

REPRODUCTION IN PROTISTS

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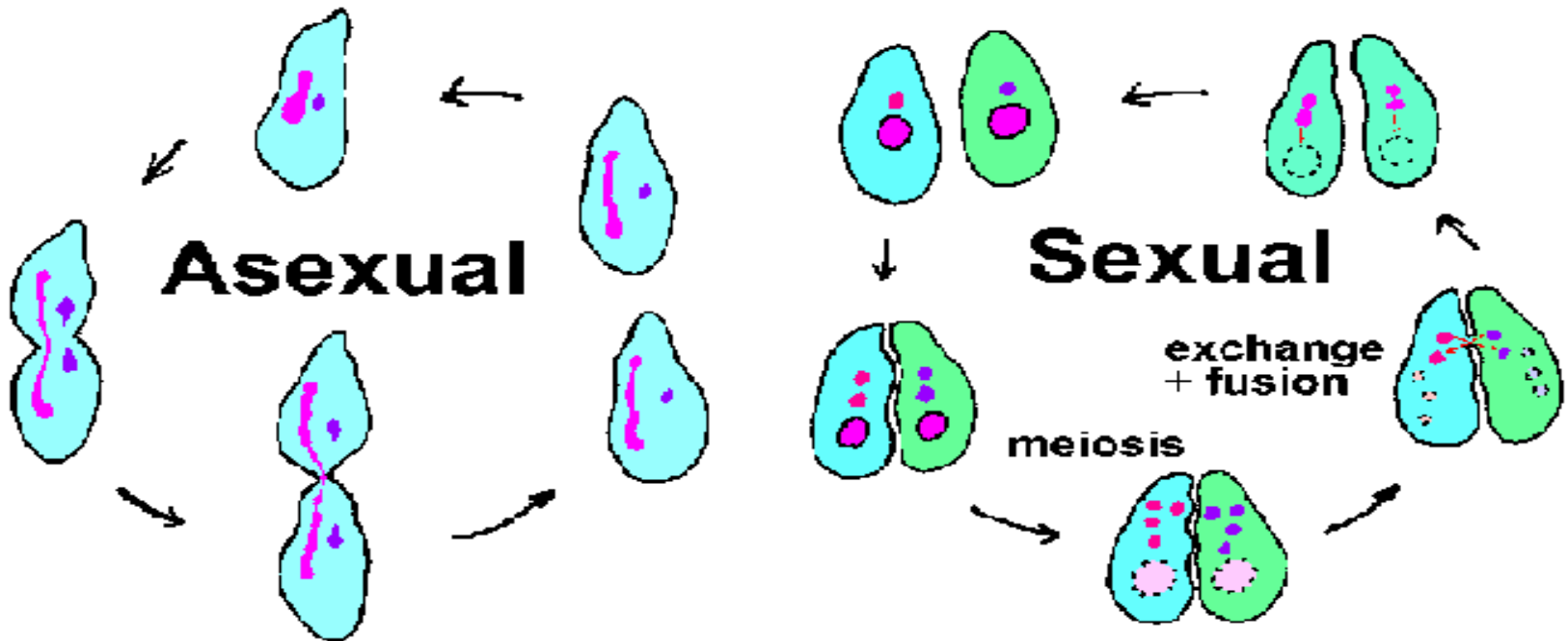
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REPRODUCTION IN PROTISTS

- Protists are simple eukaryotes.
- They have short generation time and rapid rate of reproduction.
- A major aspect of Protist success is their great and variable range of reproductive strategies.
- Most Protists have been able to capitalize on the advantages of both asexual and sexual reproduction although some reproduce only asexually.

