(3) Amphitropous or transverse ⇒ Here the body of the ovule is placed at right angles to the funicles. The hilum, chalaza & micropyle are all separated from one another. This is quite rare type & found in Ranunculus. Butomaceae

(4) Campylotropous or curved ovule ⇒ Here the body of the ovule is curved & bent round like horse shoe. The hilum, chalaza & micropyle all lie close together. eg- Some members of Chenopodiaceae, Leguminosae.

(5) Hemianatropous ⇒ In this type the body of ovule becomes at right angle to the funiculus. & the micropyle & Chalaza lie in a straight line. The micropyle in this case is not found near to the hilum.

Fig'

(6) Circinotropous ⇒ In this case the ovule is first orthotropous, but due to rapid growth on one side, the ovule becomes anatropous. The curvature of ovule, however, continues until the micropyle again becomes directed upwards. This type of ovule is found in opuntia.

Fig 12
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Parts of ovule → (their formation)-

(i) Integument ⇒ normally there are two integuments (Bitegmic ovule) but in some species Cases Single integument is formed. (unitegmic) (Salicaceae). Ategmic condition, that is ovule without integument has been reported in some members of Olacaceae. In some plants a third integument is also found known as aril. Bitegmic is characteristic of monocots & polypetalae.

(ii) Caruncle ⇒ It is formed by the proliferation of the integumentary cells at the micropylar region. The integuments may fuse between themselves or with the nucellus or with the funiculus. eg- Euphorbiaceae.

presence of chlorophyll in the integuments was first of all reported by Hofmeister in Bursrigia minor. Stomata have also been reported in the integuments of Crossypium.

(iii) Micropyle → The micropyle formed by the outer integument is known as the exo-stome & that formed by the inner integument is known as the endostome. The exostome alone rarely forms the micropyle.

eg - Euphorbiaceae.

(iv) Obturator — In several families certain structures are formed in the ovules which help in directing the path of the pollen tubes towards the micropyle. Such integuments are known as obturator. In Anacardiaceae, Labiatae.

(v) Nucellus → On the basis of extent of development of the nucellus two types of ovules have been recognised. Crassinucellate & tenuinucellate.

In crassinucellate type there is a well developed parietal layer of nucellus below the nucellar epidermis. This parietal layer consists of few to several layers of cells which separates the megaspore mother cell from the nucellar epidermis.

In the tenuinucellate type there is no presence of any parietal layer & as such the megaspore mother cell lies directly below the nucellar epidermis. The nucellus is gradually used up as the embryo sac matures.

(vi) Endothecium → In those plants where the nucellus is completely used up the embryo sac comes in direct contact with the inner layer of the integument because the nucellus degenerates early in the development

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the ovule.

The cells of inner integument become radially elongated dense in cytoplasm & large nucleate. They become similar to the tapetum of the anther. It is for this reason that this layer is known as the integumentary tapetum or endothecium.

Its suggested functions are - a) Intermediary for the transport of food material from the integument to the embryosac.

b) as agent for the conversion of food material for the use of embryosac.

c) as the protective layer