CHARA (19)

Systematic Position:

Division : Chlorophyta
Class : Chlorophyceae
Order : Charales
Family : Characeae
Genus : Chara

(A) Occurrence:

Chara, with its about 90 species is a widely distributed alga. It is a commonly submerged aquatic alga which grows attached to the soft mud at the bottom of fresh water pools, lakes and streams.

Several species of chara get encrusted with calcium carbonate, and become hard, brittle and rough, hence commonly called stoneworts.

(B) Vegetative structure:

The plant body is multicellular, macroscopic, filamentous and branched and consists of an erect, branched axis which is attached to the substratum by means of rhizoids. The plants are rough because they get deposited by calcium carbonate all over.

The rhizoids arise from the lower nodes of the main axis. They are branched, multicellular and are differentiated into nodes and internodes. The main functions of rhizoids is to attach and fix the plant body to the substratum.

From each node of the thallus arise the following four types of appendages —

i) Branches of limited growth: They are also called primary laterals, leaves or

branchlets. Each branch arises from peripheral cell of node and ceases its growth after attaining a definite length.

ii) Branches of unlimited growth: These branches arise in the axis of short laterals and continue the growth of the thallus indefinitely. Usually, these branches arises singly at some of the older nodes of the main axis. Being apparently axillary in position, they are often called the axillary branches.

iii) Stipulodes: These are unicellular outgrowths that arise from the basal node of each branchlet. The species of Chara with the stipulodes in a single whorl are called haplostephanous. Some species have the stipulodes arranged in two whorls and are called diplostephanous.

iv) Cortex: Each internodal cell of main axis is corticated by vertically elongated corticating threads constituting the cortex. Each thread consists of much smaller cells arranged in a row.

