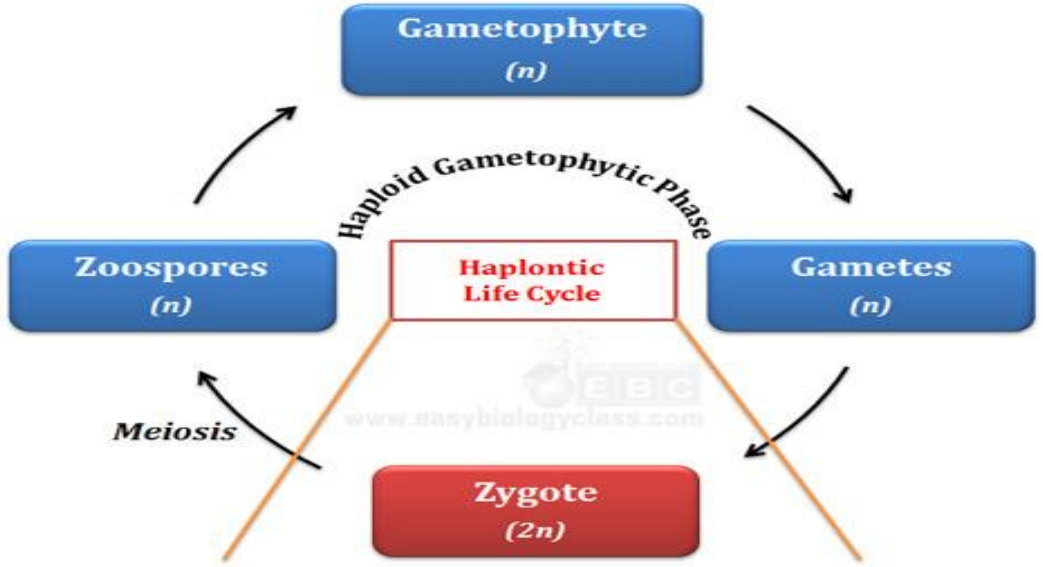
- The growth and development of algae passes through a number of distinct morphological and cytological stages in definite orderly manner. This sequence of orderly changes is called as life cycle or life history.

- It comprises the sequence of events from zygote of one generation to the zygote of next generation.

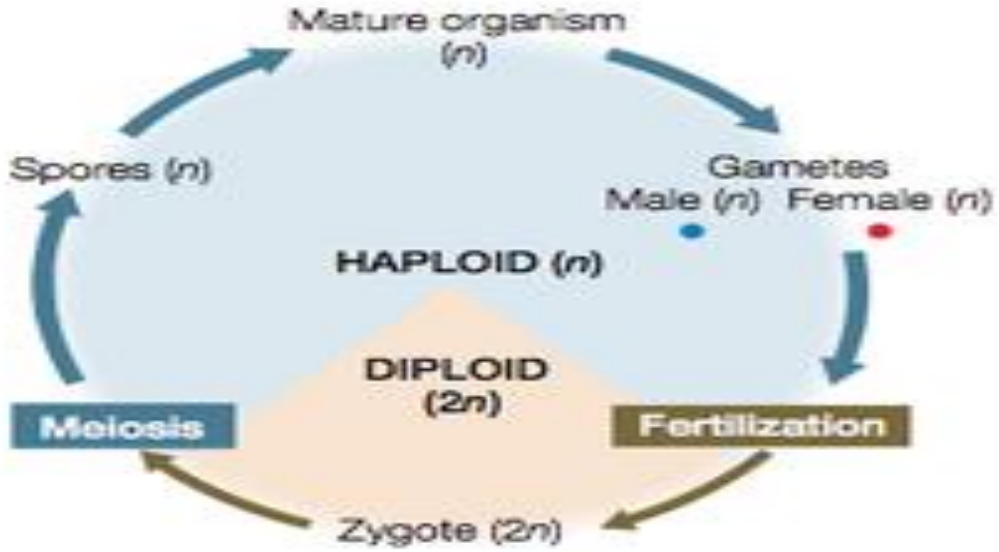
- There are five distinct types of life cycle as found in algae.

HAPLONTIC LIFE CYCLE

- **Most common type.**
- **Life cycle is diphasic.**
- **Prominent phase is haploid** gametophytic phase.
- Sporophytic diploid phase is represented by zygote only.
- Zygote is formed by the fusion of haploid gametes.
- **Zygote immediately undergoes meiosis to form haploid zoospores.**
- Zoospore on germination form haploid gametophytic generation
- Gametophytic plant produce male and female gametes by mitosis.
- This is the most simple and primitive type of life cycles found in ***Chlamydomonas, Ulothrix, Spirogyra, oedogonium, Chara Bangia etc.***



Haplontic Life Cycle



In the **haplontic life cycle**, the mature organism is haploid and the zygote is the only diploid stage.

