Elphidium: Habitat, Structure and Life Cycle

(Bsc. Part I – Paper 1st)

Habits and Habitat of Elphidium:

Elphidium crispum represents a shelled-protozoan or framiniferan having many chambered shell and thread-like axopods. It exhibits the phenomenon of dimorphism, i.e., Elphidium exists in two distinct forms—large megalospheric and small microspheric forms. Elphidium is a marine and free-living protozoan. It is found on the bottom of sea at about the depth of 300 fathoms (one fathom = 1.8 metres). It creeps among the sea weeds.

Structure of Elphidium:

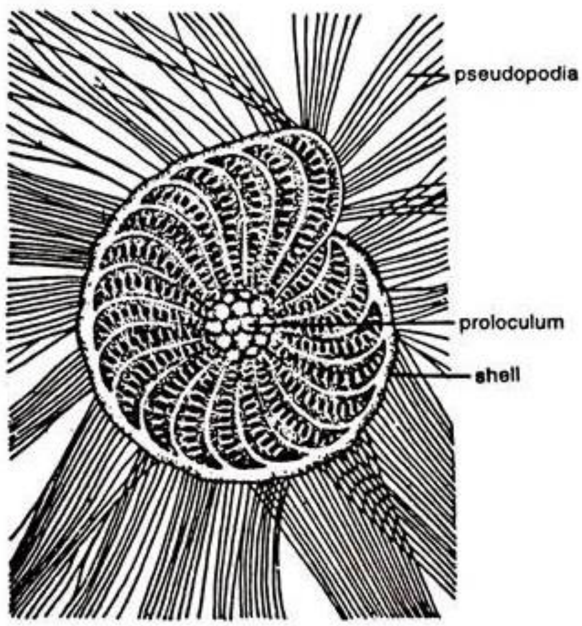


Fig. 18.6. Elphidium crispa

1. The shape of the animal is more or less round.

2. It is surrounded with a many-chambered, mullilocular and perforate calcareous shell consisting of 45 to 50 chambers.

3. The, chambers are boat-shaped and spirally arranged and each completely covers its predecessor. They communicate with each other through minute pores or foramen.

4. The margins of the shells are provided with' peg-like projections. The shell bears a keel and the last chamber has a terminal aperture.

5. The chambers are filled up with cytoplasm, which passes through the openings in the septa; the cytoplasm of the whole body of the animal is not divided into compartments but it is continuous. Nucleus may be one or many. The cytoplasm extends through the pores of the shell to form a layer over the shell.

6. Long, slender pseudopodia project outside through the minute pores present all over the shell and also through the terminal aperture; they often branch and anastomose with one another. Pseudopodia are of reticulate type, i.e. narrow, almost thread-like, branched and continually anastomose.

7. The adult Elphidium is dimorphic, some are Schizonts or Agamonts, commonly known as microspheric individual, characterised by an initial central chamber or pro-loculus of relatively minute size, and some others are gamonts, more commonly known as macrospheric individual, which give rise to gametes, characterised by a large centrally placed chamber.

Macrospheric individual (Fig. 18.7A)	Microspheric individual (Fig. 18.7B)
1. The first formed chamber or proloculus is large.	1. The first formed chamber or proloculus is small.
2. Initial chamber is naked like other chambers.	2. Initial chamber is enclosed in a thick capsule-like cyst.
3. Nucleus one, large and laterally placed.	3. Nuclei many, small and scattered throughout the cytoplasmic mass.
4. Chromidia absent.	4. Chromidia present.
5. Produced asexually.	5. Produced sexually.

i. Shell:

Body of Elphidium is covered with a hard and translucent shell made up of calcium carbonate and small amounts of silica and magnesium sulphate. The shell is biconvex, polythalamus or multilocular (many chambered) and perforated. The surface of the shell is chiseled.