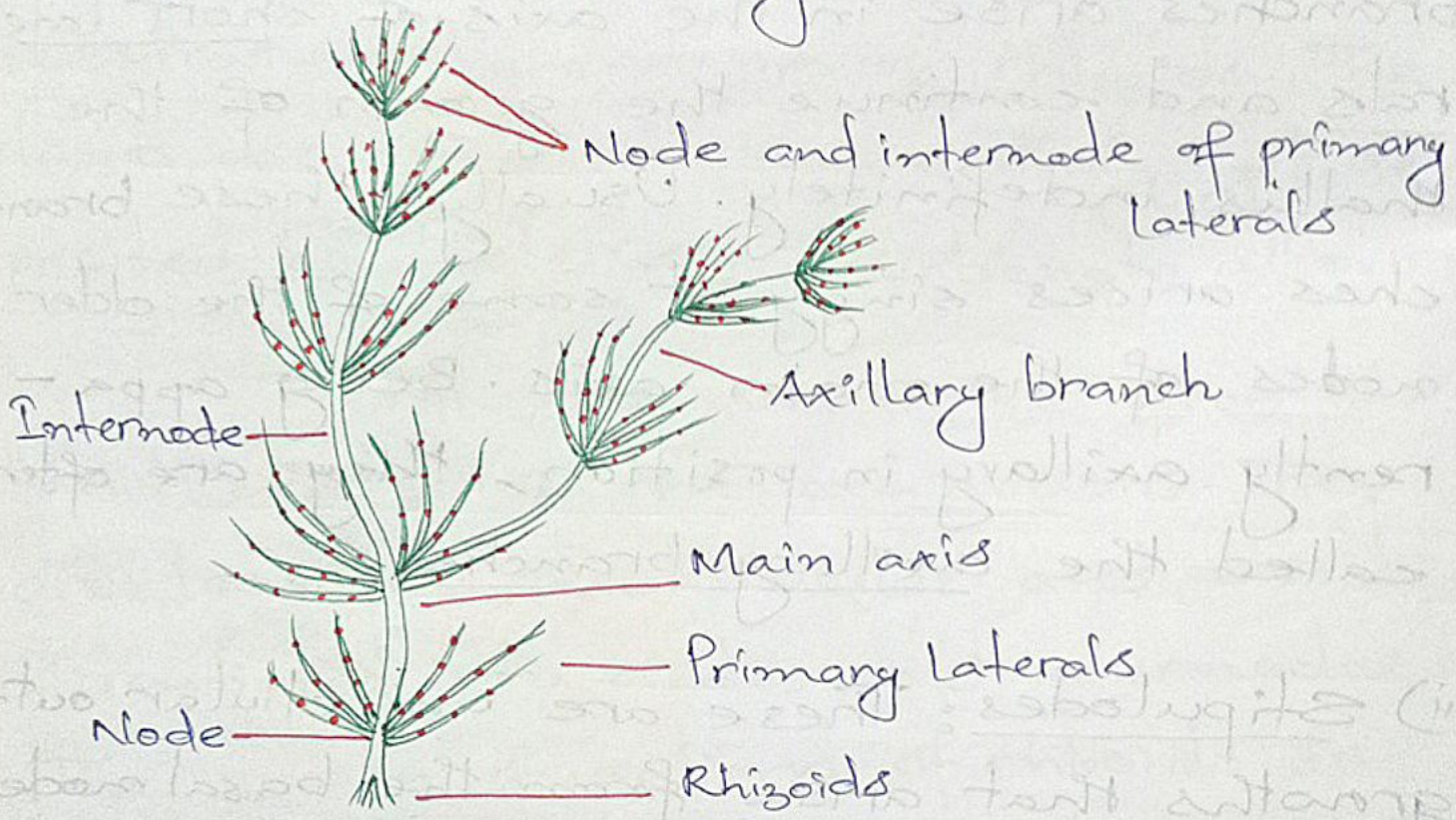

Fig: Chara. Habit of the plant

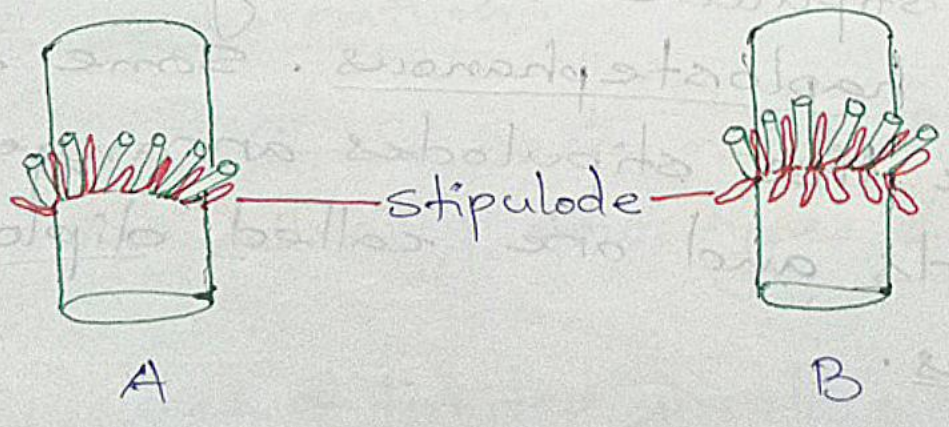

Fig: Chara. stipulodes. A, haplostephanous; B, diplostephanous.

