B. SC. SEMESTER – I

BOTANY PAPER – I

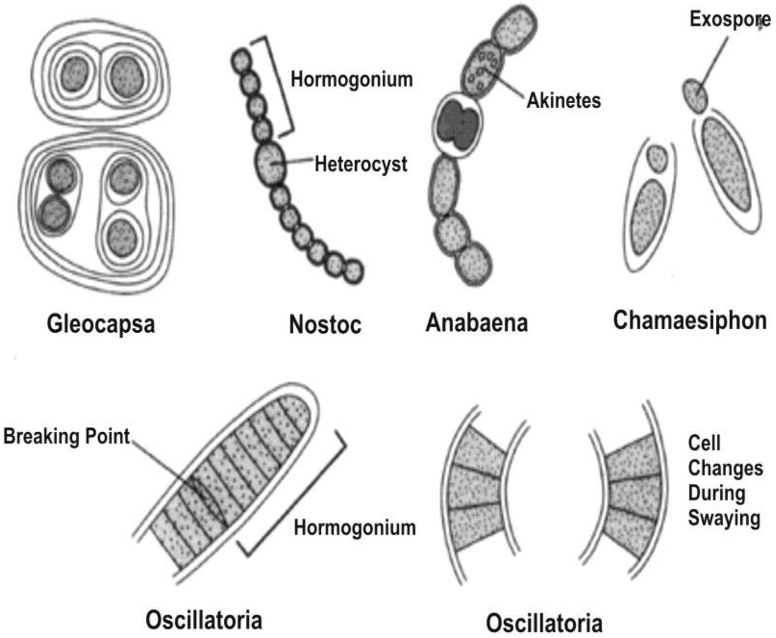
VIRUSES, PROKARYOTES, ALGAE & BIOFERTILIZERS

Unit-II: Cyanobacteria and Algae:

1. **Cyanobacteria:** Cell ultrastructure, Structure of Heterocyst, Structure and Reproduction in Nostoc, Economic importance of Cyanobacteria
2. **Algae:** General characteristics, Classification (Fritsch 1954), Economic importance of Algae.

General Characteristics of Cyanobacteria

They are omnipresent and occur in all possible kinds of habitats. Simple protoplast without any plastids, endoplasmic reticulum, mitochondria, golgi apparatus and sap cavity. The pigments found in this group are chlorophyll *a*, β-carotene, Antheraxanthin, Aphanicin, Aphanizophyll, Flavacin, Lutein, Myxoxanthophyll, Oscillo-xanthin, Zeaxanthin, Allophycocyanin, Phy-cocyanin, Phycoerytrin. The storange products are cyanophycean starch and protein. The flagella are absent. They may be unicellular, (e.g., *Chroococcus*, *Tetrapedia*, *Gloeocapsa*), colonial (e.g., *Aphanocapsa*, *Nostoc*, *Aphanothece*) and filamentous (e.g., *Oscillatoria*)



Cell Structure

The cells of cyanobacteria show a typical prokaryotic structure. There are no membrane-limited organelles within the cells although a variety of vesicles and inclusions may be present. The cytoplasm is surrounded by a plasma membrane, followed by a firm cell wall and a mucilage sheath (**Fig. 2.8**).

