

## REPRODUCTION IN PROTOZOA

**Q.4. Describe the various modes of reproduction found in Protozoa studied by you.** (Gorakhpur 1990; Lucknow 93; Bhopal 96; Rohilkhand 96)

**Describe the various modes of reproduction found in *Euglena*, *Monocystis* and *Paramecium*.** (Bundelkhand 1986)

**Make a list of asexual and sexual reproduction in Protozoa. Describe conjugation and its significance in *Paramecium*.** (Gorakhpur 1997)

**Give an account of sexual reproduction in Protozoa.** (Lucknow 1996)

The various methods of reproduction in Protozoa are grouped under the following main heads :

1. Asexual reproduction
2. Sexual reproduction
3. Nuclear reorganization
4. Other modes of reproduction

### 1. Asexual Reproduction

All protozoa reproduce asexually by four different methods :

1. Binary fission
2. Multiple fission
3. Budding
4. Plasmotomy

#### 1. Binary Fission

Binary fission is the division of the parent body into two equal daughter individuals. The nucleus divides first and is followed by the division of the cytoplasm. The extranuclear or the cytoplasmic structures either divide giving rise to daughter organelles or are retained by one and the other regenerates them or

these are partly retained by both daughter individuals and the remaining parts are regenerated.

Based on the plane of division of body the binary fission is of the following types :

- (i) **Simple binary fission**—As in Sarcodina (*Amoeba* and *Entamoeba*) the plane of division cannot be recognised.
- (ii) **Longitudinal binary fission**—In flagellates (*Euglena*) the plane of constriction is along the long axis of the animal.
- (iii) **Transverse binary fission**—In ciliates (*Paramecium*) the body constricts transversely.
- (iv) **Oblique binary fission**—In Dinoflagellates (*Ceratium*) the plane is oblique.

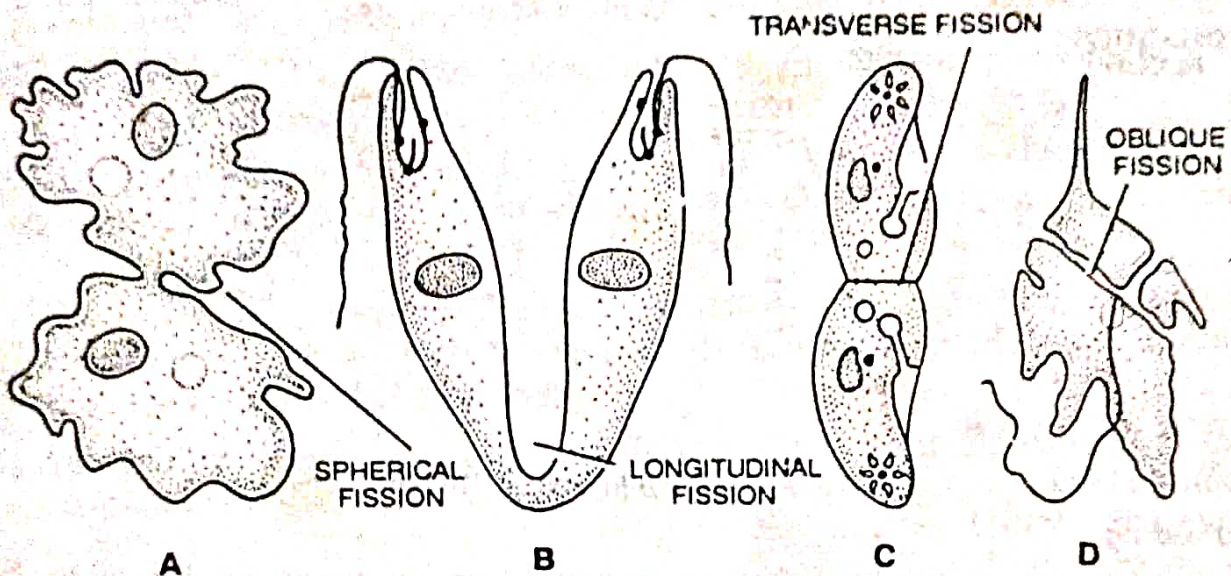


Fig. 12. Binary fission in Protozoa. A— *Amoeba*; B— *Euglena*; C— *Paramecium*; D— *Ceratium* (oblique)

- (v) **Repeated binary fission**—In *Chlamydomonas* the products of first binary fission fail to separate and undergo repeated binary fission giving rise to four or more individuals.
- (vi) **Encysted binary fission**—In ciliates like *Colpoda*, *Titlina*, etc., the division occurs in encysted condition.

In certain cases the products of repeated binary fission remain together and form colonies.

## 2. Multiple Fission

In multiple fission the nucleus divides many times either by mitosis or fragmentation. The daughter nuclei migrate towards the periphery and are surrounded by the fragments of cytoplasm forming daughter individuals. Their number is highly variable and sometimes reaches upto thousands. These are set free by the rupture of parent body. Multiple fission is seen in *Euglena*, *Monocystis* and *Plasmodium*.