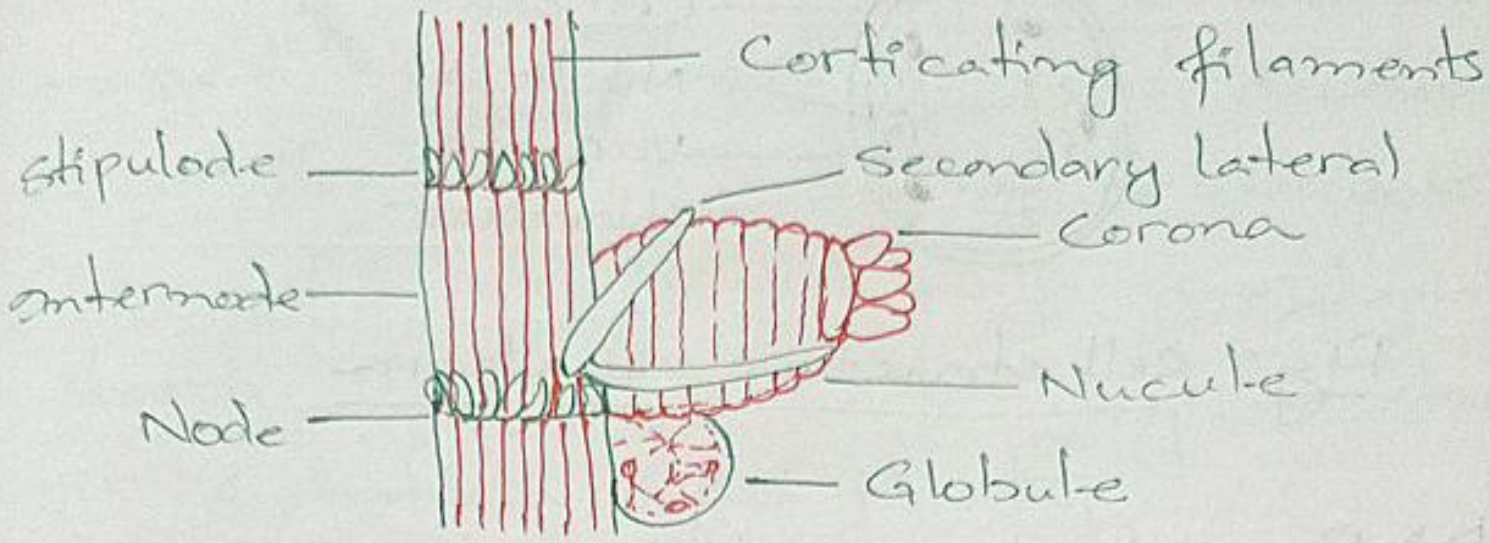

Fig: A filament of chara showing reproductive structures.

(c) Cell structure:

Each cell has a cell wall made up of cellulose. However, the walls of the internode cells are richly impersonated with silica and calcium carbonate, causing hardness and brittleness. Nodal cells and the cells of apical zones are relatively smaller and possess dense granular protoplast and single nucleus. The cells show the characteristics rotational movement of cytoplasm. This type of movement is called streaming movement or cyclosis.

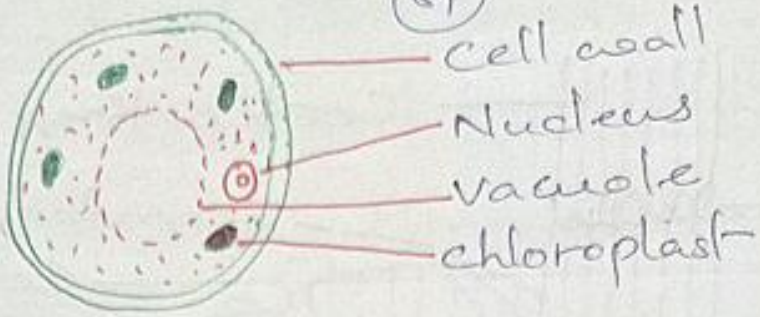

Fig: cell structure of chara

(D) Reproduction:

Chara reproduces by vegetative and sexual methods.

1> Vegetative reproduction: chara reproduces vegetatively by the following means —

(a). Bulbils: These are small, rounded tuber-like bodies; arise either from rhizoids or from the nodes of the main axis. On being detached from the plant, the bulbils germinate into a new plant.

(b) Amylum stars: These are star-shaped aggregations of cells developed on the lower nodes of the main axis. The cells are filled with amylum starch. The detached amylum star grows into a new plant.

(c) Secondary protonema: Protonemal branches may develop from existing nodes of old parents or from primary rhizoid ring or dormant apices. This develops into a new plant in a way similar to primary protonema.

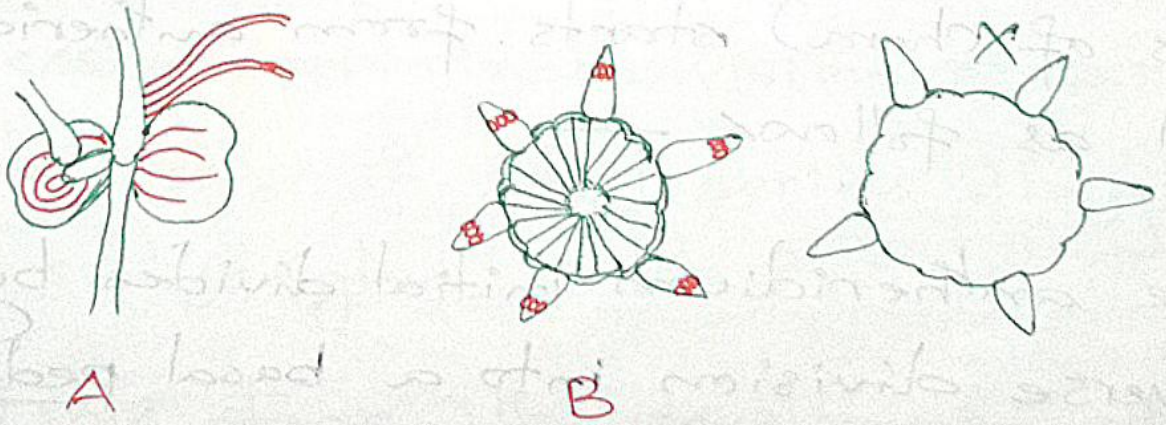

Fig: Vegetative structures of Chara

2) Sexual reproduction:

