

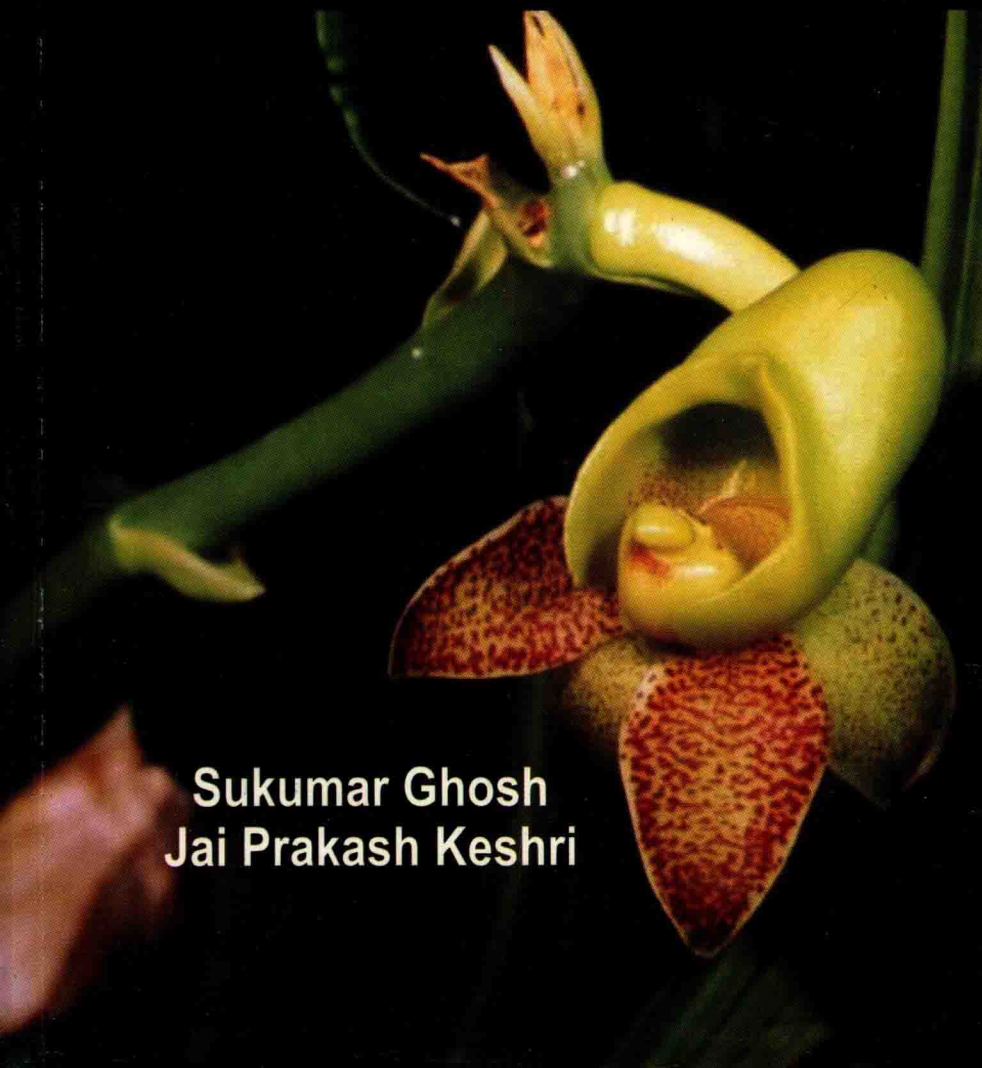
2nd Edition

Levant's Q & A Series

BOTANY

**For Graduation, Post Graduation
and All Competitive Examinations**

**Sukumar Ghosh
Jai Prakash Keshri**



LEVANT'S Q&A SERIES

BOTANY

For Graduation, Post Graduation
and All Competitive Examination

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PREFACE

The authors have been motivated to make the venture of this book, "Levant's Q&A Series – Botany" through their teaching experience for over three decades. The contents have been so designed as to cater all students of undergraduate, postgraduate and students appearing for various competitive examinations. The book is not a simple collection of questions and answers of different examinations, rather it contains chapterwise answers of all probable questions that occurred in the minds of the authors and other veteran teachers of the subject.