The multiple fission occurs at different phases in the life-cycle of different individuals and the products are named accordingly :

- (i) **Schizogony or agamogony**—In schizogony multiple fission occurs in asexual cycle and the resulting individuals (the **schizogamonts** or **agamonts**) develop into the adults, e.g. *Plasmodium* (Sporozoa).
- (ii) **Gamogony**—When multiple fission produces sex cells it is termed as gamogony and the products as gametes. **Example**—*Monocystis*.
- (iii) **Sporogony**—The multiple fission in the zygote is known as sporogony and the offsprings as spores.

### 3. Plasmatomy

It is a special type of asexual division in a multinucleate animal in which the cytoplasm divides but the nuclei do not divide. It is observed in *Opalina* and *Pelomyxa*. Later, each daughter cell regains the normal number of nuclei by nuclear division.

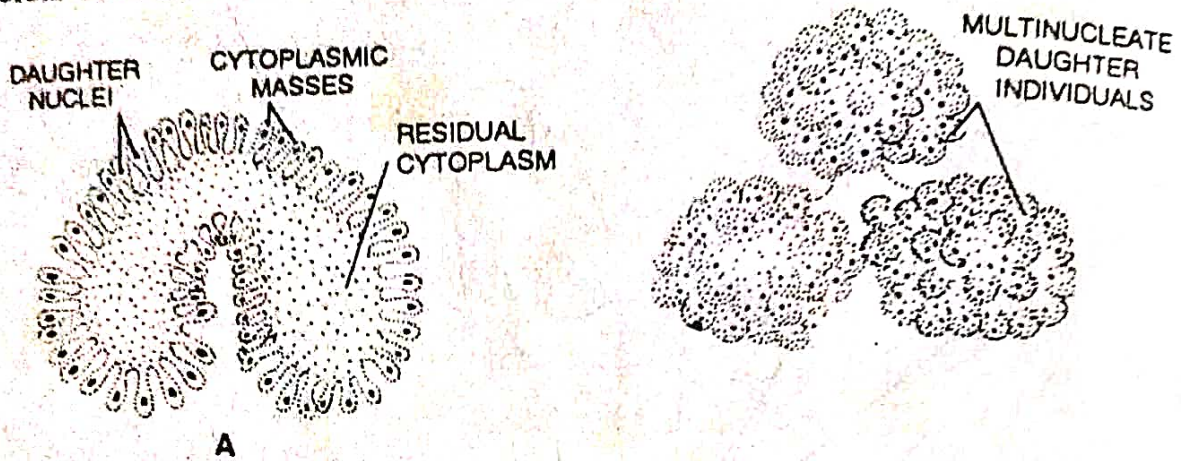


Fig. 13. A— Multiple fission; B— Plasmatomy.

### 4. Budding

Budding is a form of fission in which one or more smaller individuals separate from parent body and each undergoes differentiation either before or after separation. Budding occurs regularly in Suctoria but in other protozoa it is rare and sporadic. The buds are either **exogenous** being constricted off from the outer body surface as in *Acanthocystis*, *Noctiluca*, *Ephelota* and *Entamoeba* or endogenous inside the brood chambers as in some Testacea and Suctoria.

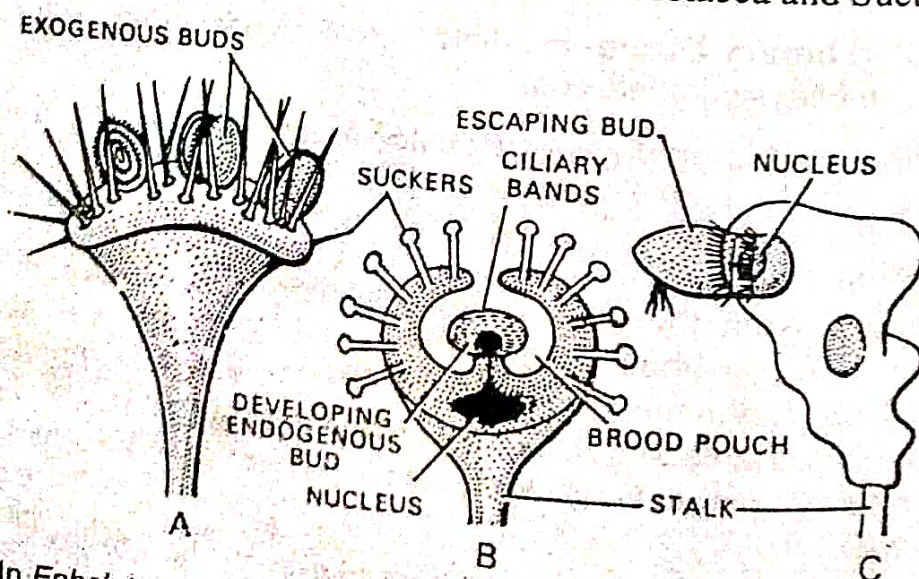


Fig. 14. A— In *Ephelota* : formation of exogenous buds; B— in a Suctorian : formation of endogenous bud; C— In *Toxophyrea* : expulsion of bud from brood pouch.

