

of perception of this distinction it may be noted that Verworn's treatment of the whole subject of cell processes is greatly weakened, if not vitiated. His facts prove that nucleus and cytoplasm are equally essential for the full function of the cell, not that they are of equal value. We may as well argue that in the community of bees the individual drone or worker is of importance equal to the Queen, because we find that the Queen-bee, if separated from the rest of the community, is incapable of obtaining food for herself and so starves to death. I shall refer later to what I regard as the right conception of the relationship between cytoplasm and nucleus.

(2) *Gross Changes in the Nucleus during Activity.*

Among these may be noted, (1) alteration in the position of the nucleus in cases in which there are indications of localized as distinct from diffuse cell activities, and (2) alteration in size and shape of the nucleus accompanying active function.

In the animal organism possessing cells with a body which is small in proportion to the size of the nucleus, examples of the first order would appear to be rare, though they are not entirely wanting. Thus Korschelt has shown that in the egg rays of the water scorpion (*Nepa*) with their cells having remarkable branching nuclei; long branches from two adjoining cells send out processes which come into close proximity. In the space between these a chitinous deposit gradually shows itself, and when the mass of chitin is fully formed the processes are withdrawn. In the plant, movement of the nucleus towards the area of new formation in the cell is relatively common; thus when there is the active formation of a thick cell membrane along one aspect of the cell it has been noted that the nucleus becomes eccentric and approximated to the region of new development. There is a similar eccentric localization of the nucleus during the development of root hairs (Haberlandt). I need but mention instances of the second, viz.: of alteration in size—they are now so well known. The earliest observations were those of Heidenhain years ago upon the different appearance of the nuclei of salivary glands when at rest and after stimulation. In more recent years we have had the striking observations of Hodge, confirmed by Gustav Mann, Lugaro and others, upon the nuclear alterations in the motor ganglion cells of bees, birds, cats and other vertebrates, brought about by natural and experimentally produced fatigue.

These observations also clearly demonstrate that *the nucleus is not merely the vegetative centre of the cell, but is involved in its functional activities.*