

Fertilization (Contd. - Part 2)

Acrosome Reaction - The first reaction it comes in contact of the sperm when egg involves acrosome. Onset of acrosome reaction takes place when there are optimal of some physiological conditions like optimal pH, Ca^{++} , Mg^{++} ion concentration and temp. The presence of Ca^{++} is an essential condition for acrosome reaction. It involves breakdown of membrane of acrosomal vesicles, release of acrosomal enzymes, formation of acrosomal tubule and fusion of plasma membrane of sperm and egg. The severed edges of the two membranes fuse to form release acrosomal material. Moreover, the sperm is phagocitized by the egg and the sperm plasma membrane does not form part of the zygote plasma membrane. The final result is the fusion of plasma membrane of the egg and a continuity between the cytoplasm of the egg and the sperm. The cytoplasmic component of sperm enters into the interior of the egg. A single cell zygote is formed.

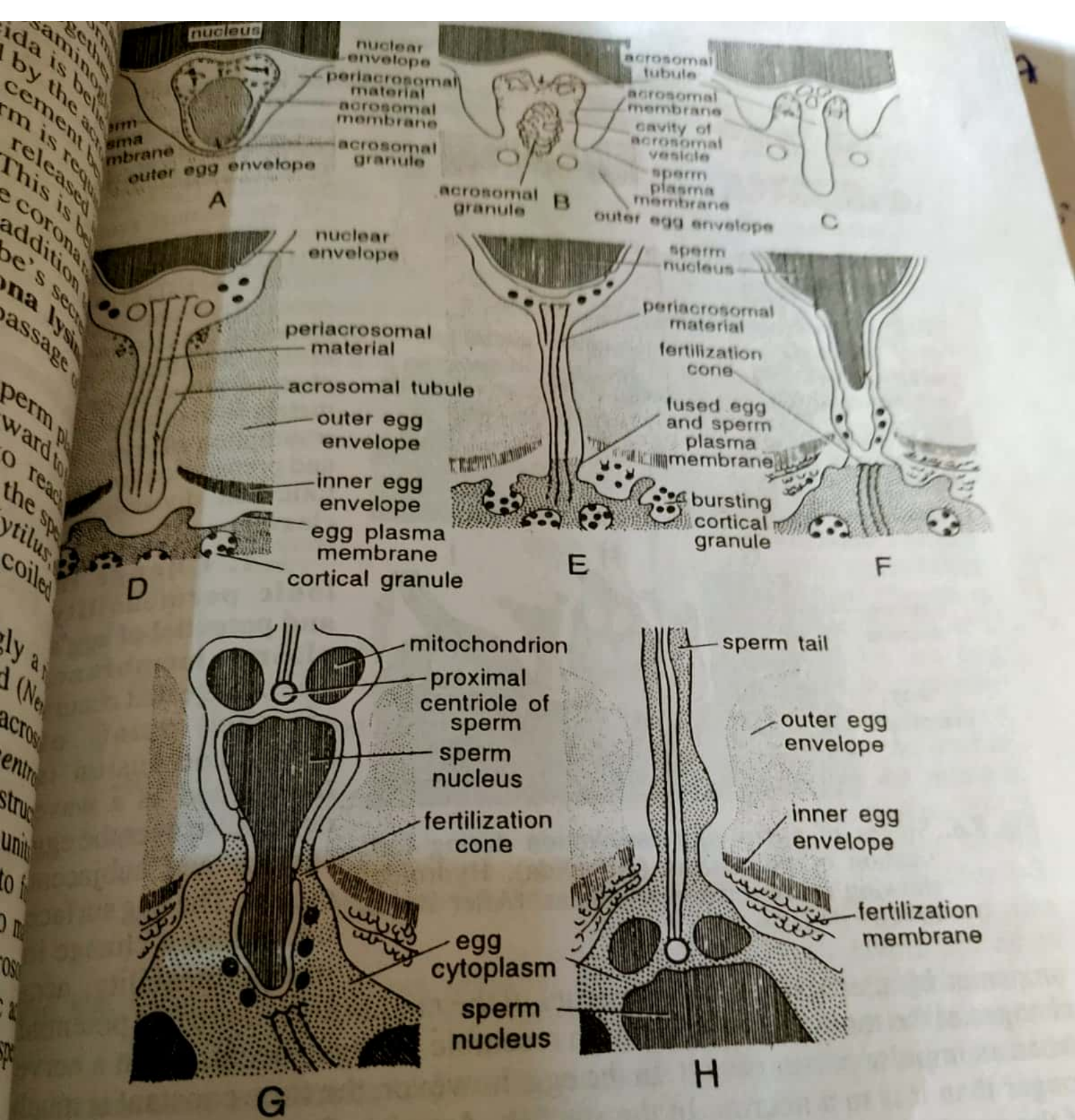
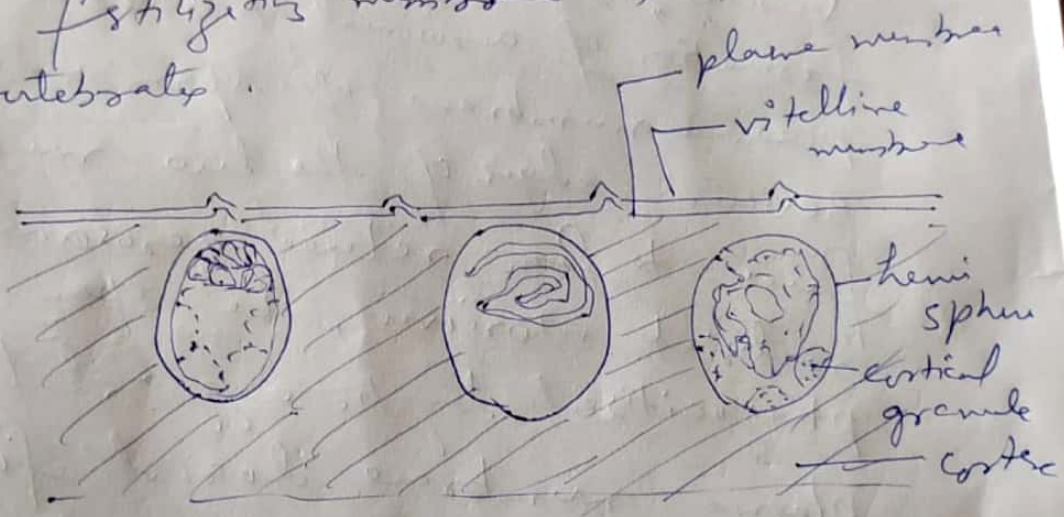
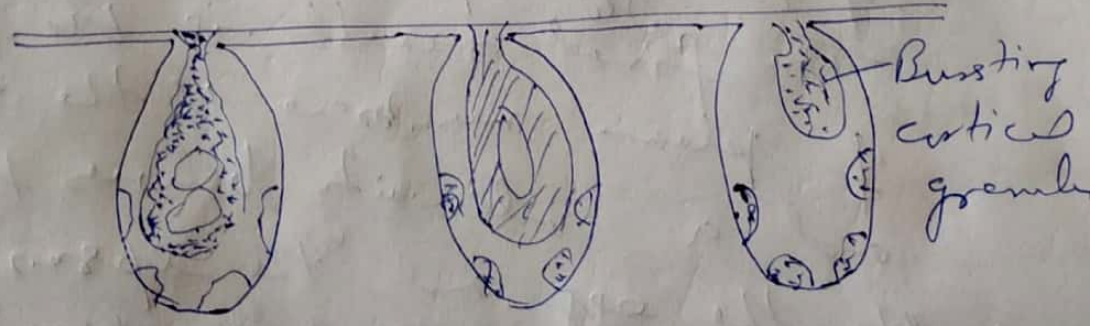


