chondrial DNA. In his speculations about the functions of these membrane-bound macromolecules Lerner considers such potential interactions as the union between antigen and M-Ig causing a conformational change in the membrane leading to either DNA replication or transcription which in turn may result in gene amplification or activation of biosynthetic processes. Moreover, the membrane-associated DNA may play a role in intercellular communications such as the interactions of B and T cells.

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## Cyclic AMP

**Advances in Cyclic Nucleotide Research.** PAUL GREENGARD and G. ALAN ROBISON, Eds. Vol. 1, Physiology and Pharmacology of Cyclic AMP. 610 pp., illus. $29.50. Vol. 2, New Assay Methods for Cyclic Nucleotides. 144 pp., illus. $12.50. A conference, Milan, July 1971. PAUL GREENGARD, G. ALAN ROBISON, and RODOLFO PAOLETTI, Eds. Raven, New York, 1972.

The presentations in the "Physiology and Pharmacology" volume of these proceedings are concerned with three major aspects of cyclic AMP function: the nature and function of cyclic AMP-dependent protein kinases, the events controlling the activity of adenyl cyclase and thus the level of cyclic AMP, and the correlation of these changes with various aspects of cellular function. The papers are arranged in groups on regulation of metabolism, membrane permeability and secretion, the response of the cardiovascular system, the peripheral and central nervous system, and pituitary and reproductive function. A short section is devoted to studies on the involvement of cyclic AMP in the regulation of gene transcription in unicellular organisms, and a final section provides abstracts of 91 unpublished papers presented at the meeting.

This volume clearly illustrates to the reader the importance of cyclic AMP as an obligatory component in cellular function and as a major participant in intracellular communication and response of the cell to the environment. Although it is too early to postulate a single mechanism for the action of cyclic AMP, the similarities of the molecular events involving cyclic AMP in the hormonal control of glycogenolysis, glycogenesis, and lipolysis suggest that activation or modulation of cyclic AMP–dependent protein kinases resulting in the phosphorylation of phosphorylase kinase, glycogen synthetase, and triglyceride lipase respectively provides an excellent model for the diverse physiological and biochemical events involving adenylcyclase. Certainly the wide distribution of cyclic AMP–dependent protein kinases and the discovery of a variety of specific protein substrates for these kinases, ranging from histones, thought to be involved in gene expression, to a component of synaptic membranes, make this a primary hypothesis for the mechanism controlling adenylcyclase activity. The specificity of response inherent in the structure of protein kinases also provides an explanation for the multiple responses of cells to changes in adenylcyclase activity.

Much of this volume concerns the current efforts to elucidate the relation between the interaction of hormones and other agents at membrane receptor sites and the subsequent response of adenylcyclase. While little is known about how the hormone-receptor interaction leads to a change in the intracellular, membrane-bound catalytic activity of adenylcyclase, the number of agents or actions that modify the activity is very large, including most of the accepted hormones and even such agents as light, which has been shown to modify the activity of the photoreceptor adenylcylase of vertebrates. Other agents such as calcium ions, adenosine, and prostaglandins are involved in the regulation of adenylcyclase activity. Perhaps the most exciting matter dealt with in the book is the correlation of factors that affect impulse conduction by neurons with the activity of adenylcyclase. Several experimental approaches toward understanding the complex role of cyclic AMP in synaptic transmission, including studies with brain slices, isolated ganglia, neuronal cell culture systems, and interactions between specific pathways in the intact brain, are described. These studies appear to point towards an understanding of the biochemical basis of cellular communication, the basis for learning and memory.

The second volume of the proceedings, consisting of nine papers dealing with methodology, is a useful companion to the first.

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## The Mind-Body Problem

**Brain and Human Behavior.** A symposium, Chicago, Oct. 1969. A. G. KARCZMAR and J. C. ECCLES, Eds. Springer-Verlag, New York, 1972. xii, 476 pp., illus. $30.50.

Unlike the usual symposium, in which a number of scientists investigating a single problem get together to compare notes and try to iron out discrepancies in their results, the Symposium on Brain and Human Behavior, held in 1969 as part of Loyola University's centennial program, was more in the nature of an interdisciplinary conference. Well-known experts in many areas of neuroscience, and some philosophers, presented papers that were in many cases excellent in themselves but unrelated to each other.

A possible explanation for the diffuseness of content (and for the somewhat misleading title; all the brains and most of the behavior pertain to experimental animals, not man) is that the symposium was organized with the idea of setting the stage for a powerful assault on the mind-body problem. This is the interpretation I put on the presence of the philosophical contingent and the tone of the introduction, which was written by the chief organizer of the symposium and editor of the volume, Alexander Karczmar. This ambitious hope was not realized, however, and Karczmar reveals his acceptance of the fact in his opening remark that the conference might have been a hundred years premature. It was, nevertheless, an interesting experiment, and even if there are few signs in the published volume that any of the participants benefited from hearing the others, it is possible that latent influences were planted that will germinate in less than a hundred years.

The symposium itself might well have served a useful purpose, but it is difficult to think of any group (other than librarians) who would get their money's worth from the published collection of papers based upon it. There are five sections, which bear the titles Molecular and Synaptic Organization, Biochemical Mechanisms and Pharmacological Approaches, Neurophysiological Correlates, Psychological Aspects, and Epistemological Aspects. Few of the contributors make any concession to the possibility that some of their audience might not be specialists in the fields they are discussing, so the book can hardly be recommended as a lay introduction to the neurosciences. At the

same time it is too small and random in scope to be considered as a comprehensive reference work. Moreover, most of the papers in the fields I am familiar with have appeared in similar form elsewhere, and I suspect that this may be true of the majority of the contributions. Thus, although many of the papers are well worth reading, few people are likely to be interested in more than a small fraction of them.

