Determinants of Plant Growth

The Shoot Apex and Leaf Growth. A Study in Quantitative Biology. R. F. WILLIAMS. Cambridge University Press, New York, 1975. viii, 256 pp., illus. $18.95.

Williams believes that contemporary analyses of growth and morphogenesis of the shoot tip of plants overemphasize biochemical and physiological mechanisms, and he sets out to demonstrate that physical constraint is an effective determinant of growth and form. His analysis is based on serial transverse sections from which he reconstructs "three-dimensional" models of the shoot tip. In the reconstructions successive sections are indicated by contour lines, producing what one of his colleagues has called "Michelin-type" drawings. By starting at seed germination and sampling at frequent intervals, Williams has been able to measure size and shape changes in the terminal meristem and in each leaf and to derive quantitative values for growth with a degree of precision that has not previously been attained. He has done this for the vegetative shoot tip of 13 species and the inflorescence of one. All the data are from his own work or that of his collaborators and students; many of them are published here for the first time.

Perhaps the most remarkable of his findings is that the relative growth rate of a newly emergent leaf rises to a peak and then declines as the leaf makes contact with its older neighbors in the bud. Its further growth is then constrained by its continued contact with these other leaves. This conclusion, which is central to his assigning priority to physical forces in development, has not been tested experimentally, but one could easily do so by removing outer leaves from a bud and measuring growth rates of the remaining unrestrained leaves. Williams's approach throughout is analytical, not experimental, but the results are presented in a way that leads the reader to devise experimental tests.

Perhaps less successful is his attempt to account for the position at which new leaves emerge in terms of physical forces. He observes that leaves are tightly packed together in the bud and supposes from this that new leaves arise at positions where packing and constraint are least. This is a restatement of an earlier hypothesis that leaves arise in the first available space. Williams considers the alternative hypothesis, that leaves arise as the centers of growth fields that can be specified in biochemical terms, to be unsatisfactory. However, the kinds of apices that he has examined, in which new leaves do emerge close to older ones, are probably not a sufficient basis for making a choice between these hypotheses. There are other apices, such as those of *Selaginella*, *Dryopteris*, and *Nuphar*, in which leaves are widely spaced at initiation. In these, leaf position cannot be defined in terms of physical contacts and constraints.

The Shoot Apex and Leaf Growth, like its predecessor in this series, *Analysis of Leaf Development* by R. Maksymowych, could not be used alone as a text for a course. Its scope is too restricted and its viewpoint too personal, since it deals almost entirely with the researches of its author and his associates. Nevertheless, its illustrations are among the best available for giving a conception of the changing shape and size relationships of the parts of a growing apex, and the method of shoot tip reconstruction, although it appears to require an enormous amount of effort, is useful for anyone interested in shape and volume changes in organs that are too small to measure in conventional ways.

IAN SUSSEX

Department of Biology,
Yale University,
New Haven, Connecticut

Hemoglobinopathies

Man's Haemoglobins. Including the Haemoglobinopathies and Their Investigation. Second edition. H. LEHMANN and R. G. HUNTSMAN. Lippincott, Philadelphia, 1975. xii, 478 pp., illus. $32.

Proceedings of the First National Symposium on Sickle Cell Disease. Washington, D.C., June 1974. JOHN I. HERCULES, ALAN N. SCHECHTER, WILLIAM A. EATON, and RUDOLPH E. JACKSON, Eds. National Institutes of Health, Bethesda, Md., 1974 (available from the Sickle Cell Disease Branch, NIH, Bethesda). vi, 414 pp. DHEW Publication No. (NIH) 75-723.

Hemoglobin was one of the first proteins to have its three-dimensional structure solved by x-ray crystallography, and it has received more attention from research workers than any other single protein. Thus at a time when basic research is under scrutiny some disappointment may be justified if the wealth of information we have about hemoglobin cannot be applied in some constructive treatment of the hemoglobin pathologies. The situation is especially acute in the case of sickle cell disease, which afflicts far more people than any other well-defined molecular disease, apparently as a result of the survival advantages conferred by the enhanced resistance to *Plasmodium falciparum*, the parasite of malignant malaria, that is associated with sickle cell trait. Taken together the two books under review provide a fairly complete view of the extensive work on hemoglobin and its variants (in Lehmann and Huntsman) and the latest efforts to understand and treat sickle cell disease (in Hercules *et al.*).

