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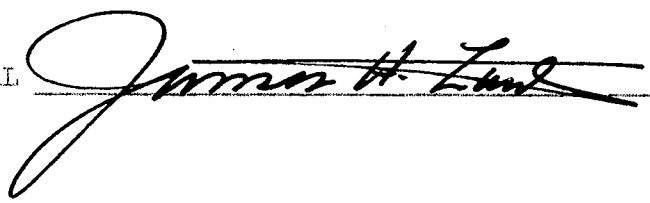
Title of Study: REPRESENTATIVE HABITATS, CHARACTERISTICS AND LIFE CYCLES OF THE PLANT KINGDOM

Pages in Study: 45 Candidate for Degree of Master of Science

Major Field: Natural Science

Scope of Study: Few, if any, high school biology textbooks have the life cycles of plants drawn or explained whereby a biology student may read and understand how the reproduction of plants take place. The habitats and characteristics of only a few may be discussed. It is the purpose of this report to make available to the high school student information that will enable him to understand the reproductive cycles, the habitats and characteristics of many of the plants normally encountered by the high school biology student. The habitats and characteristics have been listed and the life cycles have been drawn and discussed. The life cycles show the evolutionary advancement of plants from the most primitive blue-green algae, which have no sexual reproduction, to the more advanced flowering plants with a very complex reproductive cycle.

Findings and Conclusions: This report has not been used in any school system at the present time, therefore its effective use has not been proven. It is the author's opinion that it can be used by the biology teacher in making special assignments to those students with superior ability who desire more information than their textbook provides concerning plant morphology. It may be used as reference material by those students making special reports. Information which can only be found by doing endless hours of reading research in a library can be found within the covers of this report.

ADVISER'S APPROVAL 

REPRESENTATIVE HABITATS, CHARACTERISTICS AND LIFE CYCLES OF THE PLANT KINGDOM

By
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REPRESENTATIVE HABITATS, CHARACTERISTICS
AND LIFE CYCLES OF THE PLANT
KINGDOM

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ACKNOWLEDGMENTS

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CHAPTER I

INTRODUCTION

The purpose of this report is to make available to the high school biology student reference material whereby he may learn something about the characteristics, habitats and life cycles of some representative of the plant kingdom. Only those plants that are commonly encountered by the student are included in this report. An attempt to summarize representatives of the entire plant kingdom within the covers of one report would almost be an impossible task.

Many experiments with plants can be carried out in the classroom laboratory and it is very important to provide the student with living laboratory material whenever possible, but the natural habitat, some characteristics, and expecially the life cycles are not adaptable to the classroom laboratory.

The author has tried to cover at least one representative of all the divisions commonly encountered by the student from the extremely simple unicellular blue-green algae to the very complex seedbearing vascular plants. Greater emphasis has been placed on the algae because they are easily raised and collected and are usually studied by all biology students. This report will make available information not obtained from the laboratory study or from the high school textbook. The author realized that many students will not desire this information but for the more advanced students it is herein condensed in order to save valuable time consumed in library research.

The genera listed within each division are those most commonly encountered by the student. The morphology of other genera within a division vary somewhat in habitat and characteristics but the life cycles are very similar.

The author was inspired to write this report while doing his student teaching, by a high school biology student who continually asked to borrow books from him that contained life cycles of plants. All

the books obtained from the University of Oklahoma library contained only a few life cycles. It was decided to draw a number of these life cycles, along with the habitats and characteristics and place them within one cover. The interested student can find by using this report that he will save valuable library research time.

CHAPTER II

DIVISION CYANOPHYTA, (BLUE-GREEN ALGAE)

Class: Myxophyceae

Order: Chroococcales

Family: Chroococcaceae

Genus: Gloeocapsa

HABITAT: Aquatic or terrestial. Found in old aquaria tanks, on moist rocks or flower pots in greenhouses.

CHARACTERISTICS: Gloeocapsa is a one celled non-motile plant. It is one of the more simple unicellular types. This genus as well as all others in the division store their excess food as glycogen, sometimes called "cyanophycean starch". There is no apparent nucleus or plastids although some authors maintain that a nucleus is there but that it is not organized.[1]

LIFE CYCLE: There is no sexual reproduction among any of the Cyanophyta. Reproduction is by asexual methods entirely. This is accomplished in Gloeocapsa by cell division. Cell division is accomplished by the centripetal growth of a surface furrow which ultimately divides the cell. New walls are then secreted by the daughter protoplast within the persistent wall of the mother cell, which becomes distended as the division products increase in size. The nuclear material apparently is passively divided into two equal portions at cytokinesis. Thus, as in most unicellular organisms, cell division effects reproduction or multiplication

[1] Bold, Harold C., Morphology of Plants (New York, 1957), p. 20-21.

of the individual. Subsequent growth in the division product results in their achieving the size characteristic of the species.

Class: Myxophyceae
Order: Oscillatoriales
Family: Oscillatoriaceae
Genus: Oscillatoria

HABITAT: Aquatic or terrestial. Found floating in stagnant water, on muddy banks of streams, on moist rocks and on damp soil.

CHARACTERISTICS: Oscillatoria grows as individual filaments. When they are observed in aqueous media, a number of trichomes frequently exhibit an oscillating motion, as well as rotation and backward and forward movement along their long axes. There is nothing apparent that causes the movement. There is no differentiation among the component cells of a trichome, except the apical cell may differ in shape from the other vegetative cells.

LIFE CYCLE: Reproduction is by fragmentation. Multiplication of the filaments takes place by a type of fragmentation called hormogonium formation. In this process, either because of the death of a cell or because of the weakness at one point, the chain of cells break up into fragments with few to many cells, the hormogonia. These are usually motile and are capable of forming new trichomes.

CHAPTER III

DIVISION CHLOROPHYTA (GREEN ALGAE)

Class: Chlorophyceae
Order: Volvocales
Family: Chlamydomonadaceae
Genus: Chlamydomonas

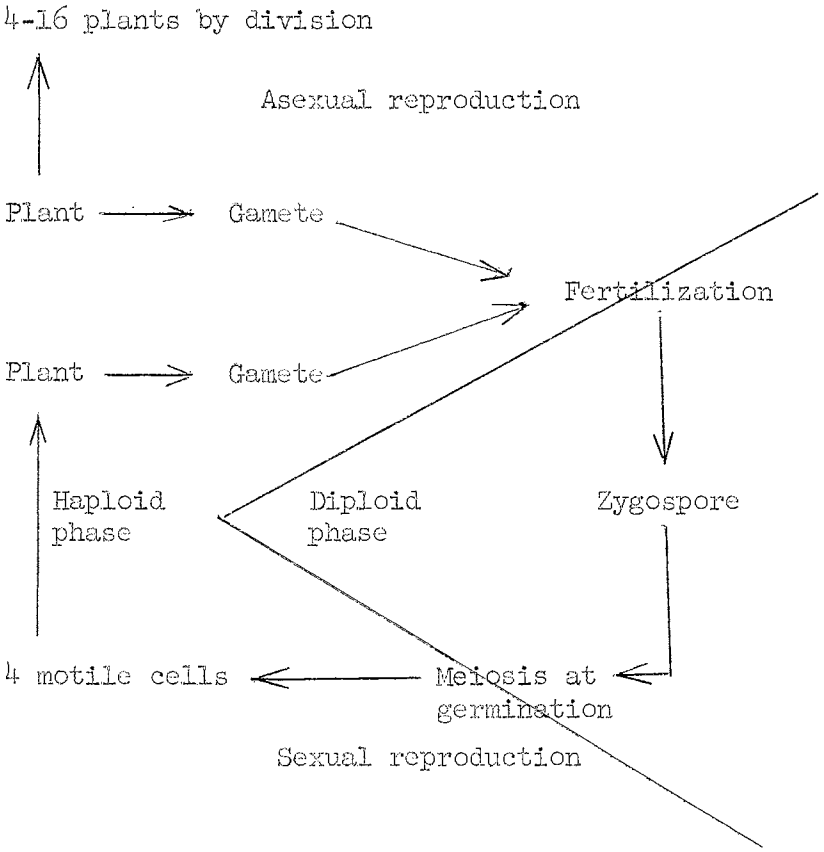
HABITAT: Widely spread in the soil and aquatic habitats. It may be found in small stagnant pools in farmyards, in rain-water containers or pipes, and in small bodies of water along roadways.

CHARACTERISTICS: Chlamydomonas is a unicellular organism. It is motile during both vegetative and reproductive phases. The single cell is surrounded by a cellulose wall through which two flagella protrude anteriorly. It is about 45 microns in length and 33 microns in width. Each organism is too small to be seen with the naked eye, but if it is examined under a microscope, it will appear green in color and it can be seen that it normally swims with the narrower end first. The two whip like flagella protrude from this end, the beating of which draws the organism through the water. It has contractile and central vacuoles not normally found in any of the Cyanophyta.

LIFE CYCLE: Reproduction is by asexual and sexual means. In asexual reproduction the flagella are lost and the protoplast splits longitudinally into similar halves while still within the original wall. More division may take place until there are as many as 16 parts within the original wall. Apparently all parts of the organism divide at the same time. Eventually the "daughter" plants each grow two new flagella and escape as small editions of the "parent"cell. They soon grow to be exactly like the original. This is an example of multiplication by division.

In sexual reproduction the union of gametes is involved. Two cells come together, the cellulose walls are dissolved at the anterior ends, the protoplasts emerge, gradually uniting to form a single unit into which the four flagella are withdrawn. Each cell which undergoes union is called a gamete. The product of the union is a zygote. The zygote enters a period of dormancy in a thick wall secreted by it. In this stage it is called a zygospore. When germination occurs the zygospore divides twice to produce four daughter cells.

FIGURE 1



Life cycle of Chlamydomonas

Class: Chlorophyceae
Order: Volvocales
Family: Volvocaceae
Genus: Volvox

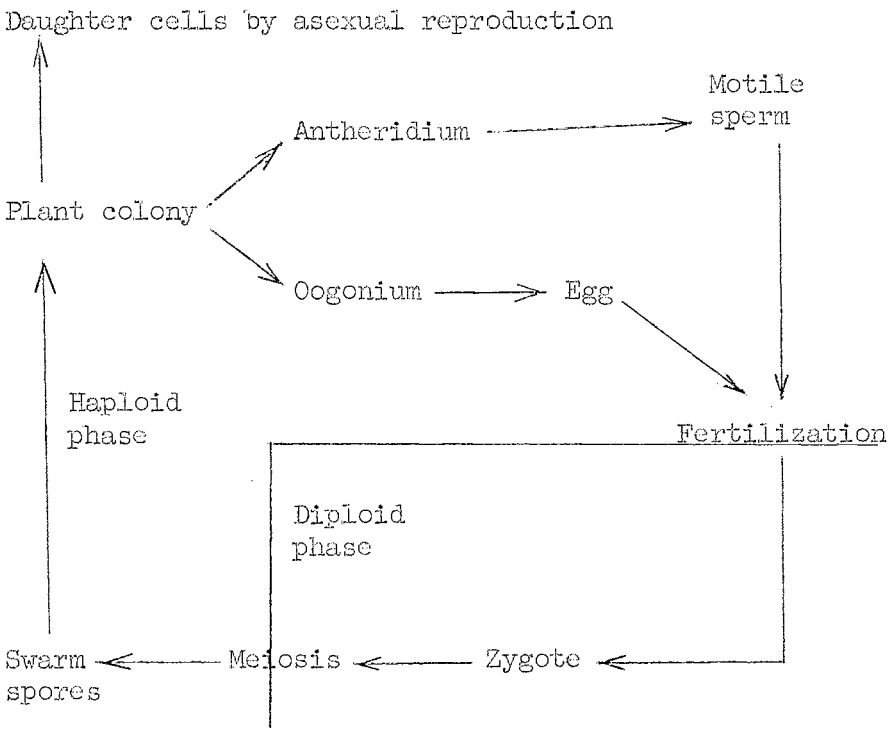
HABITAT: Volvox is found in fresh water ponds, pools and lakes.

