way of fruitful collaboration between natural and social scientists. The latter takes us back to well-traveled ground: the author's favorite induced institutional innovation hypothesis; the possible relationship between research and productivity, equity, health, and even esthetics; and the alleged standoffishness of the basic sciences community vis-à-vis both agricultural and, of course, social scientists.

In sum, the reader would have benefited from having research policy options related to the variable but often very high observed rates of return to agricultural research; from an analysis of why the institutional and economic environment for the R & D industry continues to be suboptimal; from more discussion of private versus public sector R & D activity, formal and informal; from some reference to the matter of appropriate technology; and, finally, from a more consistent comparative treatment of rich and poor country settings.

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Molecular Neurobiology

Molecular Approaches to Neurobiology. IAN R. BROWN, Ed. Academic Press, New York, 1982. xii, 422 pp., illus. $49.50. Cell Biology.

This book captures the excitement of certain applications of molecular and cell biology to the study of the nervous system. At the same time, it reveals the awesome challenge of relating biochemical findings to functional parameters and underlying developmental mechanisms.

Nervous systems develop tremendous morphological, biochemical, and functional specialization, and it is logical to investigate whether synaptic membranes contain proteins with specific functions. Isolated synaptic junctional complexes and postsynaptic membrane densities do contain a major protein, postsynaptic density (PSD) protein, distinct from actin, tubulin, neurofilament protein, and calmodulin (which are also present), plus glycoproteins not found on other types of cellular membranes. Marked increases in PSD protein, Thy-1 antigen, and protein kinases accompany morphological maturation of synapses (Gurd). Another critical feature of neurons is axonal transport of proteins synthesized in the cell body and of neurotrophic viruses, toxins, nerve growth factor (NGF), and, probably, neurotransmitters into the cell body (Karlsson). Little is known yet of the underlying mechanisms or their regulation, however.

Several powerful genetic techniques can be applied to the study of the mammalian nervous system (Breakefield *et al.*). The use of complementary DNA probes reveals that tubulins are a family of eight to 20 proteins and that six distinct messenger RNA species (one possibly for NGF) hybridize with a cDNA probe for the human insulin gene. Genes are mapped on specific chromosomes, and genotypically altered cells can be used in cultures or to construct mosaic animals. Many mutant behavioral phenotypes are being investigated; a structural defect in β-NGF or its precursor polypeptide may be the primary lesion in familial dysautonomia.

An unusually short DNA repeat length appears postnatally in chromatin only from neurons of the cerebral cortex (Brown and Greenwood). RNA-DNA hybridization shows that the number of different types of brain mRNA sequences is manyfold greater than that of other tissues, corresponding to more than 100,000 different brain polypeptides (Kaplan and Finch). This subject is ripe for investigation with specific cDNA probes, restriction enzymes, and other tools of the recombinant DNA era. Our knowledge of transposons and of gene translocations in the immune system should stimulate searches for molecular means of enhancing informational capacity in the nervous system.

Hemoglobin and immunoglobins have proved to be crucial molecular markers in their respective systems. What might be their counterparts in the nervous system? Several brain-specific proteins have been identified, but results have been limited. In this context, NGF is emerging as an especially attractive probe for certain developmental processes in the nervous system.

NGF was detected serendipitously in sarcomas that evoked outgrowth from dorsal root ganglia of chick embryos into which the tumors had been explanted. Classic studies depended upon measurements of neurite outgrowth from sympathetic and dorsal root ganglionic neurons. Recently a transplantable rat pheochromocytoma cell line (PC12) has been exploited as a target cell with receptors for NGF (Burstein and Greene). Without NGF, PC12 cells display features of adrenal chromaffin cells, bearing catecholamines. NGF reversibly converts the cells in four to seven days to ganglion-like clusters with slowly extending electrically excitable neurites. Priming (with accumulation of transcription-dependent macromolecules) and neurite outgrowth are separable processes requiring NGF. On two-dimensional gels, three of about 1000 protein spots show striking increases in relative abundance during the priming phase; one has been localized as a cell surface glycoprotein on sympathetic neurons.

The chick embryonic neural retina is a well-characterized system (Linser and Moscona). Maturation of the retina and dissociation and reassociation of the component cells occur in vitro. The glial cells manifest a transcription-dependent, cortisol-induced 100-fold increase in glutamine synthetase; contact between neurons and glia is required for full expression of cytosol receptors for cortisol. Mediators and mechanisms of the cell-cell contact might be elucidated in this system. Other hormones have major effects on brain differentiation and function. Genetic lesions causing insensitivity to androgen in rats and humans have permitted crucial insights into developmental targets of gonadal hormones in brain (McEwen). Structure-activity studies suggest that the effects of ACTH, MSH, β-LPH, and their fragments on active avoidance behavior, grooming behavior, and opiate-like analgesia are mediated through changes in phosphoinositide metabolism in neuronal membranes, inhibiting calcium influx and hyperpolarizing membranes (Jolles *et al.*). The remaining papers examine opioid peptides, substance P, cholecystokinin, and vasoactive intestinal peptide as neurotransmitter candidates, hyperthermia and LSD as perturbants of protein synthesis, macromolecules as mediators of learning and memory, and bulk isolation of neurons and glia.