TYPES OF REPRODUCTION

- Mode of reproduction variable in different groups :
- I ASEXUAL REPRODUCTION



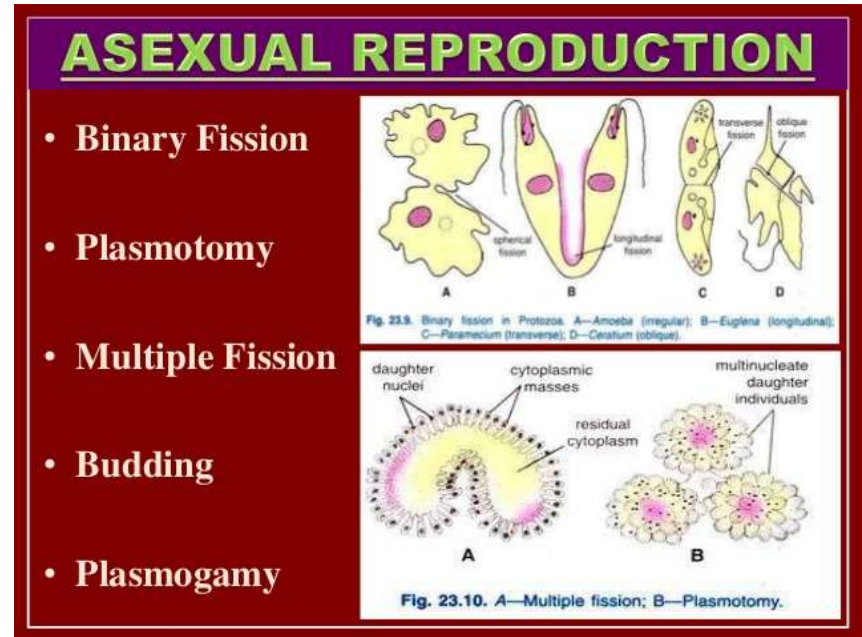
ASEXUAL REPRODUCTION

- It involves the mitotic division of the parent body into two or more individuals that develop into the mature or adult form.
- Since these are unicellular it can simply be called a type of cell division.
- It involves a single parent.
- By definition it does not generate a new genotype.
- It does not involve meiosis or fertilization.

TYPES OF ASEXYUAL REPRODUCTION

- It is of the following types:

- 1 Binary fission
- 2 Multiple fission
- 3 Budding
- 4 Plasmotomy
- 5 Endopolyogeny
- 6 Regeneration



BINARY FISSION

- It involves a single mitotic division resulting into two progenies.
- It results into two similar or equal progeny.
- It may be of the following types:
 - i Simple binary fission
 - ii Longitudinal binary fission
 - iii Transverse binary fission
 - iv Oblique binary fission

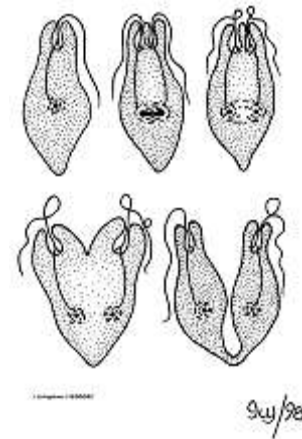
SIMPLE BINARY FISSION

- In this type of binary fission the plane of division can not be recognized *eg Amoeba*.
- Nuclear division is followed by cytokinesis.
- Nucleus divides by mitosis which is closed i.e. nuclear membrane remains intact throughout mitosis.



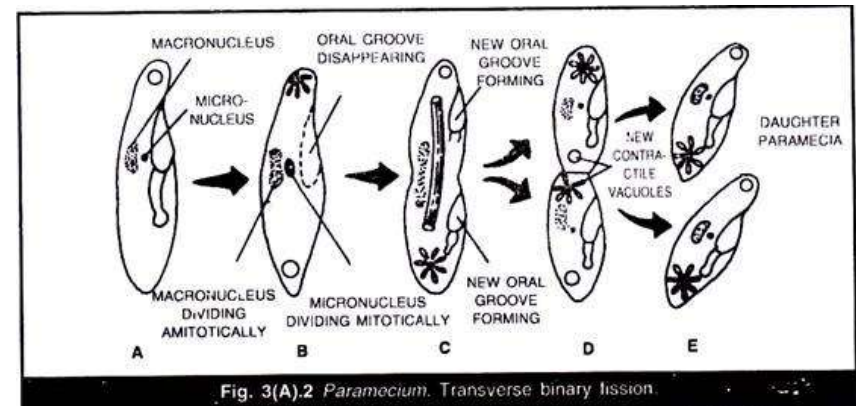
LONGITUDINAL BINARY FISSION

- In this the plane of axis of division is along the longitudinal axis of the body.
- It cuts between the rows of basal bodies.
- The progenies look similar to the parent except in size.
- *Eg- Euglena, Trypanosoma*



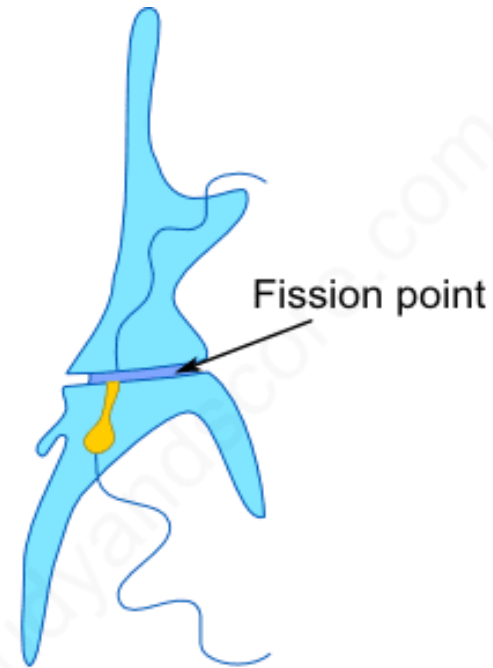
TRANSVERSE BINARY FISSION

- In this the plane of division is transverse i.e. cuts at the middle of the antero-posterior axis.
- In *Paramecium* only the micronucleus divides by mitosis. Macronucleus divides amitotically.



