which is the best currently available on ticks in general. Parasitologists, health officers, and medical entomologists, as well as people in related academic fields will find the book particularly helpful as a summary of the knowledge of ticks and to a lesser degree, as a source of information on diseases that ticks transmit to man and his domestic animals.

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Regulation of Growth

Regeneration. Dorothea Rudnick, Ed. Ronald, New York, 1962. v + 272 pp. Illus. $9.

These papers, which were prepared for the 1961 symposium on growth, reflect the importance of control mechanisms in the regulation of growth. Each paper emphasizes how the components of regeneration, including morphogenesis, differentiation, dedifferentiation, proliferation (and even reproduction) are complex processes that cannot be left to chance. It is natural, therefore, that hypothetical growth-regulating factors should be postulated. It is abundantly obvious that such factors are easier to speculate about than to identify.

However, one group of such agents has been chemically characterized—the plant hormones. Stonier, for example, describes how the application of auxins in appropriate doses to decapitated tobacco plants will elicit shoot outgrowths from wound tissues that are otherwise incapable of regeneration. Yet not all plant systems are so obliging, for Steeves stresses the importance of elucidating the nature of hypothetical "morphogenetic substances" presumably responsible for determining whether an isolated fern leaf primordium will become a shoot apex or a leaf.

Zoological systems confront the investigator with equally perplexing phenomena. Rasmont analyzes asexual reproduction by gemmule formation in sponges, and concludes that gemmulation rate is a function of the increasing population density of archeocytes in relation to the number of differentiated cells. But how one translates concepts of size and population densities into chemical and physiological terms remains to be demonstrated. In another chapter, Burnett treats the reader to a lucid account of how the hypostome of the hydra stimulates growth in the subjacent region, which in turn provides cells to the rest of the organism. This contantly regenerating creature must possess a variety of control mechanisms if it is to remain a recognizable hydra. Thus, cells induced to proliferate under the influence of growth stimulators are themselves the source of a growth-inhibiting substance that suppresses proliferation elsewhere in the body. A similar interplay of inducing and inhibiting influences is proposed by Wolff to explain the sequence of interdependent events that occur in planarian regeneration. It is encouraging that at least one of these hypothetical influences has gained some substance as a result of the demonstration that brain extracts can induce regeneration of eyes in planaria.

There may be comparable mechanisms operating in vertebrate regenerating systems. This is most clearly illustrated by Reyer's account of the proposed stimulatory effect that the neural retina exerts on lens regeneration from the iris of the newt eye, an influence also responsible for the remarkable polarized orientation of the regenerated lens. (More problematical is the status of an inhibitory effect of the original lens on the lens-regenerating cells of the dorsal iris). The regenerating amphibian limb still challenges the experimentalist to explain in theoretical terms the controlling mechanisms of its morphogenesis, as Rose's contribution emphasizes. Hay's impressive investigations with the electron microscope have gone far to dispel much of the confusion that once surrounded the phenomenon of cellular dedifferentiation. Clearly, dedifferentiation of chondrocytes and muscle fibers occurs as a prelude to blastema formation; what the implications are in relation to the potentialities of subsequent blastema cell differentiation is an important problem yet to be solved.

If we can extrapolate from these examples of current interests and achievements in the field of regeneration, we may confidently expect the experimental demonstration of many more growth-regulating factors in the future. But unless greater emphasis is placed on modern biochemical approaches, so conspicuous by their absence in this volume, the eventual chemical characterization of such factors will be inexcusably delayed.

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Reinitzer's Crystals

Molecular Structure and Properties of Liquid Crystals. G. W. Gray. Academic Press, New York, 1962. vii + 314 pp. Illus. 63s.

Liquid crystals, discovered in 1888 by Reinitzer, comprise several states of matter intermediate between ordinary liquids and true crystals, for they are capable of flowing, much like liquids, but they are optically anisotropic. Most scientists probably learned of these crystals as a result of Lehmann's book *Flüssige Kristalle,* or of the 1933 symposium sponsored by the Faraday Society on liquid crystals and anisotropic melts. This is the first book in English on this subject.

There are ten chapters: "Introduction" (16 pages); "Smectic, nematic and cholesteric mesophases" (38 pages); "The identification of mesophases and the determination of mesomorphic transition temperatures" (11 pages); "Molecular arrangement and order in the nematic mesophase—the swarm theory and the distortion hypothesis" (14 pages); "X-ray, ultra violet and infra red spectroscopic and proton magnetic resonance studies on the mesomorphic states" (17 pages); "Other physical characteristics of the mesomorphic states" (28 pages); "Liquid crystalline behavior of mixtures" (14 pages); "The mesomorphic behavior of compounds and their chemical constitution" (58 pages); "The regular trends of mesomorphic transition temperatures for homologous series" (42 pages); "The effects of substituents and of steric factors on mesomorphic thermal stabilities" (61 pages).

The first chapter is a general introduction to liquid crystals, for which a better name is Friedel's term *mesophase.* The *mesomorphic state* is known only among organic compounds that have more or less elongated molecules. Such a compound may, in general, exist in more than one mesomorphic state, in addition to the crystalline and liquid states. A typical compound might pass through these states successively when heated, with the mesomorphic states occurring between the crystalline and the liquid states. There are three distinct categories of mesomorphic states, smectic, nematic, and cholesteric. In chapter 2 some characteristic properties of these phases are described. In