The authors express their thanks and gratitude to their friends and colleagues of different institutions and also to their students with their constant inspirations right from the day the writing of the book started. The authors must acknowledge Prof Amal K. Biswas of Kalyani University, Prof A. N. Kar Gupta of L. N. Mithila University, Prof. T. K. Dutta of Burdwan Raj College, Dr. Amit Kumar Ghosh of Birbal Sahni Institute of Paleobotany for their constant motivation, suggestion and creative criticism.

The authors will consider their arduous labour rewarded if the book is widely received by the students. Any suggestion, criticism, comments for betterment of the book will be thankfully received and appreciated.

Sukumar Ghosh
Jai Prakash Keshri

CONTENTS

Chapter 1	Algae	...	1
Chapter 2	Fungi	...	61
Chapter 3	Lichen	...	89
Chapter 4	Bryophytes	...	94
Chapter 5	Pteridophyte	...	117
Chapter 6	Gymnosperms	...	148
Chapter 7	Palaeobotany	...	173
Chapter 8	Morphology	...	183
Chapter 9	Taxonomy	...	214
Chapter 10	Economic Botany	...	277
Chapter 11	Anatomy	...	298
Chapter 12	Ecology	...	329
Chapter 13	Plant Pathology	...	375
Chapter 14	Plant Physiology	...	406
Chapter 15	Biochemistry	...	448
Chapter 16	Cell Biology	...	473
Chapter 17	Genetics And Plant Breeding	...	509
Chapter 18	Tissue Culture And Embryology	...	563
Chapter 19	Microbiology	...	576
Chapter 20	Genetic Engineering	...	622
Chapter 21	Pharmacognosy	...	655
Chapter 22	Nobel Prize in Physiology or Medicine	...	661

CHAPTER-1

ALGAE

Introduction

1. Define 'Algae'.

"The algae are not one closely related taxonomic group but a diverse group of photosynthetic organisms which share only a few characteristics. Algae have a photosynthetic system based on chlorophyll a; their reproductive structures lack sterile cells; and they do not form embryos." Sze 1993.

They are the photosynthetic thallophytes (plants lacking root, stems and leaves) having photosynthetic system based on chlorophyll a that do not form embryo. Generally reproductive structures lack sterile cells.

2. What is Phycology?

The study of algae is called "Phycology". The word Phycology is derived from the Greek word phykos, which means 'seaweed'. Traditionally it has dealt with photosynthetic organisms that were not bryophytes or vascular plants.

3. Who is called father of Phycology?

Prof. F. E. Fritsch

4. Name a book wrote by Prof. Fritsch.

'The Structure and Reproduction of Algae,' Vol.I (1935), Vol.II (1945). This two volume treatise is still a monument to students of Phycology.

5. Who is called father of Indian Phycology?

Prof. M.O.P. Iyengar.

6. Name a monograph wrote by Prof. M.O.P. Iyengar.

'Volvocales' by M.O.P. Iyengar & T.V. Desikachary.

7. What is the present status of algae?

With the recognition that living organism can no longer be adequately distinguished as plants or animals, a five-kingdom system has become adopted (Whittaker 1965). In this system, the eukaryotic algae are placed in the kingdom Protista and the prokaryotic algae in the kingdom Monera with eubacteria.

8. Give examples of algae having prokaryotic cellular organization.

Cyanophytes and prochlorophytes. Presently prochlorophytes have been included under Cyanophyta.

9. What is flagellum?

Thread like projection arising from the surface of motile unicellular algae, bacteria and fungi and from spores and gametes that help in motility is called flagellum. Eukaryotic flagella consist of an "axoneme" of nine doublet microtubules surrounding two central microtubules, with all the microtubules surrounded by the plasma membrane of the cell. Prokaryotic flagella lack '9+2' organization. Prokaryotic algae however lack flagella.

10. What is "undulipodia"?

The term has been introduced by Lynn Margulis to include eukaryotic 'flagella' and 'cilia' considering the fact that both these organelles have same '9+2' structure. They are ultrastructurally completely different from prokaryotic flagella.

11. Name the algal groups lacking flagellate stage.

Cyanophyta, Prochlorophyta, Rhodophyta.

12. What is flagellar apparatus?

Flagella and associated structures constitute flagellar apparatus. It consists of the emergent flagellum, the transition region where a flagellum joins its basal body, the basal bodies and the cytoskeletal elements radiating from basal body.