Mucilage Sheath

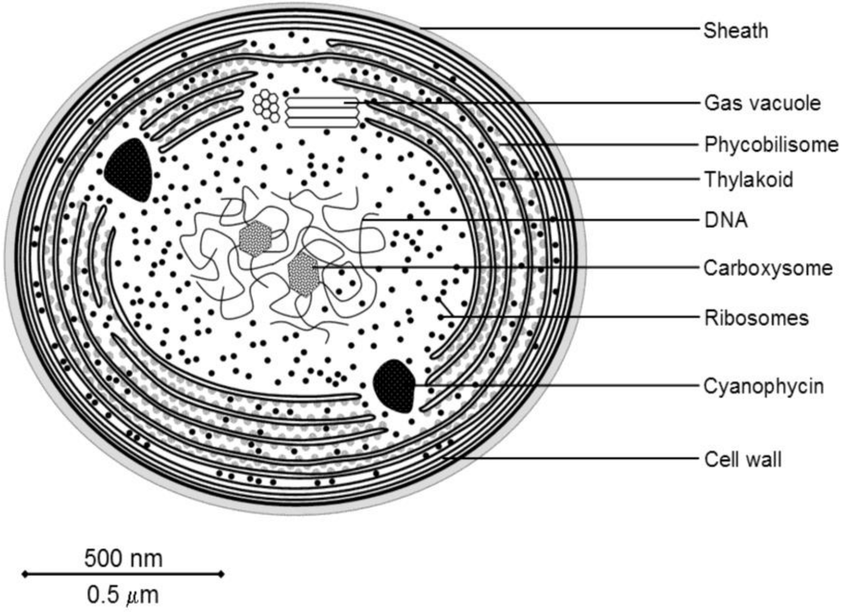
The cell wall of cyanobacteria is surrounded by a thin or thick mucilage sheath, also known as slime layer or capsule. In unicellular forms, each individual has a distinct sheath of its own, whereas in filamentous forms, there is a common gelatinous sheath. The sheath is composed of a complex mixture of **mucopoly-saccharides** and **glucononic acid**. It is made up of fibres, held together in the mucilage. The fibres arise from the cell wall, but are not firmly attached to it and as such the trichome may turn within the sheath. The mucilage sheath probably helps in protecting the cells from desiccation, particularly in those species which do not produce resistant spores. it also help in gliding movements.

Cell Wall

The cell wall of cyanobacteria is thin and firm and is basically similar to that of Gram-negative bacteria. It is differentiated into four layers which are designated as L_1, L_2, L_3 and L_4. The L_1 being the inner most lying next to the plasma membrane and L_4 the outer most. The cell wall is made up of peptidoglycan together with carbohydrates, amino acids and fatty acids. Cellulose is absent

Cytoplasmic Membrane

It forms the limiting membrane of the cytoplasm and is made up of protein-lipid-protein layers. It has many infoldings which penetrate the cytoplasm. It has been suggested that these infoldings give rise to new pigment containing thylakoids.



Chromatoplasm

It is the peripheral pigmented portion of the protoplast and h as a reticulate, alveolar or homogeneous structure. The chromatoplasm is characterized by the presence of flattened vesicular structure, called thylakoids or photosynthetic lamellae. A lamella is composed of two membranes joined at the ends and enclosing an intrathylakoid space of 70-80 A^o widtch. The lamellae thus form closed flattened sacs which contain chlorophyll *a*, carotenoids and three phycobiliproteins: *c*-phycocyanin, allophyco-cyanin and *c*-phycoerythrin. The thylakoids are arranged in parallel rows close to the periphery of the cell or they are distributed irregularly throughout the cell. Thus the pigments are not contained in true membrane-limited plastids.

The photosynthetic lamellae of cyano-bacteria are also considered as the sites of cellular respiration and as such they are preferably called photosynthetic respiratory membranes.

The cells of cyanobacteria are devoid of golgi apparatus, mitochondria, endoplasmic reticulum and other membrane bound organelles.

In addition to thylakoids chromatoplasm contains protein granules, gas and oil vesicles.

Cyanophycean granules, are also known as structural granules, are irregular or polyhedral in shape and they store protein in the form of polypeptides.

Polyhedral bodies are angular in shape and are usually associated with the DNA in the central part of the cell. They are considered to be the carboxysomes which store the carbon dioxide-fixing enzyme ribulose-1,5-bisphosphate carboxylase.

Polyphosphates bodies, also known as volutin granules, are small spherical structures, located near the centre of the cell. They store phosphate and are found abundantly in mature cells growth in the medium with high phosphate contents.

Gas vesicles are small, tubular structures, composed of protein ribs or spirals exclusively. These vesicles which contain gas have quite rigid wall but they are collapsed when pressure is applied. The gas vacuoles shield light and also provide buoyancy.

