our present knowledge: the nature of the difficulties that confronted the pioneers and the devices used to overcome them. Now that we have passed the crest of the wave of success such insight may be essential for establishing the bases of the next hypotheses. Empirical digging and a sensitivity to incongruous fact are now the order of the day, if we are to come to grips with the mysteries of regulation in differentiated cells.

Hendler's book is a timely antidote to complacency, a reminder of how little we really know, a compendium of odd observations and discrepancies in our understanding of protein biosynthesis, a catalog of embarrassing questions. Hendler is well suited to the task of providing such an antidote, having been associated with the study of protein biosynthesis from its early days and having maintained over the years a reputation for skepticism and a frequently irritating propensity for calling our attention to the parts of the machinery we have been throwing away.

All of the protein-synthesizing systems with which we work are grossly inadequate reflections of the cell's synthetic capacity. They generally function at less than 1 percent of the *in vivo* rate. Within the cell, the reactions involved occur in close association with membrane components, and there is increasing evidence that such implied intracellular organization has fundamental qualitative and quantitative effects upon the much simpler reactions we study in the test tube.

The focus of Hendler's book, then, is the application of membrane biochemistry to the study of protein biosynthesis. His first three chapters are a rather personal, but extremely thorough, accurate, and critical review of the history of the development of our present knowledge of protein biosynthesis. In the process of unfolding this history, he calls attention to striking discrepancies between the behavior of *in vitro* systems and events *in vivo*. His close attention to details of experimental work makes this portion of the book useful to the active investigator. He next proceeds to a detailed account of our knowledge of cell structure, membrane structure and biochemistry, and the relationship of hormones and membranes, again taking a historical view with emphasis on experimental approaches. These chapters are useful in orienting the uninitiated researcher in a complex literature, but their balance and completeness are compromised by the absence of citations of important developments since 1966. The final chapter is an attempt to bring together a large number of isolated, often inexplicable and contradictory observations in the literature on protein synthesis as they relate to membrane biochemistry. The problem Hendler faces, along with the rest of us, is to bring some unity out of the present welter of discordant observations. The value of this chapter is largely that its author has taken the trouble to examine the contents of the wastebasket and remind us that we have yet a long way to go in learning how the cell does the job.

Careful attention to isolated observations of more complex systems involving membrane elements will likely bring new insight into biosynthetic mechanism. Hendler has performed a valuable service in the constructive application of his skepticism and wide acquaintance with a voluminous literature.

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Thin Films

Optical Properties of Dielectric Films. Proceedings of a symposium, Boston, 1968. NORMAN N. AXELROD, Ed. Electrochemical Society, New York, 1968. vi + 290 pp., illus. $9.

Most of the 16 contributions contained in this volume have the character of very short review papers. The first contribution, by H. Ehrenreich, gives an excellent intuitive explanation of the different characteristics of semiconductors and ionic crystals that give rise to the observed differences in band gap, even though some features of the band structures remain similar. A good simplified explanation of the rationale behind the pseudopotential method is given. Thereafter the author makes the comparison between the observed and the calculated optical spectra, with particular emphasis on the importance of the critical points of the joint density of states of the electron hole pair. He might have stressed that the experimental identification of many of the critical points in the reflection or absorption spectra is frequently based on a comparison of their energies with a theoretical band structure. The agreement between the observed and calculated energies is not always good. Only in a very few cases has there been an independent determination of the symmetry of the observed critical points.

In the succeeding paper, by K. J. Teegarden, the problem of the identification of the symmetries of the states giving rise to exciton peaks is again evident for alkali halides. Comparison of the spin orbit splittings of the uppermost filled *p*-like orbitals of the different halide ions is used as a guide for the identification of the *s*-like exciton states described by a hole in a Γ_{15} band and an electron in a Γ_1 band. The Γ_{15} band is split by spin orbit interaction. Frequently one of the terms of this exciton doublet is close to the energy necessary to create other excitons. Here again, a more direct determination of the symmetries of the exciton states would be welcome. Teegarden gives a particularly interesting discussion of the ordering of the Γ'_{25} and Γ_{12} band states in fcc and bcc crystals.

H.-E. Gumlich's review paper treats the case of optical transitions in II-VI compounds (primarily ZnS) containing transition elements of the iron group. Crystal field theory has been extensively used to calculate the energy level scheme of the impurity ions. By a comparison of absorption and emission spectra, many of the energy levels that give rise to the optical spectrum are identified. The effect of different external perturbations on the energies of the lines and on the selection rules for optical transitions are extensively illustrated.

A brief review of differential optical techniques developed in recent years is given by W. E. Engeler. These techniques show particular promise for the study of symmetries and details of electronic bands in both thin films and bulk materials. K. H. Beckmann and N. J. Harrick describe an internal reflection spectroscopic technique that appears to be very suitable for studies of surface states, particularly in conjunction with strain or electric field modulation techniques. Papers by R. Jacobsson, by Burgiel, Chen, Vratney, and Smolinsky, and by P. Mark illustrate the difficulties in obtaining thin films with the required stochiometric composition and the effects of chemisorption on their electrical properties. M. Balkanski and R. Le Toullec present data that stress the importance of boundary conditions on the optical measurements of thin films. Organic

thin films, mainly anthracene, are treated by M. Pope, and internal photoemission (mainly for SiO_2) and the corresponding junction problem by A. M. Goodman.