13. What are whiplash and tinsel flagella?

When flagellar membrane has no hairs on its surface it is called whiplash or acronematic flagellum, when hairs are present it is called tinsel or hairy or pantonematic or flimmergeissel flagellum.

14. What are mastigonemes?

Hairs present on flagellar membrane are also called mastigonemes. There are two types of flagellar hairs:

- i. Non tubular flagellar hairs less than 15 nm in diameter and
- ii. Tubular flagellar hairs consisting of at least a hollow shaft (greater than 15 nm in diameter) often with one or more terminal filaments. These are bipartite (Cryptophyceae) or tripartite (Phaeophyceae, Bacillariophyceae).

Some times the term is applied to latter type of stiff hairs composed of protein and glycoprotein in strict sense.

15. What is "rhizoplast"?

It is a root like transversely striated structure that connects the flagellar basal bodies and the nucleus. It is a contractile organelle, composed of a contractile protein centrin, capable of supercoiling, e.g. *Chlamydomonas* has two rhizoplasts. Contraction in rhizoplast is induced by environmental stress.

16. What are isokont and anisokont flagella?

Flagella of equal length are called isokont and unequal lengths are called anisokont flagella. The former occurs in most green algae, where as the latter in cryptophytes.

17. What is heterokont flagellation?

When an organism holds two different types of flagella, e.g. one hairy and other smooth, the flagellation is called heterokont flagellation, e.g. in Xanthophyceae.

18. What are stephanokont flagella?

When many equal flagella are present arranged in a ring near one end of the cell like a crown, the flagellation is called stephanokont flagellation, e.g. zoospores of *Oedogonium* and *Derbesia* show this type of flagellation.

19. What is stichonematic flagellation?

A pleuronematic flagellum in which flimmer hairs arise from one side only is called stichonematic flagellum and the type of flagellation is called stichonematic flagellation, e.g. in *Euglena*.

20. What 'haptonema'?

These are the thread like extensions from the cells of prymnesiophytes (haptophytes) arising near the flagella. Haptonema are similar to flagella but thinner and containing a core of 6 or 7 simple microtubules (arranged in section in crescent) covered by three concentric membranes. They are generally covered with scales. These are sensitive organelles and can coil or bend instantly in response to obstacles to generate a propulsive force for backward swim and/or during the food capture by cells.

21. What is a 'Neuromotor apparatus'?

According to Prescott (1969) "In motile forms of the Chlorophyta the centrosome is joined by a fine protoplasmic thread (rhizoplast) to a fibre (paradesmose) which adjoins the two granules (blepharoplasts) that lie at the base of the flagella. This constitutes an incipient nervous system and is referred to as a neuromotor apparatus".

Although recent findings confirm the presence of some of the elements described in the structure but the connection of rhizoplast with the centrosome and the concept of incipient nervous system appears to be erroneous exaggerations.

22. Generally eukaryotic algal flagella hold (9+2) organization. Are there exceptions?

Spermatozoids of some diatoms hold '9+0' and green alga *Golenkinia minutissima* '9+1' organization.

23. Where to do you find flagellar scales?

In Prasinophyceae and Charophyceae.

24. What are paraflagellar bodies (paraflagellar swellings)?

These are flagellar swellings generally occurring at the base of the longer flagellum and are often associated with eyespots. Their structure suggests that they function as part of the photoreception apparatus, e.g. in *Euglena*. A photosensitive compound is generally present in this structure.

25. What is photoreceptor apparatus?

Eyespot (stigma) together with photoreceptor constitutes the photoreceptor apparatus in the flagellate algal cells. The photoreceptor is situated in a flagellar swelling (e.g. in *Euglena*) or in a specialized area of the cell membrane adjoining the eyespot (e.g. in *Chlamydomonas*). Photoreceptors

are constituted of light sensitive pigments associated with proteins. In *Chlamydomonas* the pigment is 11 cis-retinol.

26. Give examples of algae lacking cell walls?

Chrysamoeba radicans (Chrysophyceae), *Euglena*, dinoflagellates etc.

27. What is periplast?

In cryptophycean members cell covering is made of an outer fibrous layer with proteinaceous plates internal to the plasmalemma. This structure is called 'periplast', e.g. in *Cryptomonas*, *Chroomonas*.