Chara reproduces by an advanced type of oogamous sexual reproduction. The sex organs are well-developed and visible to the naked eye. The male reproductive bodies are spherical, bright yellow or red structures called antheridia or globule. The female reproductive bodies are somewhat oval, green structures called oogonia or nucule.

(a) Globule: The development of antheridium or globule (male reproductive organs of Chara) starts from antheridial initial as follows —

i) The antheridium initial divides by transverse division into a basal pedicel cell and a terminal or upper antheridial mother cell.

ii) The pedicel cell does not divide

further and form single cell, stalk or pedicel of antheridia.

iii) The antheridial mother cell becomes spherical and divides by two longitudinal division at right angle to each other forming a four-celled quadrant. Thus, known as quadrant stage of the antheridium.

iv) All the four cells of quadrant divides transversely to give rise to an eight-celled octant. Thus, octant stage.

v) Each cell of octant undergoes two successive periclinal division forming three cells of eight series diagonally opposed angles.

vi) At this stage, the developing antheridium has outermost layer of eight cells called shield cells, the middle layer of eight cells is called manubrium

and innermost layer of eight cells are called primary capitulum or head cell.

vii) The shield cell form the outermost wall of the globule.

viii) The cells of middle layer elongate radially and form rod-like manubrium.

ix) Each cell of primary capitulum divides to form about six secondary capitula. Each secondary capitulum bears a pair of branched or unbranched filaments called spermatogenous cells or androcytes.

x) Each spermatogenous filament possess about one to two hundred cells and each cell gives rise to a single spermatozoid.

