

MICROORGANISMS IN THE BIOLOGICAL WORLD

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Microorganisms or microbes are microscopic organisms that exist in different forms ranging from unicellular to multicellular and even acellular viruses. They are widespread in nature and are beneficial to life, but some can cause serious harm. They are basically divided into six major types - bacteria, archae, fungi, protozoa, algae, and viruses.

POSITION OF MICROORGANISMS

1. Early men used to consider two different kinds of population - PLANTS and ANIMALS, existing on the earth.
2. Linnaeus (1758) - recognised PLANTAE and ANIMALIA as the two primary kingdoms. His gave birth the two kingdom concept. The basis of classification was structural and functional characters such as locomotion, response to external stimuli, mode of nutrition, conductile & contractile system and the cell wall.
3. With the exploration of the microbial world in the 18th and 19th century, they were placed either in plants or animals. Multicellular microalgae and micro-fungi placed under the plant kingdom. Similarly motile microscopic forms like multicellular invertebrates and unicellular protozoa, and bacteria were lumped together as one group of animals, the infusoria, in animal kingdom.
4. About 1840, biologists perceived that the infusoria was a heterogeneous group in terms of their cellular organisation. The simpler, unicellular forms were sub-divided into two groups - the protozoa, with relatively large and complex cells, and the bacteria, with much smaller and simple cells.

The bacteria were transferred to plant kingdom

In this way fungi, algae and bacteria were placed under PLANT KINGDOM along with other plants of Angiosperms, Gymnosperms, Pteridophytes, and Bryophytes.

KINGDOM ANIMALIA included protozoa and all other animals.

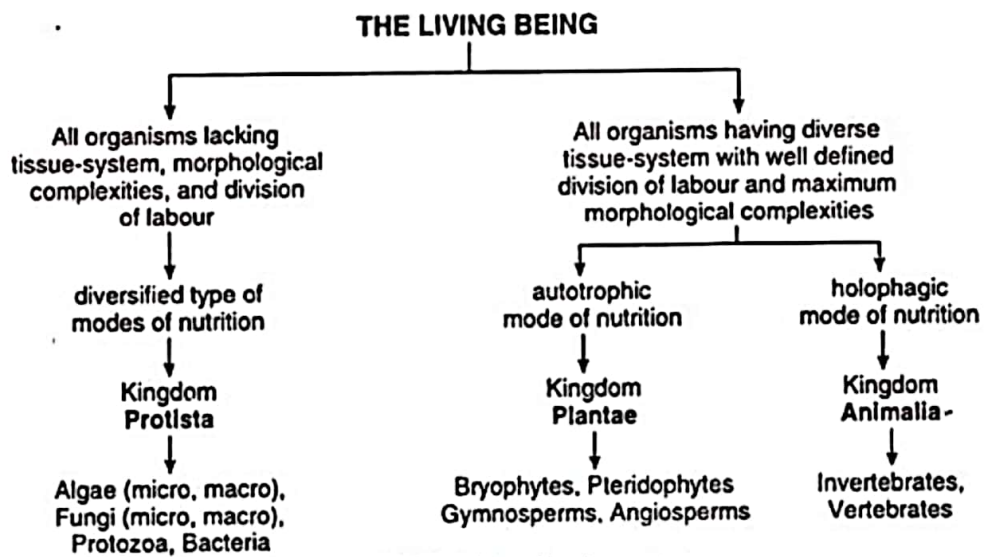
Therefore, some microorganisms (microalgae, microfungi and bacteria) were considered under plants and others (protozoa) placed under animals.

5. As more and more information about microbical life became available around the middle of the 19th century, this hardly justified this inclusion in either Kingdoms.

Many microbes possessed both plant-like and animal-like characteristics simultaneously, and many others enjoyed such characteristics which were unique to them and not found in either plants or animals. Some moulds, which were considered to be protozoan and grouped under the Kingdom ANIMALIA, were found phagotrophic and amoeboid (animal-like) in their vegetative state but they resembled true fungi in their reproductive state (plant-like). Many algae and fungi, which were earlier thought to be immobile thus classified as plants, were found either motile or producing motile structure (zoospores, gametes etc.) during their life. Unlike plants, fungi and most bacteria are non-photosynthetic. Bacteria, in general, were found having very little in common with either plants or animals. Some protozoans like Euglena and Dinobryon can carry out photosynthesis (like-plants). It was thus felt that the division of living world into "two Kingdoms" can no longer be maintained.

