Mulliken

Robert S. Mulliken: Life of a Scientist. An Autobiographical Account of the Development of Molecular Orbital Theory. BERNARD J. RANSIL, Ed. Springer-Verlag, New York, 1989. xviii, 256 pp., illus. $49.50.

This brief autobiography will be of interest to the many friends and colleagues of the late Robert Mulliken. It depicts his early life in Newburyport, Massachusetts, and the family background that directed him toward science. His father, Samuel Mulliken, a professor of organic chemistry at the Massachusetts Institute of Technology, employed him in preparing charts and proofreading for his books. In high school, Robert had a variety of scientific interests, and at his 1913 graduation ceremony he presented an essay entitled "Electrons: What they are and what they do." I found this of great interest since one of my first impressions of Mulliken came from a lecture on "what are electrons really doing in molecules?" that he gave about 1960.

As an undergraduate at M.I.T. Mulliken did research in synthetic organic chemistry, and until the end of World War I he worked on chemical warfare for the Bureau of Mines. After the war he went to graduate school at the University of Chicago, where he worked under W. D. Harkins on separating isotopes. On the side he read the papers of G. N. Lewis on "what electrons are doing in molecules."

Mulliken worked on isotope separations during two National Research Council postdoctoral fellowships. When the NRC suggested he find another project, he decided to look at isotope effects on electronic spectra of diatomic molecules. This decision finally led him to his famous work on the interpretation of the electronic structure of molecules via molecular orbital theory.

At first, however, Mulliken collected and assigned spectra from bands previously assigned to BN. He showed that these were really ^{10}BO and ^{11}BO. More important, from the isotope shift he showed (in 1924) that the vibrational energy of BO is never less than one-half of a quantum. In 1925, while attempting to explain the electronic spectra of some diatomic molecules, he adopted a united-atom molecular orbit model similar to the atomic orbit models built on the Bohr model. After the development of the "new" quantum theory by Schrödinger, Hund put this model onto a more solid theoretical footing.

In his autobiography, Mulliken remains adamant about the essential differences between his original approach and the valence-bond "atoms in molecules" approach of Heitler, London, and Pauling. The later work of Lennard-Jones, who proposed the linear combination of atomic orbitals (LCAO) description of molecular orbitals, the introduction of configuration interaction (in MO theory), and the introduction of resonance including ionic structures (in VB theory) eventually led most scientists away from these early sharp distinctions.

In the early 1930's Mulliken extended his ideas to explain the electronic spectra of several polyatomic molecules. These papers were the basis for his rather belated Nobel Prize in 1966.

This book will be of some interest to historians for the insights it gives into the early development of molecular orbital theory. It will not be of much use to psychologists of the creative process, since Mulliken says little about how he worked or how he was led to his important insights. It is also not a complete account of his life, since he omits many details about his private life. The book accidentally gives an interesting view of the superstructure of big science. Mulliken's life was full of travels and visits within the national and international scientific community. In fact, it is hard to see how he ever found time to do science during the latter part of his life.

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Robert Mulliken at the University of Chicago, 1959. [From *Robert S. Mulliken*; M. Yoshime]

Peptide Biology

Regulatory Peptides. J. M. POLAK, Ed. Birkhäuser Boston, Cambridge, MA, 1989. xii, 406 pp., illus. $168. Experientia Supplementum, vol. 56.

The modern era of peptide biology was born two decades ago with the isolation and characterization of thyrotropin releasing hormone (TRH), a tripeptide amide, virtually simultaneously in the laboratories of Guillemin and Schally—an accomplishment for which they were eventually to share a Nobel Prize. It is true that over the previous 40 years a number of important peptides had been identified, among them insulin, the missing hormone in type I diabetes mellitus; substance P, a sensory neural peptide involved in pain perception; vasopressin, the antidiuretic hormone; and gastrin, produced in the stomach and important in stimulating hydrochloric acid production by that organ. These appeared as isolated, uncoordinated events, however, until the recognition of this tiny hypothalamic releasing factor, which mediates the regulation of the thyroid gland by the brain. This event did two important things. It established the legitimacy of Harris's portal vessel chemotransmitter hypothesis on how the brain regulated the endocrine system, and it initiated the development of technology for peptide purification and identification that was critical to the cascade of developments

that was to follow, including the work outlined in this volume. Once TRH had been discovered, the race was on to find other hypothalamic releasing factors—the discovery of which soon followed.

Not wholly appreciated in 1969 at the birth of TRH was the fact that hypothalamic releasing factors were present throughout the brain, where they subserved a role as neurotransmitters or neuromodulators, quite unrelated to the regulation of pituitary or endocrine function. Later these same peptides were found distributed throughout the gastrointestinal system and pancreas. Other peptides were soon isolated from these and other organs in tissue cells or neurons, so that the idea of a diffuse neuroendocrine system was proposed by Pearse as a third division of the nervous system after the somatic and autonomic branches. The number of neural peptides isolated has since burgeoned, but for many of these substances a clear physiologic role has not been determined. This book touches upon close to 60, but even this number is far from being comprehensive.

