

lay before you the main data that have been gained under each of these headings and the conclusions that may reasonably be deduced.

(1) *The Effects of Removal of the Nucleus.*

The cell which, like the erythrocyte, undergoes natural loss of its nucleus may continue to exist for a considerable period, and, during that time actively perform function. The mammalian red corpuscle for example, according to W. Hunter, Quincke, and others, exists from fifteen to thirty days. While it exists we see no evidence of growth, and certainly it never propagates itself. The same holds good for cells artificially deprived of their nuclei; they do not necessarily undergo immediate disorganization; they can be the seat of certain metabolic activities. According to Klebs, the enucleated cells of the alga, *Spirogyra*, can in the sunlight produce new starch granules; can, that is, synthesize starch from the carbon, oxygen and water absorbed, the starch thus formed in the sunlight being used up in the dark; and this may continue for as long as six weeks. They may further continue to exhibit motion in response to external stimuli (*Lacrymaria olor*, Verworn); they may actively ingest food particles. But, on the other hand, the testimony is unanimous that higher metabolic activities are incomplete. Unlike nucleated portions of a vegetable cell, the enucleated is unable to develop a cell wall of cellulose. Among protozoa also Verworn has noted that enucleated pieces of *Foraminifera* show not the slightest capacity to form the internal calcareous skeleton. If the enucleated cytoplasm of *Thalassicola pelagica* ingest foreign particles, it is unable to digest them wholly, and while the enucleated cytoplasm can develop a new centrosome (E. B. Wilson) it cannot give rise to new nuclear material. It may be laid down that if it can form new paraplasmic substances, like starch, it cannot form new cytoplasm and cell substance proper; that is to say, it cannot increase in bulk and undergo cell division and multiplication; or, otherwise, *these observations conclusively prove that the nucleus is essential, not merely for the vegetative activities, but also for the higher metabolic activities of the cell and their due co-ordination.*

That the nucleus alone deprived of surrounding cell substance cannot regenerate the cell is another matter. It has freely to be admitted with Verworn, Boveri, and Lillie, that there must be a certain minimal quantity of cytoplasm associated with the nucleus before regeneration can take place. But what this proves is not that the nucleus is not the dominating portion of the cell complex, but only that the association of nucleus and cytoplasm is essential for full cell activity. By the lack