OBLIQUE BINARY FISSION

- In this the plane of division is oblique.
- Each one develops the missing part.
- Eg-*Ceratium*

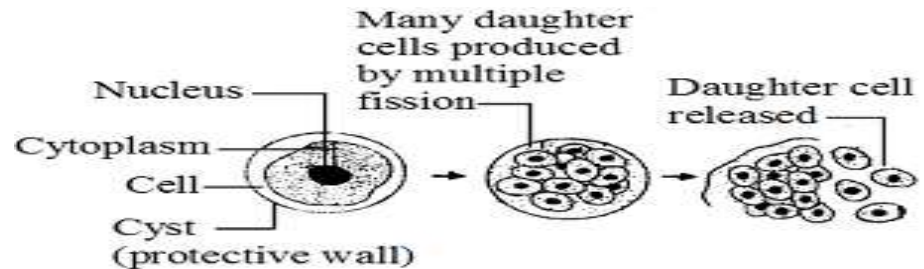


OBLIQUE BINARY FISSION

Eg: *Ceratium*

MULTIPLE FISSION

- In multiple fission, many nuclear divisions precede the rapid differentiation of the cytoplasm into many distinct uninucleate individuals.
- A mass of residual protoplasm may remain which is degenerated and lost.
- It may occur at certain phase in the life-cycle of a protist.
- It is common in *Plasmodium* (schizogony, sporogony), *Monocystis* (gamogony, sporogony), *Entamoeba* (metacyst), *Aggregata* etc.

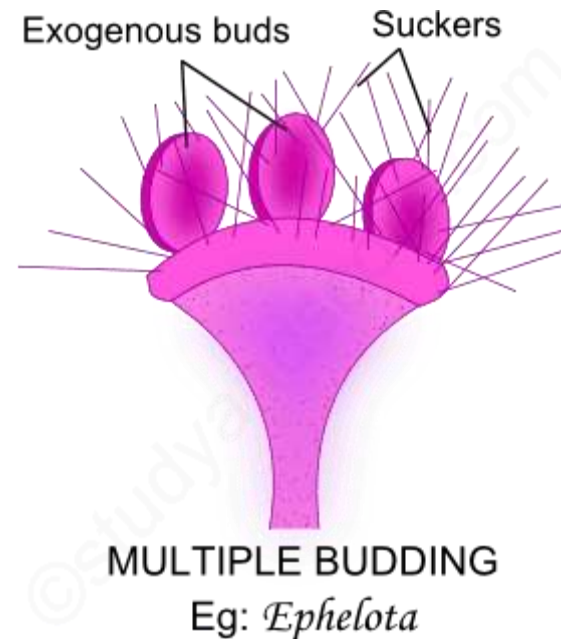


MULTIPLE FISSION

Eg: *Aggregata*

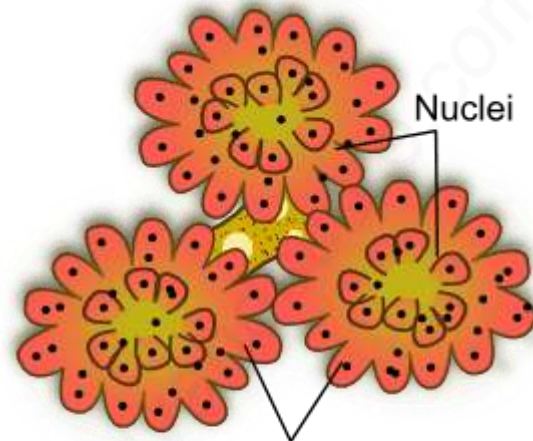
BUDDING

- It is a form of unequal fission.
- It involves a preparatory phase before division.
- In this a portion of the parent breaks off and differentiates to form a new individual.
- It may be of two types:
 - a. exogenous** budding-occurs at the surface of the body; eg *Ephelota*, *Noctiluca* etc.
 - b. endogenous** budding-occurs within an internal chamber or pouch; eg- *Suctoria*



PLASMOTOMY

- It is considered to be a form of budding.
- In the multinucleate Protists the parent simply divides into two multinucleate daughter individuals, in the absence of any mitotic division.
- The original nuclei are distributed between the two progeny.
- *Eg-Opalina ,Pleomyxa etc*



