differentiation, a change in enzymes can give better information about a causal connexion, as is the case in an intact plant.

In our experiments, and also in the literature, there are examples of many enzymes where there are characteristic changes in the isoenzyme patterns. For this purpose we have been working with plant tissue cultures of various origins (*Anagallis arvensis*, *Brassica oleracea*, *Daucus carota*, *Nicotiana tabacum* and *Sinapis alba*) to see whether the desired changes in the isoenzymes exist, and if from these results corresponding conclusions can be drawn. Moreover, it will be considered whether this change in enzymic activity depends on the new synthesis of one or many enzymes, or whether there is an activation of already existing enzymes.

Hormonal Control of Cell Division and Differentiation *in vitro*

By I. K. VASIL (*Department of Botany, University of Florida, Gainesville, Fla., U.S.A.*)

Excised 1 cm terminal root segments from germinating seeds of tomato (*Lycopersicum esculentum*) and whole mature seeds of sweet pea (*Lathyrus odoratus*) were cultured *in vitro* on modified White's and/or Murashige & Skoog's nutrient media to study the morphogenetic and fine structural effects of various plant growth substances.

Segments of tomato roots were cultured in modified White's medium in suspension cultures on a shaker. Roots grown in a medium without any auxins show normal growth and double their length in about 10 days; lateral roots appear in normal sequence. The histology of these roots compares closely with that of control roots taken from young seedlings grown on moist filter paper for 7–10 days. In media containing indol-3-ylacetic acid, extension growth of the roots is terminated, the cytohistological zonation of the root tip is lost, and a very large number of loci of intense meristematic activity appear all along the root segment in the region of the pericycle. This activity gives rise to lateral root primordia, which push their way into the cortical region of the parent root but do not emerge out of the root. As a result, the entire root takes on a nodular appearance. Kinetin induces the accumulation of numerous starch grains, which are characteristically grouped around the nucleus in most cells of the root. The typical organization of the root tip is lost, there is no extension growth, and the vascular elements differentiate and extend right up to the root-cap region. Gibberellic acid causes appreciable extension growth, enlargement of cortical and pith cells, and the formation of numerous normal lateral roots. Histochemistry and fine structure of such cultured roots has been studied.

Various phenoxyacetic acids significantly alter the course of morphogenetic development of germinating sweet-pea seeds in Murashige & Skoog's nutrient medium. Extensive cell proliferation takes place from the pericycle region of the hypocotyl, giving rise to an undifferentiated mass of callus tissue. Cells undergoing repeated mitoses are small and show large nuclei with swollen and vacuolated nucleoli, and a non-vacuolated cytoplasm that is rich in RNA. The nuclei of the callus cells are lobed and show numerous enlarged and fragmenting nucleoli with a large population of ribonucleoprotein particles around them. Actinomycin D inhibits cell proliferation caused by phenoxyacetic acids. The swelling and fragmentation of the nucleoli and the formation of numerous ribonucleoprotein particles at the nucleolar sites are interpreted as the response of cells to auxin treatment leading to the formation of increased amounts of rRNA, ribosomes and proteins. These observations confirm the results obtained in histochemical and biochemical studies on auxin action in plant tissues.

Distribution of Photosystems 1 and 2 in the Chloroplast Lamellar Structure

By P. V. SANE (*Shraddhanand peth, Post-Ajani Nagpur, India*)

Spinach chloroplasts were fragmented by using a French pressure cell. The fragments were separated by fractional centrifugation to obtain 1000g (1K), 10000g (10K), 40000g (40K) and 160000g (160K) fractions. The 160K fraction, on the basis of its chlorophyll *a/b* ratio, photochemical activities, cytochrome *P-700* content and Mn content, appeared to contain only photosystem 1, whereas the 10K fraction seemed to be enriched in photosystem 2. The ultrastructural studies showed that the 160K fraction originated from stroma lamellae and possibly end-grana membranes, whereas the 10K fraction originated from the grana stacks. On the basis of these studies a model for the distribution of function among the lamellar structure of a higher-plant chloroplast will be discussed.