Book Reviews

Bioenergetics. Albert Szent-Györgyi. Academic Press, New York, 1957. x + 143 pp. Illus. + plates. $4.50.

Bioenergetics is the latest in a series of books in which Albert Szent-Györgyi has given us a lively running account of his efforts to understand the chemical and physical bases of life-processes.

The present work is about the utilization of energy by living things. It is based on an evaluation of our present knowledge of cellular chemistry, which no student of biochemistry can afford to forget. We know a great deal about how cells release energy from foodstuffs but very little about how this energy is put to use as work. What is more, "Dazzled by our successes we even forget to ask."

With characteristic directness, Szent-Györgyi dedicates his book to an attack on this area of ignorance, for he is convinced that "Such a schism between the known and the unknown suggests that some basic information is missing."

The problem is to discover how the energy that is associated with a chemical bond, and which has no influence beyond the limits of a given molecule, may be converted into a transferable, externally active form. To make matters easy for biologists, and to avoid "an argument with statistical mechanics," Szent-Györgyi adopts separate notations for the two types of energy, the symbol E^* representing the transferable form which accomplishes work. E^* is associated with an excited state of a solid system and represents energy transferable within such a solid. Biological macromolecules, especially proteins and nucleic acids, are solid-state systems capable of conducting E^* and delivering it to the point at which it may link up with a work process.

This proposition stated, Szent-Györgyi devotes several succeeding chapters to presentation of supporting evidence. The evidence is derived from relatively simple experiments on fluorescence and phosphorescence. Since excited states of the type denoted by E^* frequently decay by delayed emission of light, these phenomena are a source of rough information about systems capable of generating and transferring E^*. The evidence is suggestive rather than final. Nevertheless, the experimental facts provide Szent-Györgyi with a framework for some stimulating discussions of the problem of energy transfer in biological systems and the possible roles played by biologically important substances, especially water.

The remainder of the book is frankly speculative, dealing with possible relations between E^* and various aspects of normal and pathological biology. Szent-Györgyi's speculations are always worth reading.

This book is valuable because it is an eloquent plea that we give attention to the vital areas which modern biochemistry, which is so successful in other ways, appears to be unable to master. Biochemical analysis of cellular processes is based on the behavior of dilute homogeneous solutions. The conceptual framework is that of the chemist; its cornerstone is the chemical reaction between colliding molecules. What Szent-Györgyi tells us is that the reactive systems of the cell are not solutions but structurally organized solids and that the chemical events of life are more nearly related to solid-state physics than they are to solution chemistry.

A partisan of Szent-Györgyi's cause would wish that his appeal were more firmly founded on modern solid-state physics. This field is developing at a remarkable rate, but relatively little of recent knowledge about energy transport in solids is reflected in Szent-Györgyi's book.

This failing is not wholly Szent-Györgyi's responsibility. His first plea that biochemistry take heed of the solid state was made 16 years ago in an article in *Science* [**93**, 609 (1941)]. Six years later, in his essay on the continuum theory—which is essentially the same as his present proposal—Szent-Györgyi made some trenchant comments on the impact of this previous article. "In the course of my career as a biochemist I was more and more depressed by the feeling of complete failure, not being able to explain a single reaction. Much relieved by the new theory of matter (*i.e.*, energy levels in solid semiconductors), I gave vent to my joy in an article in *Science* entitled 'Towards a New Biochemistry?' By this rather ambitious title I wanted to emphasize that the application of this new theory to living systems might mean a new period in biochemistry. The reaction to this article was rather amazing: There was none at all" (in *Muscular Contractions*, Academic Press, New York, p. 97).

If Szent-Györgyi's first call had been heeded by biochemists and other investigators, the intervening 16 years might have seen a vigorous application of solid-state physics to the problem of biology, and we would now be able to substitute fact for speculation.

The readability of this book is somewhat marred by printing defects.

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Educating Gifted Children. Robert F. DeHaan and Robert J. Havighurst. University of Chicago Press, Chicago, Ill., 1957. ix + 276 pp. $5.

Educating Gifted Children is one more book in the considerable number which have appeared in recent years evidencing the mounting interest in superior youngsters and awareness of the importance of finding them and nurturing their potentialities. As is set forth in this volume, there is a responsibility for helping gifted children not alone for their sake and for that of the community; the international situation makes it urgent that this country find its best young people and give them such training and opportunities as will bring them to maximal fruition.

The treatment is systematic and broad, and it aims at practicality. Thus, the third chapter, on screening children for ability, considers tests of various types and also ways of systematizing the observation of teachers, parents, and other children in locating exceptional talents of various sorts—as in science, the fine arts, and music. A following chapter, on screening programs in action, describes ways of setting up such programs in a school or school system, with a chapter next following on administrative aspects of an educational program for gifted children.

Other chapters deal with the long-standing controversy between enrichment and acceleration (why not, the authors wisely and diplomatically say, some of both?); with motivation of the gifted; with values of special grouping and ways of serving the gifted child in the classroom; and with the development of creativity and special talents. Unusual breadth is evidenced by chap-