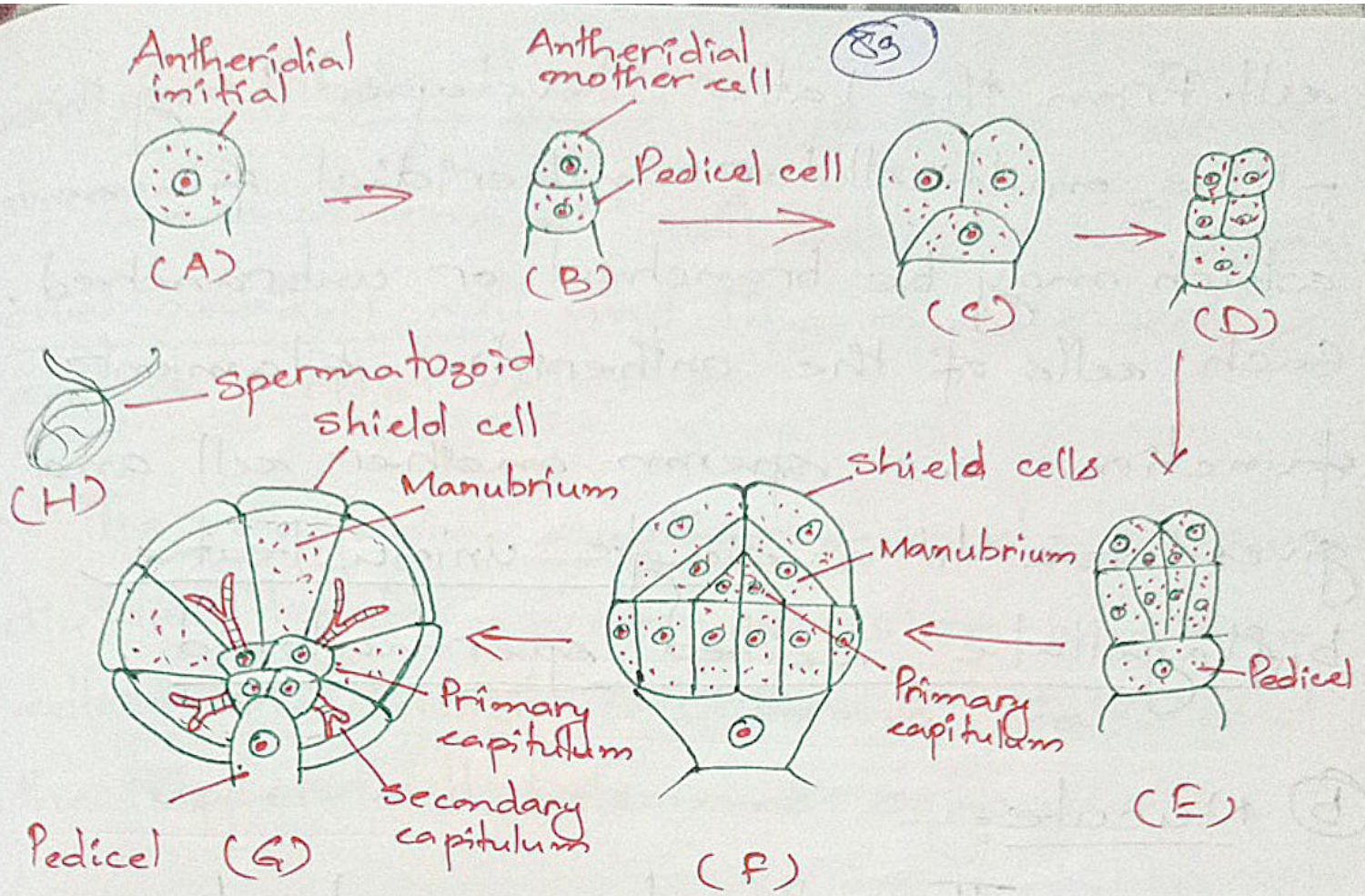

Fig: (A-G): Stages in the development of globule in chara; G, mature globule; H, spermatozoid.

Matured globule:

A matured globule or antheridium is a large bright-yellow or red, spherical body. It consist of eight closely fitted curved plate-like shield cells, eight rod-shaped radially elongated manubrial cells, eight centrally situated primary capitulum cells and about 48 secondary capitulum

cell. From the latter developed long thread-like multicellular antheridial filaments which may be branched or unbranched. Each cells of the antheridial filament functions as sperm mother cell and gives rise to a single uninucleate biflagellate coiled spermatozoid.

(b) Nucule:

The female reproductive organs of Chara is known as Nucule or oogonium. The upper peripheral cell of basal node of the antheridium functions as oogonial initial. It undergoes the following developmental stages —

i) The oogonial initial divides by two successive transverse divisions forming three cells in a row.

ii) The lowermost cell undergoes no further division and enlarges to form a

single pedicel cell.

iii) The uppermost cell behaves as oogonial mother cell and the middle cell is called nodal cell.

iv) The oogonial mother cell elongates and divides by transverse division into two cells. The lower cell forms stalk and the upper cell becomes oogonium.

v) The oogonium enlarges in size and forms within itself a single uninucleate egg or ovum. The egg is filled with starch and oil.

vi) The middle cell (or nodal cell) divides vertically to form one central and five peripheral cells. These peripheral cells elongate into five filaments, which surround the oogonium. These cells are called tube cells.

vii) The tube cells get spirally coiled around the oogonium in a clockwise

manner and form a flask-shaped jacket. Each tube cell form a small erect coronal cell at the apex of oogonium. All the five coronal cells form a corona or coronula.

viii) The cytoplasm at the top of the ovum is hyaline and constitutes the receptive spot.

