under a variety of conditions ranging from dense shade under warm, humid forest to edges of forest. There seem to exist several varieties or forms, differing in fruit size and taste and in leaf characters. Among the latter may be mentioned complete absence of thorns in leaves, more so than in the Smooth Cayenne cultivated variety. Others have thorns retrorsely and antrorsely oriented. One such variety differs so little from its relative, *Bromelia Pinguin* L., that only the expert natives (Piaroa Indians) could distinguish them. While only one variety growing wild was found sweet and palatable enough to be desirable, Piaroa Indians have had under cultivation since time immemorial some varieties which yield large, tasty fruits. The wild varieties have abundant seed, one ovary alone having yielded 14. This is in contrast to the present commercial varieties and the sparingly established Pan de Azúcar in P. R., which are largely seedless. Samples of all of these have been brought to the Institute of Tropical Agriculture, at Mayagüez, Puerto Rico, to be used for breeding purposes if they survive there.

ISMAEL VÉLEZ

Polytechnic Institute and *Institute of Tropical Agriculture, Puerto Rico*

A Nutritional Concept of Cancer

While the etiology of cancer has been categorized under infection by a transmissible virus on the one hand and gene mutation on the other (not to mention a host of other hypotheses), there has been relatively little speculation on the biochemical mechanisms whereby any of these events could lead to the process recognized as neoplastic growth. Recent studies by Beadle, Tatum, and others, on the genetic control of biosynthetic reactions in the fungus, *Neurospora,* have provided a foundation for new concepts of the biological regulation of growth. In particular, a study by Ryan and Lederberg (*Proc. nat. Acad. Sci., Wash.,* 1946, 32, 163–173), on the "adaptation" of a *Neurospora* mutant deficient in the synthesis of leucine, has provided an experimental basis for speculative analogy with neoplasia.

Field strains of *Neurospora* will grow on medium containing only sugar, salts, and biotin, which is to say that the fungus is capable of manufacturing all other essential metabolites. As the result of mutations of single genes, the capacity for synthesis of various compounds may be lost. A similar process presumably accounts for the nutritional requirements of higher forms.

Following ultraviolent treatment, a mutant strain of *Neurospora,* #33757, has been isolated which is incapable of synthesizing leucine. As a consequence, this strain requires leucine, and its growth is quantitatively regulated by the available supply.

Occasionally, cultures of leucineless *Neurospora* grown on limiting amounts of this amino acid will "adapt"; that is, an exceptional fragment of the mycelium will grow autonomously, irrespective of the available leucine, and may under certain conditions overgrow the culture until the sugar is exhausted. By genetic analysis of crosses between adapted and wild strains, it has been shown that adaptation depends on the mutation, or reversion, of the leucineless gene to an allele capable of mediating the synthesis of leucine.

A culture of leucineless *Neurospora* has, then, two growth potentialities: a regulated growth corresponding to the leucine externally available to it, and, exceptionally, autonomous growth on the basis of a gene mutation leading to the synthesis of that metabolite.

If one correlates normal tissue cells with a culture of leucineless *Neurospora,* both regulated by their environment, a simple analogy for cancer is evident—the newly found capacity of a cell to synthesize an essential metabolite otherwise available only in limiting and regulatory amounts.

While the *Neurospora* experiments suggest a mutational origin for this capacity, virus infection, by providing a missing link for a blocked enzyme system, could play a corresponding role. A consequence of this simple concept is that cancer cells may be found to differ in their growth factor requirements from cells of normal origin when they are grown *in vitro.*

JOSHUA LEDERBERG

Osborn Botanical Laboratory, Yale University, and *College of Physicians and Surgeons, Columbia University*

Education and the Foundations of Science

It is no surprise that students and leading citizens should make as poor a showing on Dr. Ralph H. Ojemann's tests of their conception and appreciation of scientific research as that exhibited in his article (*Science,* 1946, **104**, 335–338). Dr. Ojemann has evidently presumed that a pupil who has studied sciences for some years will have learned what he calls "the basic concepts involved," including, especially, one which he identifies as "study through controlled variables" (which he also calls "the most dependable type of study"). Such a presumption is unfortunately not to be justified by reference to the laboratory or to popular textbooks. Rules and procedures are learned, more or less, as are the results they produce; but the idea or philosophy of the business is either wanting altogether, or else set forth without explanation or quite arbitrarily and dogmatically.

This, however, is no wonder. Suppose an explanation of the method of "controlled variables" were undertaken; if it were of scholarly competence, it would shortly lead to Mill's celebrated Methods of Experimental Enquiry, since this particular method is but an application of one or two of these. But alas—these themselves are far from rigorous, as the explanation would also demonstrate. Supposing that it was intended to seek farther for an explanation; the concept of method *per se* and of explanation *per se* would demand attention. These are chiefly logical and epistemological matters. But logical and epistemological matters are little considered in American education. It is then a matter of course that students and others, even though long devoted to science, should be at a loss when confronted with problems which presuppose competence in those unknown directions.