DIPLONTIC LIFE CYCLE

❖This type of life cycle is the just reversal of haplontic type of life cycle.

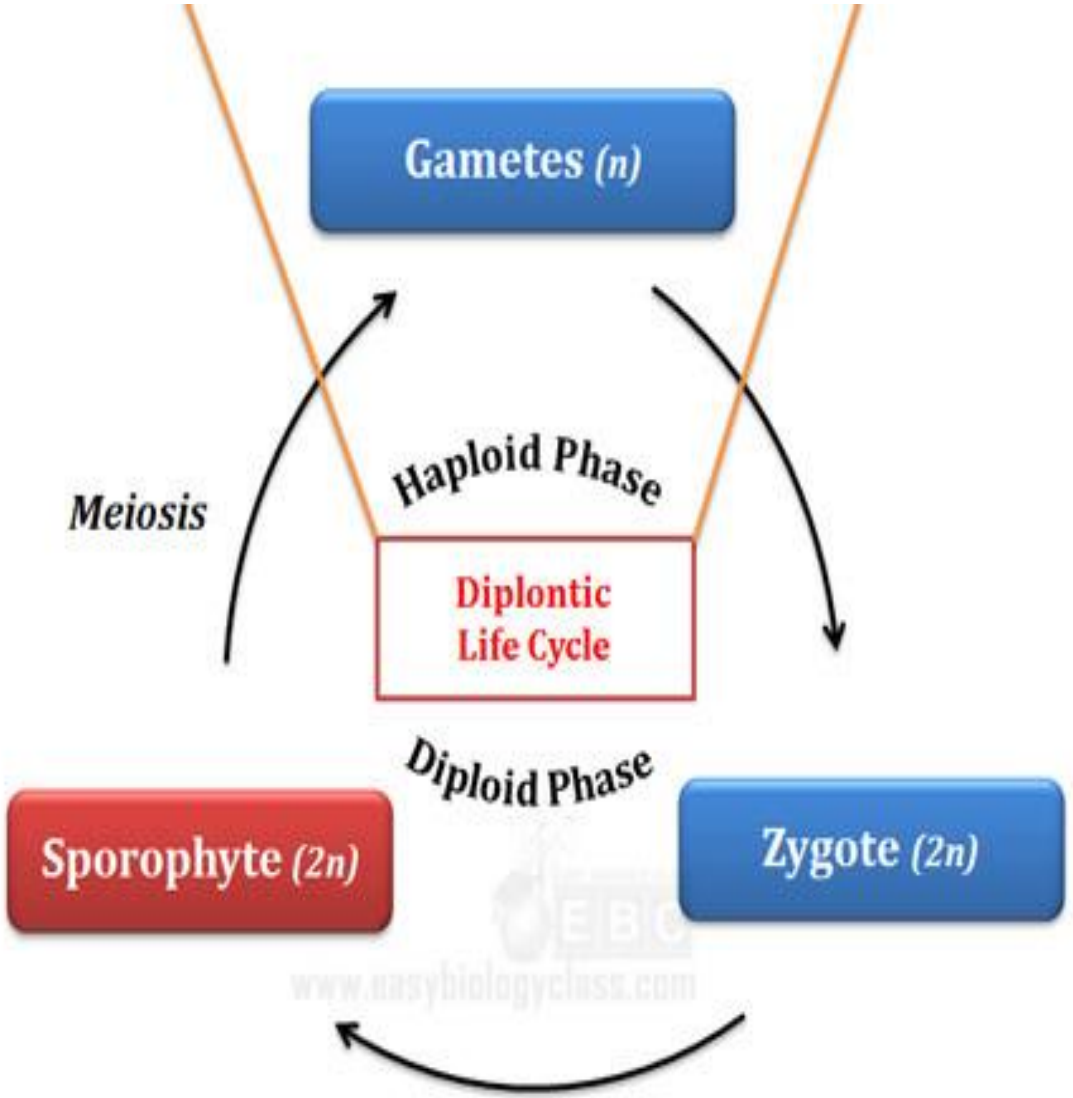
❖**Life cycle is diphasic, but the prominent phase is sporophytic.**

❖Haploid gametophytic phase is represented only by gametes.

❖Gametes are produced in the gametangia by meiosis.

❖Zygote donot undergo meiosis rather develop into the sporophytic phase by mitosis.