Centroplasm

The central colourless region of the cell is known as ***centroplasm*** or ***nucleoplasm***. It consists of several naked DNA which are not associated with histones. However, in some cyanobacteria a histone-like protein binds non-specifically with DNA. The nuclear material is not surrounded by a nuclear membrane and nucleoli are also absent. The nucleoplasm is not sharply differentiated and usually intrudes into the periopheral chroma-teplasm. Although this region stains like that of the nucleus of eukaryotes, it cannot be regarded as true nucleus and is called ***incipient nucleus***.

NOSTOC

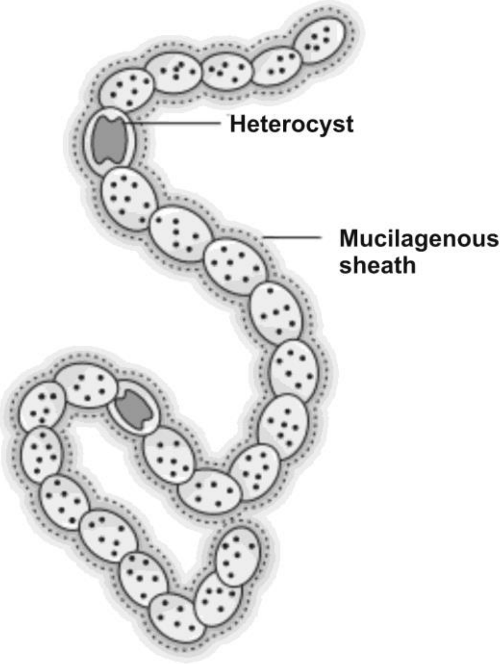
It is filamentous form of both terrestrial and aquatic habitats. It does not occur in single filaments but grow in large colonies of closely packed trichomes embedded in a firm matrix of gelatinous material. *Nostoc* colony thus forms a mucilaginous lumps or thallus which occurs floating or attached. The colour may be olive green or blue-green and the surface of the colony is warty or smooth.

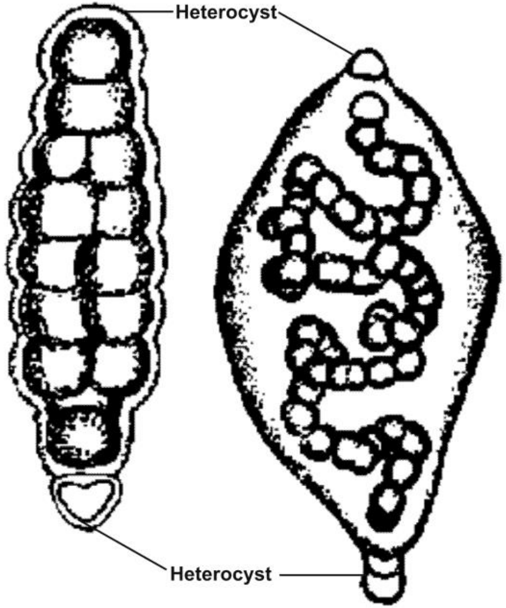
Structure of colony

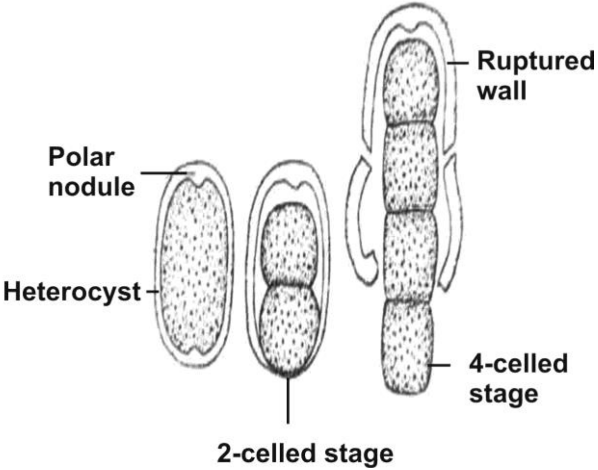
Innumerable chains of bead-like cells (trichomes) of varying lengths are enclosed in a gelatinous matrix to form a colony. Each trichome is usually enclosed by its own mucilaginous sheath and is called as filament.

