REPRODUCTION IN PROTOZOA

- The life process of producing young ones of the same kind is - **Reproduction**
- Reproduction in protozans takes place by - **asexual and sexual methods**

ASEXUAL REPRODUCTION

- Reproduction without the fusion of pronuclei is called - **asexual reproduction**
- Asexual reproduction generally occurs in protozoans during - **the favourable conditions.**
- The favourable conditions are - **optimum temperture, availability of nutrients and other suitable ecological conditions of water.**
- The methods of asexual reproduction are - **binary fission, multiple fission, budding or gemmation, plasmotomy and sporulation**
- In asexual reproduction - **genetic recombination does not occur.**
- The young ones show uniparantal inheritance, without any genetic variation (clone) in - **asexual reproduction.**

BINARY FISSION

- The most common type of reproduction in protozoans is - **Binary fission.**
- The division of nuclei is called - **Karyokinesis**
- The division of cytoplasm is called - **Cytokinesis**
- During the binary fission karyokinesis is followed by cytokinesis

TYPES OF BINARY FISSION

- The binary fission is irregular in - **Amoeba proteus**
- Longitudinal in - **Euglena**
- Transverse in - **Paramecium**
- Longitudinal binary fission is common in - Mastigophores
  a) Euglena is a - **spindle shaped organism**
  b) The body is surrounded by - **proteinaceous pellicle**
- The contractile vacuole in Euglena is present in - **ectoplasm**
- Endoplasm contains - **nucleus, chloroplasts etc.**
- Near thye base of longer flagellum is - **parabasal body (photoreceptor)**
- The organelle present close to the cytopharynx is - **stigma**
- Binary fission in Euglena takes place during - **fovourable conditions and also in the encysted state.**
- During binary fusion of Euglena karyokinesis - **Occurs by mitosis.**
- The cytokinesis takes place by - **a longitudinal furrow from the anterior end which proceeds towards the posterior end.**
- With the result of the karyokinesis and cytokinesis Euglena divides into - **two daughter individuals**
- Besides the nucles, the organelles that undergo division are - **blepharoplasts and chloroplasts.**
- The old flagella go to one daughter individual and the other individual develops the new flagella.
- The organelles which disappear (donot divide) during binary fusion and newly developed by the daughter individuals are - **the contractile vacuote, stigma and paraflagellar body.**
- The daughter Euglenae formed as a result of Binary fission are like mirror images, hence called - **Symmetrogenic division.**

TRANSVERSE BINARY FISSION IN PARAMECIUM

- Paremecium is a - **Ciliate protozoan**
- The common name of paramecium is - **Slipper animalcule**
- The body is - **slipper shaped (hence the common name is slipper animalcule)**
- The oral surface is - **flat**
  and the aboral surface is - **convex**

- The oral surface contains - **oral groove**
- The oral groove opens - **into the cytopharynx through cytostome.**
- The ectoplasm contains - infraciliary system and trichocysts.
- The endoplasm contains - **two nuclei and two contractile vacuoles, food vacuoles.**
- The two nuclei are
  1. **large kidney shaped macronucleus** and
  2. **a small spherical micronucleus.**
- Macronucleus controls - **vegetative function**
- Micronucleus controls - **reproductive function**
- The contractive vacuoles are present - **one at each end.**
- During binary fission Paramecium - **stops feeding and the oral groove disappears.**
- During Karyokinesis :
  Macronucleus divides by - **amitosis**
  Micronucleus divides by - **mitosis and form each two daughter nuclei**
- Then two oral grooves begin to appear - **one in the anterior half and another in the posterior half.**
- During cytokinesis - **a constriction appears in the middle of the body.**
- By the deepening of the constrictin transversely - **two daughter cells are formed.**
- The plane of fission is at right angles to - **Kinetia (perikinetal fission)**
- The anterior daughter individuals is called - **Proter**
- The posterior daughter individual is called - **Opisthe**
- Each daughter individual receives - **One contractile vacuole of the parent.**
- The second contractile vacuole is formed - **newly by each daughter individual.**
- The cytopharnyx of the parent is retained by - **Proter**
- In the Opisthe - **new cytopharynx is formed**
- The process of binary fission in paramecium is compled in about - **2 hours**
- In paramecium the number of binary fissions that may take place in a day is - **four**
- All the Paramecia produced asexually by repeated binary fissions from a single parent constitute - **a clone**
- The transverse binary fission in Paramecium is called - **homothetogenic binary fission**

