sions" Gymnocystidea and Ascophora) are in fact so novel in content that they amount to new orders. Some terms introduced in the chapter on stenolaemates—"coelocyst," "eustegal," "colonial epithelium," and others—are set down without a hint that they are altogether new. These sections seem to have been directed more toward the author's colleagues than toward the student and general zoologist, for whom a more conservative approach would have been desirable.

The book comes attractively bound and happily low priced. This situation will no doubt speed its dispersal to its intended audience. I hope so; these interesting and important little animals deserve more attention.

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A Key Biological System

The Lactose Operon. JONATHAN R. BECKWITH and DAVID ZIPSER, Eds. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y., 1970. x, 438 pp., illus. $12.

This useful and distinguished volume, organized as 10 review chapters and 16 research articles, resulted from a conference on the *lac* system held at Cold Spring Harbor in September 1969. As the editors point out, the lactose operon of *Escherichia coli* clearly is one of those key biological systems on which much of the development of molecular biology has depended. The publication of the book comes nearly a decade after the announcement of the operon concept by Jacob and Monod (who wrote the introduction) and some 25 years after the pioneer work of Monod on enzymatic adaptation. The book constitutes an eloquent statement of the progress made since those early days.

Genetic aspects of the *lac* system are stressed throughout the book. A general review features diploid analysis, deletion mapping, and uses of transducing phages and fusion strains. A broad spectrum of mutants is described. The enzymes specified by *lac* genes, betagalactosidase and thiogalactoside transacetylase, are characterized in terms of isolation, composition, subunit structure, isoenzymes, complementation, and immunological properties, as well as various features of enzymatic activity. The normal *lac* repressor and several mutant repressors, including superrepressors, are treated. The *lac* permease system is reviewed thoroughly. It is suggested that the name "permease" be reserved for the entire transport system rather than for an individual protein component. Specific messenger RNA and its formation are covered, with emphasis on kinetics, polarity, and transcription starts and stops. Translational punctuation and polarity and the effects of deletion of translational start signals are likewise considered. A DNA-directed cell-free system for betagalactosidase synthesis that has a variety of experimental potentialities is reported. Catabolite repression and effects of cyclic adenosine monophosphate receive their share of thoughtful attention.

Appropriately, this volume by and large is written in the style of the experimentalist, and it goes a long way toward documenting the influential role that the *lac* system has played in the exploration of the cell's informational macromolecules. This system has no doubt contributed much to the *E. coli*'s-eye view that many life scientists have of molecular biology. And *lac* is estimated to represent only 0.15 percent of the *E. coli* chromosome! It is clear that a highly successful extrapolation has occurred. By the same token, there is of course the danger of overgeneralization. Is action at the gene the only mode of regulation of protein synthesis? Is the *E. coli* operon, with its high degree of clustering of functionally related genes, characteristic of the organization of all genetic material?

This note of caution notwithstanding, the stimulating contributions do bear out what is stated in the introduction, namely, that "the *lac* system is as yet far from having lost all its charm and mysteries" and that much "remains to be learned from bacteria." Thus, coupled with a reference to the enthusiasm with which a number of molecular biologists "are abandoning K12 for BALB C or some other mammal, such as a nematode," is the apt reminder that "there is always 'room at the bottom.'"

All in all, this book recommends itself as a very authoritative and readable source of information for anyone interested in macromolecular biosynthesis and its regulation.

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Neurochemistry

Protein Metabolism of the Nervous System. A symposium, New York, April 1968. ABEL LAJTHA, Ed. Plenum, New York, 1970. xxii, 732 pp. illus. $45.

This is an ably organized tome on a process pivotal to cellular existence in general and to neural response in particular. Its 38 chapters (by 67 contributors) are grouped into four sections.

In the section Metabolism Related to Turnover, S. Roberts considers characteristics of cytoplasmic ribosomes derived from neural tissue. The problem of ribosomal research is unbelievably complex, particularly if one is to translate from findings in vitro to actual events in the cell. The salient observations in this chapter relate to the unusual instability of cerebral neuronal polyribosomes at low magnesium concentrations or in the presence of pancreatic ribonuclease. Cerebral ribosomes appear to be unusually responsive to polyuridylic acid in stimulating incorporation of amino acids. M. R. V. Murthy's studies deal with the separation of membrane-bound and "free" ribosomes of rat brains as a function of development. He finds that membrane-attached ribosomes are largely polysomal and more resistant to degrading agents than the "free" polysomes. This may be due to multicomponent association of the membrane, messenger RNA, and the *de novo* polypeptide. Most of the observations in this paper are offered in support of the idea that membrane-bound ribosomes are responsible for secreted protein while "free" ribosomes synthesize proteins for intracellular uses. B. D'Monte, N. Marks, R. K. Datta, and A. Lajtha examine protein turnover in mitochondrial subfractions with respect to proteinase and aminopeptidase content, incorporation of amino acids into membrane proteins, and protein composition of submitochondrial fragments. Study of the outer membranes shows localization of aminopeptidase. The authors justifiably take a cautious approach to interpreting from "marker" enzymes. Their succinct discussion of these enzymes reveals the unsatisfactoriness of findings in this area.

The significance of protein breakdown as a regulatory mechanism is further elaborated by N. Marks and A. Lajtha and by A. V. Palladin and Ya. V. Belik. Work on insoluble proteins of the synaptic plasma membranes (SPM) is described by H. R. Mahler and C.