Structure of trichome

The trichomes are much contorted, moniliform and intertwined. They wind about in every direction in the gelatinous matrix. They are more crowded towards the periphery of the colony to form a dense limiting layer. Each trichome is composed numerous rounded or oval cells. The cells are joined loosely from end to end into a trichome somewhat resembling a string of beads.


Heterocyst
Mucilagenous sheath


Heterocyst
Heterocyst


Ruptured wall
Polar nodule
Heterocyst
4-celled stage
2-celled stage

At frequent intervals along the trichome are found colourless, empty looking, spherical or barrel shaped cells called as **heterocysts.** They are slightly larger and have thicker walls than the vegetative cells and are intercalary as well as terminal. Each intercalary heterocyst, when formed has two polar pores (nodules). Through these pores cytoplasmic connections are maintained with the adjacent vegetative cells. Under unfavourable conditions vegetative cells here and there in the trichome may become greatly enlarged, stored with food materials and greatly thickened to become resting bodies called as **akinetes.** Each trichome with its individual sheath is called **filament**. The sheath may be hyaline or coloured. Sometimes it is very indistinct or even absent

Cell structure

The cell consists of the cell wall surrounding the protoplast. The protoplast, as usual in the cyanophycean cell, is vaguely defined into the outer pigmented cytoplasmic region called the chromoplasm and the inner colourless centroplasm. The chromoplasm has the usual pigments (phycocyanin and chlorophyll *a* etc.) located in the lamellae which form a system of peripheral area of parallel paired membranes embedded in the granular matrix. There is no chromoplasm without lamellae. It also contains the colourless granules of myxophycean or cyanophycean starch and the cyanophycin granules of proteinaceous nature. The centroplasm is not separated from the chromoplasm by any kind of membrane.

Reproduction

Nostoc reproduces entirely vegetatively by the following methods:

Colony fragmentation

The *Nostoc* colony as it becomes larger, frequently breaks up into flat expanses as a result of storms and other disturbances. Each of these grows up to the size of the parent colony.

Hormogonia

Hormogone formation is very common in *Nostoc*. The trichome ruptures at places where a heterocyst and the vegetative cell adjoin. This junction is the weakest link in the chain. In fact some algologists believe that heterocysts represent a mechanism for the fragmentation of the trichome. In this way short segments of living cells called the **hormogonia** become isolated. The hormogonia slip out of the enclosing gelatinous matrix and establish new colonies by division

The terminal cells of the hormogonia differentiate as heterocysts. The intercalary cells then divide in a plane parallel to the axis of the trichome forming a packet of cells. Sometimes the hormogones develop into fresh trichomes without being liberated from the colonial sheath and increase the number of trichomes in the adult colony.

Resting spores or akinetes

Under unfavourable conditions, some of the vegetative cells of the trichome become enlarged and each secretes a thick, highly resistant wall around it. They get gorged with reserved food materials. Such specially modified vegetative cells are called the **akinetes** or **resting spores** or **arthrospores**. These are well adapted to survive unfavourable conditions such as water shortage and unsuitable temperature. It is not unusual to find all the cell between two heterocysts and occasionally the entire trichome convert into akinetes. With the return of favourable conditions each akinete germinates to form a new filament of *Nostoc*.

Heterocysts

In exceptional cases the heterocyst may become functional. It germinates to form a new filament. At first a 2-celled and later 4-celled germling is formed. It escapes either by the rupture of the heterocyst wall at the equatorial region or by gradual dissolution and widening of the pore

Endospore formation

Brand (1901) and Spratt (1911) reported that the contents of the heterocysts in *Nostoc* sp. Divide to reproduce endospores. The endospores, on liberation, give rise to new filaments.