❖E.g. ***Sargassum, Fucus, Codium***

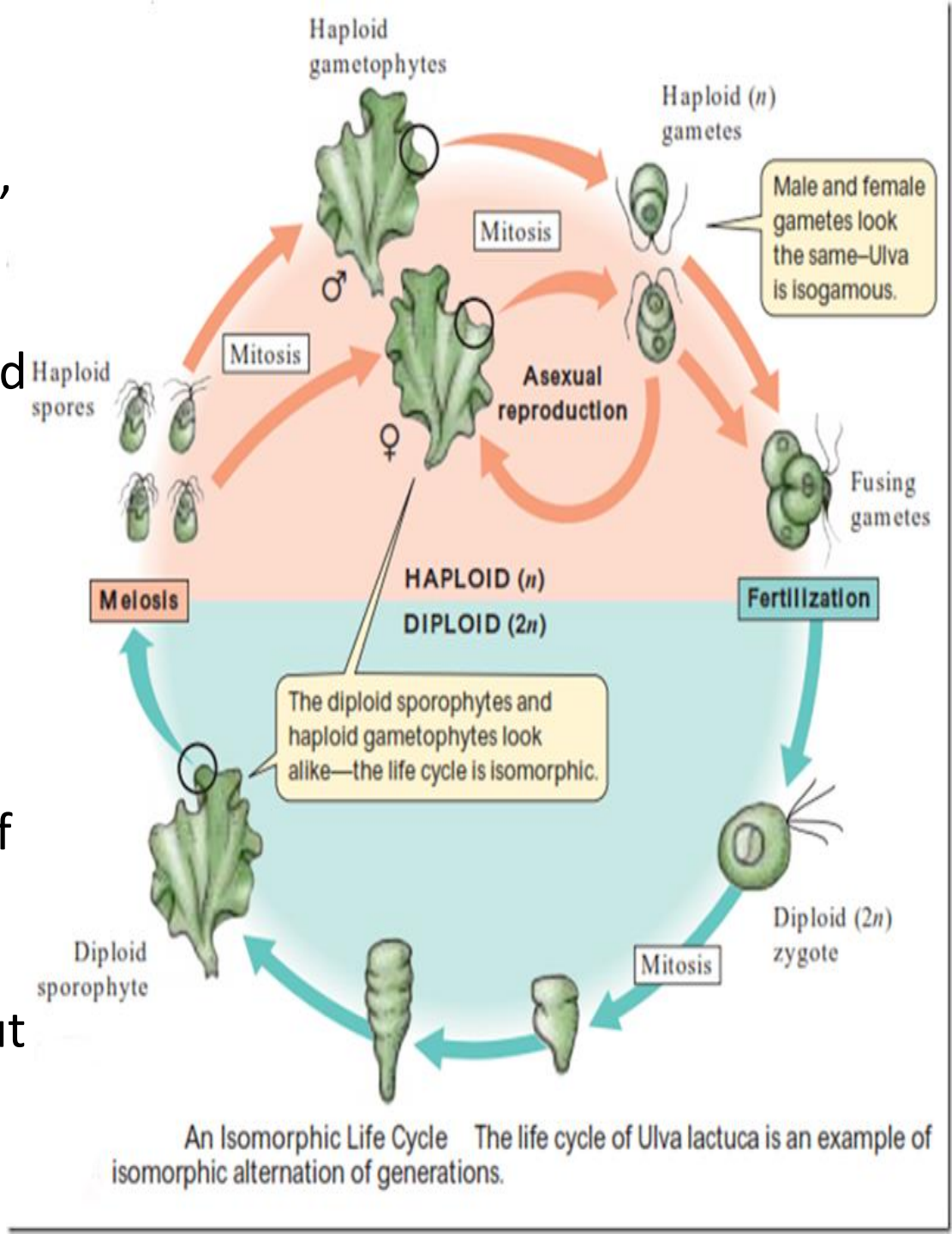


Diplontic Life Cycle

DIPLO-HAPLONTIC LIFE CYLCE:

- Haploid and diploid phases are equally prominent
- Gametophyte concerned with production of gametes, which fuse to form diploid zygote
- Zygote germinate to form diploid sporophytic plant body, which is concerned with the production of haploid spores.
- The haploid spores are known as meiospores and geminate again to form gametophyte.
- In this type sporophytic (2n) phase alternates with gametophytic phase equally.
- On the basis of morphological characters of gametophytic and sporophytic plants, this life cycle is of two types:

i)**Isomorphic type:** When both gametophytic and sporophytic plant bodies are morphologically similar but genetically different, this type of diplo-haplontic life cycle is known as isomorphic or homologous life cylce, e.g. *Cladophora, Ulva, Dictyota* etc.