CHARACTERISTICS: A mature Volvox is a motile, hollow, colonial sphere. Its colonies may contain thousands of cells arranged in a single layer just below the mucilaginous surface of the sphere with their flagella extending from the surface. A colony is barely visible to the eye. The sphere is filled with a watery muscilage and the whole colony is surrounded by a gelatinous sheath. Each cell is also enclosed in a gelatinous sheath and connected to other cells by cytoplasmic strands. Each cell contains a single chloroplast, a pyrenoid, vacuoles and an eye spot. Each bears two flagella which point outward and render the colony motile.

LIFE CYCLE: Reproduction is by sexual and asexual means. In asexual reproduction certain cells enlarge, divide and form new colonies.

Sexual reproduction is heterogamous, and both homothallic and heterothallic species exist. The male gametes (sperms) are borne in spherical or disc-like colonies each of which may contain as many as 512 male cells. The eggs resemble asexual reproductive cells. In the heterothallic species the sperm are liberated from the parent colony and are chemically attracted to the female colonies. They penetrate the colony and the eggs are fertilized within the colony. The zygotes form thick walls and lie dormant for a period of time after they are liberated from the parent colony. Germination eventually takes place during which time meiosis takes place.

FIGURE 2



Life cycle of a homothallic Volvox

A heterothallic life cycle would differ in that the sperm and egg would be produced in separate colonies.

Class: Chlorophyceae
Order: Zygnematales
Family: Zygnemataceae
Genus: Spirogyra

HABITAT: Floating bright green, slimy, or frothy masses in small bodies of water and submerged fields. It is usually referred to as pond scum.

CHARACTERISTICS: Spirogyra is a filament, round in cross-section, made up of cylindrical cells placed end to end. The filaments are unbranched, generally unattached and grow by cell division and elongation. The filaments are surrounded by a watery sheath which cause masses of them to feel slimy to the touch. The watery sheath can be demonstrated by the use of India ink or methylene blue.

The chloroplast in Spirogyra are spiral bands with a beautiful grass-green color. The spiral bands are a good means of identifying this plant. It might be noted that the Spirogyra as well as all plants in this division store their excess food as starch. This process is also used by all higher plants. This may be some evidence that higher plants developed from this division.

LIFE CYCLE: In sexual reproduction cells of parallel filaments form a tubular structure between them. The protoplast from a cell of one filament initiates movement through the tubular structure into the cell of another filament. The two protoplasts and their nuclei unite forming a zygote. The zygote may lay dormant for some time after which it is called a zygospore. Upon germination only one filament is formed from each zygospore.

Asexual reproduction is by fragmentation only according to some authors.[2] According to others it is also by akinetes, aplanospores, parthenogenesis, and fragmentation.[3]

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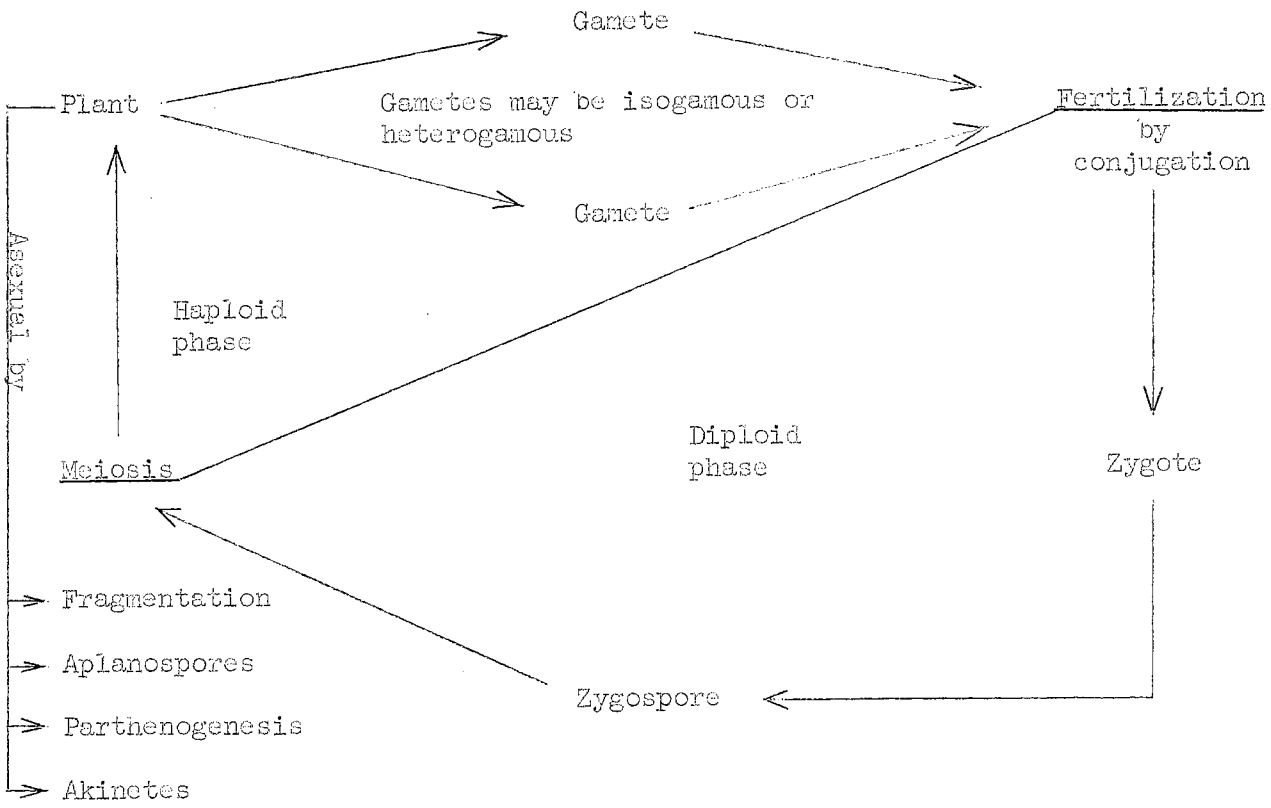
[2]Ibid., p. 59.

[3]Gibbs, R. Dornley, Botany (Philadelphia, 1950), p. H 2.

FIGURE 3



Life cycle of Spirogyra

Class: Chlorophyceae
Order: Oedogoniales
Family: Oedogoniaceae
Genus: Oedogonium

HABITAT: The genus Oedogonium is strictly fresh-water.

CHARACTERISTICS: It consists of a basal hold-fast cell and a simple row of cylindrical cells which are rather long. Each cell contains a protoplast with a single large nucleus and a more or less net-like chloroplast which has several pyrenoids and which occupies most of the cytoplasm. Close examination shows that some of the cells have curious "caps" at one end. These are peculiar to Oedogonium and its close relatives and enable us to recognize them. They are formed by the usual method of growth and cell division which these plants employ when division is to occur, a tubular band is formed against the lateral wall near one end of the cell, and this, after the outer wall is ruptured, expands to form a new wall segment. The protoplast divides and a new cross-wall separating the two daughter cells is formed in such a position that one daughter cell has a wall largely composed of the new segment while the other is almost entirely old wall.

The cell whose wall is mostly new has a "cap" of old wall, and it is this cell which usually divides again and again, each new wall segment being formed just below the old cap and resulting in another scar.

LIFE CYCLE: In asexual reproduction the protoplast of any but the basal cell forms a single large multiflagellate zoospore, which is almost spherical. It is dark green except for a small colorless region at one end and around this colorless region a circlet of flagella is formed.

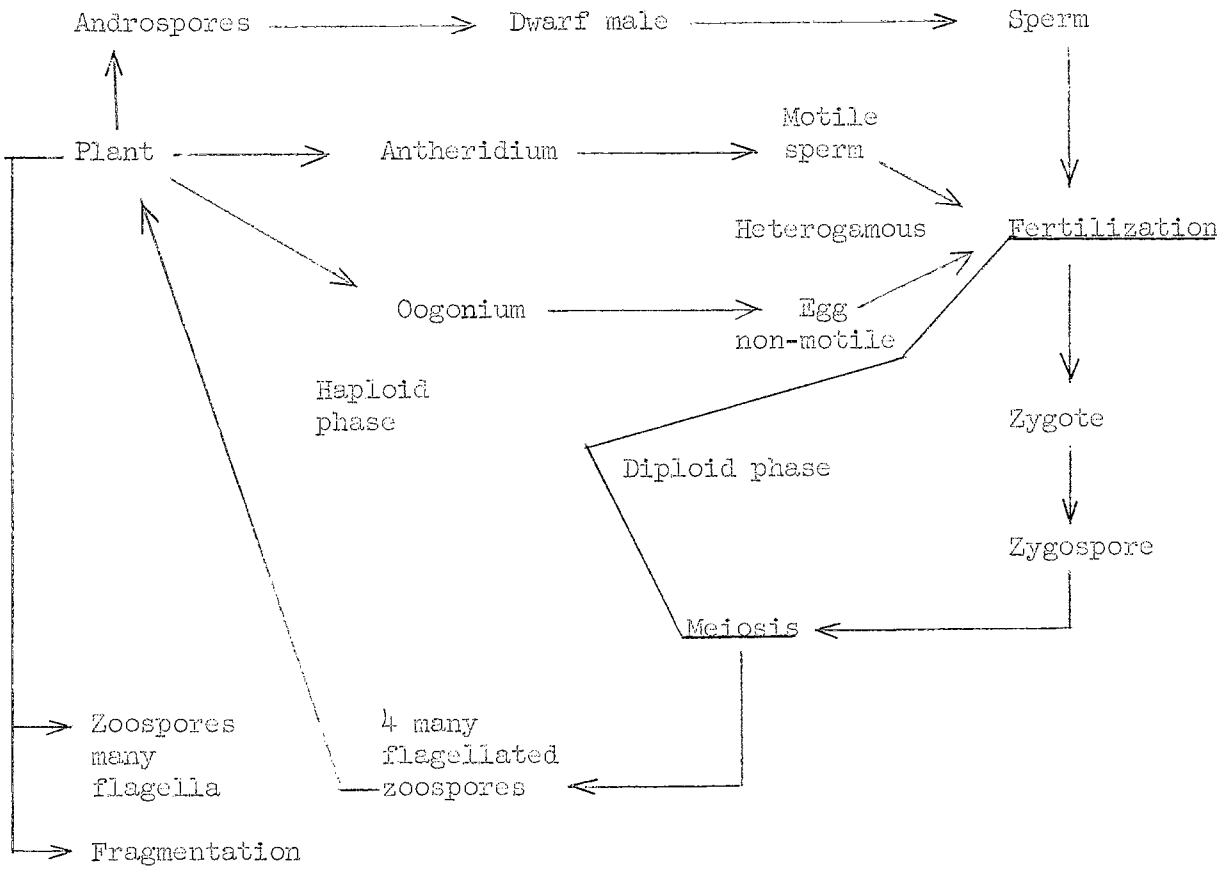
The parent cell now ruptures (usually just below a scar) and the zoospore is extruded in a delicate mucilage residue within which it may move. This residue then ruptures and the zoospore swims rapidly away, moving with the colorless end in front and spinning around as it goes. After a few minutes it settles down on its colorless end upon any nearby object, loses its flagella and begins to elongate. By

repeated cell-division a new filament is then formed.