Economic Importance of Cyanobacteria

The blue green algae furnish food for fish and other aquatic animals. According to Chako (1970), "*Oscillatoria* is the most favoured blue-green alga consumed by 56 species of fishes. Other in order of preference these are *Spirulina*, *Anabaena*, *Microcystis*, *Lyngbya* and *Merismopedia*." The blue-green algae add organic matter to the soil and increase fertility. Barren alkaline soils in India have been reclaimed and brought to a productive state by inducing a proper growth of certain cyanobacteria. Decomposition of successive crops of these neutralized the alkalinity of the soil. Recent investigations have definitely proved that some of the blue-green algae increase the fertility of the soil by fixing atmospheric nitrogen. The important nitrogen fixing blue-green algae are *Oscillatoria*, *Anabaena*, *Spirulina*, *Nostoc* and *Cylindrospermum*. Some species of species of *Scytonema* and *Mastigocladus* also have the ability to fix atmospheric nitrogen.

Verma (1970), stated that the blue-green algae form an important group of soil organisms which are of great agricultural importance because of the ability of some of them to synthesize organic substances as well as fix atmospheric nitrogen. They serve as an excellent source of nitrogen and organic matter. The practical application of the cyanobacteria is the seedling of rice fields with nitrogen fixing species. This results in appreciable increase in the yield of rice. Marathe (1970), suggested that some blue-green algae bring about aggregation of loose, unbounded soil particles and thus improve the physical texture of the soil which helps in checking soil erosion. The cyanobacteria, therefore, play an important role in soil conservation to certain extent.

The blue green algae are of negative value as well. They contaminate water supplies by producing colour, odour and giving a fishy taste to the drinking water. Their growth can, however, be checked by adding very small quantities of copper sulphate and dichloro-phen to the water. Some of the cyanobacteria are poisonous to fish and domesticated animals. Chacko (1970), reported that thick blooms caused by *Microcystis*, *Nostoc*, *Anabaena*, *Oscillatoria* etc. bring about depletion of oxygen resulting in large scale death of fish and other aquatic animals.

ALGAE

"*Algae are chlorophyll bearing organisms which possess unicellular sex organs or multicellular ones in which every cell forms a gamete"*. In this respect, the algae differ from all other green plants.

They are aquatic, both marine and fresh water and occur on and within soil and on moist stones and wood as well as in association with fungi and certain animals. The algae are of great importance as primary producers of energy rich compounds which form the basis of the food cycle of all aquatic animal life. For this purpose, the planktonic algae are of special importance, since they serve as food for many animals. It is thought that 90 per cent of the photosynthesis on the earth is carried on by aquatic plants; the planktonic (suspended) algae are chiefly responsible for this. While photosynthesizing, they oxygenate their habitat, thus increasing the level of dissolved oxygen in their environment.

There are approximately 1800 genera with 21,000 species which are highly diverse with respect to habitat, size, organization, physiology, biochemistry and reproduction. Phycology is the study of algae and those who pursue such a study seriously are phycologists.

Characteristics

- The algae are chlorophyll bearing organisms with a thallus-like plant body
- The thallus shows little differentiation of true tissues.
- Even the complex thalli lack vascular tissue and epidermis with stomata.
- The sex organs are one-celled, when multicellular, each cell is fertile and there is no jacket of sterile cells.
- There is no embryo formation after gametic fusion.
- Both the generations when represented in the life cycle are independent. There are no algae with sporophyte parasitic on the gametophyte plant.
- Excepting a few all the algae are aquatic.
- Under favourable conditions the gametophyte multiplies repeatedly by means of asexual spores called the mitospores.

Fritsch’s Classification

In the beginning of the twentieth century, the class Xanthophyceae was separated from Chlorophyceae and certain pigmented flagellate types were included in the class.

Dr. F. E. Fritsch (1944), published his classification in his book entitled “*The Structure and Reproduction of the Algae*”. He divided algae into following 11 classes on the basis of following characteristics:

Number and mode of attachment of flagella in the motile cells.

Thallus structure and chemical nature of pigments

Reserve food materials

Method of reproduction

Variation in the life cycles

These 11 classes proposed by Dr. Fritsch are as follows:

Chlorophyceae (Grass green algae)

The main pigments of this class are chlorophyll *a*, chlorophyll *b*, carotenoids and xanthophylls. The reserve food material is starch. Chloroplast have pyrenoids. Starch grains are usually aggregated around the pyrenoids. Flagella, if present, are of equal length, whiplash type and inserted at the anterior end.