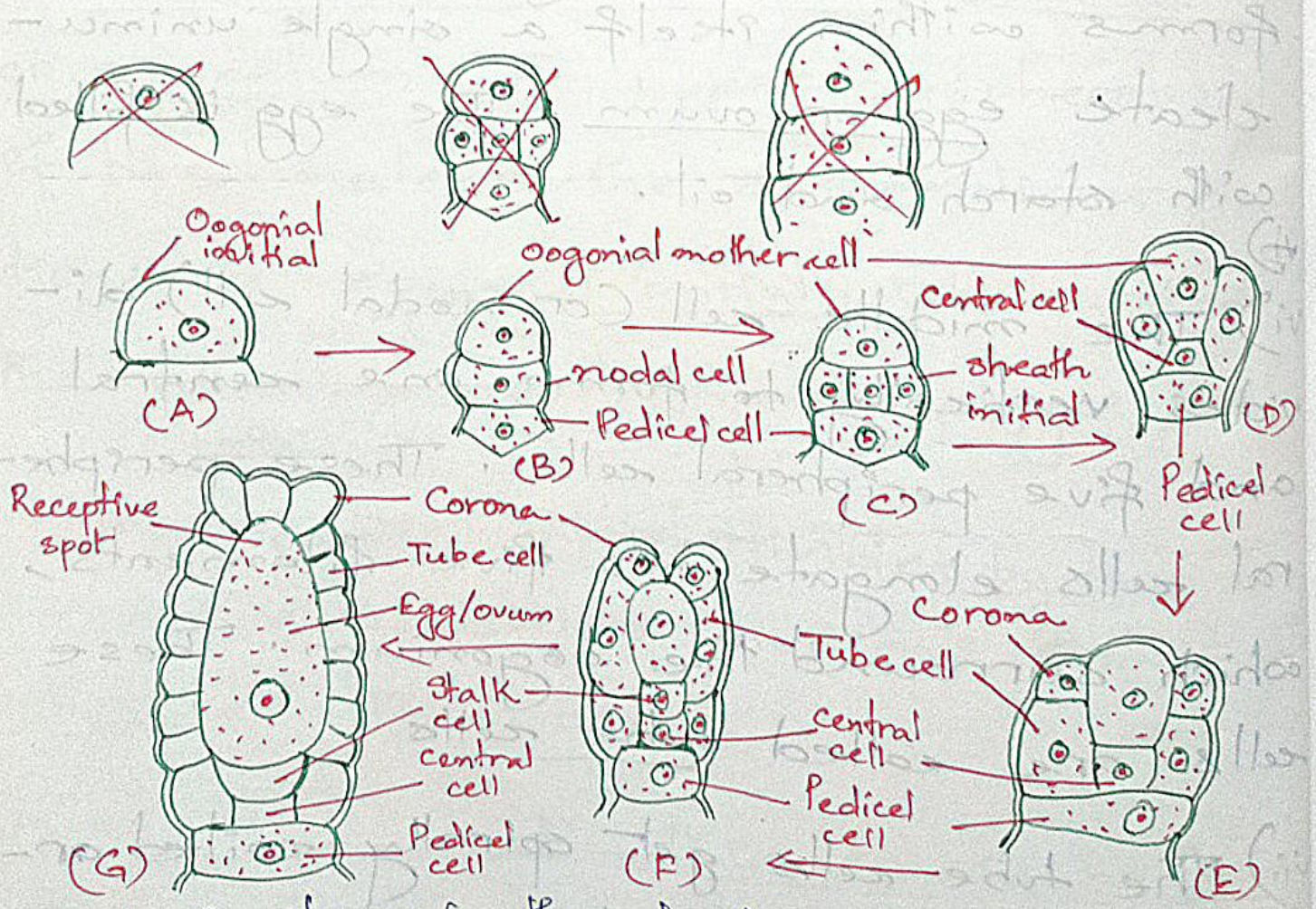

Fig: (A-G), stages in the development of nucule

Structure of nucule (oogonium):

The oogonium or nucule is an oval structure, attached on the node with the help of a pedicell cell. It remains surrounded by five long, spirally twisted tube cells, at the top of each is present a coronary cell. On a short suppressed central or nodal cell is present a shortly stalked oogonial cell.

The latter contains a single large egg or ovum. The mature egg contains a single nucleus situated towards the basal side and a receptive spot on the tip. It remains filled with large amount of starch and oil.

Fertilization:

A large number of antherozoids are liberated from the globule. The antherozoids are biflagellated and swim towards the mature nucule.

shortly before fertilization, the tube cells separate slightly from one another below the corona to form five narrow slits. Through these slits the sperms gain entrance into the sheath.

One of the sperms makes its way through the gelatinised apex of the oogonial wall. It penetrates the ovum at the receptive spot and fuses with the egg nucleus, forming the zygote.

Germination of zygote:

After fertilization, the zygote secretes a cellulose membrane and becomes an oospore. Before germination, the diploid oospore nucleus divides by meiosis forming 4 haploid daughter nuclei. Out of 4 nuclei, one migrates to the apical pole, while other three move to the basal part. A septum is laid down at the

apex separating the single apical cell with one haploid nucleus from the lower cell with three nuclei. The 3 nuclei of lower cell soon degenerates. The outer wall breaks at the tip of oospore exposing the upper cell.