In sexual reproduction a few kinds produce both male and female gametes in the same filament. They are monoecious. Most plants are dioecious. The male and female gametes are produced on separate filaments. The female gamete is a large, non-motile egg formed singly in an almost spherical oogonium provided with a pore or slit near one end. The male gametes are like miniature editions of the zoospores and are produced two to an antheridium. When the male gametes are released they swim actively about and enter the oogonia through the pores or slits and fuse with the egg.

Some species of this algae have a somewhat more complicated sexual reproduction. In these types the oogonia are similar to those described above, but other filaments give rise to cells very much like antheridia which instead of producing two male gametes, each give a single androspore, intermediate in size between a zoospore and a male gamete. This settles down as a rule upon the cell below an oogonium and germinates to give a small plant called a dwarf male, which often consists of a single vegetative cell and one or two antheridia. From the antheridia male gametes are produced, and these fertilize the egg.

FIGURE 4



Life cycle of Oedogonium
may be monoecious or dioecious

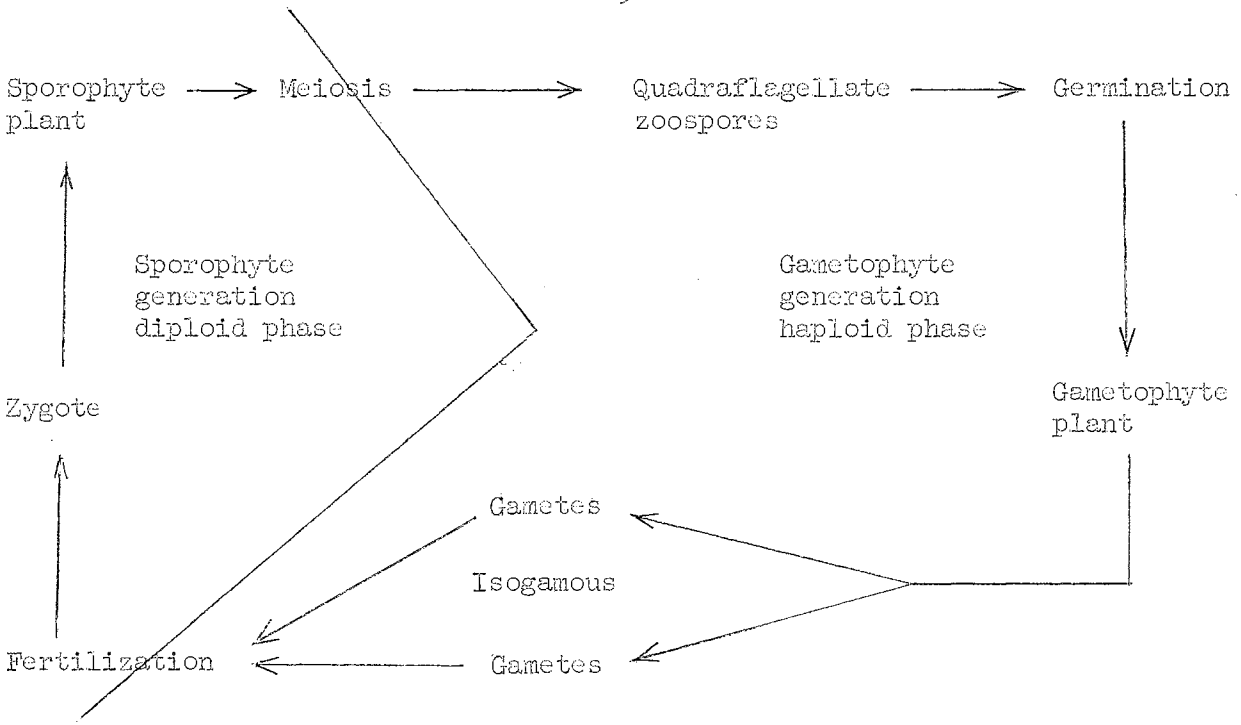
Class: Chlorophyceae
Order: Ulvales
Family: Ulvaceae
Genus: Ulva

HABITAT: Ulva is strictly a marine algae. It is common in the upper part of the tidal zone of temperate shores. It is attached firmly to rocks or other seaweeds.

CHARACTERISTICS: Ulva is flat and expanded and looks somewhat like a lettuce leaf without veins. The attachment organ is formed of slender outgrowths from cells near the base of the blade and is perennial, the expanded blade of the plant dying more or less completely each winter. This blade is two cells thick, but many cells wide and long.

LIFE CYCLE: The life cycle of Ulva is very interesting. Although alike as far as the eye is concerned, there are actually two kinds of Ulva plants; one reproducing asexually, the other sexually. Almost any cell of an asexually produced plant may produce four to eight quadriflagellate zoospores. Since this is the case we may call this plant a sporophyte. The zoospores grow into new Ulva plants that look like the original one but these produce biflagellate gametes, usually eight from each cell. Such plants may be called gametophytes. The gametes fuse in pairs (probably each gamete coming from a different plant) and from the zygote as new sporophyte plant arises. We have here then a life cycle that involves two generations alternating with each other.

FIGURE 5



Life cycle of Ulva showing alternation of generation

CHAPTER IV

DIVISION PHAEOPHYTA (BROWN ALGAE)

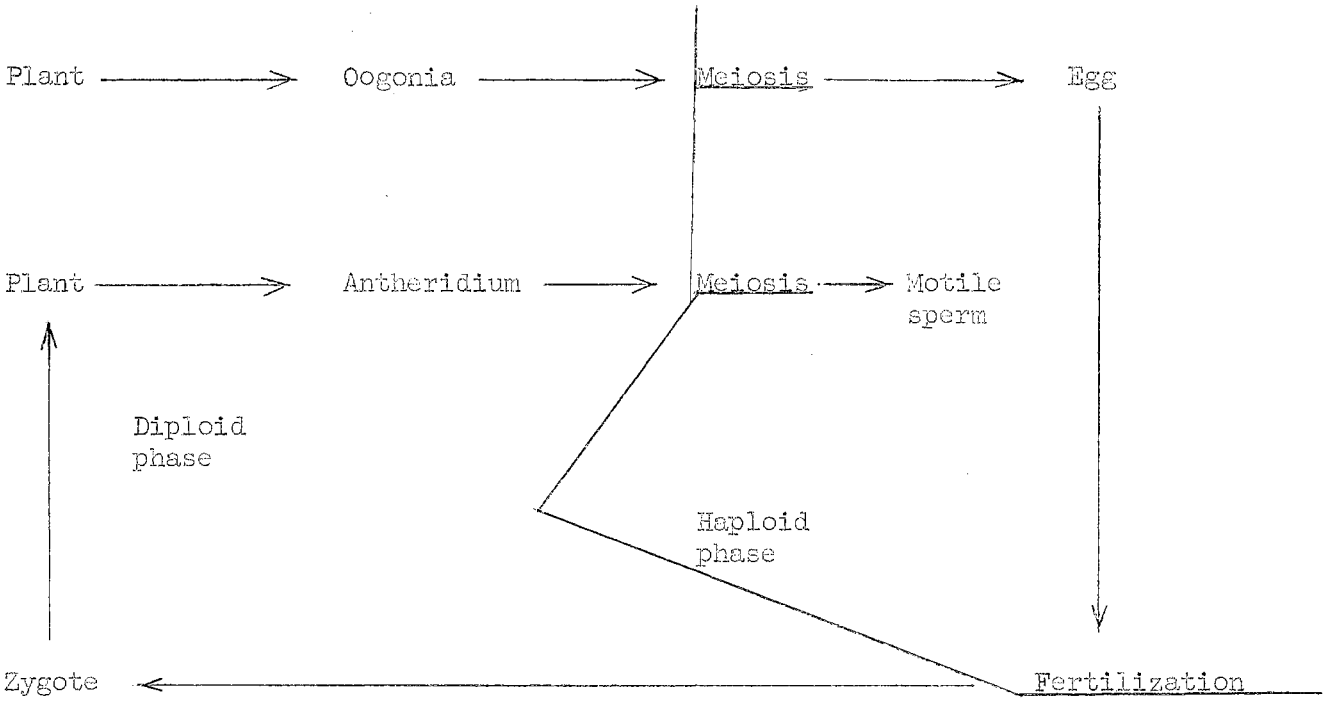
Class: Phaeophyceae
Order: Fucales
Family: Fucaceae
Genus: Fucus

HABITAT: All marine and found attached to rocks in intertidal zones where they are exposed at low tide.

CHARACTERISTICS: Fucus grows up to two meters long, is flattened and dichotomously branched. Growth is by clearly differentiated apical cells. Plants are attached by multicellular holdfast discs. Air bladders occur in some species.

LIFE CYCLE: The production of reproductive cells is localized at the tips of branches in fertile areas called recepticles. The recepticles bear scattered pustule-like cavities called conceptacles. When mature the conceptacles bear eggs and sperms; these may be either in the same conceptacle, or those which produce eggs may be on different plants from those producing sperm, depending on the species. Fucus is heterogamous and may be homothallic or heterothallic. The drawing of the life cycle is heterothallic.