Class Chlorophyceae has been divided into following nine orders:

Volvocales
Chlorococcales
Ulotrichales
Cladophorales
Chaetophorales
Oedogoniales
Conjugales
Siphonales
Charales

Xanthophyceae (Yellow-green algae)

Main pigments are chlorophyll *a*, chlorophyll *e*, β-carotene and xanthophylls. The reserve food material is oil. Pyrenoids are absent. Flagella, if present, are two, unequal and inserted anteriorly. The short flagellum is of whiplash type and the longer one is tinsel shaped.

Class Xanthophyceae has been divided into following four orders:

Heterochloridales

Heterococcales

Heterotrichales

Heterosiphonales

Chrysophyceae

The main pigment is phycochrysin which gives brown or orange colour to these algae. The reserve food material is chrysolaminarin and leucosin. Pyrenoids are naked. Flagella if present, are two equal or unequal in length, inserted at the anterior end.

Class Chryophyceae has been divided into following three orders:

Chrysomonadales

Chrysoaphaerales

Chrysotrichales

Bacillariophyceae (Diatoms, yellow or golden brown algae)

The main pigments are fucoxanthin, diatoxanthin and diadinoxanthin. The reserve food materials are fat and volutin. Pyrenoids are present. The motile cells have single flagellum.

Class Bacillariophyceae has been divided into following two orders:

Centrales

Pennales

Cryptophyceae (nearly Brown algae)

The main pigment is xanthophylls. The reserve food material is starch and/ or oil. Pyrenoids are present but often independent of chromoatophores. Mainly plants are motile cells and most advanced forms are coccoid. The flagella are slightly unequal and anteriorly inserted.

Class Cryptophyceae has been divided into following two orders:

Cryoptomonadales

Cryptococcales

Dinophyceae (=Peridiniaeae; Dark Yellow or Brown algae)

The main pigment is xanthophylls, which imparts brown or red colour. Chromatophores are numerous, discoid, dark yellow, brown etc. The reserve food materials are starch and oil. Plants are unicellular motile to branched filamentous. The body of motile cells has two furrows, one is transverse having transverse flagellum which encircles the body and the other is longitudinal with backwardly directed longitudinal flagellum.

Class Dinophyceae has been divided into following six orders:

Desmomonadales
Thecatales
Dinophysales
Dinoflagellate
Dinococcales
Dinotrichales

Chloromonadineae (Bright Green algae)

The main pigment is xanthophylls which is present in excess; chromatophores are numerous, discoid and bright-green in colour. The reserve food material is fat and oil. Pyrenoids are absent. The plants are motile flagellates with two almost equal flagella.

Class Chloromonadineae has only one order:

Chloromonadales

Euglenophyceae or Euglenineae (Pure Green algae)

The main pigment is chlorophyll; each cell has many chromatophores which are pure green. The reserve food material is polysaccharide paramylon. Pyrenoids like bodies are found in some forms. The plants are motile flagellates; flagella may be one or two arising from the base of canal-like invagination at the anterior end.

Class Euglenophyceae or Euglenineae has been divided into following three families.

Euglenaceae

Astasiaceae

Peranemaceae

Phaeophyceae (Brown algae)

The main pigment is fucoxanthin besides chlorophylls *a* and *c*. The reserve food material is alcohol mannitol, polysaccharide laminarin and fats. Some lower forms have naked pyrenoid like bodies. The motile reproductive cells have two lateral or sub-apical flagella, one directed forward and the other backward.

Class Phaeophyceae included following nine orders:

Ectocarpales
Tilopteridales
Cutleriales
Sporochnales
Desmarestiales
Laminariales
Sphacelariales
Dictyotales
Fucales

Rhodophyceae (Red algae)

The main pigments are tow types of phycobilins; r-Phycoerythrin and r-phycocyanin besides chlorophylls *a* and *d*. the reserve food material is solid polysaccharide: the floridean starch. Some lower forms have pyrenoi like bodies. Motile stages are totally absent.