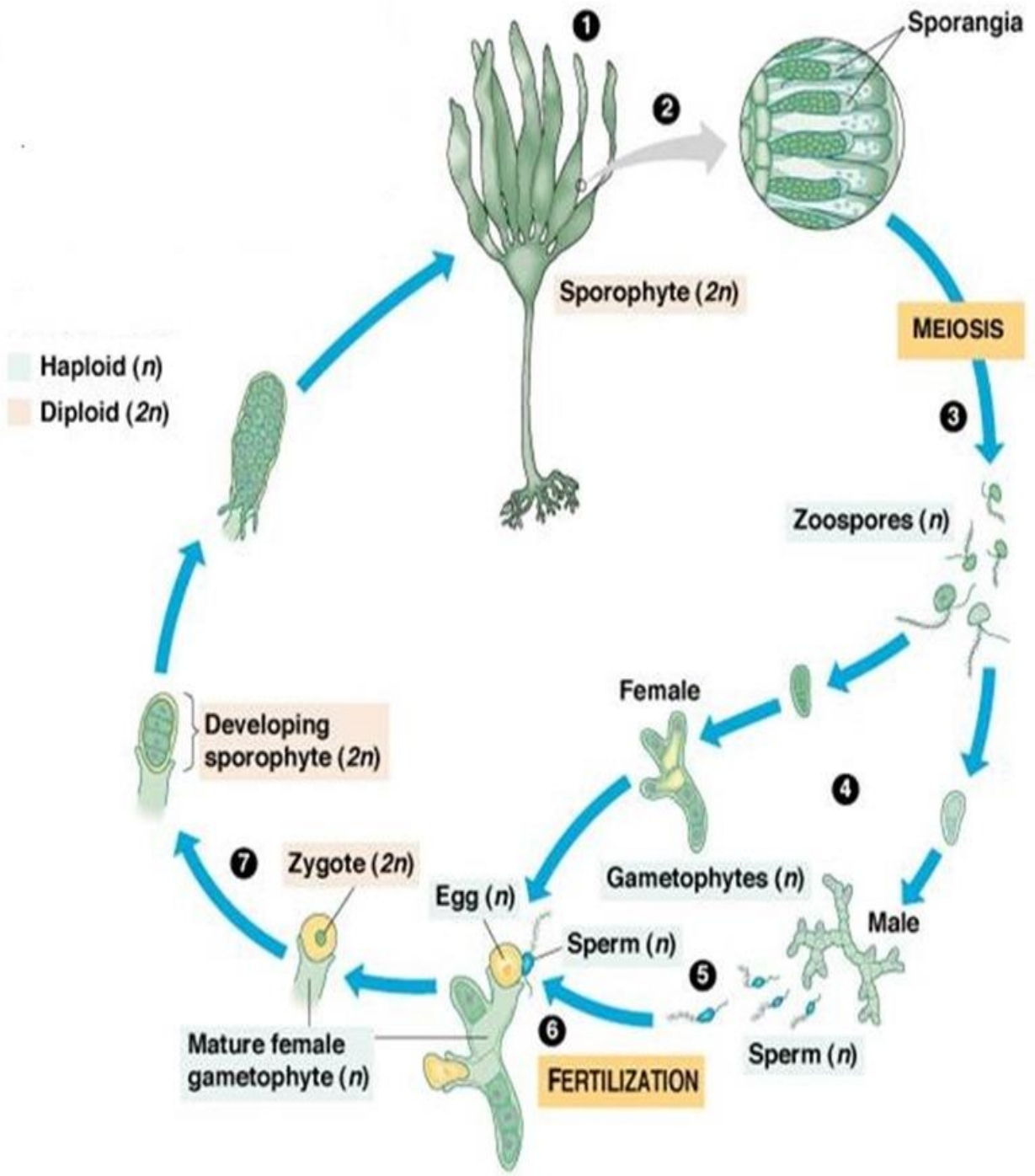


ii) **HETEROMORPHIC TYPE:**

when gametophytic and sporophytic plant bodies differ morphologically as well as genetically.