FIGURE 6



Life cycle of Fucus

CHAPTER V

DIVISION MYXOMYCOPHYTA (SLIME MOLDS)

Class: Myxomycetes
Order: Stemonitales
Family: Stemonitaceae
Genus: Stemonitis

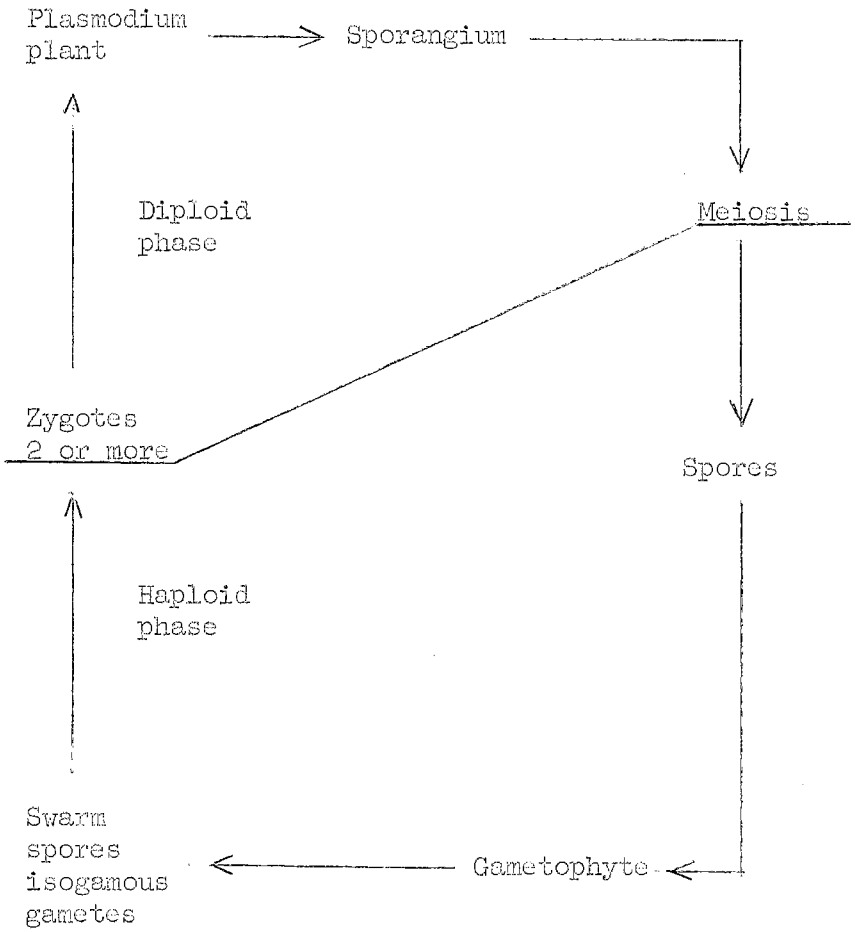
HABITAT: It is found on decaying wood, leaves, and soil in moist situations.

CHARACTERISTICS: The vegetative phase of these organisms is known as the plasmodium. The plasmodium is a macroscopically visible mass of multinacleate protoplasm, normally in a more or less active flowing state. The organism injests various micro-organism such as pollen grains and spores as food. Its nutrition is holozoic. Injested food lies in vacuoles where it is digested by enzymes. Some soluable organic matter is also absorbed, so nutrition is part saprophytic as well as holozoic.

The organisms are capable of moving about at the rate of three cm per hour. They are coenocytic or have no cell walls.

LIFE CYCLE: When the conditions are right for reproduction, the plasmodium becomes a sporongium. The sporongium produce spores and from these spores develop the gametophyte which in turn produce motile swarm-spores with two anterior flagella. These swarm-spores may divide several times, but in the end their progeny behave as gametes, fusing in pairs.

FIGURE 7



Life cycle of Stemonitis

CHAPTER VI

DIVISION EUMYCOPHYTA (THE FUNGI)

Class: Ascomycetes
Order: Endomycetales
Family: Endomycetaceae
Genera: Saccharomyces (the yeast)

HABITAT: Yeasts are well distributed over the surface of the earth. They are particularly abundant in substrata which contain sugars, such as the nectar of flowers and the surface of fruits. They are also found in the soil, in animal excreta, in milk, on vegetative parts of plants, and in other habitats.

CHARACTERISTICS: In contrast to most other Ascomycetes, the yeast are one celled organisms. They contain a definite cell wall and a rather easily demonstrable nucleus surrounded by cytoplasm. The nuclear vacuole is very large, and occupies the greatest portion of the cell. Yeast cells vary in shape with the species and within the species. They may be globose, oval, elongated, or rectangular in shape. They sometime adhere in a chain, forming a false mycelium. Individual cells appear colorless.

LIFE CYCLE: Yeast reproduce by both asexual and sexual reproduction. Asexual reproduction is by budding or by transverse division.

In the process of budding the protoplasm of the cell, covered by a thin membrane, pushes out of the cell wall in the form of a daughter cell. The bud enlarges until it is separated from the mother cell by a constriction at the base. The daughter cell may in turn produce a bud while still attached to the mother cell. A chain of cells may thus be formed.

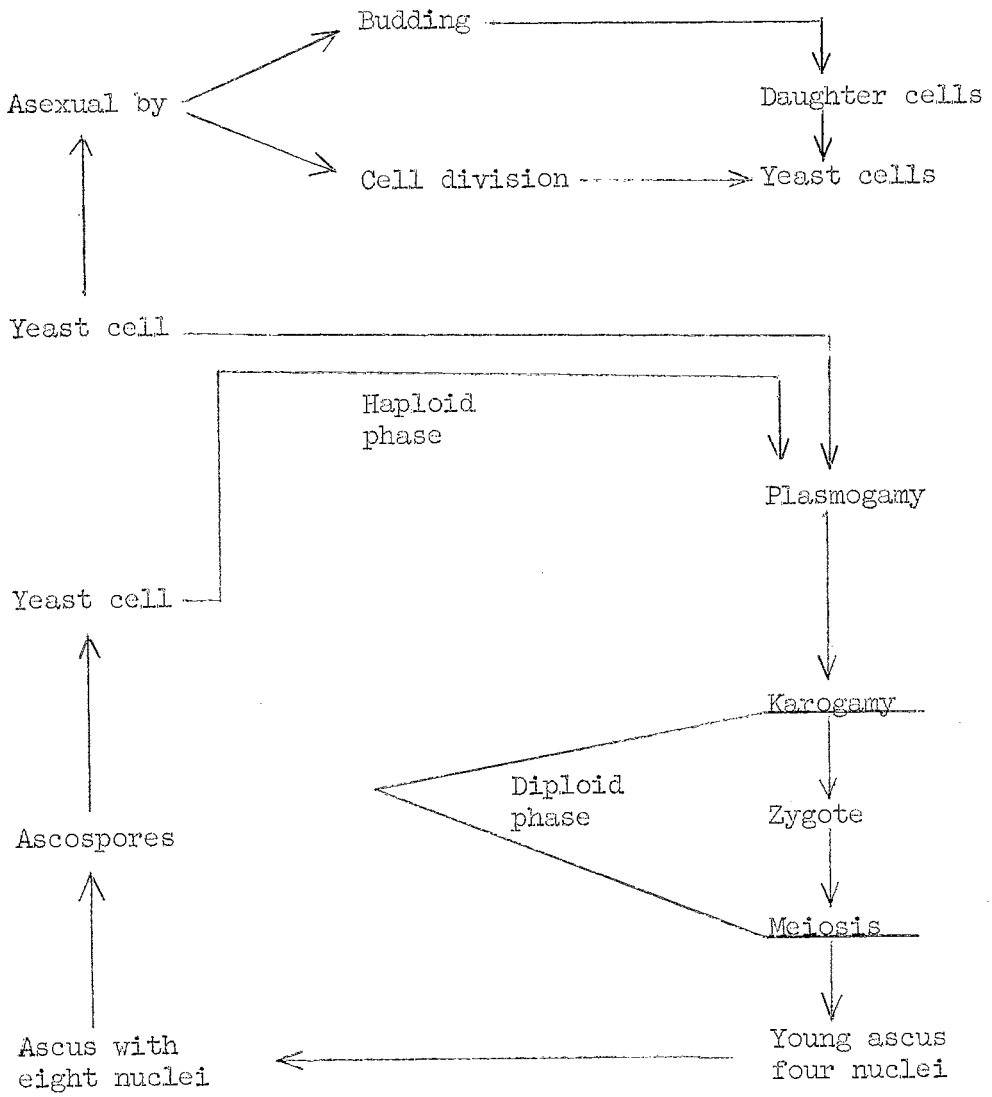
In transverse division the parent cell elongates, the nucleus

divides, and a transverse wall is laid down somewhere near the middle separative the mother cell into two uninucleate daughter cells.

The sexual reproduction in any cell is apparently a potential gametangium. Two cells come in contact, a neck-like protrusion is formed from each cell at the point of contact, and its nuclei move into the neck region. The two nuclei fuse, the cytoplasm flows into the neck and the two cells unite.

The nucleus now undergoes three divisions, the first of which is meiotic, and within the zygote cell, which is now the ascus, eight ascaspores are formed, one around each nucleus. The breaking of the ascal wall finally liberates the ascospores, each of which now behaves like a somatic cell, giving rise to daughter cells by transverse fusion or budding.

FIGURE 8



Life cycle of Saccharomyces

Class: Phycomycetes
Order: Mucorales
Family: Mucoraceae
Genus: Rhizopus (black bread mold)

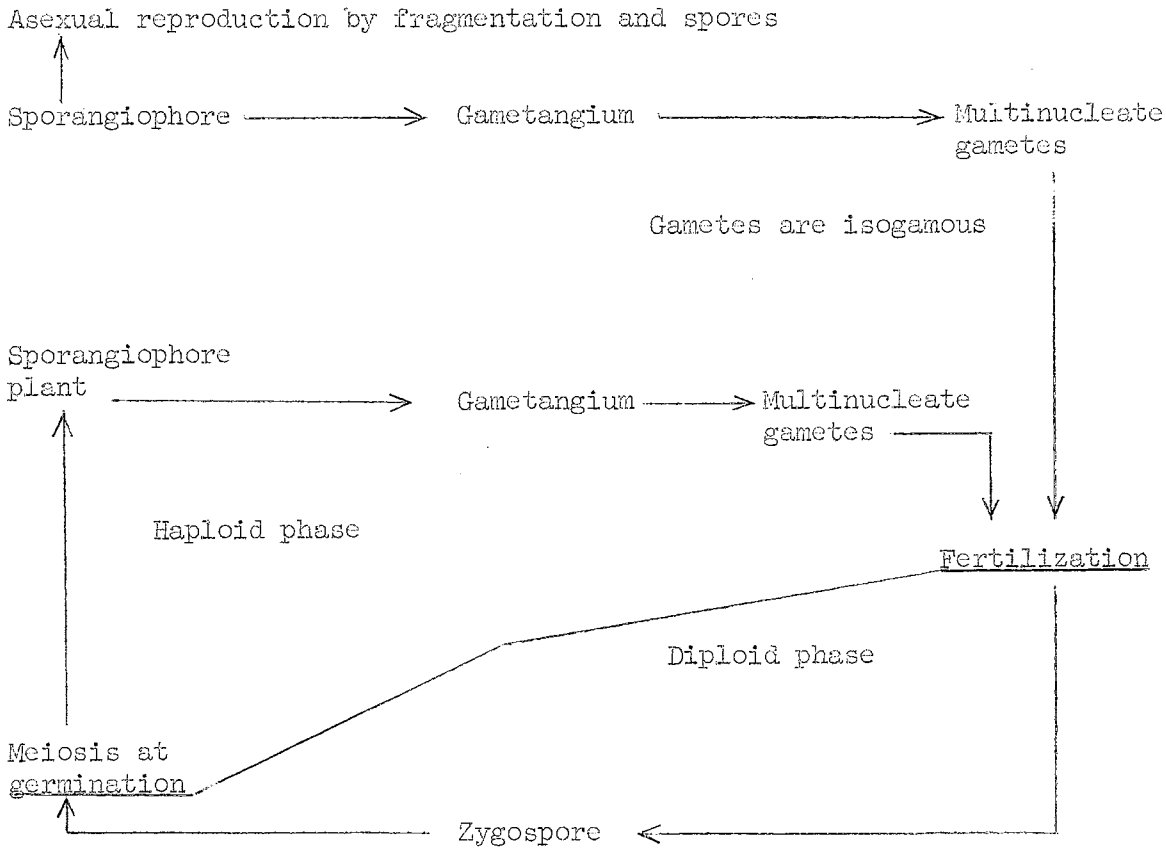
HABITAT: Frequently appears on bread during damp, warm weather. Rhizopus and related genera may be found in all sorts of organic matter, including fruit, dung, and fleshy fungi, when moisture is sufficient to support growth. Its spores are almost always present in the atmosphere. This can be demonstrated by exposing moist bread to air currents and then keep it in a humid atmosphere.