Individual multinucleated daughters

PLASMOTOMY

Eg: *Pleomyxa*

ENDOPOLYGENY

- It is also considered to be a form of internal budding.
- In this more than two offsprings are formed within the parent organism.
- In this two or possibly more nuclear divisions occur before merozoite formation begins.
- Eg – *Toxoplasma gondii*

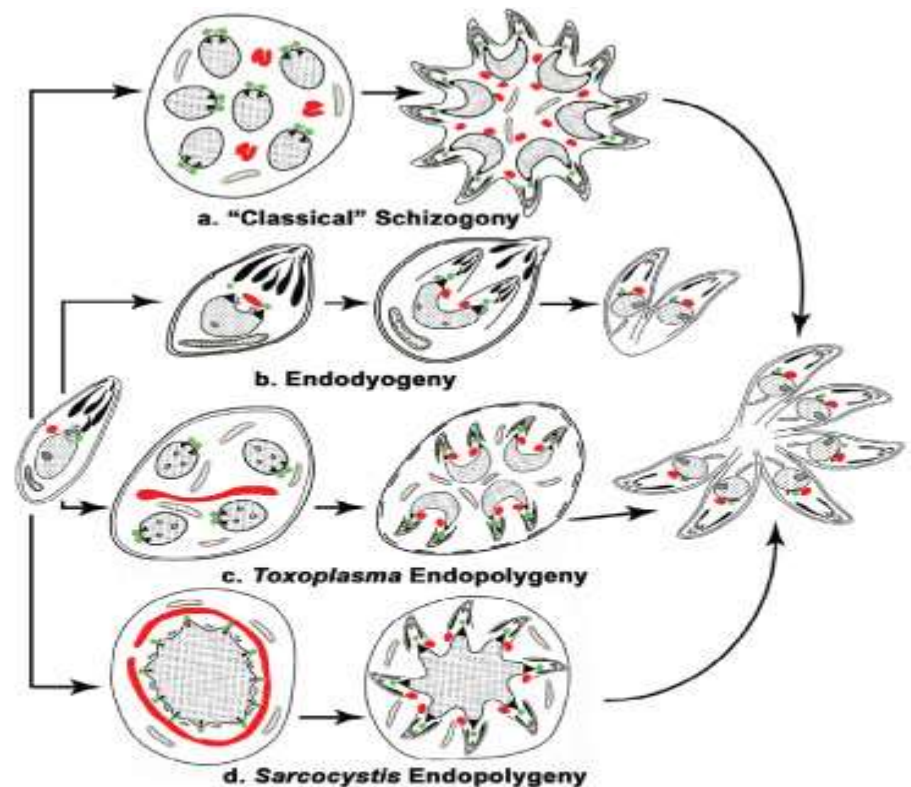
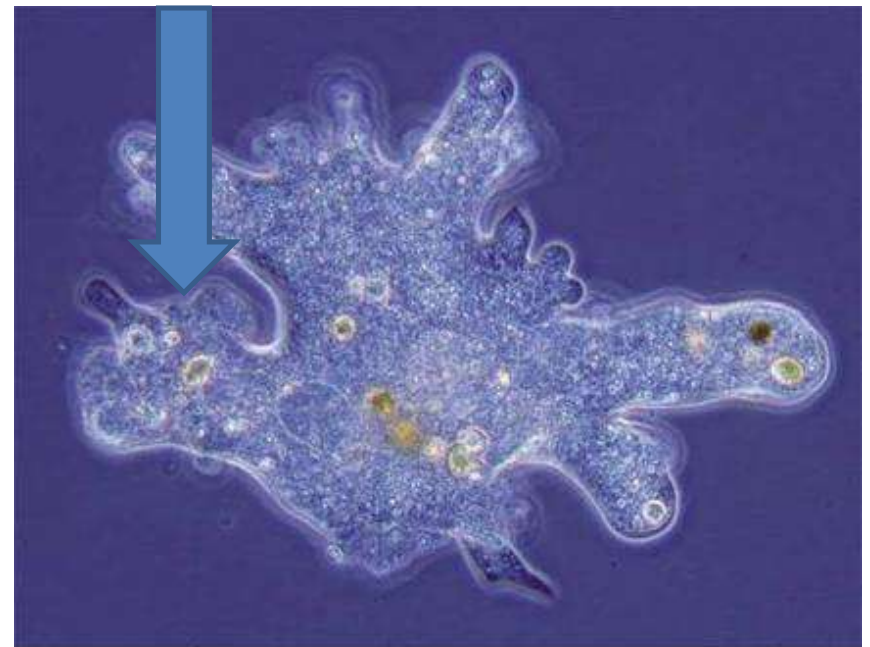


Fig. 6: diagram summarising the differences in timing of nuclear division and the location of daughter formation in the four forms of asexual proliferation undergone by apicomplexan parasites. The coccidian stages of *Toxoplasma gondii* employ *Toxoplasma* endopolygeny, while the tachyzoites and bradyzoites undergo endodyogeny (Ferguson et al. 2007, with permission).