28. What is pellicle?

The outer covering of englenoids is called pellicle. It is composed of proteinaceous plates made 80% of protein and remainder lipids and carbohydrates, immediately beneath the cell membrane. There is no cell wall covering outside the cell membrane e.g. in *Euglena*, *Trachelomonas*.

29. What is theca?

Outer covering of some chlorophytes and dinoflagellates is called theca. In chlorophytes this structure is formed by the fusion of scales. These scales are formed in Golgi vesicles and then deposited on the outer surface of the cell in e.g. *Tetraselmis*. In dinoflagellates the theca is made of flattened vesicles generally containing distinct plates of cellulose beneath the cell membrane, e.g. in *Gonyaulax*.

30. What is amphiesma?

Outer most layers of dinoflagellate cell including the cell membrane, underlying flattened vesicles containing thecal plates with their ribs and attendant microtubules constitute amphiesma.

31. What are coccoliths?

These are calcite scales made of calcium carbonate deposited on the surface membrane of some prymnesiophytes (i.e. coccolithophorides). They are beautifully ornamented scales and are characteristic for each species. These are also formed in the Golgi vesicles.

32. Which algal group possesses cell walls similar in structure to certain Gram negative bacteria?

Cyanophytes. Another group is Prochlorophyta.

33. What is a lorica?

Incomplete envelope around the protoplast of certain flagellates, not attached to the protoplast like a cell wall is called lorica. It is a flask or cup-shaped protective case e.g. in *Platymonas*.

34. In which algal group do you find muramic acid in their cell walls?

Cyanophyta. Prochlorophytes also contain muramic acid.

35. Which green alga does not contain cellulose, rather it contain mannan?

Caulerpa and other siphonaceous green algae.

36. What is Alginic acid? Where do you find it?

It is a complex polysaccharide composed of β -1, 4-linked mannuronic acid units and α -1, 4-linked L-guluronic acid units in varying proportions. Alginic acid is present in the intercellular spaces and cell walls of the brown algae. It also occurs in the cell walls of some red algae.

37. What is Fucoidin?

It is a complex sulphated polysaccharide (a polymer of α -1, 2; α -1, 3; α -1,4 linked residues of L-fucose sulphated at C-4) found in mucilaginous fraction of the cell walls of the brown algae (Phaeophyceae). It is a water soluble compound.

38. What is agar-agar?

Agar is a Malay word for the gelling substance extracted from *Eucheuma* (red algae) which is ironically now known to be a carrageenan. Agar is a galactan and constitutes the gelatinous fraction of the cell wall of certain red algae (e.g. *Gelidium*, *Pterocladia*, *Gracilaria* etc) consisting of a sulphated complex polysaccharides composed mainly of β -1,3 linked D-galactose and 1,4-linked anhydro-L-galactose. Agar is used as solidifying agent in various culture media. It remains as stiff gel in 1-2% aqueous solution at normal temperature but are liquified when hot. Pure agarose is now used as a gel in electrophoretic and chromatographic studies.

39. What are hydrocolloids? Give examples.

Mucilaginous material extracted from the walls of some brown and red algae are called hydrocolloids. These are hydrophilic in nature and used as a thickener and gel in commercial products. They are obtained from other plant groups also. Therefore the term phycocolloid is more appropriate for hydrocolloids from algal sources e.g. agar, carrageenan etc.

40. What is carrageenan?

It is phycocolloid derived from certain red algae. It occurs as amorphous content in cell wall. Similar to agar it is also a galactan but due to higher ash content it requires higher concentrations to form gels. It is composed of negatively charged high molecular weight polymer of k-carrageenan and λ -carrageenan in varying proportions. k-carrageenan contains galactose-2, 6 disulphate and λ -carrageenan contains 3, 6 anhydro-D-galactose. Commercial carrageenan is obtained from *Chondrus crispus* and some species of *Gigartina*. It is used chiefly as an emulsifying, gelling and stabilizing agent and as a viscosity builder in foods, cosmetics and pharmaceuticals. Recently it has been reported that carrageenans inhibit HIV virus replication and reverse transcriptase in vitro.

41. What is agarophyte?

Any seaweed that yields agar is called agarophyte e.g. *Gelidium*, *Gracilaria*.

