Fertilization

in getting rid of the excess

Q. 14. Write an essay on fertilization. [M.U.99,02,06; B.U.93,97; J.P.U.00,05; V.B.U.03; Bh.U.97; R.U.97,99; S.K.U.98,00; B.N.M.U.02; V.K.S.U.02,04; L.N.M.U.03]

or, Give an account of fertilization in vertebrates [P.U. 92]

Ans. The fusion of the sperm with the ovum to form diploid zygote is known as fertilization. The sequence of changes during fertilization includes **Karyosomy** (fusion of the nuclei of the two gametes) followed by **plasmogamy** (mixing of the cytoplasm of the two gametes). *Completion of fertilization involves following three phases :*

(i) Movement of the sperm towards the ovum :

As the ovum is non-motile, the movement of sperm becomes essential to reach ovum. This is done by the sperm with the help of its tail by whip like lashing movement. The movement is initiated by the attraction caused by a glucoprotein substance known as **fertilizin.** The fertilizin is secreted by the plasma membrane of the ovum. An other acidic proteinous substance

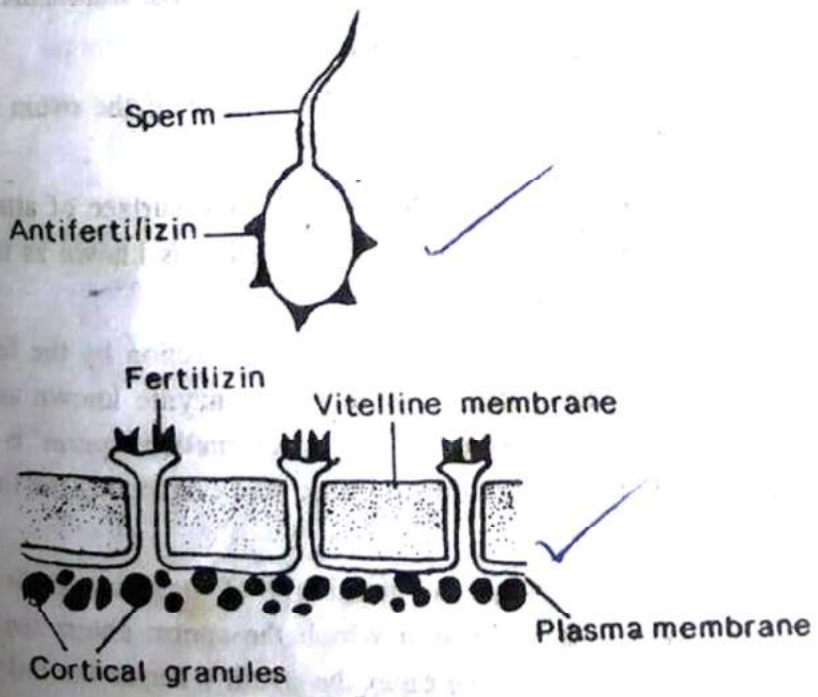

Fig.1.88. Fertilizin of egg & antifertilizin of sperm.

known as **antifiertilizin** is also secreted by the surface of the sperm. Both these secretions fertilizin and antifertilizin are specific just like only its own key can fit into the lock.

On reacting the surface of the ovum, the sperm becomes attached to the surface of the latter with the help of fertilizin and antifertilizin. Some people also call fertilizin and antifertilizin as *gynogamones* and *androgamones* respectively.

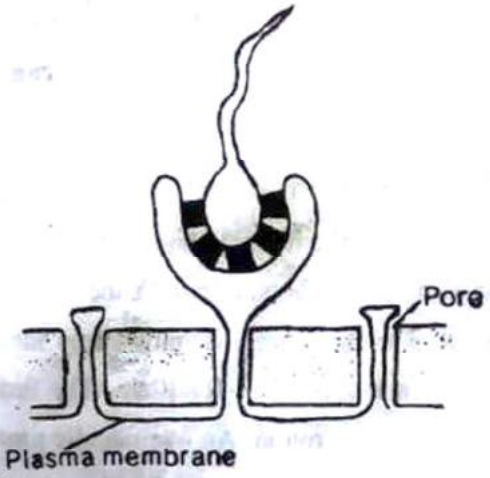

Fig. 1.89. Attachment of sperm with ovum by fertilizin and antifiertilizin.

(ii) Penetration of the sperm into the ovum :

The attachment of the sperm with the surface of the ovum initiates several biochemical changes.

The cytoplasm of the ovum bulges out at the surface of attachment to form a conical projection. This conical projection is known as the cone of **reception** or **fertilization cone.**

The sperm is activated to initiate acrosomic action by the fertilizin. Once the acrosome is stimulated it secretes an enzyme known as sperm lysin. The sperm lysin secreted by the mammalian sperm is called **hyaluronidase** which dissolves the hyaluronic acid connecting the follicular cells around the ovum.