The chambers of the shell are V-shaped, lay down serially and arranged in a flat spiral in which each whorl of chambers overlaps the previous whorl i.e., equitant. The overlapping portions are known as alar processes. Due to the overlapping of the chambers only the last chamber is visible from outside. The hinder margin of each chamber has a row of numerous minute backwardly directed, hollow, blind protoplasmic pockets called retral processes.

The adjacent chambers remain separated from each other by perforated septa. The chambers are interconnected or communicate with each other as well as with the exterior through minute pores present in the septa. The outer whorl opens to the outside by a row of large pores.

The chambers of the shell originate from the initial chamber known as proloculum which may be small or large in size. The small production is known as microsphere and the shell having small proloculum shall be called microspheric whereas the large proloculum is known as megalosphere and the shell having large proloculum is called megalospheric. Thus the animal is dimorphic.

ii. Cytoplasm:

The shell's chambers are filled with inner cytoplasm or medulla. A thin layer of outer cytoplasm or cortex covers the shell from outside. The inner cytoplasm contains nucleus or nuclei, food particles, minute vacuoles, Golgi apparatus, mitochondria, endoplasmic, reticulum, ribosomes and brown granules or xanthosomes containing waste matter. Contractile vacuoles are absent.

iii. Nucleus:

The medulla contains a single nucleus in megalospheric individuals and many nuclei in microspheric forms.

iv. Reticulopodia:

The pseudopodia of Elphidium are in the form of numerous fine and often very long slender thread-like structures, which are often branched and anastomosing. This type of pseudopodia is characteristically called reticulopodia, rhizopodia or myxopodia. Each rhizopodium is made of an inner fibrillar axis and the outer fluid-like cortex.

The streaming circulation of cytoplasm has been observed in the rhizopodia. These are, in fact, temporary extensions of the outer cytoplasm and can be withdrawn within the shell. However, these are locomotory in function and often form feeding nets for catching diatoms on which animal feeds.

Physiology of Elphidium:

i. Locomotion:

Elphidium creeps slowly with the help of its reticulopods on sea weeds at the bottom of the ocean. Locomotion of animal is performed by contraction and expansion (extension) of the reticulopods.

ii. Nutrition:

Nutrition is holozoic. The food consists mostly of diatoms and algae; it also captures other Protozoa and micro-crustaceans. The net-like rhizopodia are said to secrete an external mucus layer to entangle the food particles. The mucus layer also contains proteolytic secretions which help in paralysing the prey and the process of digestion soon starts.

The entangled food in mucus is enclosed in a food vacuole and then the rhizopodia are withdrawn within the shell. The food is digested almost exclusively outside the shell and the digested products pass into the inner cytoplasm.

Reproduction and Life history of Elphidium:

Elplndium reproduces by both asexual and sexual modes. A well-marked alternation of generations is always present. The made of reproduction in different species of Elphidium is not exactly similar. The following is the description of life-history of Elphidium crispum.

The following description is applicable to Elphidium crispa (Fig. 18.7C-H):

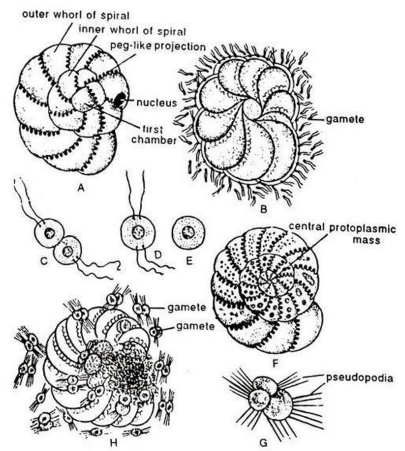


Fig. 18.7. Elphidium sp. Structure and life history. A. Macrospheric individual (pseudopodia not shown). B. The same surrounded by gametes. C. Two gametes Uniting. D-E. Zygote. F. Microspheric individual (pseudopodia not shown). G. Young macrospheric individual with three chambers. H. Microspheric individual surrounded by gametes

Formation of macrospheric individuals:

Microspheric form contains several nuclei. The smallest form as described by Schaudin had nine chambers and 28 nuclei. At first, nuclei are homogeneous structures, but they make their appearance as soon as the animal grows in size.