REGENERATION

- It is the replacement of the lost parts of the body.
- It is also a specialized type of asexual reproduction.
- A specific part of the protoplasm and nucleus can regenerate the entire organism.
- Widespread among free living Protists such as *Amoeba*.
- Not so common in parasitic Protists.



SEXUAL REPRODUCTION

- It is the production and fusion of male and female gametes to form a zygote which develops into the adult.
- But mostly it is a specialized case of nuclear exchange or reorganization in a unicellular eukaryote like protists.
- It involves **meiosis**.
- It may take place in between asexual reproduction

TYPES OF SEXUAL REPRODUCTION

In the Protists it is of the following type:

- 1.Syngamy
- 2.Conjugation
- 3.Autogamy
- 4.Endomixis
- 5.Hemixis
- 6.Cytogamy
- 7.Parthenogenesis



SYNGAMY

- It is the complete fusion of the whole individual which act as gamonts or gametes.
- Fused diploid nucleus is known as synkaryon.
- It may be of the following type:

HOLOGAMY-it is the fusion of two mature individuals which do not produce gametes.Seen in some rhizopods and flagellates;eg

PAEDOGAMY-it is the fusion of two young individuals which are not mature; eg

Sometimes ,fusion of similar gametes is called **isogamy** and fusion of dissimilar gametes is called **anisogamy**.

