

Having now discussed the causes of hyperæmia, there remains for consideration the changes in cell structure, and these have been demonstrated in a remarkable and most interesting manner by the researches of Hodge. This observer found that the metabolic changes in nerve cells could be seen quite as distinctly under the microscope as those changes occurring in gland cells (for example, the salivary glands), and farther, that these were always of the same character. He examined animals, birds and bees. For the former he used electrical stimulation, and for the latter the observations were conducted from a standpoint of normal fatigue. For the electrical stimulation he exposed a posterior nerve connected with a spinal ganglion, and after the nerve had been acted on for a certain time, the animal was killed and the ganglion removed, together with its unstimulated fellow of the opposite side, and both were then treated identically the same for microscopical examination. Birds and bees were examined by taking a specimen from the brain early in the morning before any labor was done, and another from the brain of the same genus in the evening after the day's work was over, treating each in exactly the same manner for mounting. In all instances changes were found in the nerve cells, and, moreover, those changes were always the same. The nucleus is most markedly affected and in this is found, after both electrical stimulation and normal fatigue, a decided decrease in size, a change from a smooth and rounded to a jagged outline, and a tendency to take on darker stains than during a state of rest. The protoplasm of the cerebral cells shows a considerable shrinking with enlargement of the pericellular lymph space and a decreased power of taking on stains. The diminution of nucleus volume shrinkage in these cells varied in fatigued birds from thirty-six to sixty-seven per cent. A glance at the accompanying photographs will show (1) that in the unstimulated cell the nucleus stains lighter than the protoplasm; (2) that the first effect of stimulation reduces the staining both of nucleus and protoplasm to one of equal intensity, which condition would indicate that the nutrient material is being used up by bringing the cell into action. As stimulation is continued it is seen (3) that the nucleus stains steadily and distinctly darker, and that it becomes deformed and crenated. This would indicate that the limits of functional activity have been reached, but that the cell may still recuperate with rest. On farther stimulation the cell experiences a condition of collapse in which neither protoplasm or nucleus will take any stain, and from which probably no recuperation can take place.