Nuclei are irregularly scattered, although they are absent in terminal chambers. Nuclei multiply by simple division. Nuclei in larger chambers are larger than those in the smaller chambers near the centre. Nuclei give off irregular strands of darkly stranding substances, which are termed by some authors as chromidia. In some cases, no definite nucleus is visible, only stained substance is present in the form of irregular strands.

The first indication of reproduction starts with the great increase in the number of pseudopodia. They become so abundant that they form a sort of a milk-while halo about the brown shell. This halo consists of hyaline protoplasm. Within a short time, coarse brown granules termed are chromidia pass out.

Whole of the protoplasm comes out of the test and is amassed within the area covered by the halo. Protoplasm by streaming movements separates into spherical masses of a uniform size; the centre of each is occupied by a nucleus with an area of clear cytoplasm surrounding it.

After a short time, each sphere or amoebula or pseudopodiospora thus formed secretes a shell. Each pseudopodiospore forms a number of chromidial granules, which fuse to form a nucleus. Soon, a second chamber is formed. Amoebula or pseudopodiospore grows, feeds and gives rise to a series of new chambers. Thus, a macrospheric form of Elphidium is formed.

Formation of microspheric individuals:

Whole protoplasm in specimens fairly advanced in growth, Schulze noticed them in or near the chamber, which is almost in the middle of the series. Nucleus is at first a homogeneous structure, but soon it grows and round nucleoli are formed. Lankester describes that small fragments of irregular bodies are separated off from the nucleus.

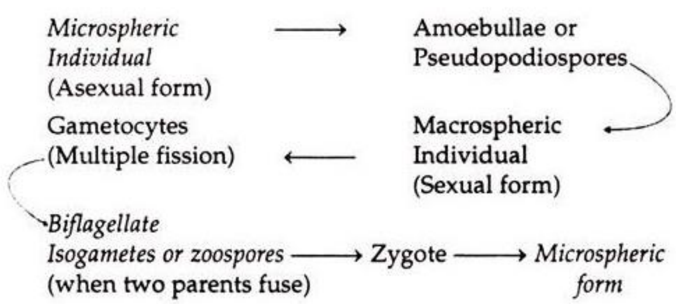
Towards the end of the vegetative phase of the life-history of megalospheric form the nucleus disappears and minute nuclei are formed scattered uniformly or in groups throughout the protoplasm. When nuclei are uniformly distributed the protoplasm breakup into small rounded masses, the center of which is occupied by a nucleus.

These nuclei divide by Karyokinesis or mitotic division. This is followed by a second division of protoplasm so as to from rounded bodies 3-4μ, termed as biflagellate isogametes, which are set free and escape outside the shell.

These gametes or zoospores from the same parent will not unite with one another; those from different parents will conjugate readily. Schaudin describes that the nuclei of the two gametes fuse and flagella drop off and the zygote thus formed undergoes a considerable increase in size, so that in a few hours its diameter is more than doubled.

The zygote secretes a gelatinous envelope and the microspheric individual is formed. Nucleus of the zygote divides by successive mitotic division and thus acquires multinucleate condition.

Life History of Elphidium:



Alternation of Generations:

An alternation of generations in the life history of Elphidium is quite distinct. The microspheric form gives rise to the gametocytes (macrospheric) by multiple fission. The gametocytes in turn produce gametes, which by their union form the zygotes and, thereby, the microspheric individual is formed, and the two generations alternate with each other.

The usual mode of reproduction may be stated in the following way. When ‘m’ represents microspheric individual; am = amoebula; ‘M’ = Macrospheric individual, ‘fl’ = flagellula, → m → am → M →(fl + fl) → m ……….

Sometimes this normal cycle may be disturbed when a number of asexual generations are repeated before a sexual generation interferes.

This may be stated in the following way:

m → am → m → am → M (fl + fl) → m….