W. Cotman, with a particularly good methodological section. The results of amino acid analyses are not very meaningful because of the heterogeneity of the samples albeit they are suggestive of differences between SPM and other membranes. P. Mandel and M. Jacob offer evidence of transfer of intact nucleotides to the nucleus in their paper on regulation and transcription in "nervous" cells They consider cytidine triphosphate to be the limiting factor of RNA synthesis with uridine triphosphate aminase as the rate-limiting enzyme. That homopolymers function as a storage form in the cell is an interesting idea but awaits demonstration in the brain. There are several useful methodological suggestions for isolation of RNA polymerase free of DNA from cerebral nuclei. However, the reviewer would have liked greater detail in the section on determination of fractions of the genome coding for RNA. In spite of the many interesting and important observations in this section, the reviewer is left with the nagging question of how protein synthesis and metabolism are translated into cerebral function—a question raised by some of the contributors themselves.

In the section Metabolism Related to Function, L. Austin, I. G. Morgan, and J. J. Bray present a series of well-documented experiments on the differential effects of antibiotics on the synthesis of synaptosomal protein. Further elaboration is given to distinct rates of axonal flow with [^{3}H]leucine and [^{14}C]-orotic acid. A fast and slow rate of axonal flow for labeled protein and the slow spread of RNA (both ribosomal and transfer RNA) are reported. The origin of axonal RNA is speculative. Additional information on slow and fast axonal transport is given in the chapter by S. Ochs.

Several chapters deal with hormonal control of protein synthesis in the brain, and though well documented raise more questions than they answer. L. Sokoloff's chapter on the mechanism of action of thyroid hormones is by and large an interesting excursion into the realm of hepatic biochemistry. Sokoloff postulates a functional site in the mitochondria for the primary action of thyroid hormones which is lost in the adult brain mitochondria. This attractive theory should be experimentally assessable—perhaps by isolating the fraction from "immature" mitochondria and adding it to mitochondrial systems from mature brain. A quantitation of the differences between mature and immature cerebral mitochondria might be useful by establishing binding constants and sites with labeled thyroxin. If such data are available it is not obvious from the references.

The role, localization, and fractionation of cerebral glycoproteins are detailed in a chapter by E. G. Brunngraber, and the significance of glycoproteins in the brain of "training pigeon" is described by S. Bogoch. The idea that training affects levels of glycoprotein in pigeon brain is criticized by Brunngraber, who finds Bogoch's data unconvincing.

In the section Alterations of Metabolism, D. A. Rappaport and H. F. Daginawala consider the changes in RNA and proteins induced by stimulation. Their introductory comments are six pages too long. They propose a new concept of information processing in the nuclei of brain cells, postulating that upon receiving a stimulus the particulate components of the nuclei activate an enzyme, polynucleotide phosphorylase, which in turn synthesizes RNA in the absence of a template or a primer. The RNA will then serve as a template for a protein which will contain the information coded in this specific RNA. The nature of charged and uncharged side groups on the protein is supposed to represent a code given to the nuclei as frequency components in the afferent impulse. Their concept fails to account for the enzyme's selection of one specific nucleotide from the pool in response to a new stimulus and for the ability of the sensor to distinguish between new and old signals as well as for the relation between the sensor and the transducer. It is therefore strange that no qualitative or quantitative assessment of cerebral polynucleotide phosphorylase in catfish is presented. The observed changes in the composition of RNA in catfish brain following stimulation with natural odorants are equally difficult to understand. Natural odors should already be familiar to the catfish, and as such they should be recognized as old stimuli.

The reviewer's Gold Star award goes to the chapter by H. Koenig, C. Y. Lu, S. Jacobson, P. Sanghavi, and R. Nayyar. Apart from the excellent methodology there is a great deal of novel information. Their experiments prove that earlier findings are incompatible with the steric hindrance theory based on interaction between actinomycin D (AMD) and DNA. That white matter shows earlier and more severe inhibition than gray matter suggests that glia are more sensitive to AMD. Significantly, no structural changes of glial polysomes following AMD treatment could be discerned by electron microscopy. They propose that AMD-induced changes of the neural nuclei are responsible for the repression of RNA transcription. S. H. Barondes demonstrates that disturbance in protein synthesis during training affected long-term memory. Inhibition of cerebral synthesis was obtained with subcutaneous injection of cycloheximide, hence the use of an intracerebral route was obviated.

G. Ungar's chapter relating to chemical transfer of learned information summarizes several important criteria for reproducibility of the transfer phenomenon. His results cannot fail to kindle intense activity in the field of chemical transfer of information, particularly since his work seems to narrow the field to peptidic units as the natural transfer factors.

The last section is on Metabolism Related to Pathology. A reader looking for specific answers related to causal connections between protein metabolism and mental diseases will be disappointed, but from the point of view of the immunologist the chapters are significant. E. Roboz Einstein and L. P. Chao discuss a correlation of the appearance of encephalitogen protein to age, demonstrating that this protein appears much later than other proteins in the myelin. Therefore they conclude that the encephalitogenic protein is not recognized by the immunocompetent cells. This may relate to the induction of experimental allergic encephalomyelitis. M. W. Kies finds from immunological, electrophoretic, and gel filtration data that myelin basic protein in most species consists of a group of proteins of uniform size but of different charge and about 17,000 molecular weight.

The reviewer has been inescapably biased in selecting chapters from this book for special mention. As a whole it is well documented and commendably thorough in its methodological aspects (although a chapter on protein *S*100 would have been welcome) and should be valuable to researchers and to teachers of neurochemistry.

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