Julia Polak, the editor, has made significant contributions to our appreciation of the potential roles of neural peptides, especially through her immunohistochemical studies. She has recruited a group of experts predominantly from Europe. This volume is especially strong in contributions related to histochemistry, both immunocytochemistry and in situ hybridization. Certainly the chapters on autoradiography and axonal transport tracing for peptide mapping will be of value to all workers involved in the investigation of peptide function. The sections on molecular biology do not fully reflect the current extensive studies addressing the mechanism of peptide regulation at a transcriptional level. The discussions of the versatility of the functional role of peptides in different organs are valuable, showing for example that deficiency of vasoactive intestinal polypeptide, or VIP, may in the chest play a role in causing asthma and in the pelvis be involved in male impotence.

As members of the "peptide generation," we have already benefited from important advances in the diagnosis and treatment of disorders of both brain and bowel directly arising from discovery of these substances; further contributions to our welfare from regulatory peptides, their analogues, or both are anticipated. Polak's book can be recommended as a useful source of information to all who have an interest in peptides.

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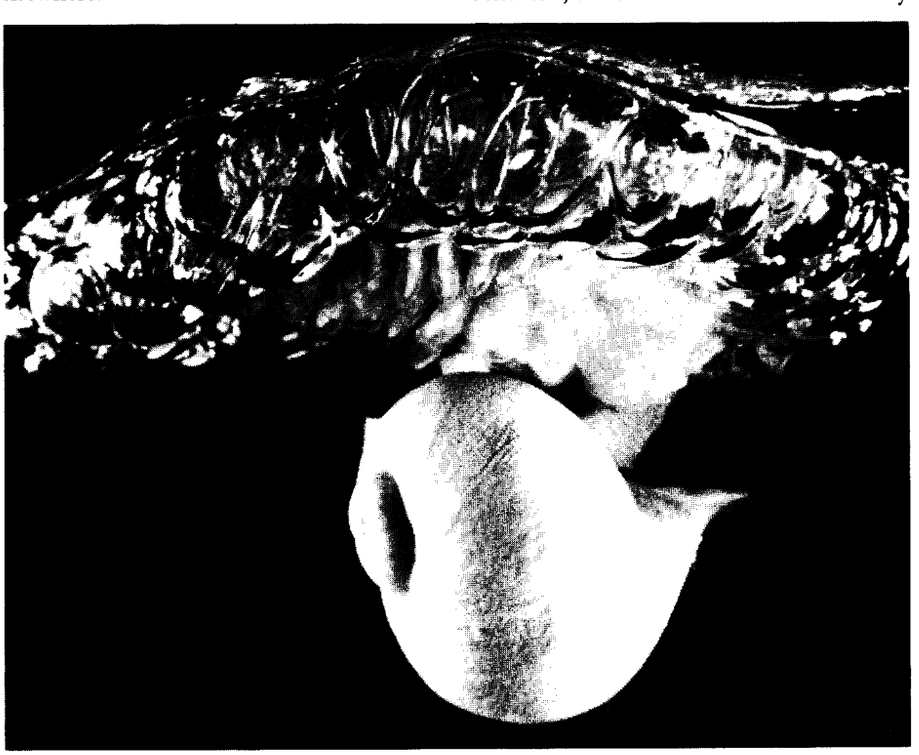
Oceangoing Mollusks

Pelagic Snails. The Biology of Holoplanktonic Gastropod Mollusks. CAROL M. LALLI and RONALD W. GILMER. Stanford University Press, Stanford, CA, 1989. xvi, 259 pp., illus., + plates. $49.50.

The gastropods are the largest class of mollusks (comprising over 40,000 species). They have been remarkably successful and occur in a variety of marine, fresh-water, and terrestrial habitats. The vast majority of marine gastropods are benthic as adults, living in association with the sea bottom. Though the larvae of many benthic species are planktonic for varied lengths of time, only a small number of species (about 140) are pelagic as adults and live out their entire life histories in the water column. A primary focus of this book is the description of the unique and varied ways in which these animals have adapted to the pelagic environment. The authors have done an excellent job of reviewing the literature (which is scattered among journal articles and expedition reports) and organizing it into a readable and informative text. An important feature of the book is that it goes beyond a synthesis of the published literature on these animals by incorporating unpublished observations and data of the authors. Thus, this book is a source of information that is not available elsewhere.

The text is divided into chapters dealing with each of the five major groups of pelagic gastropods: janthinids, heteropods, thecosomes (shelled pteropods), gymnosomes (shell-less pteropods), and nudibranchs. The major topics discussed for each group are external anatomy, mechanisms of locomotion and buoyancy, feeding mechanisms, diet and trophic relationships, metabolism and energetics, reproduction and development, parasites and epifauna, growth and reproduction, and evolutionary relationships. Topics such as internal anatomy, taxonomy, and geographical distribution are not discussed to any extent. Despite the low number of species of pelagic snails, the species composition of most of the groups is incompletely known or controversial. Thus, those who work with these groups will undoubtedly disagree with the inclusion or exclusion of particular species from the lists of "recognized species" provided at the ends of the chapters. However, by referring readers interested in taxonomy to the relevant literature, the authors sidestep an area of minimal concern to most readers of the book.

The beauty of the pelagic snails in their natural environment is portrayed by a series of 16 color photographs. Descriptive sections of the text are supported by in-situ photographs of the animals printed in black and white. The inclusion of a glossary is beneficial, since most readers will have only



Janthina prolongata with egg capsules. The "adaptation [of the janthinid snails] for an open-ocean existence has occurred largely through behavioral change, the major modification being the ability of the animal to construct a raft of air bubbles, from which they hang suspended, upside-down, from the water surface." [Magnification about 2½; from *Pelagic Snails*]