MULTIPLE FISSION

- The division of the parent into numerous daughter individuals is called - **multiple fission**
- The nucleus divides into many nuclei followed by the cytoplasmic division and many daughter individuals are formed during - **multipole fission**
- Multiple fission is seen in - the **sarcodines and sporozoans**
- Schizogony is - **asexual multiple fission.**
- The end products of schizogony grow into - **trophozoites**
- The multiple fission by which gametes are formed is - **Gamogony**
- The multiple fission by which spores or sporozoites are formed is - **Sporogony.**

PLASMOTOMY

- The division of a multinucleate protozan into multinucleate duaghter individuals by cytoplasmic division but without nuclear divisional is called - **Plasmotomy eg : Opalina**

BUDDING

- Budding is common in - **Suctorian protozoans eg : Acinata**
- The bud is - **a smaller individual formed after nuclear division**
- If only one bud is formed at a time such budding is called - **monotonic budding.**
- Monotonic budding occurs in - **Vorticella**
- Multiple buds are formed in - **Suctorians.**

- Exogenous buds are formed in **- Ephelota**
- Endogenous buds are formed in - **Acineta**

SEXUAL REPRODUCTION

- Reproduction that takes place by the fusion of pronuclei with or without the formation of gametes is - **Sexual reproduction**
- Genetic recombination occurs during - **Sexual reproduction.**
- The fusion of similar gametes is called - **Isogamy eg : Monocystis.**
- The fusion of dissimilar gametes is called - **Anisogamy eg : Plasmodium**
- Temporary pairing or two individuals for the exchange of the pronuclei and the fusion of pronuclei takes place during - **conjugation**
- The individual that participate in conjugation are called - **Conjugants.**
- During conjugation, fusion of pronuclei is followed by - **Postconjugation fissions.**
- Generally, after the mutual exchange of the pronuclei the conjugants - **separate eg : Paramecium**

SYNGAMY

- In protozoans, sexual reproduction takes place by - **syngamy and conjugation.**
- Complete fusion of two gametes is called - **Syngamy**

CONJUGATION

- The scientists who defined conjugation as a temporary union between two ciliates belonging to two different mating types for the exchange and reconstitution of nuclear materials (nuclear reorganization) is - **Wichterman. (1953)**

Factors and conditions for conjugation :

- Unfavourable conditions like shortage of food.
- It always occurs only between the individuals belonging to two different "**mating types'.**
- They exhibit physiological differentiation but appear like morphologically (**Paramecium**) **(Morphologically also different in Vorticella)**
- Conjugation occurs between two inactive individuals, which have lost their vigour and vitality due to chromosomal imbalance in their macronuclei, caused by **repeated amitotic divisions.**
- Conjugation does not take place during **favourable conditions.**

CONDOTION IN VORTICELLA

- Vorticella is a - **fresh water ciliate protozoan - bell shaped and sessile, attached to the substratum by a long stalk.**
- Cilia are present - **around the mouth as peristomial cilia (adoral cilia)**
- Body is covered by - **Pellicle**
- Endoplasm contains - a horse shoe shaped macronucleus and a round micronucleus
- Macronucleus is - **a vegetative nucleus & disappears during conjugation.**
- Micronucleus is a reproductive nucleus and involved in - **Conjugation (sexual pronuclei)**
- New macronucleus after conjugation is formed from - **Micronucleus**
- Conjugation in Vorticella moniliata takes place between - **a long stalked macro conjugant and a small free swimming microconjugant**

EVENTS IN THE CONJUGATION

- Formatin of micro and macroconjugants.
- Attachment of the conjugants
- Disappearance of macronucleus
- Prezygotic nuclear divisions
- Amphimixis
- Postzygotic nuclear divisions

- Post conjugation fissions

Formation of Micro and Macrojugants

- Conjugants in Vorticella are formed by - **longitudinal binary fission and unequal division**
- The larger part develops into - **Macroconjugant**
- The smaller part developos into - **Microconjugant**
- The microconjugant acquires cilia - **at the aboral end.**
- The free swimming conjugants is - **microconjugant**
- The microconjugant differs from the fres swimming young individual produced in binary fission, in being smaller in size, and does not develop into an adult with stalk.
- The conjugant which does not feed or encryst and sruvive for about 24 hours only is - **microconjugant**
- The macroconjugant is - **sessile & stationary.**
- The conjugant which physiologically differs from the normal young, individual is - **Macrojugant**
- Macroconjugant attracts the microconjugant for about - **2 hours**
- Macro & Micro conjugants differ - **physiologically & morphilogically**