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Organelles

The Eukaryotic Ribosome. HEINZ BIELKA, Ed. Springer-Verlag, New York, 1982. 338 pp., illus. $35.

Ribosomes, the complex ribonucleoprotein particles that mediate cellular protein synthesis, have proved a rich source of information on the architectural and functional attributes of supramolecular structures that enable such structures to carry out intricate tasks like the

accurate and efficient assembly of polypeptide chains. The 70*S* ribosomes from prokaryotes—mainly *Escherichia coli*—have been examined closely from a variety of perspectives. As a result, a wealth of data have been accumulated on the way in which their three RNA and 50-odd protein components are assembled and arranged and on how they contribute to specific interactions with transfer RNA, messenger RNA, and nonribosomal protein factors during the growth of nascent protein molecules. The far less intensively studied 80*S* ribosomes from eukaryotic organisms are similar to their 70*S* counterparts in gross morphology, biological activity, and structural organization, yet they are half again as large. Most of this difference is ascribable to larger and more numerous protein components, but eukaryotic ribosomal RNA's are bigger than their prokaryotic analogs as well. Why then do eukaryotic ribosomes require additional constituents and greatly increased mass? What functions do they carry out that prokaryotic ribosomes do not?

Although the present volume does not provide definitive answers to these questions, it does coherently and straightforwardly set out the facts and figures that define the properties of the eukaryotic ribosome and its component molecules. Individual chapters offer detailed status reports on the size, shape, and subcellular location of the ribosomal particles, the biosynthesis and chemical properties of their protein and RNA constituents, the structural and functional integration of these constituents in the ribosome, interactions of the ribosomal particles with each other and with cellular membranes, and the role of the ribosome in protein synthesis. Most of the chapters are quite thorough and informative; others are dated. Because the literature review was completed in 1979, a number of important new results could not be included in the text; major developments through the middle of 1981 are covered in a series of chapter-by-chapter notes at the back of the book. Though helpful, this procedure leads to a disjointed presentation of several subjects of active research. For example, a postulate concerning the involvement of 5*S* and 5.8*S* RNA's in the binding of tRNA to the ribosome is advanced in chapter 11 and retracted in the notes. The volume nevertheless contains a good factual description of the eukaryotic translational apparatus, though the discussion would have been enlivened by a more concerted effort to evaluate, compare, and synthesize the large amount of information available.

One of the strongest justifications for a book of this sort is the opportunity it provides for illuminating comparisons of eukaryotic 80*S* ribosomes and prokaryotic 70*S* ribosomes. It is here that *The Eukaryotic Ribosome* misses the mark. The ribosomal particles of higher organisms are treated as entities apart; the authors have made no effort to correlate the morphological and functional domains in eukaryotic ribosomes with those in prokaryotic ribosomes, nor have they traced the lineage of acidic ribosomal proteins, which provide compelling examples of functional relatedness and evolutionary continuity. Moreover, they fail to point out that the high-molecular-weight ribosomal RNA's from prokaryotes and eukaryotes contain numerous highly conserved nucleotide sequences and almost certainly possess very similar secondary structures. At the same time, there is a lack of focus on features peculiar to the translational apparatus of higher organisms, such as the complexity of the polypeptide chain initiation reaction, translational regulation and the role of ribosomal-protein phosphorylation, the special problem of ribosome assembly for cells in which protein and RNA synthesis is compartmentalized, and the vectorial synthesis and transport of secretory proteins by membrane-bound ribosomes. Though all of these topics are mentioned, their uniqueness remains largely unacknowledged and none of them emerges as a central theme of the narrative.

The Eukaryotic Ribosome is the work of five contributors in addition to the editor; the six have achieved a consistent and homogeneous style. The book could have benefited from more interpretative schemes and diagrams as well as closer scrutiny for typographical errors. And, although there are relatively few factual mistakes, there are some quite disconcerting ones, such as the statement on p. 203 that the nucleotide sequence 5′...AGGAGGU...3′ precedes the coding segments of all prokaryotic mRNA's. All in all, the authors have made a conscientious effort to provide a comprehensive summary of current knowledge about the eukaryotic ribosome. Though a broader view of the translational apparatus would have been desirable, the volume provides a useful compendium of published data, and its extensive bibliography will be of considerable value to investigators with interests in this field of research.

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