Calss Rhodophyceae included following seven orders:

Bangiales
Nemalionales
Gelidiales
Cryptonemiales
Gigartinales
Rhododymeniales
Ceramiales

Myxophyceae (=Cyanophyceae, Blue-green algae)

The pigments are chlorophyll *a*, β-carotene, c-phycocyanin and c-phycoerythrin; well developed chromatophores are absent due to prokaryotic type of cell organization. The reserve food materials are sugars, glycogen and cyanophycean starch. No motile stages are known.

Class Myxophyceae or Cyanophyceae includes following five orders:

Chroococcales

Chamaesiphonales

Pleurocapsales

Nostocales

Stigonematales

Economic Importance of Algae

Exploration of of the seas, which are full of algae, has brought home to man the usefulness of algal flora. The algae are of importance in the field of agriculture and industry. In addition they are used as food, fodder and manure.

Role in Industry

The algae are useful as the source of many commercial products. The four major products derived commercially from them are agar-agar, carrageenin, alginic acid and diatomite. The industrical utilization of algae, particularly the sea weeds, dates back to many hundreds of years.

Agar-agar

It is mucilage produced by certain red algae and stored along with cellulose in the cell walls. The main sources of agar in Japan are the thalli of *Gelidium*, *Gracilaria* and *Gigartina*. Japan is the largest agar producing country. It is a gelatinous, clear, nitrogen free extract synthesized from the algae. The extract is a gel containing galactose and a sulphate. At lower temperature it changes into a solid. Agar-agar is of great value in the preparation of foodstuffs and is particularly used in the articles of diet for invalids.

It is insoluble in cold water but soluble in hot water. It is almost necessity to research as it is used as a base for culture media for bacteria, fungi, algae and other plant tissues. It is also useful in preparation of certain medicines and in cosmetics, leather and textile industries. It is largely used as a laxative, culture medium, baked goods, and meat industry and as an emulsifier in dairy products.

Alginic acid

The chief sources of Alginic acid are *Ascophyllum*, *Laminaria*, *Lessonia*, *Ecklonia*, *Macrocystis* and *Eisenia*. Algin is a carbohydrate which occurs in the middle lamellae and primary walls of these sea weeds. The soluble calcium salt of alginic acid is knon as algin. The insoluble extract is alginic acid. The salts of alginic acid found in the cell walls of above mentioned sea weeds are called alginates. The alginates are used as thickneners in food industry, consmetics and in textile industry as printing pastes. They are also useful in the rubber industry and in latex production. All told algin is used in about eighty different commercial products.

Carrageenin (Carrageen)

The chief source is red algae. It is a cell wall polysaccharide and is a mucilaginous extract. Carrageenin is used in food, textile, pharmaceutical, leather and brewing industries. It is also used to stabilize emulsions and as remedy for cough. Its use as a component of tooth pastes, deodorants, cosmetics and paints is no less important.

Iodine

Japan produces about 100 tons of iodine annually from the kelps (brown sea weeds). The chief genera employed for the purpose are *Laminaria*, *Ecklonia*, *Fucus* and *Eisenia*. The kelps are also a source of soda and potash. The red algae are also a source of bromine.

Glue

Glue manufacturing is another important algal industry in Japan. Red alga *Gloeopeltis furcata* is used for this purpose. This glue is known as *funori*. It is used for sizing paper and cloth. It is also used as an adhesive.

Diatomit

It is a rock like deposit formed from the indestructible, siliceous frustules (cell walls) of the past diatoms that had collected over many millions of years on the floors of sea to form oceanic sediment. The latter extends hundreds and thousands of feet in depth in some localities. These diatomaceous deposits are mined in several parts of the world to obtain the diatomaceous earth which is put to several commercial uses. It is whitish substance, firm but usually soft and light. It is highly porous and insoluble. It has abrasive qualities and is chemically inert. It is used in insulation for pipes and furnaces, in the manufacture of dynamite, a constituent of some tooth powders, bleaching powders, a reinforcing agent in both concrete and rubber. It is also used as a base on automobile and silver polishes. Its use in wine and paper industries is no less important.