It is a pity that the typography of the volume does not do justice to the contents, which should be appealing to many readers. Figures are presented at the end of each paper, in the manner used for a preprint. It would have been more helpful if they had been inserted in the appropriate places in the text.

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Cows, Sheep, Pigs

Growth and Development of Mammals. Proceedings of the 14th Easter School in Agricultural Science, Nottingham, England, 1967. G. A. LODGE and G. E. LAMMING, Eds. Plenum, New York; Butterworths, London, 1968. xii + 528 pp., illus. $32.

The intent of the 14th Easter School at the University of Nottingham was to provide an interchange between workers in fundamental sciences related to growth and experts in animal husbandry. The stated objective of the resulting volume is to review factors that govern growth and development of mammals. The book is coherently organized into sections on tissue growth, hormonal influences, prenatal and postnatal development, genetic and nutritional influences, carcass quality and assessment, and practical implications of factors affecting growth. As often happens with collections of papers, the volume contains a mixture of pedantic summaries, reviews of work from specific laboratories, extolment of favorite hypotheses, and presentation of original data. The coverage is about equally divided between the basic and the applied sciences. Chapter summaries rarely do so, but thoughtful readers will find that the presentations usually lead into timely and significant problems.

Anthropometric data derived from parallel radiograms illustrate how proportions of bone, muscle, and fat can be estimated during growth. Superposition of such data after phasing growth has exposed sex differences in rate of growth during childhood and adolescence which previously had been obscured by chronological summations. The implication is that seasonal and cyclical growth phenomena in other animals may similarly be obscured by nondiscriminate summations of growth parameters.

A discussion of the development of skeletal muscle gives a provocative but belabored review of the electron microscopy of muscle and the embryonic origin of multinucleate muscle fibers. Several pages are devoted to the latter although developmental biologists have regarded the controversy as settled for some eight or nine years. Adipose tissue is reviewed as a dynamic organ which synthesizes fatty acids and triglycerides. The roles of glucose, insulin, adrenalin, and the sympathetic nervous system as regulators of deposition and mobilization of fats are reviewed.

In adults as well as in children both lipolysis and protein synthesis correlate positively with concentrations of growth hormone in blood plasma. The authors suggest that "growth" hormone may have been a misnomer, since its pattern of secretion in children and adults appears to differ only quantitatively. The review, although speculative and teleological, is a synthesis of possible mechanisms for regulation by growth hormone.

A positive correlation between rate of growth and the quantity of RNA per cell (RNA : DNA ratio) in the pituitary gland is supported by original data. The growing animal thus has more protein-production machinery per cell and possibly, therefore, a higher rate of production of protein hormones by the pituitary gland. This interesting thesis apparently has not been reinforced by serum concentrations of pituitary gonadotropins or related to RNA : DNA ratios from growing but nonsecretory tissues.

Young, growing individuals have high and delicately balanced levels of output of thyroid hormone. Attempts to optimize thyroid hormone output in growing animals presuppose knowledge of endogenous thyroid activity for each animal and the optimum dose for that particular animal.

Potentials for production of wool, milk, and meat may be determined during gestation. Furthermore, knowledge of growth during prenatal life becomes increasingly more important as improved husbandry makes slaughter possible at earlier ages and an increasing proportion of the life span of the meat-producing animal is spent *in utero*. A calf, for example, may spend twice as much time in the uterus as it does in independent existence. It is reported that in the sheep compensation for undernutrition during gestation may require seven months, whereas lambs can be slaughtered at four or five months of age. Effects of reduced nutrition on prenatal growth in the pig, and polytocous mammals in general, are less detectable—in fact, it is controversial whether or not such exist. (Unfortunately the term "multiparous" is used in the loose medical and not in the precise zoological sense.) Because of this uncertainty a reduction in protein and energy intake in sow herds is suggested. A 30-percent reduction in daily protein intake might affect the compositions and weights of piglets at birth. (It is estimated that 30-percent reduction in protein intake has the value of less than one-half of one weanling pig saved.) Since the effects of reduced prenatal nutrition are difficult to detect and since reservations about the consequences remain, studies appear needed on the biological quality and economic performance of pigs after high and low planes of prenatal nutrition.

The last half of the volume is devoted largely to the more practical aspects of animal husbandry for meat production. Genetics of growth of cattle, sheep, and pigs, for example, covers breed differences in utilization of food, selection for growth characteristics, and heritability of body weight. The chapter on minerals in growth and development gives a generalized discussion emphasizing mineral elements as cofactors of hydrolysis, uptake, and biosynthesis. The titles "Assessment of carcass quality" and "Practical implications of factors affecting growth" speak for their contents.

The volume will be of more interest to those who are concerned with livestock production than to basic biologists. Because most of the eight sections are neatly subdivided into chapters on cattle, sheep, and pigs, this reviewer finds the title *Growth and Development of Mammals* misleading. The diversified topics are skillfully organized into a volume with more continuity than one usually expects from 24 contributed papers. The objective of relating basic research to practical problems of meat production has been achieved.

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