

of certain metabolic activities, but the cytoplasm is progressively used up and is not renewed, there being no cytoplasmic or nuclear material formed. On the other hand, the nucleus without the cytoplasm is equally incapable of regenerating the cell, for it has been proved that there is a minimal limit to the amount of cytoplasm necessary for its combined existence. If there be less cytoplasm than this, no growth or regeneration can occur, and we add this statement to what we have already said of the dominance of the nucleus, that nucleus and cytoplasm are equally essential, though not of equal value to the cell. The nucleus cannot treat directly with the medium around the cell, but requires the intermediation of the cytoplasm for its vital processes. We need only refer to the part played by the nucleus in cell division, to the series of processes by which it insures that each daughter cell obtains its share of the nuclear material, to the part it plays in fertilization and the reproduction of the individual, and we shall refer in some detail to the great activity of the nucleus in cell metabolism. In basing its dominance upon these facts, we do not lose sight of the fact that the cytoplasm is able to manifest certain definite, if lower, vital activities, such as absorption, respiration, mobility, and contractility, and these independently of nuclear control.



FIG. 5
Relationship of nuclear plasmasomes to zymogen granules and secretory substances of secreting cell: a, intranuclear plasmasomes (nucleolar bodies); b, granule (extranuclear plasmasome or chromidial body) in cytoplasm, near nucleus, having same staining reaction as, and evidently discharged from, the nucleus; c, conversion of same into more feebly staining secretory (prezymogen) granules; d, further stage: zymogen granules about to be discharged. (After Maximow.)

The Part Played by the Nucleus in Metabolism.—The specific function of certain cells, especially certain secreting cells, seems to be governed largely by the nucleus. The calcareous frame of the foraminifera is not formed if the nucleus be absent; the amoeba cannot fully digest, though it can kill living organisms if it have no nucleus; the formation of chitin in insect cells occurs only when the nucleus is present, and the nucleus is essential to the production of slime by

the amoeba. In mucous goblet cells and in the cells of salivary glands the process of secretion is accompanied by and probably depends upon the separation from the nucleus, and that more especially through the nucleolus, of granules, or **chromidia**, which stain deeply at first while they lie near the nucleus, and stain less deeply as they move away, until they appear actually to become the secretory granules. The secretory granules are either actually extruded parts of the nucleus, or the products of interaction between such extruded parts and certain constituents of the cell body. The "prezymogens" of the cell are given off from the nucleolus, and in the cytoplasm become zymogens, being again given off from the cytoplasm as specific secretions.

The formation of fat in fat cells is evidently a nuclear process, for