II Attachment of the conjugant

- Attachment of microconjugant (of different parentage) with the macroconjugant takes place-at the aboral surface end)
- Microconjugant looses its cilia - **after attachment.**

III. Disappearance of the macronucleus

- Macronucleus is a - **vegetative nucleus & has no role in conjugation**
- Macronucleus of the conjugants - **distintegrates and disappears**

IV. Prezygotic nuclear divisions

- The divisions of nucleus without cytokinesis before zygote formation are called - **prezygotic nuclear divisions**
- The micronucleus of the microconjugant undergoes - **three successive divisiions.**
- These divisions are - **first two divisions are meiosis I & meiosis II and the third one is mitosis (cytokinesis does not occur)**
- The total number of nuclei formed after prezygotic nuclear divisions in the microconjugant are - **eight (8) haploid nuclei (half the no of parent chromosomes)**
- Of these eight nuclei the number of nuclei that disappear are **(7) seven. (only one nucleus remains)**
- The number of prezygotic nuclear divisions that occur in the micronucleus of Macroconjugant - **two successive nuclear divisions.**
- The type of these nuclear divisions is - **two divisions of meiosis (Meosis I and II) (without cytokinesis)**
- The total number of nuclei formed after prezygotic nuclear divisions in the macroconjugant are - **four haploid nuclei.**
- Of these four nuclei - **three distintigrate and disappear (only one nucleus remains)**
- The remaining one nucleus in each conjugant (micro & macro) undergoes one mitotic division and forms a - **migratory (male) pronucleus and a stationary (female) pronucleus.**

V. Amphimixis

- Between the two conjugants a passage at the place of contact is formed due to - **dissolving of the pellicle**
- The migratory pronucles (male) of the microconjugant migrates into - **the cytoplasm of macroconjugant.**
- The migratory pronucleus, after entering the cytoplasm of the macroconjugant it fuses with - **the female (stationary) pronucleus of macroconjugant**
- The union of the two pronuclei and the cytoplasm is called - **Amphimixis**

- The migratory nucleus of macronucleus enters the - **microconjugant**
- The two pronuclei in the microconjugant - **does not fuse but disintegrate.**
- The synkaryon (diploid) in the macroconjugant is called - **zygote nucleus.**
- Heploid chromosomal number of vorticella is **-2**

VI. Post Zygotic nuclear division :

- The number of divisions thta take place in the zygotic nucleus are - three series of successive mitotic divisions (post zygotic nuclear divisions)
- The number of nuclei formed by post zygotic nuclear divisions - **(8) eight.**
- Of these eight postzygotic nuclei - **7 becomes macronuclei and one becomes micronucleus.**
- During the postzygotic nuclear divisions - **cytoplasm does not undergo division**

VII. Post Conjugation Fissions

- During the post conjugation fissions, the number of divisions are - **three series of binary fissions.**
- During postconjugation fissions - **only the micronucleus divides & the macronuclei are distributed.**
- The number of daughter Vorticella formed at the end of conjugation are - **(7) seven**

Significance of Conjugation

- The vigour and vitality lost due to chromosomal imbalance is regained (Rejuvenation) during - Conjugation.
- The macronucleus becomes senile (inactive) due to - **repeated binary fission.**
- During conjugation new and active macronucleus is formed from - **micronucleus (material of skykaryon).**
- Conjugation is a process of - **nuclear reorganization**
- As meiosis and gametic nuclear fusion of different parentage occur during conjugation, it results in - **gene recombinations and genetic variations.**
- Multiplication of Vorticella occurs - **during conjugation.**

II. Other Methods of Nuclear Reorganization:

i. Autogamy :

- The process of autogamy was described by - **W.F. Diller**
- Autogamy occurs in - **P.aurelia**
- The asexual reproduction resembling conjugation is - **autogamy.**

ii. Cytogramy :

- The process of cytogamy was reported by - **R. Wichterman.**
- Cytogamy occurs in - **P. caudatum.**
- The sexual process without neclear exchange is - **Cytogamy.**
- It occurs between - **two individuals.**
- Only cytoplasm exchanging method is - cytogamy

iii. Endomixis :

- The process of endomixis was reported by - **Woodruff and Erdmass.**
- Endomixis occurs in - **P.aurelia.**
- In endomixis micronucleus divides by - **Mitosis.**
- Nuclear fusion does not occurs in - **Endomixis**
- Senile macronucleus disintegrates and new active macronucleus is formed from - **micronucleus.**