Haeckel (1886) proposed PROTISTA as a new Kingdom to accommodate organisms exhibiting characters either common to both plants and animals, or unique to their own. All organisms with relatively simple biological organisation were kept in Protista. Thus a THREE KINGDOM SYSTEM consisting of protista, plantae, and Animalia came into being. This arrangement of Haeckel was done on the basis of morphological complexities and tissue system, division of labour and mode of nutrition.

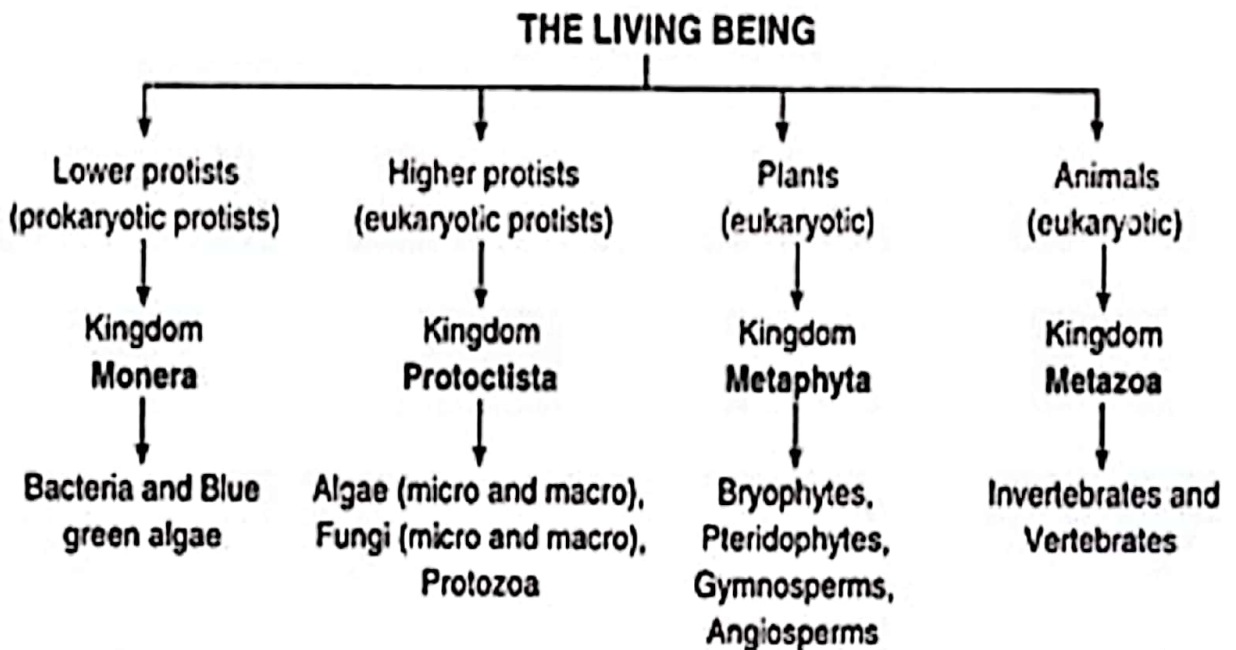
Organisms lacking morphological complexities, tissue system, division of labour, and enjoying diversified type of mode of nutrition were segregated and put under the Kingdom Protista (algae, fungi, protozoa and bacteria).



6. Haeckel's system remained dominant for a long time. With the discovery of Electron microscope (Knoll and Ruska, 1932) and further development of several other techniques led to the recognition of the details of the structure of cells. The internal architecture of the cell revealed the existence of two radically different kinds of cell in the contemporary living world. It was found that the cells of less complex protists do not have a membrane bound nucleus and also lack membrane bound organelles (termed PROKARYOTES), Contrary to it, the more complex protists possessed true nucleus and membrane-bound organelles (termed EUKARYOTES).