CHARACTERISTICS: The Phycomycetes differ from the Ascomycetes and Basideomycetes by the absence of spores. It is nonseptate or incompletely septate and coenocytic.

The mycelium of Rhizopus is a cottony white mass during the vegetative phase but presents a sooty appearance at time of sporulation. This is caused by the presence of large numbers of black-walled spores.

LIFE CYCLE: Rhizopus is heterothallic and isogamous in sexual reproduction. When spores of two sexually compatable strains are planted reasonably close in agar cultures, sexuality usually occurs. Hyphae of the two strains increase in size at their tips. Transverse septa are laid down so that the multinucleate tip of each branch is delimited from the remainder of the hyphae. The delimited portions are called gametangia and are considered to be multinucleate gametes. The walls between the contiguous gametangia dissolve, with the results that the cytoplasm and nuclei then lie free within a single lumen. The nuclei increase in number and many unite in pairs forming a zygote. A thick wall is secreted by the zygote. When the zygospore germinates, there is evidence that the nuclear divisions which occur are meiotic.

FIGURE 9



Life cycle of Rhizopus

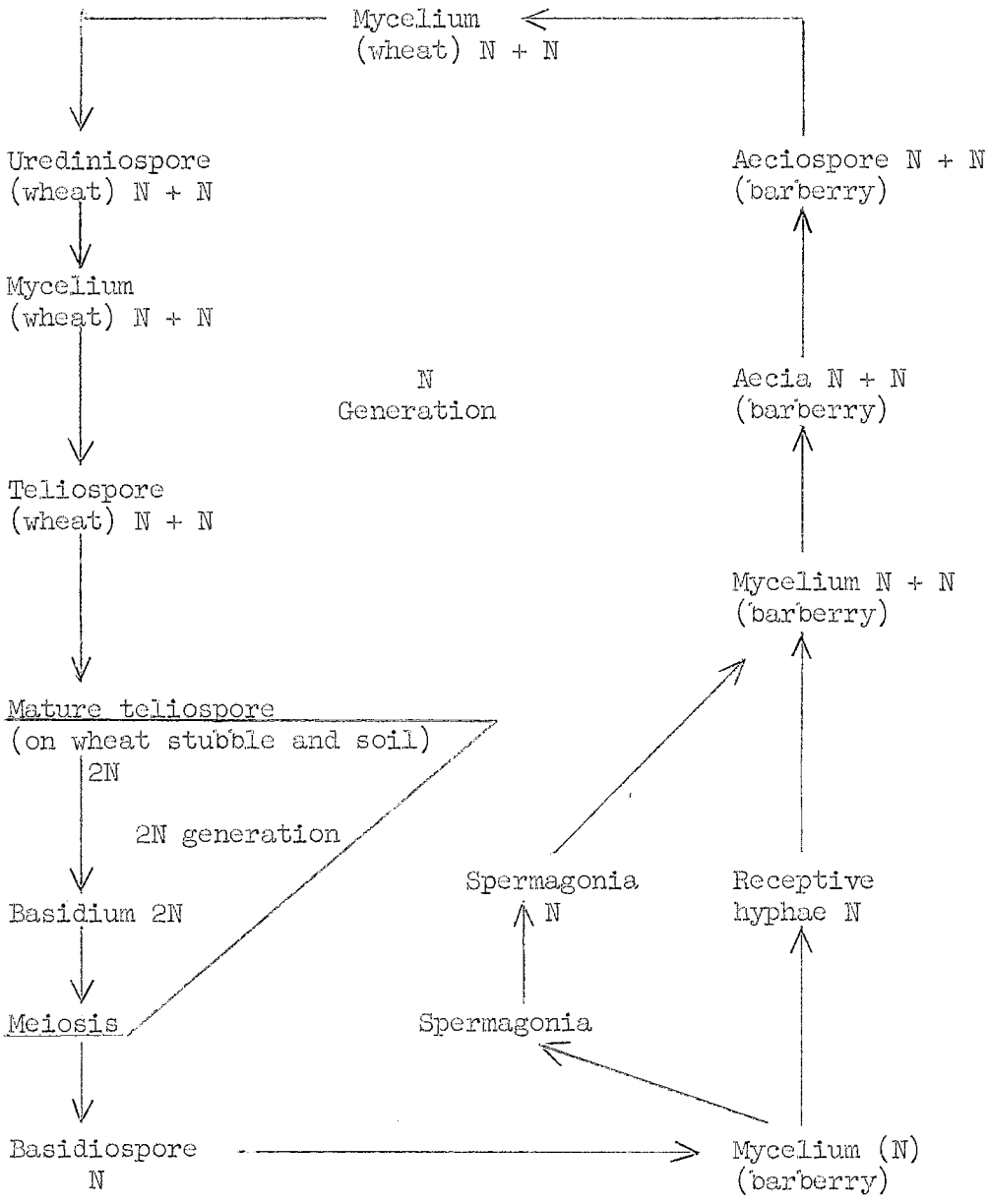
Class: Basidiomycetes
Order: Uredinales
Family: Pucciniaceae
Genus: Puccinia graminis (rust)

HABITAT: Obligate parasites on vascular plants such as wheat, corn, oats, barley and rye.

CHARACTERISTICS: Puccinia is rust colored, usually linear streaks or lesions on grain. Its growth causes the epidermis of infected plants to be lifted up by formation of uredinum.

LIFE CYCLE: During the growing season of the host plant the infection is spread by urediniospores. After being released by the uredinium, they are blown about by the wind and if they reach the stem or leaves of the proper host they can germinate. A hyphal tube emerges from one of several spores in the urediniospore wall, grows over the surface of the leaf, and enters it through a stoma. Once inside the leaf, it spreads through the cellular spaces as the host reaches maturity, another type of spore is produced, the teliospore, from which develops the mature teliospore. Mature telispores require a period of dormancy and low temperature in order to germinate. This is where they pass the winter. When they germinate, they produce a basidium, which in turn produce basidiospores. Basidiospores are carried by wind or other means and eventually some land on the barberry bush where they germinate and form spermagonia and receptive hyphae. From the spermagonia are formed spermatia. There is evidence that the spermatia and receptive hyphae unite and from this the aeciospore is formed. The aeciospores are violently discharged and if any happen to fall on or be carried to young stems or leaves of grain they germinate and produce an intercellular mycelium by which the urediniospore cycle is again initiated.

FIGURE 10



Life cycle of Puccinia graminis

CHAPTER VII

DIVISION BRYOPHYTA

Class: Hepticae (liverworts)

Order: Marchantiales

Family: Marchantiaceae

Genus: Marchantia

HABITAT: Entirely terrestial.

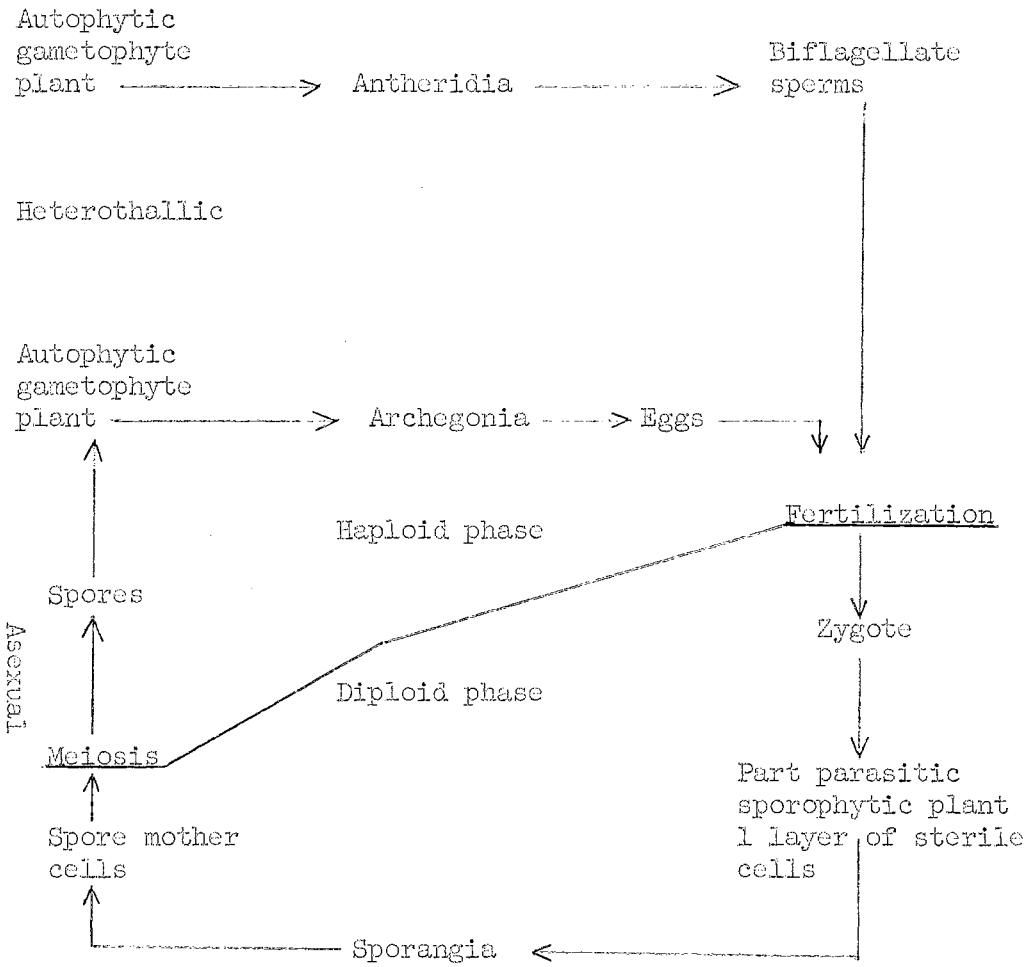
CHARACTERISTICS: In the Bryophyta there are two clearly distinct plants, the gametophyte and the sporophyte. In almost all plants the gametophyte generation is the dominant one, while the sporophyte generation is smaller and is completely or partially dependent upon the gametophyte for its nutrition. The thallus of Marchantia is a flat green structure growing by means of apical cells and is branched dichotomously. On the underside of the thallus two or more rows of scales occur and between these are numerous rhizoids.