42. What is chloroplast endoplasmic reticulum (CER)?

Generally chloroplasts are bound by two membranes. But in eukaryotic algal groups other than Rhodophyta and Chlorophyta additional membranes

of chloroplast envelope are present. These membranes are called chloroplast endoplasmic reticulum. Chloroplast endoplasmic reticulum (CER) may be one (Euglenophyta and Dinophyta) or two (Cryptophyta, Phaeophyta, Xanthophyta etc). Sometimes these membranes enclose nucleus also and one of the chloroplast endoplasmic reticulum becomes continuous with the outer membrane of the nucleus e.g. in Cryptophyta, Prymnesiophyta etc.

43. What are phycobilisomes?

These are about 40 nm discrete granules or discs containing phycobiliproteins encountered in cyanophycean and rhodophycean chloroplast on the thylakoid membranes. They are the reserve of nitrogen & also serve a shield for light harvesting.

44. What are phycobiliproteins? In which algal groups they have been encountered.

Unlike chlorophyll and carotenoids these are water soluble pigments recorded only in three groups of algae viz. Rhodophyta, Cyanophyta and Cryptophyta. In the former two groups they occur as discrete particles in form of phycobilisomes whereas in Cryptophyta they remain dispersed in thylakoids. As the pigments are tightly bound to protein moiety the term phycobiliproteins is applicable to them. There are four to five types of these pigments occur: R-phycoerythrin, phycoerythrin (Rhodophyta), C-phycoerythrin (Cyanophyta); R- phycocyanin (Rhodophyta), C-phycocyanin and allophycocyanin (Cyanophyta).

45. What is pyrenoid?

It is a spherical or ellipsoid structure lying in the chloroplast of most algal groups, generally visible under a light microscope. Pyrenoids contain RuBisCo enzyme. It is frequently associated with storage products. Presence of pyrenoid in a group of algae however designates of primitive evolutionary characteristics.

46. What is an 'eyespot' or 'stigma'?

A red spot, usually noted in certain unicellular or colonial flagellates involved in light perception is called stigma. An eye spot or sigma consists of a group of tightly packed lipid globules containing carotenoides and occurring inside or outside the chloroplast but associated near a photoreceptor located in the chloroplast envelope or cell membrane. Therefore they are involved in light perception by shading or unshading the original photoreceptor which is directly involved in light mediated responses. In *Chlamydomonas* this photoreceptor is a rhodopsin (11-cis retinol) associated with proteins. In Eustigmatophytaes stigma lies outside the chloroplast.

47. How many types of chlorophyll are recorded in algae? Mention the types citing examples.

Chlorophyll a, b, c (c_1 & c_2) and d

Chlorophyll a is common to all the algal groups.

Blue green algae/Cyanophyta commonly possess only chlorophyll a

Prochlorophyta, Euglenophyta and Chlorophyta possess chlorophyll b in addition to chlorophyll a.

Chlorophyll c is recorded in Dinophyta, Cryptophyta & most of the Heterokontophytes.

Chlorophyll d has been recorded in some higher red algae & in a marine blue green alga *Acaryochloris marina*.

48. How is chlorophyll c unusual?

Unlike chlorophyll a & b it lacks a phytol tail and as a result is not embedded in membranes and is therefore water soluble. Some experts also not consider it as a true chlorophyll as it is derived from porphyrins rather than chlorines. Absorption properties are also different.

49. What are accessory pigments?

These are the photosynthetic pigments that aid in light harvesting not absorbed directly by chlorophyll molecules. Algae growing at depths require these pigments in sufficient amounts since longer wavelengths are filtered out first so that only faint blue green light reaches these algae. Eventually these accessory pigments like carotenoids channel the light energy to chlorophyll as the faint blue green light can not be absorbed by chlorophyll.

50. What are carotenoids? Mention the types encountered in algae citing examples.

These are isoprenoid polyene pigments synthesized by most algal groups, other green plants and certain photosynthetic bacteria. They are mostly unique to algal groups and play their role as light harvesting pigments. Pigments located outside the thylakoids may function in light shielding to prevent photo-oxidation as well as damage from UV radiation.