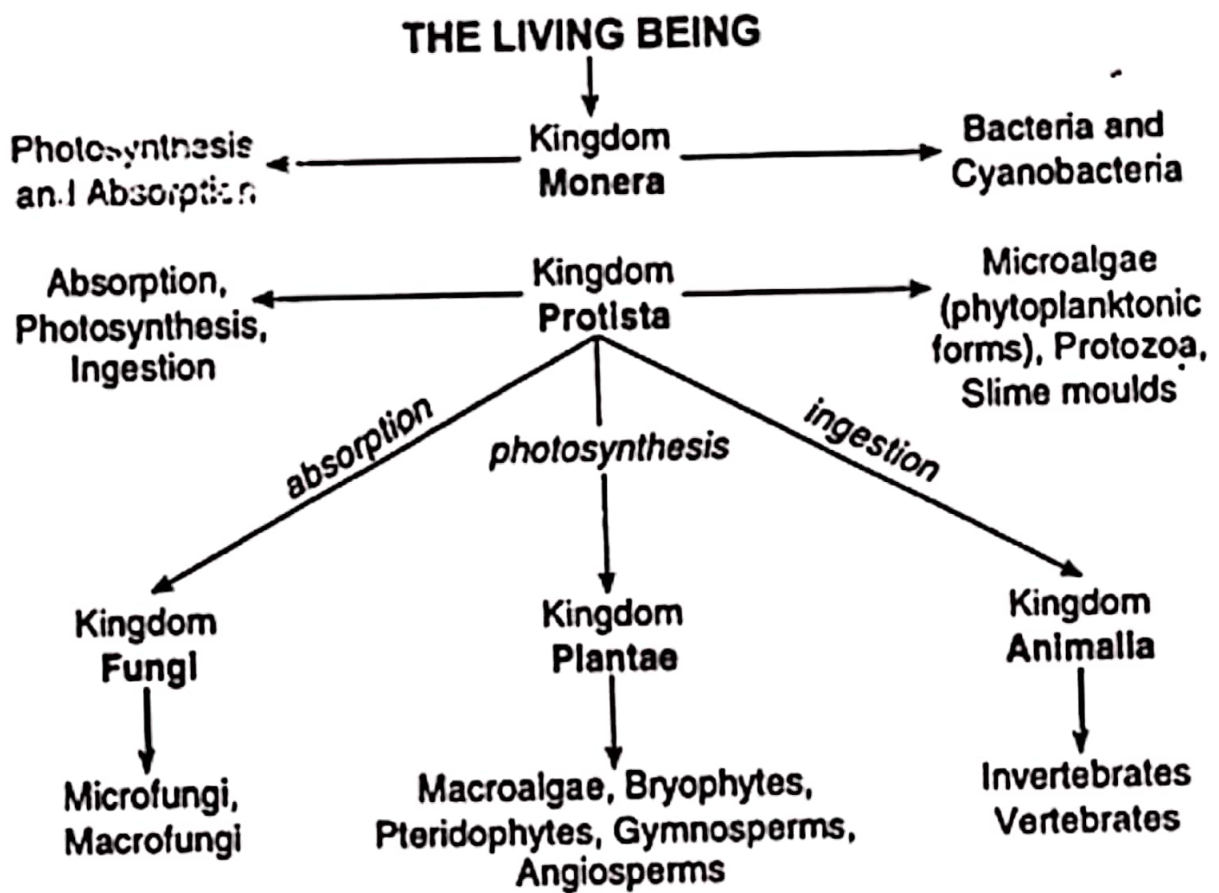
Thus, the Kingdom Protista was subjected to a division into two groups - the lower protists, which included all prokaryotic protists (bacteria and blue-green algae), and the higher protists including all eukaryotic protists (algae other than blue-green algae, fungi and protozoa).

On account of this clear cut division of protists, COPELAND (1959) came forward with a four kingdom system to classify the living being. A new kingdom Monera was created to accommodate prokaryotic protists. The eukaryotic protists were kept under a new named kingdom Protoctista. The kingdoms 'Plantae' and 'Animalia' remained as such but now called as 'Metaphyta' and 'Metazoa', respectively. Therefore, the four kingdoms for living being are - MONERA, PROTOCTISTA, METAPHYTA, METAZOA.