Man's Haemoglobins focuses on the discovery and structures of the variants of human hemoglobin. Beginning with hemoglobin S many variants have been studied during the last 25 years, and the list now numbers over 200. The implications of the resulting body of information for medicine, biochemical genetics, and anthropology are discussed in detail. Considerable background is presented in each of these areas. For example, individual chapters are devoted to protein synthesis, to protein chemistry, and to elementary genetics. The emphasis in each of these treatments is on the variants of hemoglobin. Sickle cell hemoglobin receives the most attention, but other abnormal forms and the thalassemias are discussed in detail and a list of all known hemoglobin variants is presented. The final part of the book is a description of techniques used in the study of abnormal hemoglobins, such as detailed recipes for electrophoresis.

Lehmann and Huntsman's book is very much a "natural history" of the hemoglobins and includes many anecdotes; humor and tangentially related photographs of works of art are also interspersed with the scientific material, so that the book has an unusual flavor for a scientific monograph. The humor may appear to many as from another era, but to some extent so is the naturalist's approach taken by the authors. Although strong and up to date on the structure and distribution of abnormal hemoglobins, the book is weak on their physical-chemical properties. A number of important parameters in the characterization of hemoglobins, such as the kinetics of oxygen binding, are ignored completely, and the few mechanistic details that are presented suffer from a too-literal acceptance of some speculative hypotheses presented by Perutz in 1970. No mention is made of the allosteric model, which has provided the basis for interpreting many functional properties of hemoglobin and its variants. A token four-page chapter on x-ray diffraction does not do justice to the subject. Thus the book should be viewed principally as a resource on the more medical side of hemoglobin abnormalities. Considerable space is devoted to the treatment of several hemoglobin diseases, with a major section on approaches to sickle cell disease. However, research on the sickle cell

problem is moving rapidly, and for the latest findings the *Proceedings of the First National Symposium on Sickle Cell Disease* should be consulted.

The *Proceedings* is a compilation of 500- to 800-word summaries of some 140 papers prepared for or presented at the symposium. The summaries were submitted at the time of the conference and generally contain ample references. The summaries were not refereed, but most of the authors show a considerable degree of self-restraint in interpreting the therapeutic implications of their findings. The summaries include interesting new findings on the relationship between sickle cell disease and zinc deficiency and the problems of nerve conduction abnormalities in patients given the otherwise effective cyanate treatment. The book also contains a list of references on sickle cell anemia for the period January 1970 to June 1974, obtained by a computer-based literature search. The summaries are organized according to the nature of the session in which they were originally presented: plenary sessions and sessions devoted to molecular, cellular, or clinical aspects of the disease. This arrangement aids the reader in finding items of interest to him and also conveys the breadth of the conference, which covered the full spectrum of approaches to the sickle cell problem. The book represents an excellent compromise between rapid publication of short abstracts, which generally contain only limited information, and the publication of a tailored monograph, which is a more lengthy process and risks producing a work that is somewhat outdated by the time it appears.

STUART J. EDELSTEIN
Section of Biochemistry, Molecular and Cell Biology, Cornell University, Ithaca, New York

Pituitary Histophysiology

The Anterior Pituitary. A. TIXIER-VIDAL and MARILYN G. FARQUHAR, Eds. Academic Press, New York, 1975. xvi, 248 pp., illus. $37.50. Ultrastructure in Biological Systems, vol. 7.

Pituitary morphology, both general and comparative, has been the subject of a number of recent publications that have concentrated on the fetal development, histochemistry, and ultrastructure of the gland, but the approach and subject matter of this collection of papers are refreshingly uncommon. This compact volume is a compilation of current work, much of it still in progress, that combines techniques of cell biology with elegant ultrastructural studies.