The one feature of the volume that might widen its appeal is the section on epistemology. It is obvious that the organizers attached great importance to this part of the symposium; Karczmar devotes almost half of his 20-page introduction to a discussion of the philosophical contributions, for example. Even so, the section on epistemological aspects contains only four of the 20 papers in the book, and of those the first, by the neurophysiologist Ragnar Granit, consists of a relatively brief appeal to investigators not to lose sight of the purpose of mechanisms they study in an excessive worship of causal relationships. Thus a small tail attempts to wag a very weighty dog. Not that the simile is very exact; the tail ignores the dog almost as completely as the dog ignores the tail, and on the one occasion when a philosopher did borrow a concept from one of the psychological offerings he misunderstood it, apparently under the impression that Barnett had stated that only man and guinea pig synthesize ascorbic acid, when he had in fact stated the reverse. The error made no difference to the point being illustrated, that biochemistry, in its application to human behavior, must be considered not in isolation but in the light of many factors ranging from the physiological milieu to the evolutionary history of man, but it is symptomatic of the communication difficulties at interdisciplinary meetings.

I was interested and somewhat surprised to discover that two of the three philosophers believe that the "will" is still an insurmountable barrier to the acceptance of any materialistic or reductionist explanation of behavior. Toulmin expresses this belief in the blatantly dualistic statement that the brain is only "our" servant in carrying out our desires. McMullin says the same thing rather more subtly, lumping conscious decisions with other forms of conscious awareness as being outside the scope of physics. He does not consider the possibility that the decisions may take place independently of consciousness and that the reasons we give for an action may be no more accurate than those of a well-informed observer.

I tend to Taylor's view (that is, if I understand him) that the reasons we may give for our actions, when called upon, are always in a sense rationalizations, reactions of a verbal cognitive system to the results of decision processes taking place in parts of the brain not accessible to consciousness.

For me the mind-body problem resolves itself to the difficulty of reducing immediate awareness, or "raw feel," to physical processes. McMullin, in his excellent analysis of scientific reductionism, deals with this problem along with many others with great clarity, but his conclusion that "to tell one what it is like to hear" is not a function of science, although I cannot disagree, is not very helpful metaphysically, and leaves the basic problem, as far as I am concerned, as insoluble as ever.

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## Nuclear Probe

**Mesic Atoms and Nuclear Structure.** Y. N. KIM. North-Holland, Amsterdam, and Elsevier, New York, 1971. xii, 250 pp., illus. $20. A North-Holland Research Monograph in the Field of Nuclear Physics.

The principal concern of this book is with what mesic atoms have been able to tell us about nuclear structure. We recall John Wheeler's remarkable paper "Mu meson as a nuclear probe particle," which he circulated privately in 1949 and then published in 1953. This paper illuminated in considerable detail many of the ways in which measurements of mu-mesic x-rays could reveal the structure of the nucleus. In a certain sense, this book may be regarded as a 20-year progress report on Wheeler's program.

The book tells what has been learned from mu-mesic x-ray measurements about the size and shape of the nuclear charge distribution, about the distribution of magnetism in nuclei, about nuclear quadrupole moments, and about nuclear polarization. Separate sections deal with isotope shifts, isotone shifts, and isomer shifts as well as a number of other related topics. There is a chapter on the atomic physics of mesic atoms and chapters on other exotic atoms such as pionic atoms, kaonic atoms, $\Sigma$-hyperonic atoms, and others. The work on muonic molecules and muonum is also reviewed. Altogether, the book is a careful and orderly distillation of some 300 or so papers that have been published since Wheeler's.

The book is written with very little appreciation of the experimental problems. In all the 132 pages devoted to muonic atoms there is little to indicate where the muons come from or how they are detected. Nothing is said about how many muons are available and what the resolution capabilities are. There is no indication of what the future holds in store.

In the main, the tables of experimental results have been simply lifted from the original papers. The author has made no attempt to compile the results of different measurements. There is, for example, no comprehensive table of nuclear radii as determined from muonic x-rays, although measurements of these have been reported by many authors. Thus, the table given by Acker *et al.* (1966) is reproduced, but no mention is made of later and more precise work. The author has added very little to what has already been printed in the original papers and earlier reviews. There is selection but no digestion.

Relatively little is done in the book to compare what has been learned about nuclear structure from muonic atoms with results obtained by other techniques. Thus, in comparing muonic atom results for root-mean-square nuclear radii with those obtained by electron scattering, the author is content to review a paper on this subject by Elton in 1967, and other methods of determining nuclear radii go without mention. If you wanted to know the value of the quadrupole moment of the thorium-232 as measured by muonic x-rays, you would find a value in a table taken from DeWit (1967), but you would have to go to the literature to learn that McKee (1969) measured the same thing more accurately a little later. Moreover, you would have no indication that the same quantity had also been measured by Coulomb excitation methods.

The book is a useful collection of a great deal of information on mesic atoms. It is not a definitive work, however, and cannot be relied upon to be the last word on any aspect of the subject.

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