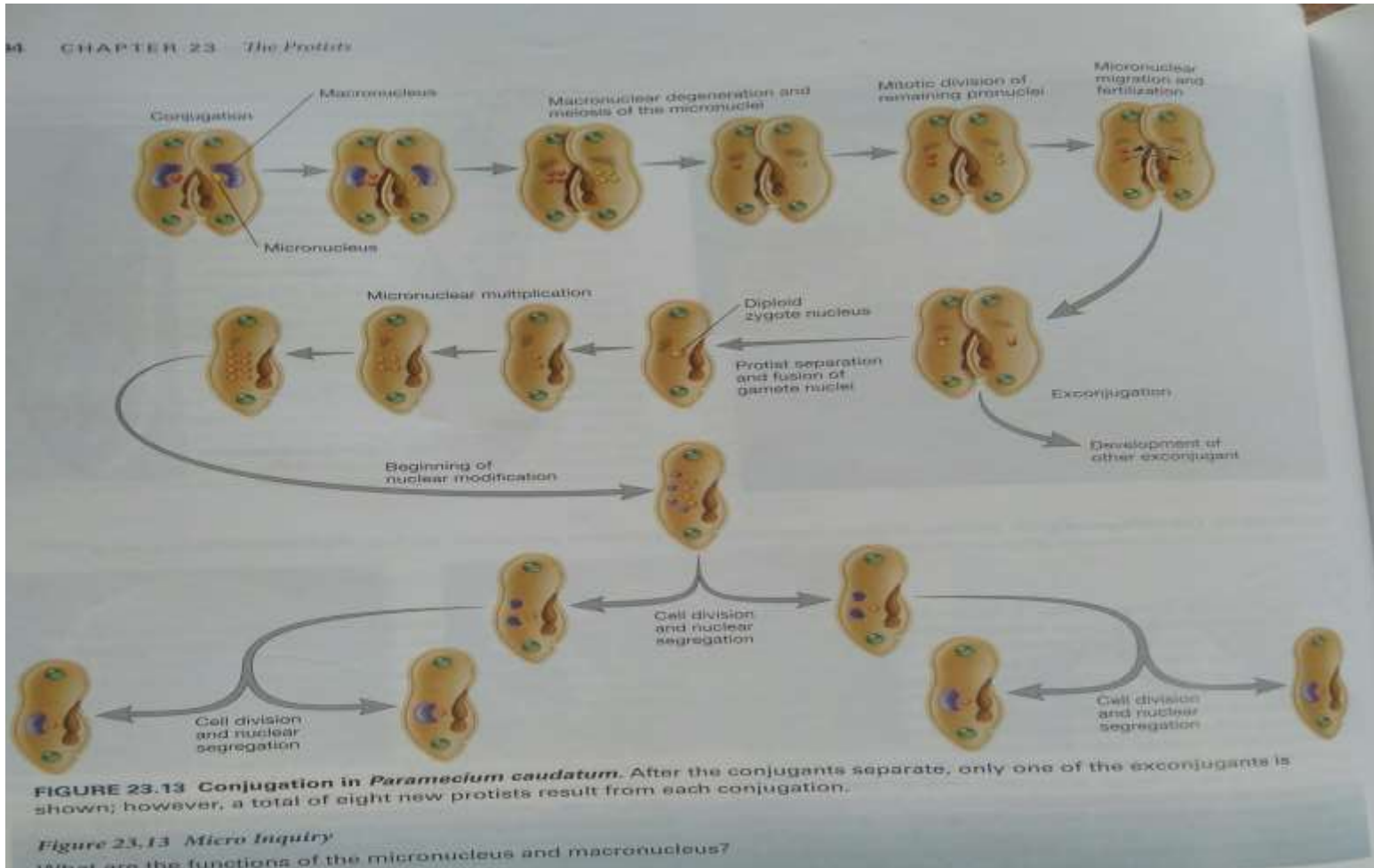
CONJUGATION

- It special type of sexual reproduction seen in *Paramecium caudatum* which has *one macronucleus and one micronucleus*.
- It involves two individuals of the same species but of two different mating strains.
- There is temporary union of the two individuals for about 24 to 48 hours and they are called conjugants.
- They unite ventrally and the pellicle fuses at the place of contact to form a cytoplasmic bridge
- Macronucleus degenerates and micronucleus undergoes changes in series.
- Micronucleus divides by meiosis to form four haploid daughter nuclei.
- Only one in each remain viable which divides by mitosis into two.
- One becomes large, stationary female pronucleus and the other becomes small, migratory male pronucleus.
- There is reciprocal exchange of micronuclei and its fusion with the macronucleus to form the diploid zygote by this AMPHIMIXIS process.
- Each conjugant then separate. They are now called as exconjugants.

CONJUGATION contd.....

- In each exconjugant the zygotic nucleus divides by three quick mitotic divisions.
- Eight daughter nuclei are formed in each.
- Four in each grows big to form the macronuclei.
- Four remain small of which three degenerates in each.
- One micronucleus in each divide by mitosis followed by cytokinesis.
- Each daughter receives two macronuclei and one micronucleus.
- Micronucleus divides by mitosis followed by cytokinesis
- Thus four+four=eight small daughter *Paramecia* formed from the two exconjugants
- These grow to retain the adult form.

CONJUGATION: PROCESS



AUTOGAMY

- Described by Dilller in 1936.
- He called it as self fertilization.
- It takes place in *Paramecium aurelia* which has one macronucleus and **two** micronuclei.
- It involves only one individual.
- It always leads to homozygosity.
- It is a special type of nuclear reorganization.
- It takes place as follows:
 - The macronucleus disintegrates.
 - A temporary protoplasmic cone forms near the cytostome.

AUTOGAMY contd

both the micronuclei divide by **MEIOSIS** to produce eight daughter nuclei.

