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