Role in Agriculture

Blue green algae increase the fertility of the soil by fixing atmospheric nitrogen. The practical application of these algae as fertilizers in the rice fields which increase the nitrogen contents of the soil.

Another important use of the blue green algae is in the reclamation of barren, alkaline soils. Such soils have been reclaimed and brought to a productive state by inducing a proper growth of certain cyanophyceae. Successive crops of these neutralize the alkalinity and increase fertility of the soil.

The algae are used as fertilizers particularly the sea weeds in the farm land near the coastal regions. Large brown and red algae are used as organic fertilizers.

Algae and space travel

A spaceman will need a device to get rid of carbon dioxide and other body wastes and will also require sources of oxygen and food. It has been considered beneficial to use microscopic, unicellular algae such as *Chlorella* sp. as a possible source of food in anticipated space flight.

Algae as Food

The algae are important as a source of food for the fishes, aquatic amphibian, mammals and other animals. Man's dependence on fish and aquatic animals to supplement his diet is a well known fact. Indirectly, therefore, the algae are of great value to man.

In fact in some coastal parts of the world they are sued directly as human food. In China and Japan some sea weeds are regularly harvested as food for man. It has been estimated that near about 25% of the daily diet of Japan consists of sea weeds. It is an important food form man because it contains protein, fats and vitamins A, B, C and E.

Use of Algae as Fodder

The sea weeds are used as a fodder for animals with beneficial effects. In many courtries sea weeds are used as fodder for the cattle and also the kelps are chopped for sheep and chickens. Some countries have been developed small industries for processing the sea weeds. The processed food is given to cattle, poultry and pigs. Milk yielding capacity and egg laying capacity of poultry enhanced when dried sea weeds are feed.

Role of Algae in Medicine

Many sea weeds contain a high percentage of iodine content and thus are employed in the preparation of various goiter medicines or are administered directly as a powdered weed.

A patient suffering from prolapsed stomach is fed on a diet containing dried agar-agar and asked to drink a lot of water. The stomach gets distended and regains its normal condition. A few algae are a source of antibiotics which inhibit the growth of other bacteria. Chlorellin from *Chlorella* is one of such antibiotics. Agar-agar is an important algal product used in the manufacture of pills, ointments and also laxative. Carrageenin extract, which is another product of algal origin, acts as a blood coagulant. In addition to this, many algae are used in the treatment of lung, kidney and bladder ailments by unani and hakims.

Role of Algae in the origin of petroleum and fuel gas

The fuels such as petroleum and natural gas have their origin in the organic matter in the marine environment. Minute algae constituting the plankton trapped the sun's energy during photosynthesis. It was transferred to the marine animals as they fed upon them. The organic compounds derived from the dead bodies of plants and animals constituting the plankton gradually accumulated at the bottom of the ocean and were buried in the course of time by sedentary action. In the environment free from oxygen these compounds were decomposed and converted into oil and gas.

The natural gas associated with oil is largely methane which is produced by the action of methane producing bacteria upon organic compounds.

Algae and sewage disposal

Sewage is the foul domestic and industrial liquid waste which is deficient in oxygen but abounds in dissolved and suspended organic and inorganic materials. It harbours microorganisms of decay and decomposition. The use of small green algae in large, shallow tanks of effluent has proved a rapid, cheap and effective means of converting the dangerous and expensive waste into an odorless and valuable fertilizer. These tanks promote growth of the algae which flourish at the expense of the mineral nutrients present in the sewage. The rapid photosynthetic activity of the algae produces abundant oxygen which is used by the miro-organisms responsible for decomposition of remaining organic matter in the sewage.

Algae and water supplies

The algae are of negative value as well. In the rainy season and spring the blue-green algae, some green algae, some golden brown algae and the diatoms become so abundant that the water in the ponds, lakes and reservoirs become cloudy and assumes a yellowish or greenish tinge. Sometimes a floating yellowish green scum may develop on the surface of water. Popularly we call these manifestations of algal growth as water blooms. Such concentrations of algae impart unpleasant odour, oil and fishy taste to the drinking water. Some of the blue green algae produce toxic protein products which are poisonous to fish, cattle, sheep and other domestic animals.

THE END