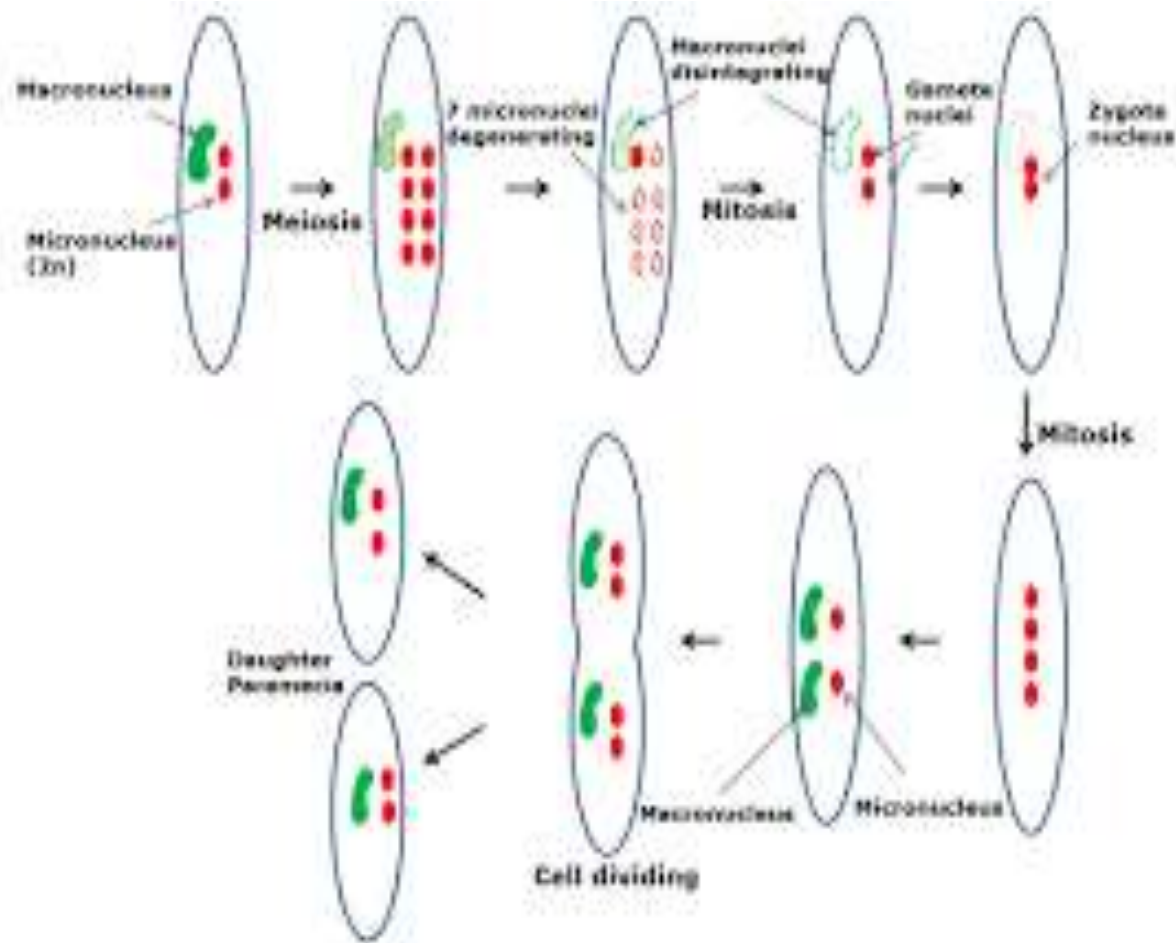
seven of these degenerate and only ONE remains which divide by **mitosis** to produce two gamete nuclei.

these two enter the protoplasmic cone and fuse to form the diploid zygote nucleus.

it divides by **TWO** quick **mitosis** to produce FOUR daughter nuclei of which two become large (macronuclei) and two remain small(micronuclei).

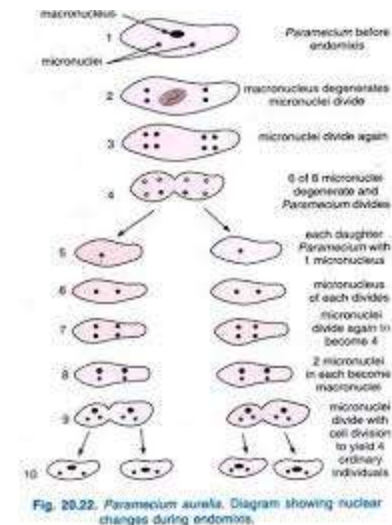
The micronuclei divide by **mitosis** followed by cytokinesis to produce two *Paramecia* each with a macronucleus and two micronuclei.

PROCESS OF AUTOGAMY



ENDOMIXIS

- Described by Woodruff and Erdmann in 1914.
- Special method of nuclear reorganisation in *Paramecium aurelia*.
- It involves a single individual and is similar to autogamy or hemixis.
- Four daughter *Paramecia* are formed, each having one macronucleus and one micronucleus



HEMIXIS

- Described by Diller in *Paramecium aurelia*.
- Special type of nuclear reorganisation in a **single** individual.
- In this the macronucleus is rejuvenated.
- Macronucleus gives off chromatin balls which are supposed to consist of redundant or waste materials.
- Micronuclei divide normally.