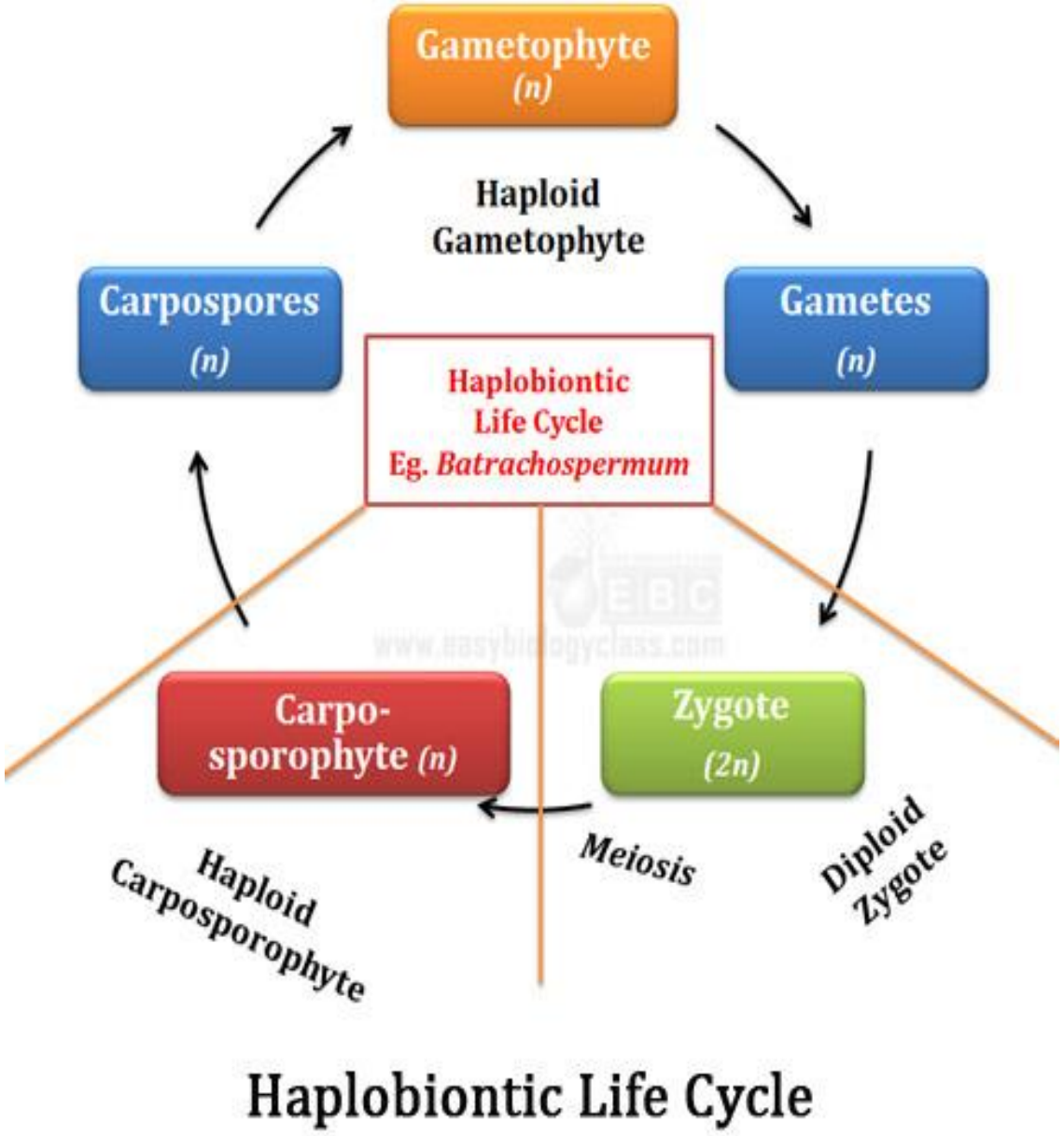
Genetically sporophytic plant body is macroscopic and gametophytic plant body is comparatively smaller, e.g. *Laminaria, Desmaresita*

In few cases this process is vice- versa, e.g. *Cutlaria, Urospora*



DIPHASIC HAPLO-BIONTIC LIFE CYCLE:

- Two haploid gametophytic plant bodies alternate with sporophytic phase of short duration represented by zygote.
- Main plant body is free living gametophyte concerned with production of gametes
- Gamete fuses to form zygote
- Zygote undergoes meiotic division and form small parasitic haploid carposporophyte.
- Terminal cell of carposporophyte behave as carposporangia, which produce haploid carpospores
- Carpospores germinates into haploid gametophytic plant body, e.g. primitive red algae such as *Nemalion*.



Haplobiontic Life Cycle

TRIPHASIC HAPLO-BIONTIC LIFE CYCLE:

❖Three prominent haploid gametophyt plant bodies alternates with sporophyt phase of short duration

❖Represented by zygote.

❖Similar to diphasic haplo-biontic life cycl except one additonal haploid "Chatrant stage" after haploid carposporophyte.