7. A distinct mode of nutrition in fungi (non-photosynthetic; being absorptive and osmotrophic) and some other heterogeneity among protists like loss of photosynthetic ability in some algal forms (eg, some euglenophycophytes), lack of cell wall, free mobility (more close to protozoa) led to the creation of a new kingdom and the transfer of such organisms to their near group. Thus a five-kingdom classification was proposed by R.H. WHITTAKER (1969) - MONERA, PROTISTA, FUNGI, PLANTAE AND ANIMALIA.

The microorganisms spread over to three kingdoms i.e. Monera, Protista and Fungi. He retained bacteria and cyanobacteria (blue-green algae) under Monera; retained microalgae (the phytoplanktonic algal forms considered closely related to protozoa), protozoa, and slime molds under kingdom Protista; Fungi.



were kept under a new kingdom - Fungi; completely photosynthetic algal forms (the macroalgae) considered closely related with plants and placed under Plantae along with other eukaryotic plants; retained invertebrate and vertebrate animals under Animalia.

The phenotypic characteristics taken into account by WHITTAKER are -

- (i) complexity of cell structure - Prokaryotic or Eukaryotic
- (ii) Level of organisation - Unicellular or simple or multicellular and complex.
- (iii) Mode of nutrition - Photosynthetic, by absorption or ingestion.

MONERA: includes all prokaryotic organisms - bacteria (true bacteria like rickettsiae, chlamydiae, mycoplasmas); archaeobacteria; cyanobacteria (blue-green algae)

Characteristics

1. Microscopic cells which are without well organized nucleus and membrane bound organelles.
2. Nutrition is heterotrophic, chemosynthetic or photosynthetic.
3. Reproduction mainly asexual but primitive type of sexual reproduction is present in a few members.

PROTISTA: The kingdom includes a variety of unicellular and primary aquatic eukaryotes. consists of unicellular algae, protozoa, slime molds includes i
fungi

- Characteristics
1. Typical eukaryotic cell organisation
 2. Nutrition varies from auto- to heterotrophic.
 3. Reproduction by asexual or sexual modes.

Note: Slime molds & water molds are traditionally been studied under fungi but phylogenetically they are said to be more related to protists.

PLANTAE: The multicellular photosynthetic eukaryotes - red, green and brown algae, bryophytes, tricolpates, gymnosperms and angiosperms.

Characteristics

1. Plant body simple thalloid or well differentiated
2. A definite rigid cell wall.
3. Mostly non-motile, except a few aquatic forms.
4. Reproduction asexual & sexual.

FUNGI: Eukaryotic, predominantly multicellular heterotrophic organisms. Fungal forms & lichens.

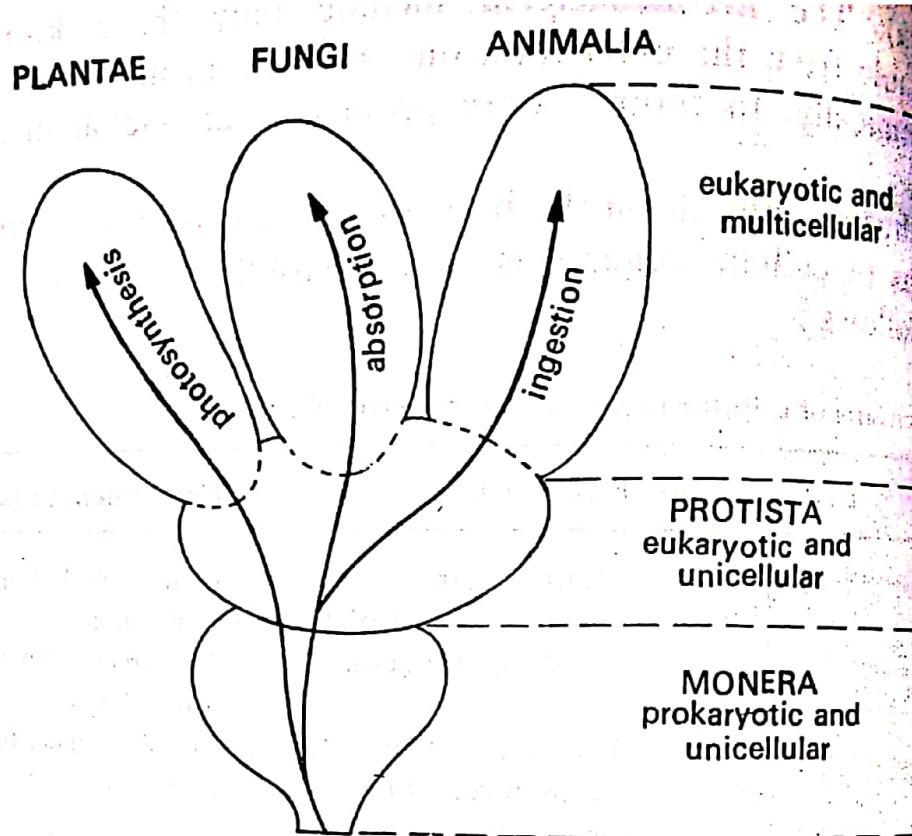
1. Nutrition by absorption either parasitic or saprophyte.
2. Chitin is main constituent of cell-wall.
3. Reproduction asexual or sexual.