From the gametophyte, upright stalks are grown upon which the sex organs and the sporophyte plants are produced. The sporophyte is composed of a foot, seta and capsule. The gametophyte is internally complex and externally simple. It is macroscopic but the sporophyte is microscopic.

LIFE CYCLE: It is heterothallic and heterogamous. Upon separate plants special sex organs are produced. The female being called archegoniophores and the male being called antheridiophores. Motile sperm are discharged by flooding of water and reach the archegonium by swimming.

Asexual reproduction is by fragmentation, by decay, and by gemmae.

FIGURE 11



Fragmentation by decay

Gemmae

Life cycle of Marchantia

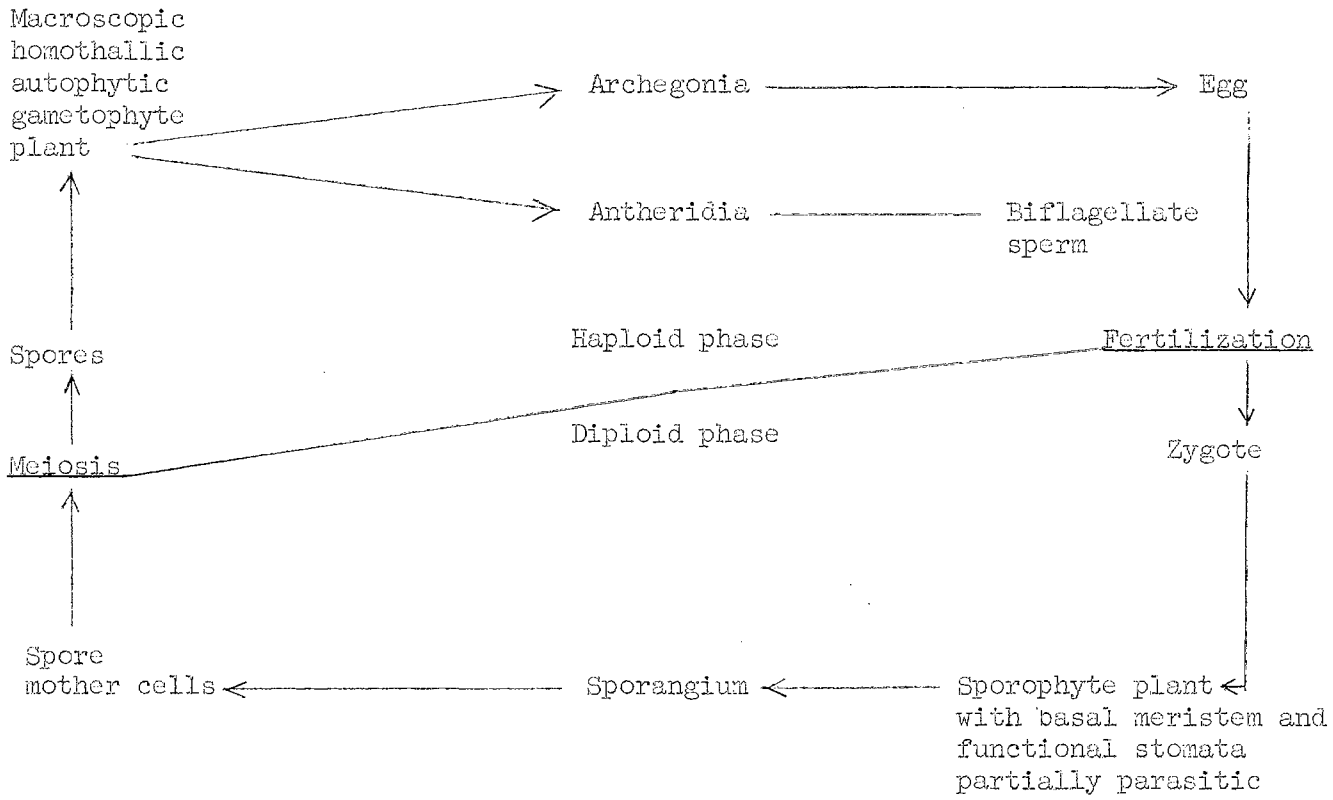
Class: Anthocerotae
Order: Anthocerotales
Family: Anthocerotaceae
Genus: Anthoceros

HABITAT: Inhabits moist soil and rocks. It is frequently over shadowed by other vegetation.

CHARACTERISTICS: Anthoceros is a little plant growing flat upon the ground. It shows somewhat irregular branching. Rhizoids are produced on its underside. The sporophyte grows upright from the gametophyte and unlike most plants continues to grow from the base. This is called intercalory meristem. Its sterile outer cells contain chlorophyll and the epidermis contains stomata. It is thus only partially dependent upon the gametophyte for its nourishment.

LIFE CYCLE: Some are heterothallic and some are homothallic. Both antheridia and archegonia are formed imbedded just below the upper surface of the gametophyte. The gametophyte is very simple and the sporophyte is complex.

FIGURE 12



Life cycle of a homothallic Anthoceras

Class: Musci
Order: Sphagnales
Family: Sphagnaceae
Genus: Sphagnum (peat moss)

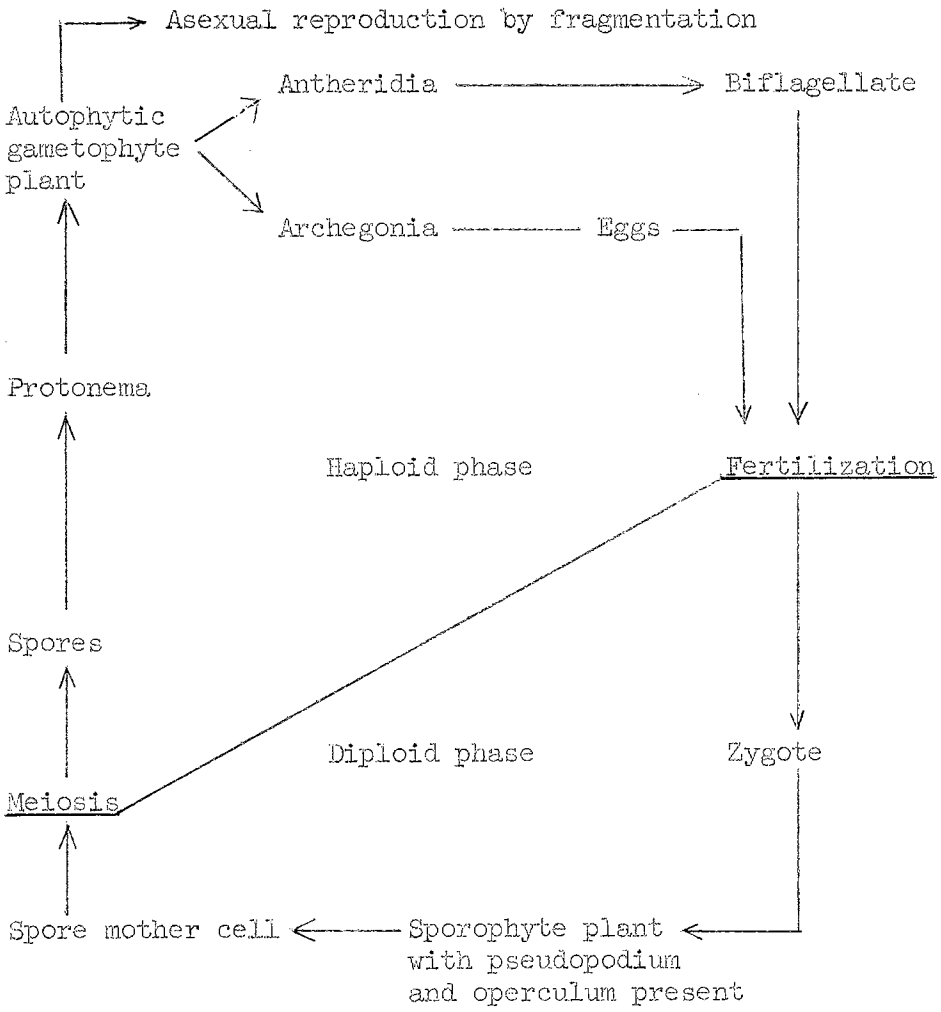
HABITAT: Found in wet pools, bogs, swamps, and around shores of ponds and lakes.

CHARACTERISTICS: It is a macroscopic, closely matted plant. Each plant terminates in a dense series of apical branches. There are no rhizoiks on mature plants. It has two types of cells. It has hyaline cells which are large dead water holding cells and small photosynthetic cells in between the large ones. The gametophyte is a leafy upright plant. The leafy upright structure grows from a flat thallus -- like protonema. The leaves are small and the plant body is radially symmetrical.

The sporophyte consists of a foot, a very short stalk and a capsule containing spores. The capsule is borne upon a long stalk resembling a seta, but is in this case part of the gametophyte called a pseudopodium. Here the gametophyte plant is still the dominant plant. This plant is commonly used by gardeners as peat moss. It makes good absorbent material because of the large dead water holding cells.

LIFE CYCLE: Sphagnum may be homothallic or heterothallic. It is heterogamous. The sporophyte has a definite means of dehisence. It has a lid or operculum that opens up and allows the spores to be forcibly discharged. This mechanism has been called an "air gun" by Ingold (1939).