❖Carpospore geminate to produce haploi independent chatrantia stage, which giv rise to independent main gametophyt plant body as lateral growth.

e.g. *Batrachospermum*

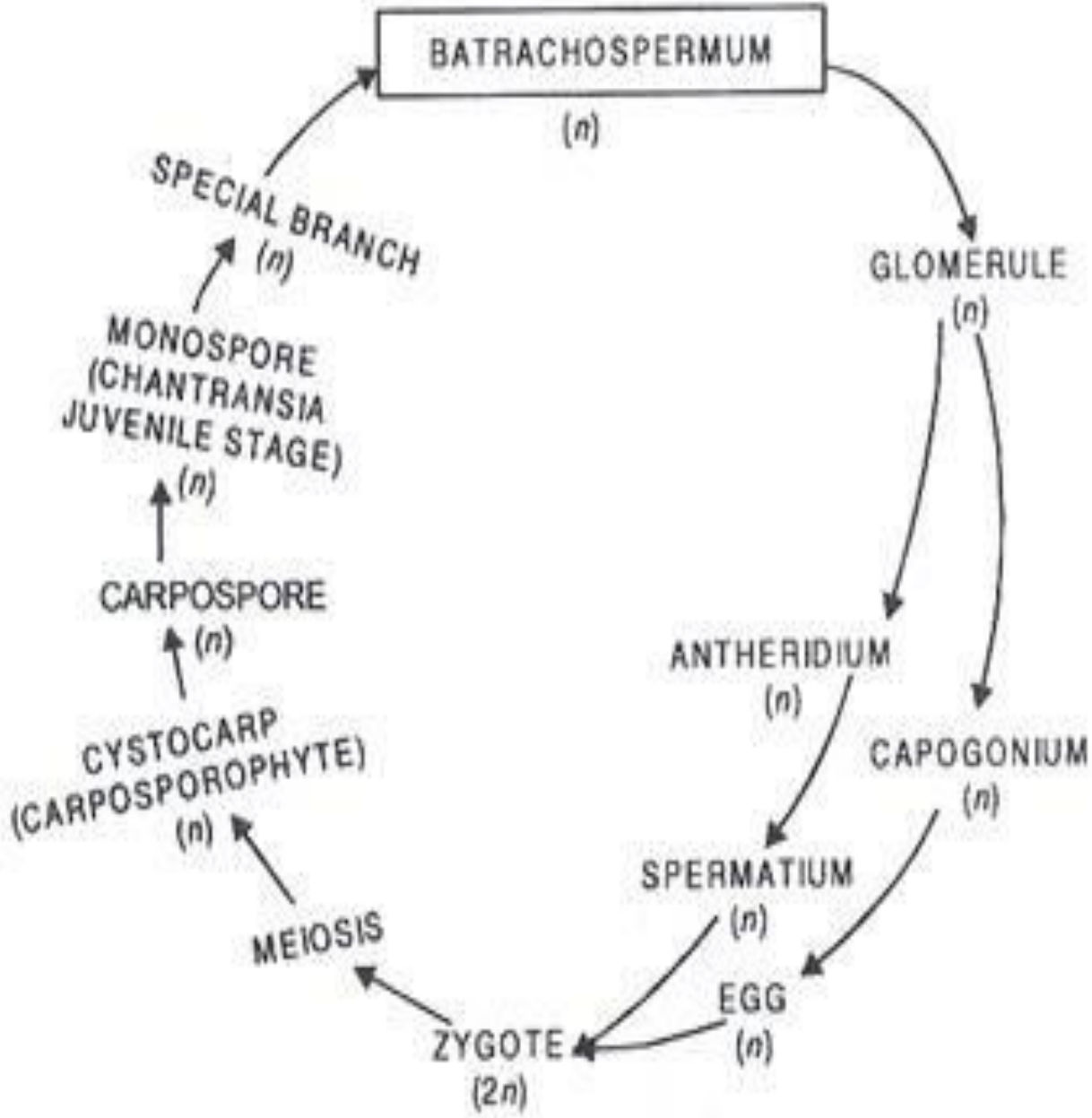


Fig. 7.10 *Batrachospermum*. Graphic life-cycle.

DIPLOBIONTIC LIFE CYCLE:

✓Most complex and advance type of life cycle.

✓**Triphasic life cycle:**

✓Among three phase two will be diploid and one will be haploid.