ANIMALIA : Multicellular holozoic eucaryotes. Multicellular Consumers.

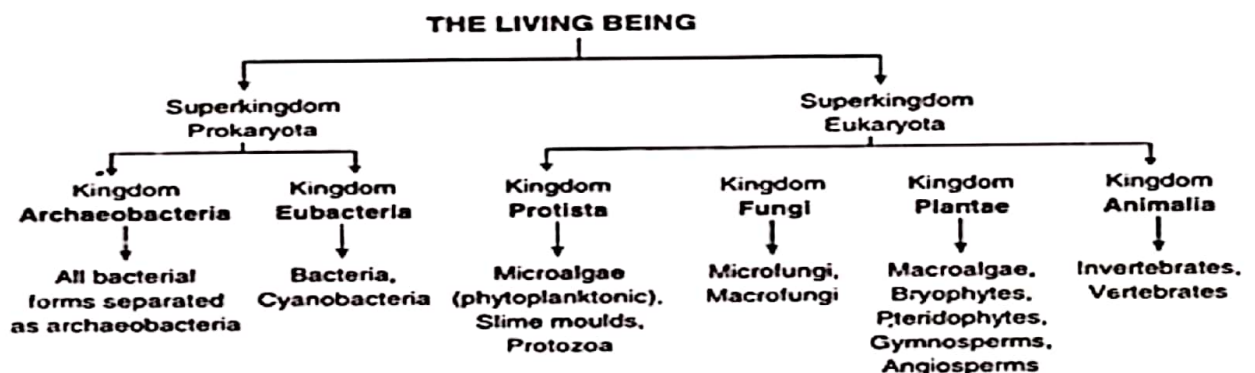
Characteristics

1. Heterotrophs - holozoic nutrition
2. Sensory & nervous systems are present.
3. Reproduction mainly sexual.

Of these, the first three kingdoms (together with viruses) are studied in microbiology.



8. Distinction among archaeobacteria (Archaea) and Eubacteria was made by Grey and Dolittle (1982), thus a six-kingdom classification was proposed. He made two super kingdoms - PROKARYOTA and EUKARYOTA. Prokaryota was divided into ARCHAEOBACTERIA & EUBACTERIA. The eukaryota included PROTISTA, FUNGI, PLANTAE & ANIMALIA.



9. Protists were divided by Cavalier-Smith (1987), thus making EIGHT KINGDOM SYSTEM.

Cavalier-Smith, using ultra-structural characteristics as well as rRNA sequences, divided all organisms into two Empires and 8-Kingdoms. The Empire Bacteria consists of two Kingdoms - the Eubacteria and the Archaeobacteria. The Empire Eukaryota contains six Kingdoms of eukaryotes - Archezoa, Protozoa, Chromista, Fungi, Plantae and Animalia. Archezoa and Chromista are two new Kingdoms of eukaryotes.

Kingdom ARCHEZOA - consists of primitive eukaryotic unicellular microbes (e.g., *Giardia*) that possess 70S ribosomes and lack cell organelles like Golgi complex, mitochondria, chloroplast and peroxisomes.

Kingdom CHROMISTA - represented by diatoms, brown algae, crypto-monads and oomycetes, mainly the photosynthetic microorganisms that have their chloroplasts within the lumen of the rough ER rather than in the cytoplasmic matrix (as is found in other plants).

The four Kingdoms Plantae, Fungi, Animalia and protozoa are retained but their boundaries have been adjusted to better define each Kingdom and differentiate it from others.