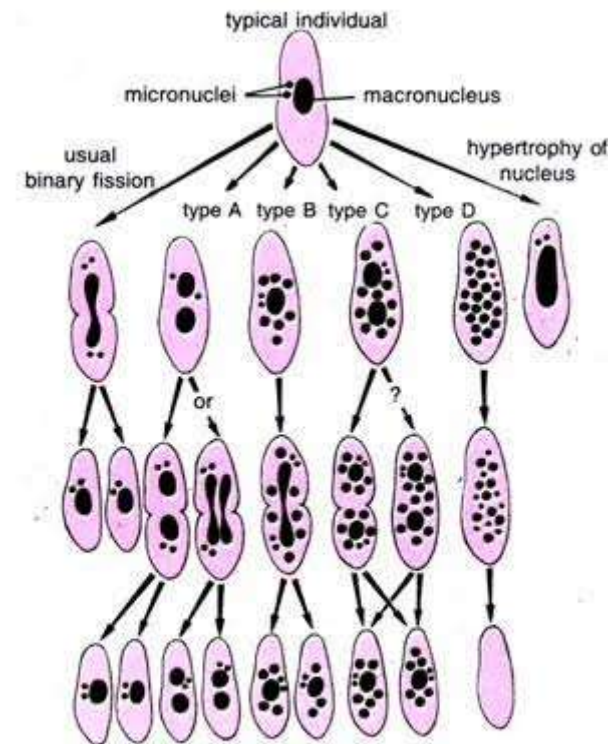
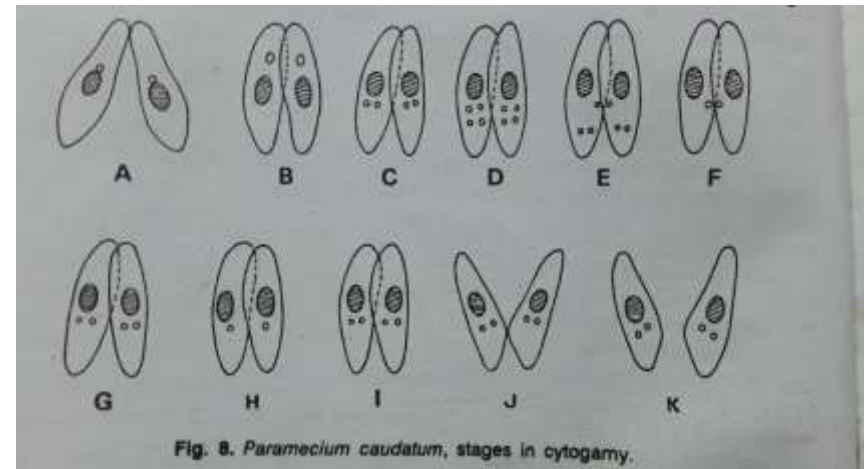


Fig. 20.24. *Paramecium aurelia*. Diagrams of the macronuclear behaviour during hemixis.

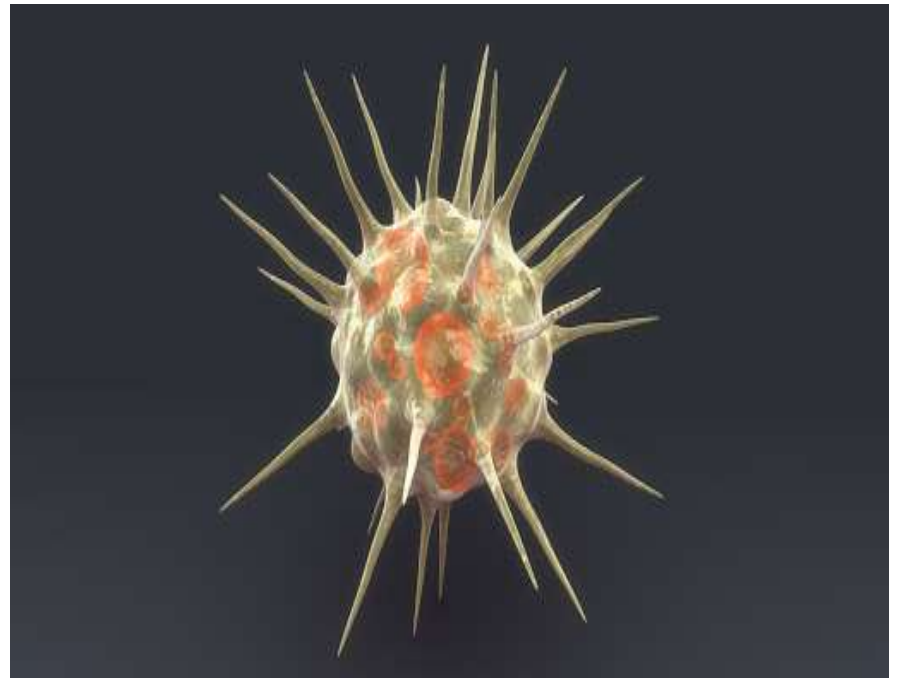
CYTOGAMY

- It was reported by Wichterman(1940) in the small strains of *Paramecium caudatum*.
- It involves **two** *Paramecia*
- The process is similar to conjugation but there is no exchange of gametes between the two.
- Instead , in each the two haploid gamete nuclei fuse to form a diploid synkaryon or zygote nucleus.



PARTHENOGENESIS

- It takes place in certain Protists in which the gametes fail to fertilize.
- It is a special type of asexual reproduction.
- It is the production of offsprings from unfertilized eggs.
- Eg- *Actinophrys*



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