Fig. 8.5. Fertilization in *Saccoglossus*. A—Intact acrosome; B—Breakdown of acrosome; C—Growth of acrosomal tubule; D—Polymerisation of acrosomal filaments; E—Fusion of plasma membranes of sperm and ovum; F—Fertilization cone formation; G and H—Entry of sperm components into the egg cytoplasm (After Torrey, 1971).

Activation of Ovary - The phenomenon of egg activation involves change in ionic plasma membrane (due to activation of various pumps such as proton pump, sodium potassium pump etc. of all the ions involved, calcium ions plays a major role in egg activation. In the absence of calcium, fertilization does not occur. Sperm viability, motility and fertilizing capacity are also diminished. Egg stability also depends upon calcium. This results in the formation of fertilization membrane in these vertebrates.

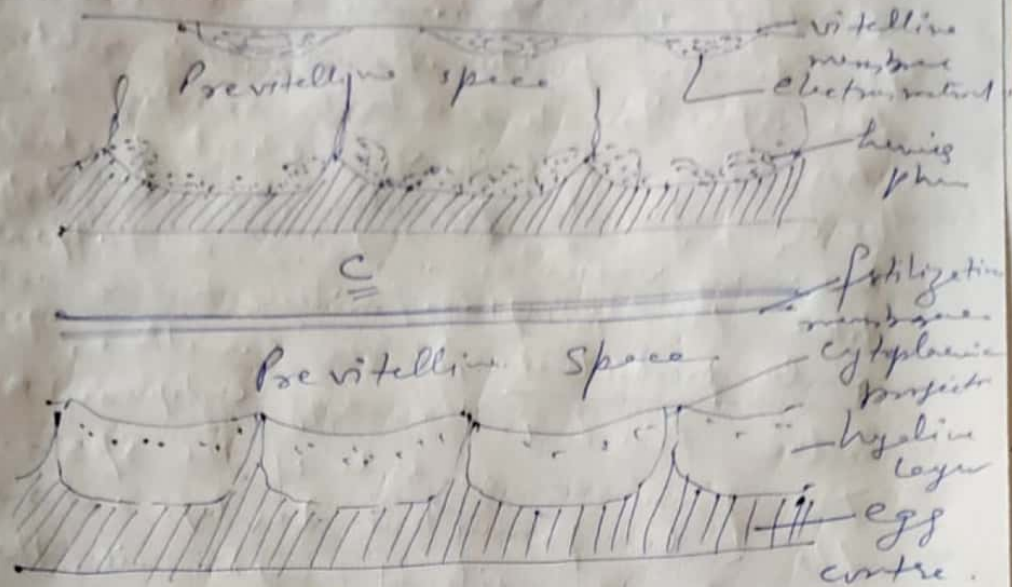


A



B

changes in egg cortex in sea urchin of unfertilized egg
 The explosion of cortical granule



c Adhesion of electro-opaque material to the vitelline membrane.

d The egg surface after completion of cortical changes.

6 Migration of Pronuclei and Amphimixis →

At the time of penetration of spermatozoa inside the egg cytoplasm, the sperm nucleus remains compact and its mitochondria and centriole situated behind it. To perform the act of amphimixis, the sperm nucleus has to perform two activities - (i) it has to become pronuclei. And it has to migrate from the site of fertilization to the site of amphimixis. As the sperm nucleus moves inward from the site of the fertilization, it turns through the angle of 180°.

so that its mitochondria and centriole assume the leading position. Besides this rotation, the sperm nucleus starts swelling and its chromatin which is very closely packed, becomes finely granular. It ultimately becomes vesicular and has an appearance like the interphase nucleus and is called male pronucleus. At the same time, the sperm aster forms in the egg cytoplasm, around the proximal centriole of the sperm. As the male pronucleus develops and migrates towards the site of amphimixis, the sperm aster seems to lead it. As the sperm pronucleus and centriole move inward it may be accompanied by some cortical and subcortical cytoplasm. If the egg is heavily pigmented, the trajectory of the sperm pronucleus may be marked by the pigmented granules trailing along its path. This is called penetrating path.

In the meantime, the nucleus of the egg also undergoes certain changes. After completion of second mitotic division, the haploid nucleus of the egg occurs near the surface of the egg in the form of several vesicles known as karyosomes. In a fertilized egg, three karyosomes fuse together to form a female pronucleus, which increases in volume and becomes

vesicular. It also migrates towards the site of amphimixis.

The final stage of fertilization is amphimixis, when male and female pronuclei fuse. In this process, the two pronuclei fuse together by dissolution of nuclear membrane of both pronuclei and the contents of both pronuclei unite into one mass. In the meantime the Centrioles of the spermatozoan has divided in two and an achromatic spiralle is formed and in this spiralle, the chromosomes derived from the male and female pronuclei become attached. Only after the completion of the first division of the fertilized egg, the paternal and maternal chromosomes become enclosed by common nuclear membrane to form the nuclei of two blastomeres.

Biological roles of Fertilization →

Fertilization has its primary role is sexual recombination during syngamy where mixing of genes of two gametes take place and genetic variations are introduced in the species. The genetic variations provide the raw material to the natural selection. The genetic sex of the

individual is also determined at the time of fertilization.

It also triggers the developmental programme in a rapid burst of metabolic activity. In a sense, study of fertilization also helps in improving breed of many domesticated animals which serve in the benefit of mankind.

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