The three chapters dealing with in vitro culture methods for pars distalis cells are an exceptional contribution. The cellular heterogeneity of the pituitary and the complex hormonal milieu affecting the intact gland have limited morphologic analysis of secretory processes and prompted numerous attempts at culture. Tixier-Vidal reviews and analyzes the more conventional methods of explant and monolayer culture. Changes in subcellular organelles are correlated with specific supplementation of the medium with such hormones as synthetic thyrotropin- and luteinizing-hormone–releasing factors. Technical problems inherent in the culture methods, such as the preferential outgrowth of prolactin cells in tissue monolayers and the ubiquitous problem of fibroblastic overgrowth, are discussed. Perhaps the most exciting portion of the book concerns the studies of Farquhar *et al.* on successfully maintained, individually separated (dispersed) pituitary cells in vitro. Use of this method permits for the first time clear analysis of secretory function of specific endocrine cells without the problems inherent in whole organism, explant, or conventional tissue culture. The apparent physiological heterogeneity of rat somatotropes revealed by leucine pulse-labeling implies that there may be functionally different subpopulations of all specific endocrine cells.

Follicular cells, which historically have been misinterpreted as chromophobes in light microscopic studies, are studied in vitro. A discussion of their phagocytic capabilities by Farquhar, who first described these cells in 1957, makes enlightening reading for the investigator not directly involved with pituitary morphology who might have been unaware of their existence, let alone their potential significance in the biology of the gland.

Hymer comprehensively reviews the technology of separation of both intact cells and subcellular organelles, particularly secretion granules. Of great interest and potential usefulness is the possibility of density gradient separation of intact pituitary cells into groups of a single class. Although only partial success has been achieved, the method promises to make possible in vitro studies of large populations of a single cell type.

Olivier *et al.* report on a wealth of personal experience with the ultrastructure of human pituitary neoplasms (72 cases). The problem of the functional chromophobe adenoma, reviewed by Herlant in an excellent introductory chapter, is well illustrated. Presentation of the material in tables would have facilitated comparison of secretion granule morphology of tumor cells with that of the corresponding normal cell and might have more clearly expressed the variation in granule profiles in tumors of the same functional type. Follicular cells as components of the commonest pituitary neoplasm, the nonfunctional chromophobe adenoma, are mentioned, but the single electron micrograph does not illustrate the point convincingly. Profiles of small secretion granules in some apparently nonfunctional chromophobe adenomas may, as the authors speculate, represent fragmentary peptide synthesis such as is known to occur in some adrenocorticotropic-hormone–producing adenomas. It will be interesting to test this hypothesis using the elegant methods of immunoelectronmicroscopy reviewed by Nakane elsewhere in the volume.

This volume will be useful to mammalian or comparative morphologists, cell biologists, and clinical investigators. The brief and cogent reviews that introduce each chapter, particularly that of Herlant, put into perspective morphologic problems of the pituitary and their significance to the newer applications of cell biology and make this an ideal review for the student. Clear presentations of the technical methods employed and their limitations are exceptional features of the experimental reports.

MICHAEL D. LAGIOS
Department of Pathology, Children's Hospital of San Francisco, San Francisco, California

Molecular Virology

Early Interaction between Animal Viruses and Cells. KARL LONBERG-HOLM and LENNART PHILIPSON. Karger, Basel, 1974. x, 150 pp., illus. Paper, $35.75. Monographs in Virology, vol. 9.

This is a tightly packed and informative monograph by two investigators of long-standing and productive association with the field. The approach to the subject is patterned somewhat after an earlier review by Philipson (*Prog. Med. Virol.* **5**, 44 [1963]). The expanded scope of the present monograph reflects the enormous amount of new information that has become available in the intervening dozen years, particularly on the penetration of viruses into cells, the uncoating of the viral genome, and the early phases of virus-dependent or other host-cell macromolecular syntheses.

The discussion of individual virus groups in the section on uncoating of the viral gen-