The lytic enzyme dissolves the membrane of the ovum at the site of reception cone, makes a way through which the sperm enters the ovum. Only the head and the middle piece enter the ovum whereas the tail is shed outside. But in case of mammal the entire sperm enters the ovum.

(iii) **Fusion of gametic nuclei :**

As soon as the sperm enters the ovum, the nucleus of the former is separated from the rest parts i.e. the middle piece and the tail. This separated nucleus is now known as *male pronucleus*. The latter moves towards the *female pronucleus*. The path of its movement can be marked due to arrival of an enormous amount of migratory pigment granules on the path. Its path in the ectoplasm is known as *penetration path* whereas its path in the endoplasm is called *copulation path*. The two pronuclei fuse resulting in the formation of diploid zygote. The rest parts of the sperm are absorbed in the cytoplasm of the ovum.

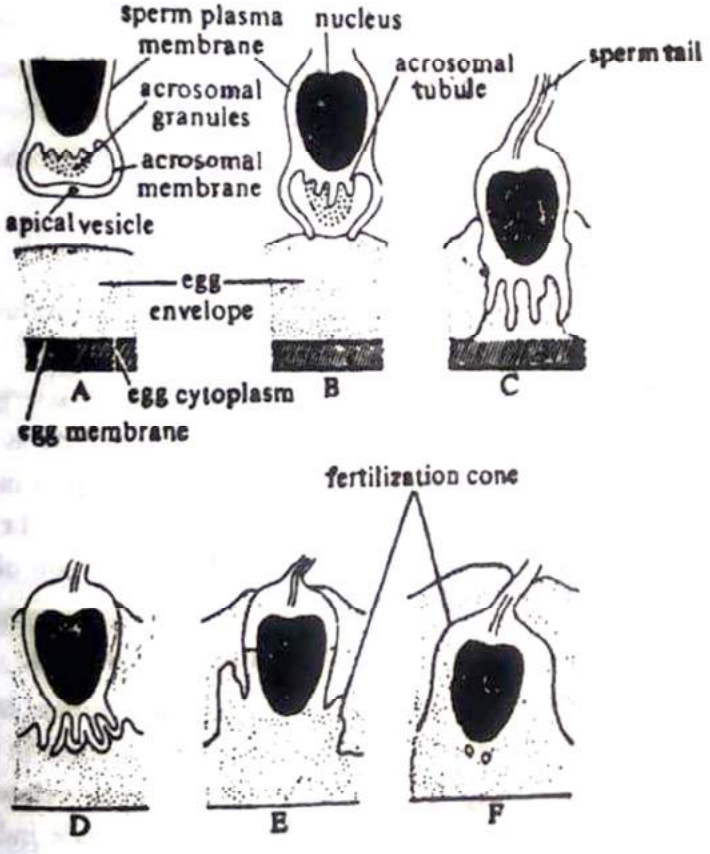

Fig. 1.90. Events in the union of male and female gametes.

Post fertilization changes :

The cytoplasmic mass of the ovum shrinks and the vitelline membrane rises above the surface. It causes an increase in the width of the perivitelline space present between the vitelline membrane and the plasma

membrane. The increase in the perivitelline space and its fluid provides free movement to the developing embryo. The vitelline membrane becomes more distinct and is now known as **fertilization membrane**. This checks the further entry of the sperm. The case in which more than one sperm enter is known as **polyspermy**. However in case of the latter only one sperm takes part in the process of fertilization while other disintegrates.

Importance of fertilization :

(i) Fusion of the haploid gametes provides diploid status of chromosomes similar to the parent.

(ii) Fertilization stimulates the ovum to complete maturation and initiate the development of the embryo.

(iii) New type of genetic combination is formed as a result of the fusion of the maternal and the paternal halves of the chromosomes. It brings about the variations in characters which enable the progeny to become more adaptive to the new environment i.e. useful variations in characters make the animal fitter for the struggle of existence.

Types of fertilization :

Fertilization involving the fusion of two gametes produced by the same individual is known as **self fertilization.**

The individual capable to produce both male and female gametes i.e. the individual who possesses both male and female gonads is known as **hermaphrodite** or **bisexual** or **monoecious**. Bisexual individuals in most cases try to avoid or to restrict self fertilization by adopting **protandry** i.e. the earlier maturation of the sperm or **protogyny** i.e. the earlier maturation of the ovum.

Fertilization involving the fusion of the two gametes produced by the two different individuals is known as **unisexual** or **dioecious.**

Fertilization of an ovum outside the body of the female individual is known as **external fertilization.** This type of fertilization occurs in the animals which lay their eggs. The egg laying animals are known as **oviparous.**

Fertilization of an ovum inside the body of the female individual i.e. in the female genital tract is known as **internal fertilization.**

Q. 15. Write an essay on parthenogenesis.