✓**Diplobiontic life cycle is found in Rhodophycean members exept Nemalionales.**

✓***Polysiphonia*** is showing such Haplodiplontic life cycle:

1) **Carposporophyte ; diploid**

2)Gametophyte; haploid

3)Tetrasporophyte; diploid

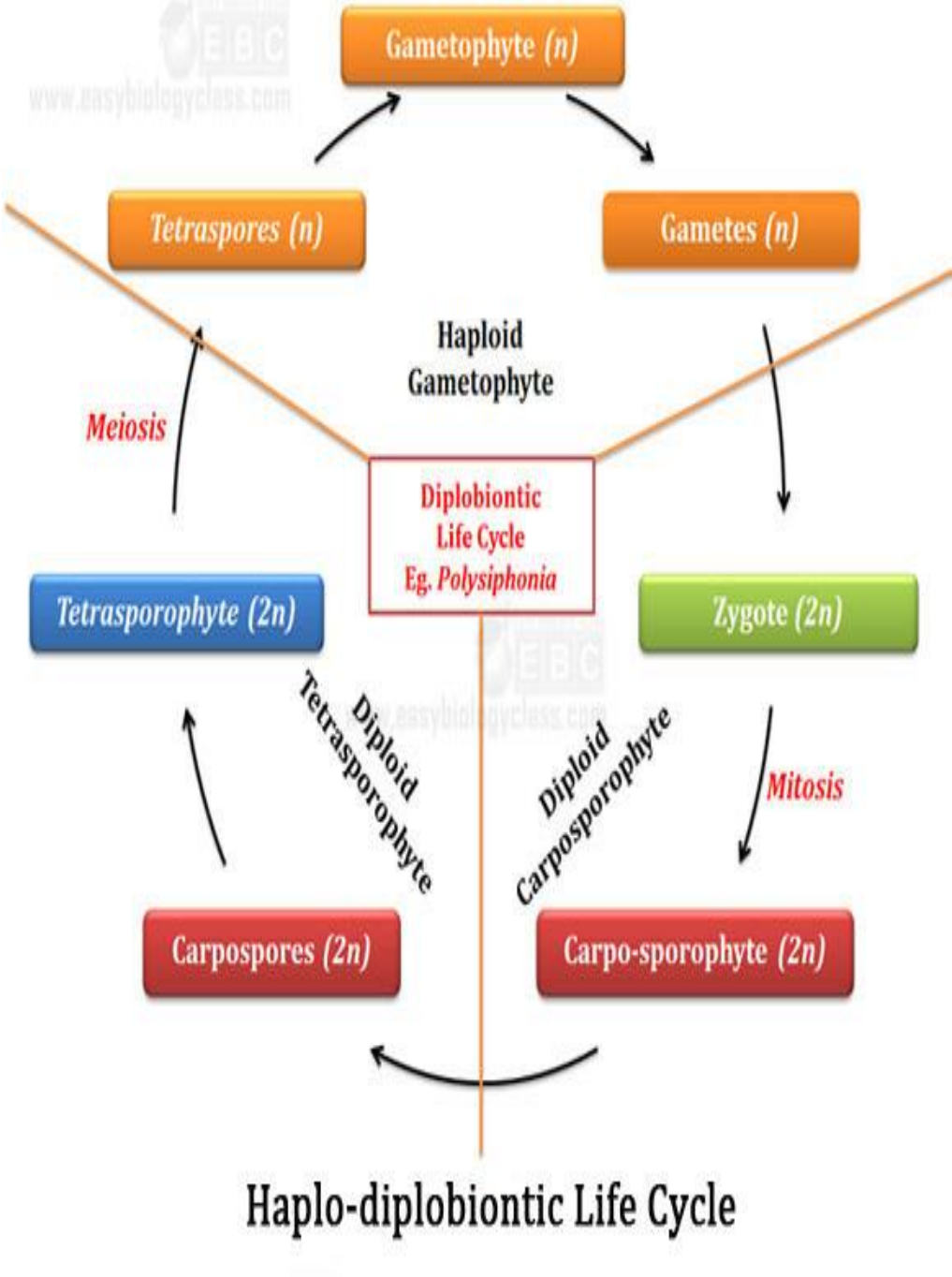
❖Diploid zygote develop mitotically into diploid Carposporophyte

❖Carposporophyte produce diploid carpospore.

❖Carpospore germinate into diploid tetrasporophyte which in turn produces haploid **tetrsapore by meoisis.**

❖Tetraspore germinate into haploid gametophytic plant body which produces haploid gametes.

❖These gametes later on get fused to form zygote



Also known as Diplo-diplohaplontic.

It is further of two type:

i)Isomorphic type: free living independent generations are morphologically similar, e.g . *Polysiphonia*.

Heteromorphic :When two free living generations are morphologically dissimilar, also known as heteromorphic or heterologous.e.g order Nemalionales.