There are two types of carotenoid pigments: hydrocarbon carotenes and their dihydroxy derivatives, the xanthophylls. β - Carotene is most common and occurs in almost all algal groups except certain cryptophytes. α - carotene is recorded in Rhodophyta, Cryptophyta and most siphonaceous green algae; γ - Carotene and ϵ - carotene are rather uncommon. There are a large number of xanthophylls occurring in algae. Composition of these pigments exhibit different shades of colour pertaining to the respective alga. Some xanthophylls are characteristic to particular algal groups. For example siphonein and siphonoxanthin occur in siphonaceous green algae. Siphonoxanthin probably helps light absorption in deep waters. Similarly peridinin occurs in Dinophyta. Zeaxanthin and lutein are the commonest xanthophylls in the Rhodophyta, while cyanophytes contain mixoxanthin (= echinenone) and myxoxanthophyll.

51. What is fucoxanthin? In which algal groups it occurs.

It is a type of xanthophyll occurring in certain groups of algae characteristically golden brown in colour e.g. Chrysophyceae, Bacillariophyceae, Prymnesiophyceae and Phaeophyceae.

52. What is floridean starch?

These are high molecular weight α 1-6 linked glucans similar to the amylopectin fraction of true starch found in Rhodophyta. Unlike true starch which turns blue-violet with iodine it stains red violet.

53. What is myxophycean starch?

These are also α -1, 4 linked glucans similar to amylose portion of starch (or glycogen) encountered in Cyanophyta. They occur as granules of approximately 25 nm and also known as α -granules.

54. In which algal groups true starch occur?

Chlorophyta, Cryptophyta and Dinophyta. True starch is α -1, 4 linked glucan with variable portions of amylose and amylopectin fraction.

55. What is laminarin?

It is a β -1, 3 linked glucan occurring in Phaeophyta in form of oil - like liquid containing vesicles outside the chloroplast surrounding the pyrenoid.

56. What is chrysolaminarin?

It is also a β 1-3 linked glucan similar to laminarin but have more glucose residues per molecule & consisting of β -1-3 linked D- glucose residues with two 1 \rightarrow 6 glucosidic bonds per molecule. Chrysolaminarin occur in Chrysophyta, Prymnesiophyta and Bacillariophyta. Chrysolaminarin containing granules are also known as leucosin granules.

57. What is paramylon? In which algal group it occurs.

Paramylon is a water soluble single membrane bound cytoplasmic inclusion consisting exclusively of β -1,2 linked glucose residues occurring mainly in Euglenophyta, & Xanthophyta.

58. In which algal groups fructosans occur?

Some Chlorophyta e.g. *Acetabularia* and members of Cladophorales.

59. Which algae store glycerol as reserve product? Mention its importance.

Some marine flagellate green algae, especially *Dunaliella* store glycerol as product of photosynthesis. It is halotolerant alga and manages for salinity fluctuations by immediately changing the intracellular concentrations of glycerol. This property opened a new avenue for the commercial production of glycerol. Many successful viable projects have already been undertaken by commercial agencies for the exploitation of this alga.

60. In which class of algae we get nitrogenous compound as reserve food. Cyanophyceae.**61. What are algaenans?**

These are the decay resistant polymers of unbranched hydrocarbons lacking phenolic groups, deposited in the cell walls of certain green algae and eustigmatophycean members. These polymers are known to withstand millions of years of burial. A part of fossils fuel deposits are known to be derived from these polymers.

62. What is phytoferritin?

Certain algae can store iron as protein aggregates, if it is available abundantly in water, called phytoferritin.

63. What are siderophores?

These are iron binding organic molecules present in certain bacteria and algae such as dinoflagellates, diatoms and cyanophytes. Siderophore can accumulate iron from low concentrations in seawater e.g. in *Trichodesmium*.

64. Are peroxisomes known in algae? Mention their function.

Certain reds, browns, xanthophycean and charophycean members of algae possess peroxisomes. Glycolate oxidase, an enzyme involved in oxidizing phosphoglycolate produced by photorespiration, is located here. Location of this enzyme in this organelle has phyllogenetic significance.

65. What is CA? Mention its role in algae?

(CA) Carbonic anhydrase is a zinc containing enzyme that converts carbon dioxide to carbonate & vice versa. The enzyme release carbon dioxide from the bicarbonate accumulated through CCM (carbon dioxide concentrating mechanism) in various locations in various prokaryotic & eukaryotic algae to make it available to Rubisco for fixation.