The upper cell then divides longitudinally into two cells i.e. Protonemal initial and Rhizoidal initial. These two projects out and grow in opposite direction to form protonema and rhizoids respectively.

The rhizoid is colourless and differentiated into nodes and internodes. whorls of secondary rhizoids arise from the nodes of primary rhizoids. The protonema is green in colour and is composed of nodes and internodes. The primary protonema then develops into

secondary protonema, which develops into a new chara plant.

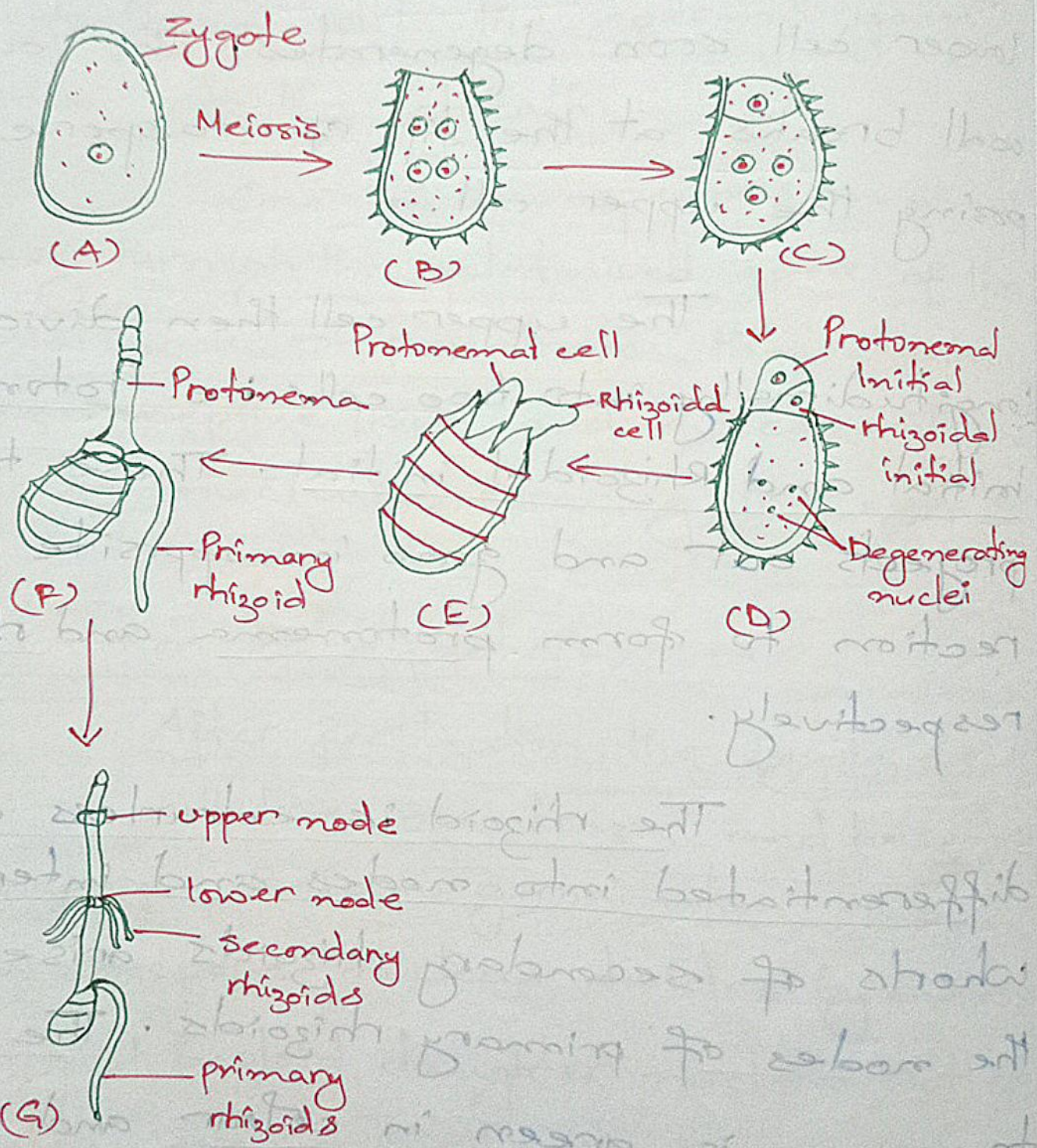

Fig: (A-G), stages in the germination of zygote and formation of young thallus.