FIGURE 13



Life cycle of Sphagnum

CHAPTER VIII

DIVISION LYCOPSIDA

Class: Lycopodineae

Order: Lycopodiales

Family: Lycopodiaceae

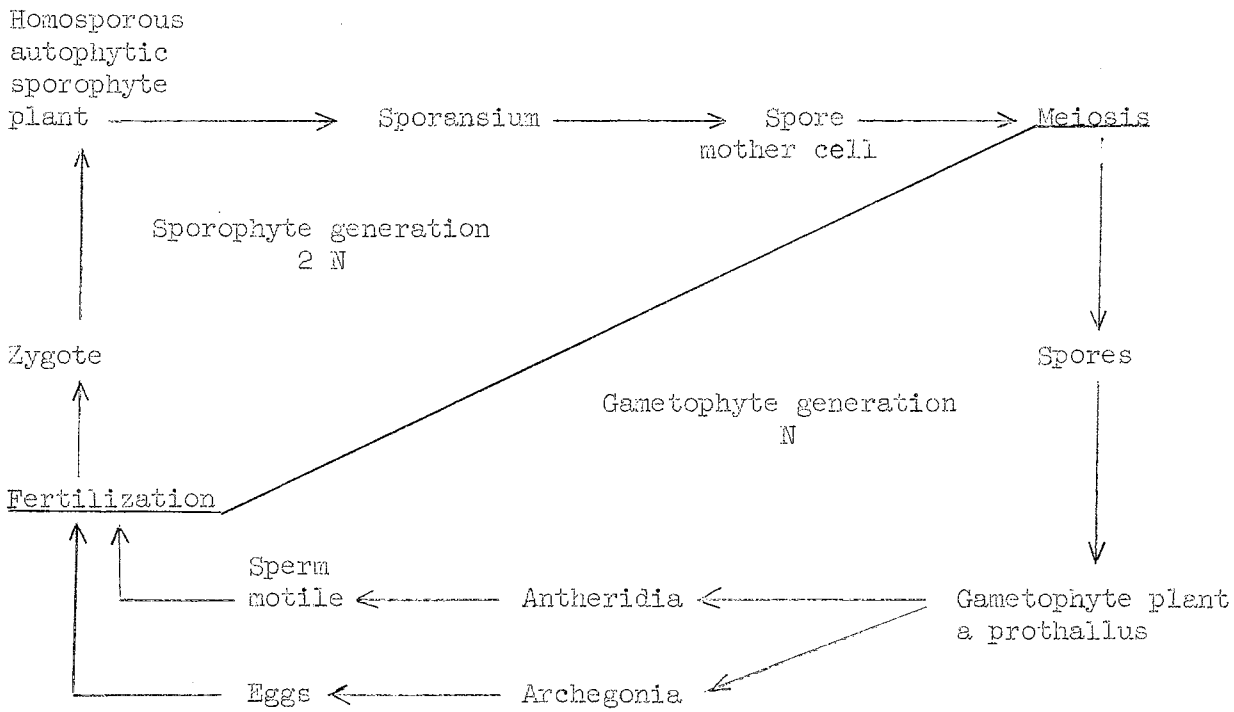
Genus: Lycopodium (club mosses)

HABITAT: Terrestial.

CHARACTERISTICS: For the first time the sporophyte plant is the dominant one and is autophytic. This is also the first plant to have true leaves, stem, roots, stomata, and vascular tissue. It is a primitive vascular plant in that it is dichotomously branched and has no leaf gaps. Many have sporophyll leaves among the sterile leaves which is also a primitive characteristic. The gametophyte is usually saprophytic, some may be autophytic, or partially so. It is associated with mycorrhizal fungus. Lycopodium bears only one type of spore. When the higher plants are studied, it will be seen that two types are borne.

LIFE CYCLE: Lycopodium is homosporous and heterogamous. Reproduction is as shown in figure 14.

FIGURE 14



Life cycle of Lycopodium

CHAPTER IX

DIVISION SPHENOPSIDA (HORSETAILS)

Class: Equisetineae
Order: Equisetales
Family: Equisetaceae
Genus: Equisetum

HABITAT: Equisetum are all terrestial. Some grow in moist habitats, some grow in marshy habitats, and still others grow in xeric habitats.

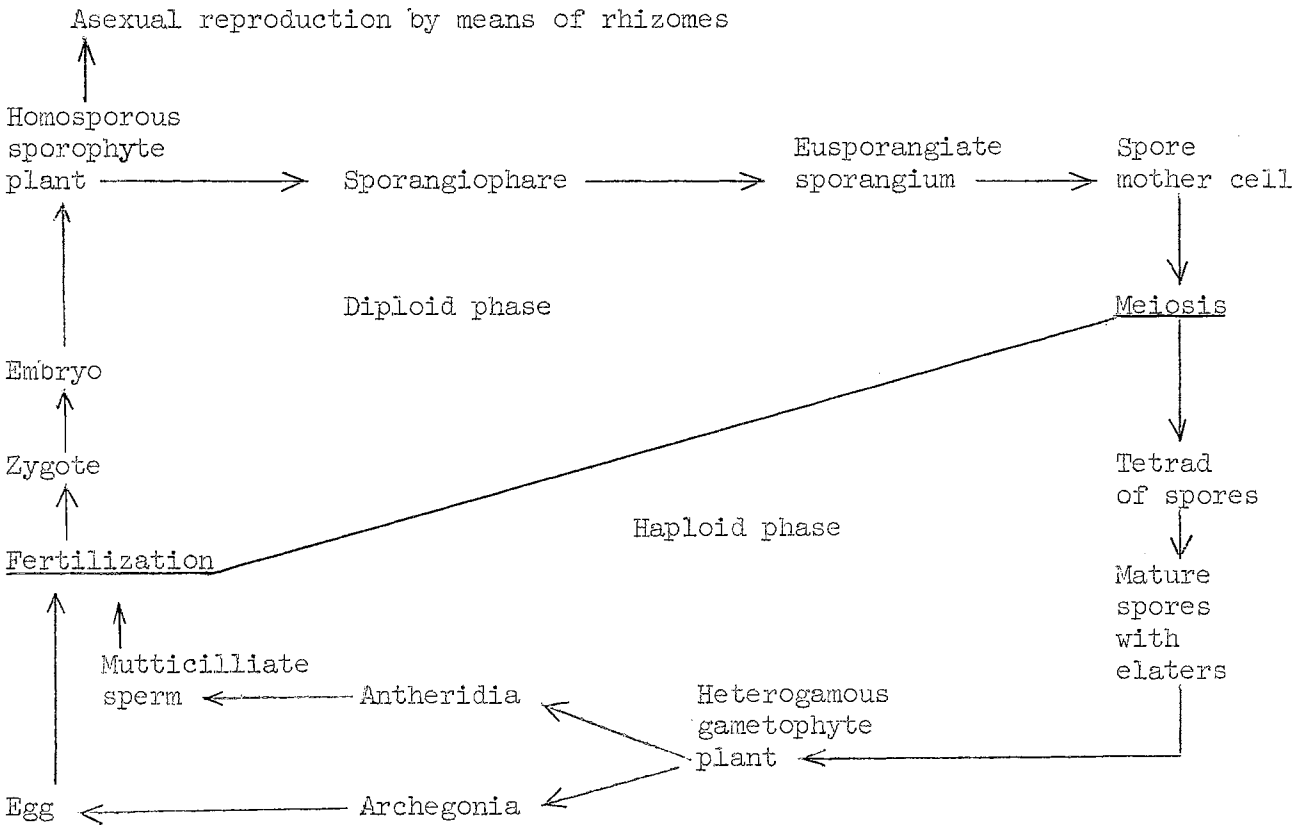
CHARACTERISTICS: The sporophyte being the dominant plant is distinguishable from all other vascular plants by the whorled arrangement of the leaves and branches. It consists mostly of just an upright stem with minute leaves. The stem is the dominant organ of the plant body for the small leaves, although photosynthetic for a short period of time after their formation, soon become dry and scale-like.

The base of the leaves are fused and are attached to the stem. Some plants are branched and some are unbranched and all have well defined nodes and internodes. The surface of the stem is ridged and has stomata along the side of the ridges. In Equisetum the branches originate from the region of the node between the leaves whereas in all other vascular plants the branches originate from the axils of the leaves. The plants all have hollow stems. The sporogenous tissue is always in a strobilus at the tip of a vegetative axis. The gametophyte is small ranging from the size of a pinhead to eight mm in diameter. It is a disc-like or cushion-like green plant which is anchored to the substratum by unicellular rhizoids.

LIFE CYCLE: The strobilus, which is apical, produces many appendages called sporangiophores. From the sporangiophores develop the sporangia (eusporangiate), from the sporangia the spore mother cells, from the

spore mother cells, tetrads of spores, from the spores the gametophyte plants. The gametophyte produces the sperm and eggs which unite at fertilization to form a zygote. The zygote develops into an embryo and then into a sporatphyte plant. Most new plants are probably produced by asexual means, the vegetative multiplication by means of rhizomes.

FIGURE 15



Life cycle of Equisetum

CHAPTER X

DIVISION PTEROPHYTA (TRUE FERN)

Class: Leptosporangiopsida
Order: Filicales
Genus: Cyrtomium

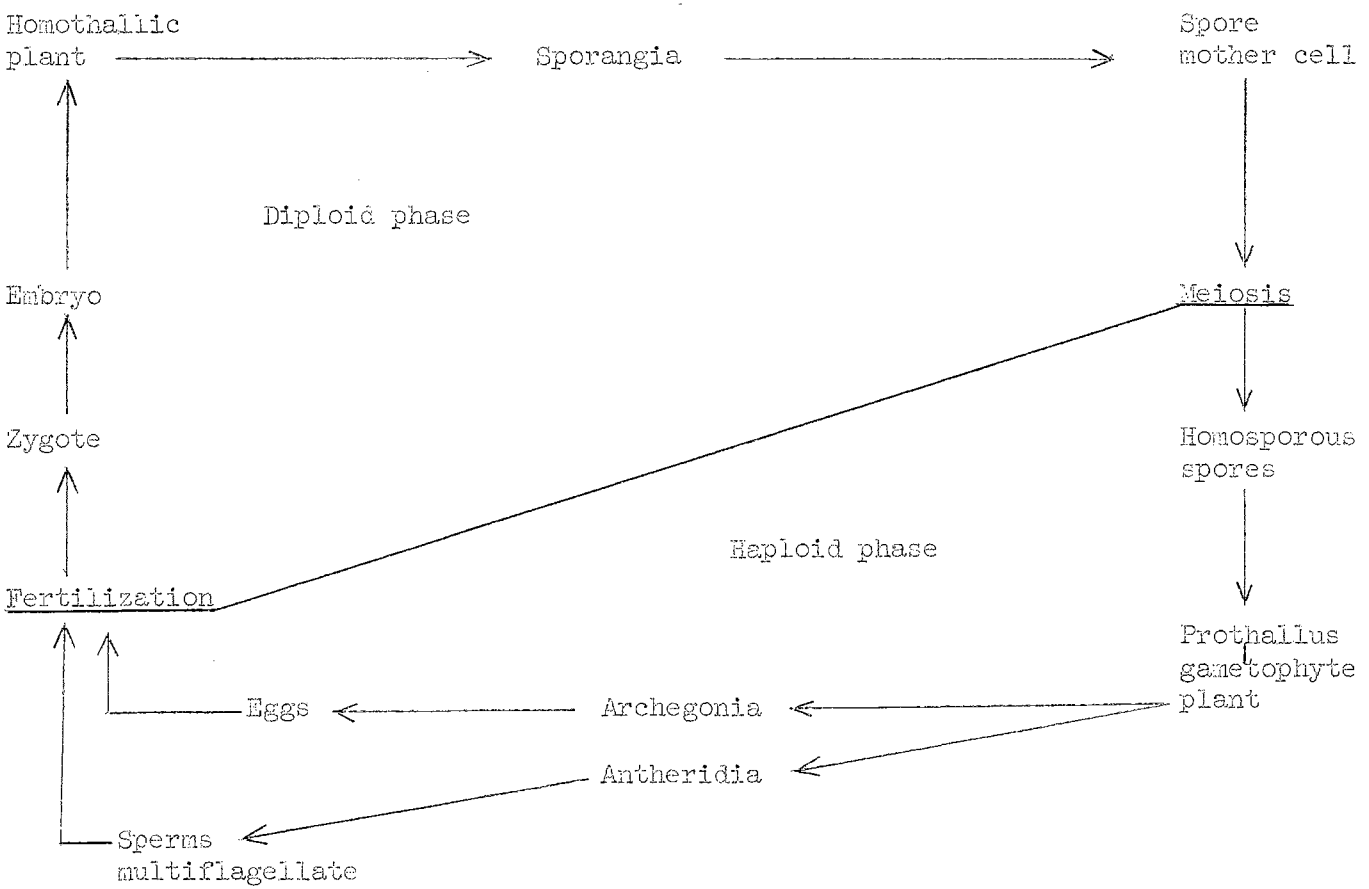
HABITAT: Most are terrestial. Some small ones are aquatic. They grow mostly in the tropics, in wet damp areas, but are occasionally found in the temperate zones on hillsides and mountains.