66. What is the location of carbonic anhydrase (CA) in algae?

It is located in carboxysomes in cyanobacteria whereas in green algae possibly in pyrenoids & also in thylakoids of some algae.

67. What are carboxysomes? Are they related to pyrenoids?

Also known as polyhedral bodies, these structures are located in the cytoplasm of cyanobacteria. These are the sites of carbon metabolism and fixation in cyanobacteria and two very important enzymes Rubisco and CA (Carbonic anhydrase) are located in it. Pyrenoids are discrete structures present in many algae and in most cases it performs the same function as the carboxysomes.

68. What is nucleomorph?

In between the chloroplast E.R. and chloroplast envelop some genetic material has been recorded in certain algal groups like Cryptophyta. It is being claimed as the remains of an earlier endosymbiotic association.

69. Which algal groups show mesokaryotic nuclear characteristics?

Dinophyta and Euglenophyta. They show following mesokaryotic characteristics:

- i. No condensation and relaxation cycle of chromosomes during the cell division rather they remain condensed throughout the cell cycle.
- ii. Nucleolus persistent.
- iii. Nuclei large.
- iv. Chromosomes attached to nuclear membrane inside the nucleus rather to the spindle fibers.
- v. Nuclear membrane remains intact through out the cell cycle.

70. What is phytoplankton?

A community of plant like minute organisms suspended in water is known as phytoplankton. Most phytoplankton are algae. According to size phytoplankton may be categorized as follows:

Microplankton	20-200 μm
Nannoplankton	10-20 μm
Ultraplankton	2-10 μm
Picoplankton	0.2-2 μm

71. What are epibiont? Name an epibiontic alga.

Organisms that pass most of their time in life cycle attached to other organisms are known as epibionts e.g. *Colacium vesiculosum* on *Daphnia*.

72. Name a few pathogenic algae.

Phormidium corallyticum kill coral colonies. *Cephaleuros* on many plants like Tea, coffee etc causing 'red rust disease'; *Prototheca* on humans, cattle and other animals causing 'protothecosis' in humans.

73. What are euryhaline algae?

Organisms that can tolerate wide range of salinity fluctuations are called euryhaline organisms. *Enteromorpha* could grow on ship bottoms that ply both in fresh and marine waters.

74. What are benthic algae?

Algae growing attached on the lake or river bottoms are called benthic algae e.g. *Dichotomosiphon*.

75. What is 'Neuston'?

Algae growing at the interface of water and atmosphere are called 'neuston' e.g. *Nautococcus*, *Nautococcopsis*, *Botrydiopsis* etc.

76. What are epipellic algae?

Algae growing on mud or sand are called epipellic algae. Diatoms are the most common inhabitants of mud, some cyanophytes like *Aphanocapsa*, *Chroococcus* etc, members of conjugate green algae like *Closterium*, *Spirogyra* etc & xanthophytes like *Vaucheria* are common epipellic algae

77. What are corticolous algae?

Algae growing on tree bark are called corticolous algae e.g. *Trentepohlia*, *Physolinum* (the genus has now been included under *Trentepohlia*), *Porphyrosiphon* etc.

78. What are chasmolithic algae?

Algae growing in rock fissures are called chasmolithic algae e.g. *Chroococcidiopsis*.

79. What are fluviatile algae?

Algae growing in rivers & streams (fluvial= lotic) are called fluviatile algae e.g. *Lemanea* (a freshwater red algae).

80. What is "marine snow"?

Some part of the dissolved aquatic carbons in seawater are resistant to bacterial decay. This include acylpolysaccharides (APS) which aggregate with bacteria, zooplankton remains and fecal pellets form $>500\ \mu\text{m}$ particles that sink in water forming a snow like appearance known as marine snow. Marine snow is consumed by many marine animals.

81. What are calcareous algae? Give examples.

Many algae generate and precipitate calcium carbonate on their surface and within cell walls. These algae are known as calcareous algae e.g. Stromatolite forming Cyanobacteria, stoneworts (members of Charales), coccolithophorids and calcareous browns, reds and green seaweeds. (Green algae – *Halimeda*, Brown algae: *Padina*; Red algae: *Corallina*, *Amphiroa* etc.)