## 2. Sexual Reproduction

Asexual multiplication is interrupted at regular or irregular intervals by sexual phenomena. These have been distinguished as :

- (1) Syngamy
- (2) Conjugation, and
- (3) Automixis

### 1. Syngamy

Syngamy is the complete fusion of the **gametes** to form a zygote which gives rise to adult. The fused diploid nucleus is called **synkaryon**. The fusing gametes may be similar or dissimilar. Depending upon the degree of differentiation of gametes syngamy is distinguished into the following types :

(i) **Hologamy**—It is the fusion of two mature organisms which do not produce gametes, but behave as gametes as in certain Rhizopods and Flagellates.

(ii) **Paedogamy**—If the fusing individuals are young, the phenomenon is known as paedogamy.

(iii) **Merogamy**—The sex cells or gametes are formed from the ordinary individuals by fusion. These often differ in size and morphology from the vegetative form.

(iv) **Isogamy**—The gametes, similar in form and size, are known as isogametes and their fusion is called **isogamy**. It is common in Foraminifera, Phytomonadida and Gregarinida.

(v) **Anisogamy**—The fusing gametes differing in size, form and behaviour, are **anisogametes** and their union is known as **anisogamy**. All possible grades of differences are noted in the pair of fusing gametes. Usually the male gamete is small, active and may be flagellated and is known as **microgamete**. The female gamete is large, immotile and food-laden. It is known as **macrogamete**. Anisogamy occurs in Sporozoa and Phytomonadida.

(vi) **Microgamy**—Certain Foraminifers and *Arcella* produce two types of microgametes and these unite together forming the synkaryon. This union is known as **microgamy**.

(vii) **Macrogamy**—When union occurs between the macrogametes of a species it is known as **macrogamy**, e.g. *Actinophrys*.

(viii) **Autogamy**—Autogamy is the permanent fusion of two gametes from the same parent cell e.g. *Actinophrys* and *Actinosphaerium*.

(ix) **Exogamy**—It is the fusion of nuclei of two individual derived from two different parent cells of the same species.

### Significance of Syngamy

- (a) Syngamy brings about a combination of two different lines of hereditary characters.
- (b) It increases the external differences in offsprings.
- (c) It renews the vigour which is lost by repeated binary fission.
- (d) The fusion of nuclei initiates the development of egg.

## 2. Conjugation

The conjugation is the temporary union of two mating types of individuals of the same species to facilitate exchange of the nuclear material. These separate out after nuclear exchange. The pairing gametes are known as **conjugants**. These may be either **isogamous** (equal) as in *Paramecium* or **anisogamous** (unequal) as in *Vorticella*. Conjugation occurs exclusively in Euciliata and Suctoria.

**Significance of conjugation**—Conjugation is considered to be an episode in reproduction and not a mode of multiplication. It leads to :

- (a) New nuclear combinations and new hereditary combinations.
- (b) Rejuvenation and revival of the lost vigour and overcoming the period of depressions resulting due to repeated binary fission.
- (c) Reorganisation of a fresh macronucleus to accelerate the metabolic activities.

## 3. Automixis

Automixis is the fusion of two **gametic** nuclei originating by the division of the single nucleus of an individual. This can be :

- (i) **Autogamy**—The fusing nuclei come from the same cell as in *Paramecium aurelia*.
- (ii) **Paedogamy**—In this case, fusion occurs between two nuclei coming from two different cells of a parent.
- (iii) **Cytogamy**—Cytogamy occurs in a number of species of *Paramecium*. It is intermediate between conjugation and autogamy. The two small organisms fuse with their oral surface. The nuclear changes occur as in conjugation but there is no nuclear exchange. The two gametic nuclei in each individual fuse to form a synkaryon.

## 4. Endomixis

It is a type of nuclear reorganisation without meiosis and fusion of nuclei. It is a regular feature in the life history of *Paramecium aurelia*. It occurs in a single individual either at regular intervals or when conjugation is prevented or delayed. As a result of nuclear changes a new macronucleus is formed from the micronucleus which accelerates metabolic activities and brings renewed vigour and vitality.

## 5. Hemixis

In certain species of *Paramecium* an aberrant behaviour of nucleus has been studied by Diller in a single individual of mass culture. The macronucleus throws out fragments of different sizes which are absorbed in the cytoplasm. The remaining part of macronucleus functions as a normal macronucleus. During this process the micronucleus remains unchanged and inactive. The hemixis is presumed to be sort of purification act.