CHARACTERISTICS: The plant body of the fern is the leaf or frond in most cases with rhizomes running parallel with the ground. The rhizomes are sometimes referred to as stems. True roots penetrate the soil from the rhizomes. The sporaphyte is the dominant plant consisting of leaves and underground rhizomes. Spores are produced on the leaves.

The fern can be separated from all other plants by having leaf gaps and no seed.

LIFE CYCLE: It is homothallic and heterogamous. The sporophyte bears sori on the abaxil side of the leaf. Spores are developed within a sporangium which has a violent means of dehisence. The spores germinate to form the prothallus gametophyte plant. The gametophyte plant produces both sperm and eggs which unite at fertilization to form a zygote. The zygote develops into an embryo and then into a sporophyte plant.

FIGURE 16



Life cycle of Cyrtomium

CHAPTER XI

DIVISION SPERMATOPHYTA (THE FLOWERING PLANTS)

Class: Gymnosperm
Order: Coniferales
Family: Pinaceae
Genus: Pinus

HABITAT: All species of the genus Pinus are terrestial. They are well distributed in the western hemisphere.

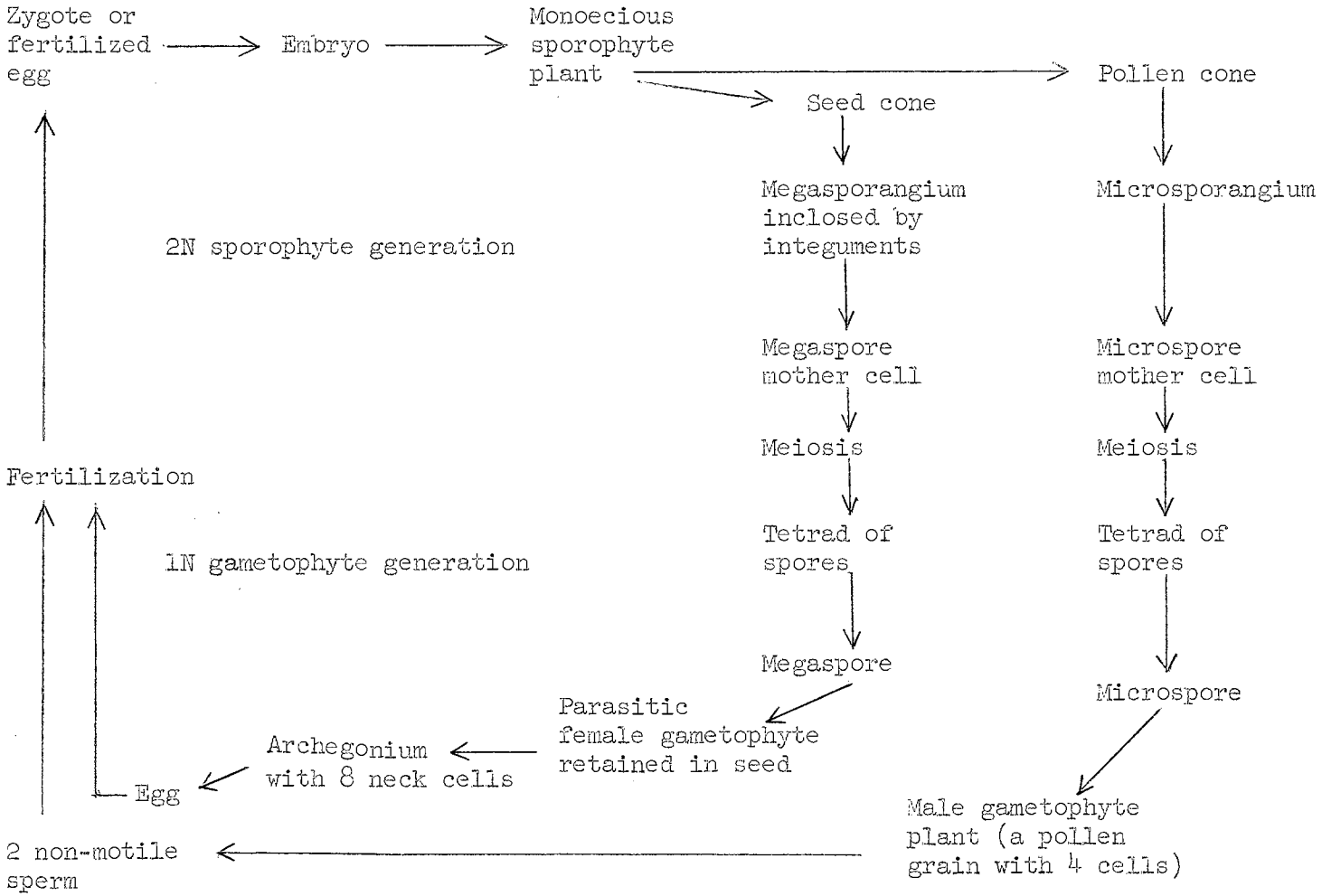
CHARACTERISTICS: All Spermatophyta are seed bearing plants. All Gymnosperm bear naked seed. The trees are freely and excurrently branched and evergreen and therefore conspicuous elements of the area where they occur during the winter months when the surrounding deciduous trees are leafless.

Two kinds of branches and two kinds of leaves are produced in Pinus. In addition to the familiar needle leaves, less conspicuous leaves, the scale leaves, occur on the main branches and at the bases of the branches that bear the needle leaves. Only the needle leaves are photosynthetic. They occur singly or in groups that vary from one to eight in number in the several species.

The needle leaves of species of Pinus have been observed to persist on the trees for periods varying between two and fourteen years, after which they are abscised with the spur shoots which bear them. They are shed gradually, so that their fall is not as striking as leaf fall is in deciduous plants.

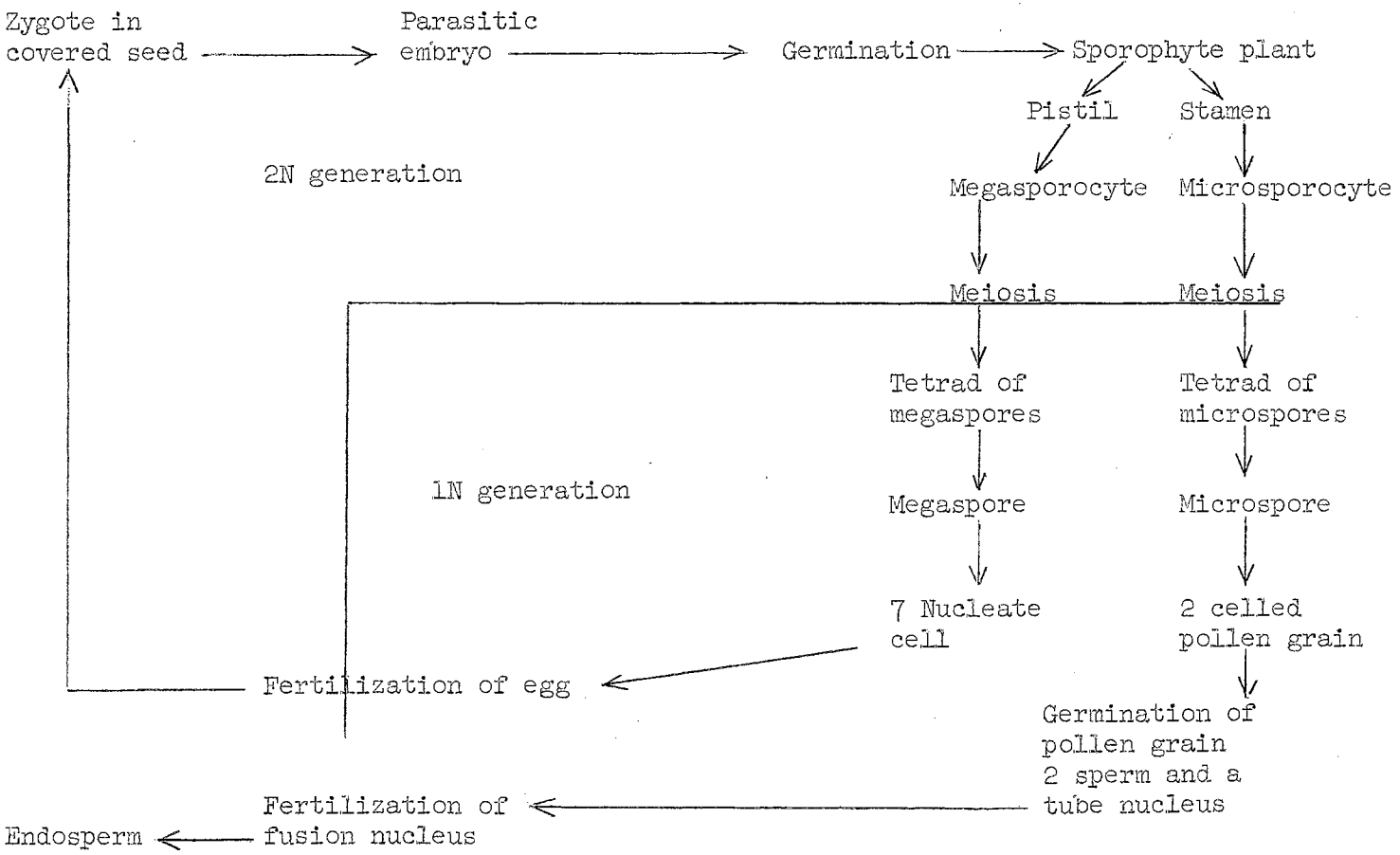
LIFE CYCLE: The microsporangia and megasporangia of Pinus occur in separate strobili, but both are borne on the same individual. Pine therefore are monoecious in contrast to some of the other Gymnosperms and many of the Angiosperms.

FIGURE 17



Life cycle of Pimus

FIGURE 18



Typical life cycle of the angiosperm

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