82. What is 'zooxanthallae'?

Non-green pigmented cells usually dinoflagellates growing endosymbiotically in certain marine invertebrates, especially reef-building corals are known as zooxanthallae.

83. What are 'stromatolites'?

These are the calcareous layered, assemblage of micro-organisms chiefly cyanobacteria occurring as fossils or in modern waters in sheltered areas. They may represent hummocks up to 2-3 meters high in Shark Bay Australia and tidal channels close to Exuma Island in the Bahamas. Examples of Stromatolite forming cyanobacteria are *Schizothrix fuscescens*, *Plectonema terebrans* etc.

84. What is water bloom?

Bloom-flowering. A profuse growth of microscopic or submicroscopic algae, generally planktonic, which discolours water, is called water bloom. It generally occurs for a short duration e.g. *Trichodesmium erythraecum* forms bloom in red sea; freshwater bloom forming algae are: *Microcystis*, *Anabaena*, *Euglena* etc.

85. What is 'periphyton'?

Organisms growing and attached on submerged aquatic plants at the water level are called periphyton e.g. *Oedogonium*, diatoms etc.

86. What is 'cryptobiotic crust'?

A consortium of organisms occurring on soils or rocks of arid regions is known as cryptobiotic crust. These crusts include water stable surface soil aggregates held together by microorganisms such as algae, fungi, lichens and mosses. Also called 'cryptogamic crust' or 'microbiotic crusts' because mostly microorganisms are involved. Cyanobacteria occurring in the desert as cryptogamic crust are: *Microcoleus*, *Phormidium*, *Plectonema* etc

87. Give a few examples of algae growing in extreme unusual conditions?

Some algae grow inside the hollow hairs of polar bears imparting characteristic colour. Similarly *Nostoc* grows in the glands at the petioles of giant leaves of an angiosperm *Gunnera*.

88. What are auxotrophs? Cite examples from algae.

Autotrophs incapable of synthesizing certain vitamins are called auxotrophs. They require vitamins like biotin, thiamin and cobalamine etc from external sources e.g. most chrysophytes.

89. What is 'mixotrophy'?

Mixed mode of nutrition exhibited by some algae is called mixotrophy. The algae that exhibit mixotrophy are although autotrophic also exhibit osmotrophy and/or phagotrophy. In fact these algae are able to utilize both inorganic and organic carbon sources e.g. *Amphidinium cryophilum*, *Caulerpa*.

90. Which algae exhibit diazotrophy?

Cyanobacteria.

91. Name an important oceanic diazotrophic cyanobacterium?

Trichodesmium is common nitrogen fixing bloom former cyanobacteria occurring in the Tropical North Atlantic and Caribbean Sea.

92. Which organisms are earliest known oxygenic photosynthesizers?

Cyanobacteria.

93. What are 'osmotrophs'? Give examples.

A type of nutrition where dissolved organic carbon is imported into the cells from environment is called osmotrophy. Algae performing this type of nutrition are called osmotrophs. Some algae are obligate osmotrophs e.g. *Paraphysomonas* (Chrysophyceae), *Prototheca* & *Polytoma* (Chlorophyceae).

94. What is chlororespiration?

It is a form of respiration that occurs in the chloroplast of some algae e.g. *Closterium*, *Coleochaete* etc. This adaptation provides greater ability to use saturating levels of light in photosynthesis.

95. What is phagotrophy? Give some examples of phagotrophic algae.

It is the ingestion of solid particles such as cells by certain organisms as food. Some mixotrophic algae e.g. *Dinobryon*, *Uroglena*, *Ochromonas*, *Peranema* etc could ingest and digest bacteria in addition to their normal photosynthetic activity.

96. What is trichothallic growth?

Type of growth by an intercalary meristem producing hair in one direction and the thallus in the other direction is called trichothallic growth e.g. *Desmarestia*.

97. Where do you find palmelloid habit in algae?

It is a nonmotile type of thallus organization in which cells are embedded in gelatinous matrix. The cells may or may not have capacity to develop flagellates. Since the cells are arranged in more or less tetrasporal configuration such colonies illustrate tetrasporine series e.g. *Tetraspora* (Tetrasporales: Chlorophyta), *Chlorosaccus* (Xanthophyceae), *Phaeophaera* (Chrysophyceae).