

FORMATION OF THE INTRANUCLEAR ROD IN  
SUCCINEA OVALIS SAY.

C. P. HICKMAN, DePauw University.

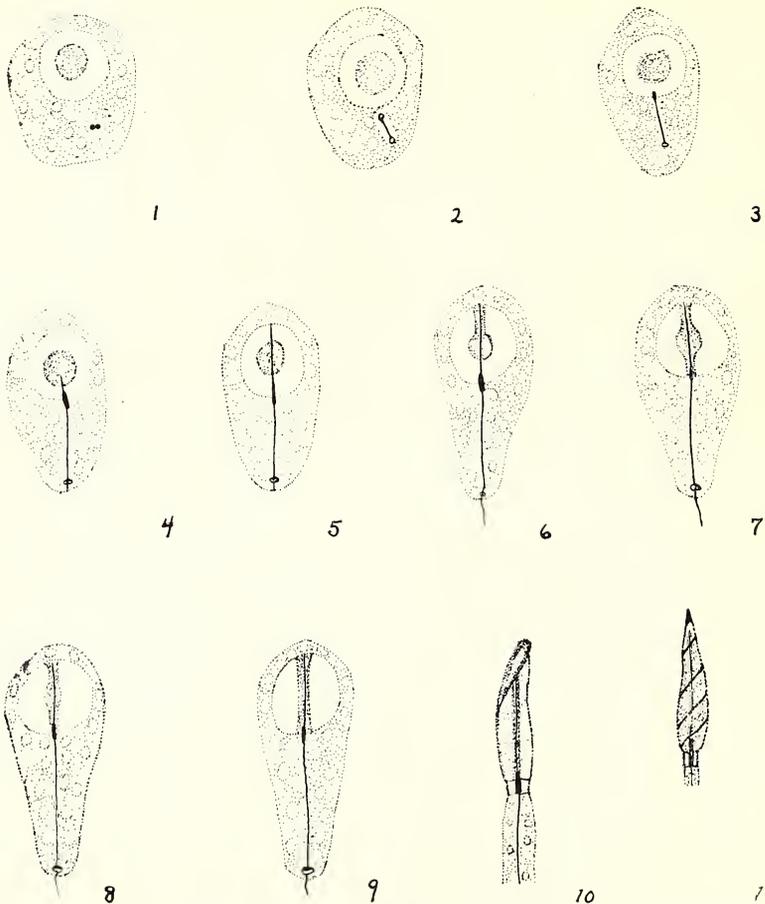
The view of the older cytologists that the centriole and accessory structure axial filament were confined to the middle piece and base of the sperm head has been disproven in a number of cases brought to light in the past few years. It is now definitely decided that, in some forms at least, there are prolongations of the centriole extending through the entire head of the sperm. Whether or not one of these structures (commonly known as intranuclear rods) represent the actual centriole itself has not been proven. But it is quite evident that this rod does represent a definite part of the main axis around which the sperm is built. Or, in other words the intranuclear rod may be considered to play the same part in the sperm head that the axial filament plays in the tail of the sperm.

Although the presence of an intranuclear rod has been reported by a number of observers, its exact mode of origin seems to vary greatly with the different forms in which it has been described. It is possible, of course, that there can be considerable variation in its mode of formation, but it is also quite probable that a large percentage of this lack of uniformity has arisen out of the difficulties attending the study of the sperm head at the time when the rod is being formed. Only the most careful technique and under the most favorable circumstances will reveal the secrets of this baffling structure.

In the case of the common terrestrial pulmonate, *Succinea ovalis* Say, the intranuclear rod is formed in a manner entirely different from that described in other forms. This snail, in common with other pulmonates, has two centrioles in its spermatid stages. One of the centrioles is found located eventually at the periphery of the sperm nucleus and is known as the proximal centriole; the other is found in that part of the spermatid that becomes the tail and is called the distal centriole. In the early history of the spermatid the two centrioles which at first lie close together separate and an axial filament grows between them (figs. 1 and 2). The proximal centriole grows toward the nuclear membrane, becomes thick and rod-like and finally penetrates the nuclear membrane, thus partially extending into the nuclear cavity (fig. 3).

As the spermatid elongates a very fine projection, the anterior axial filament, grows forward from the proximal centriole into the nuclear cavity, finally reaching a dense darkly-staining mass located within the central region of the nucleus (fig. 4). Later, the rod or filament reaches the nuclear membrane at the point where the future acrosome is laid down (fig. 5).

Just as soon as the anterior axial filament has reached through the nucleus, the darkly-staining mass of material begins to undergo a change. At first, a prolongation of the mass is sent along the filament toward the anterior pole (fig. 6), and later another prolongation of the mass is sent toward the proximal centriole (fig. 7). In later



Figs. 1-11. 1-4. Early spermatids. Development and growth of centrioles and axial filaments; 5-6. Later spermatids, showing origin of anterior axial filament; 7-9. Still later spermatids. Sheath is being formed around the filament; 10. A late stage in the formation of the sperm head; 11. Mature sperm head. Intranuclear rod shows faintly after destaining. (All figures drawn with a 2mm. Leitz apochromatic objective and a No. 12 ocular.)

stages this mass is closely applied to the filament, forming a very compact sheath (figs. 8 and 9). The whole structure is now known as the intra-nuclear rod and can be made out in all later stages with the proper technique.

In the mature sperm head the rod is most commonly obscured by the deep stain of the dense chromatin. However, its presence can be detected by destaining or by maceration of the sperm (fig. 11).

From this account, it is seen that there is no evidence in this form for the view that the mitochondria help form the sheath around the filament, such as has been described for certain prosobranchs. The sheath here is formed entirely from a darkly-staining mass of material which resembles chromatin in many respects. Whether or not it is chromatin has not yet been determined with certainty.