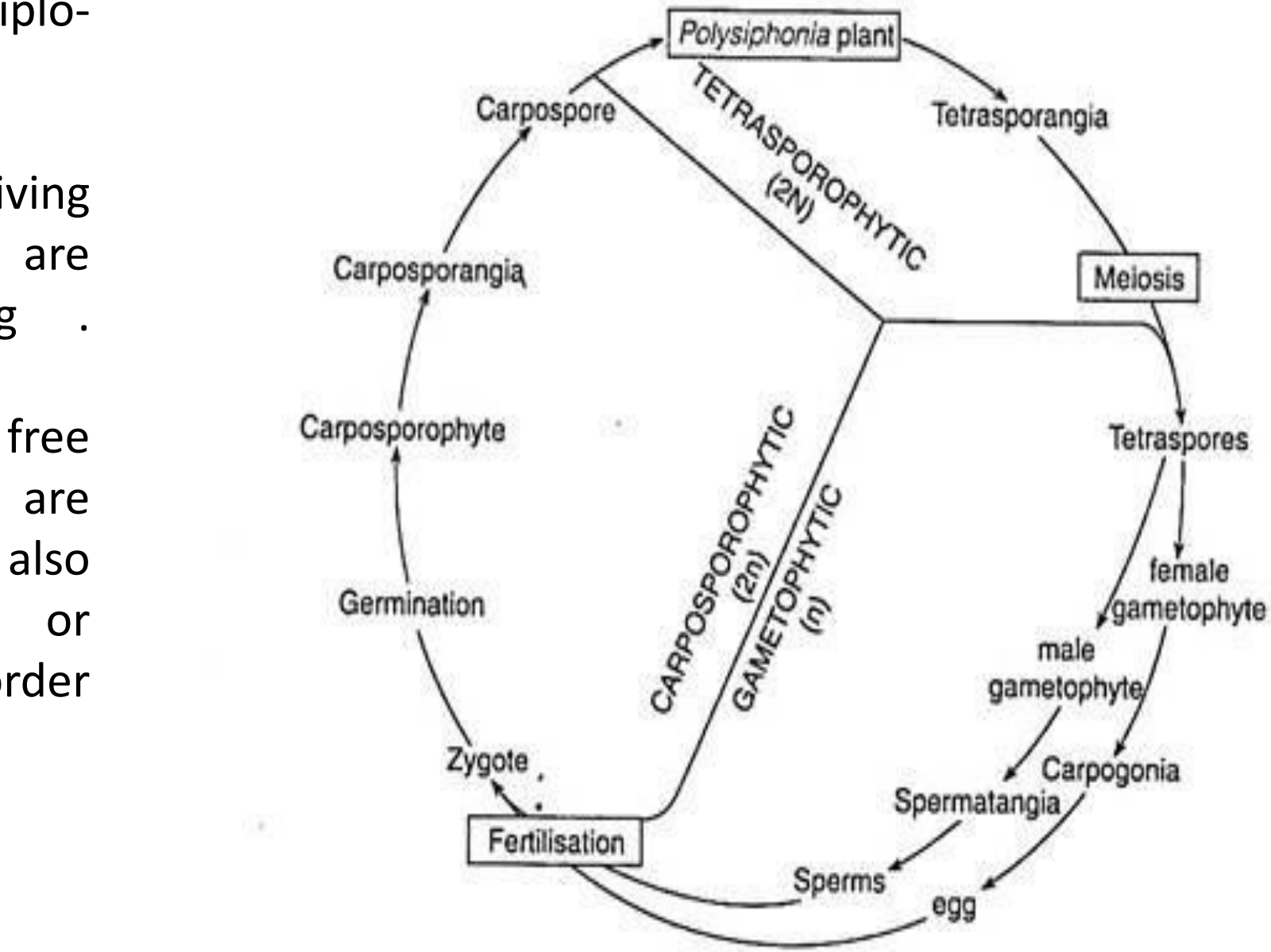


Fig. 3.138 : Graphic life cycle of *Polysiphonia* sp.

CLASSIFICATION OF ALGAE

CLASSIFICATION

- **Fritsch's Classification of Algae:**
- F.E. Fritsch (1935, 1945) in his book **"The Structure and Reproduction of the Algae"** proposed a system of classification of algae. He divided it into 11 classes. His classification of algae is mainly based upon **characters of pigments, flagella and reserve food material.**

- **Eleven classes proposed by Fritsch are as follows:**
- 1. **Chlorophyceae**
- **2. Xanthophyceae**
- **3. Chrysophyceae**
- **4. Bacillariophyceae**
- **5. Cryptophyceae**
- **6. Dinophyceae**
- **7. Chloromonadineae**
- **8. Euglenineae**
- **9. Phaeophyceae**
- **10. Rhodophyceae**
- **11. Myxophyceae(Blue green algae)**