the so-called simple nervous system is able to accomplish so much, or, an equally reasonable puzzle, why nervous systems with millions of cells do not accomplish more."

Dethier's work has not only isolated the difficulties of the electrophysiological approach to ethology, it has also provided the most encouraging signs of ultimate success. Although the chemoreceptor code remains largely unbroken, the details of the ingenious circuits by which the fly controls feeding have been worked out. The most significant of these, discovered by Dethier's student Alan Gelperin, turns feeding on and off according to the output of stretch receptors spanning the crop and foregut (5). This *lac* operon of behavior remains the outstanding example of the physiological basis of a behavior.

In looking to the future, Dethier predicts that the most rewarding problems will be those of "specific hunger" and learning. By specific hunger, Dethier means the ability of the blowfly to alter its preference for carbohydrate over protein as egg laying approaches. He expects that another elaborate operon will be found, this time involving the added dimension of hormonal feedback. With regard to learning, he is less enthusiastic. Dethier points out that learning in blowflies is weak (indeed, why do they need to learn at all?) and suggests that they may be deliberately dumb, having "lost the ability to learn . . . in the interests of parsimony." In any case, the success of Quinn *et al.* (6) in conditioning *Drosophila* to odor and color, in demonstrating both long-term and short-term memory, and in obtaining mutants blocked in both phases makes a shift away from the blowfly inevitable.

Although Dethier says *The Hungry Fly* is "a book to be enjoyed," it is not a revised edition of his earlier and very entertaining *To Know a Fly* (7). Though wittily written, it depends too much on physiological details and methodology to make for light reading. Nor is *The Hungry Fly* merely a summary of the current state of the field, or a source book on feeding and blowfly physiology, though it fills each of these needs. Rather, it is Dethier's personal history of how we came to know what we now think to be true. It is an exciting and fascinating story in its own right, told intelligently and humorously by the pioneer of the physiological approach, and as such is of enduring value.

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Memoirs

Adventures of a Mathematician. S. M. ULAM. Scribner, New York, 1976. xii, 318 pp. + plates. $14.95.

It was inevitable that S. M. Ulam would tell his story. A native of Lwów, Poland, he was a member of its distinguished school of mathematics; later studies and global events led to a series of residences spanning two continents, and his scientific interests spread into physics and then into mathematical biology. Such activity implied, of course, a host of new colleagues. A conversationalist of first magnitude with ample scientific curiosity, Ulam would have much to write. Apart from the time it would take away from scientific meditation, the only real obstacle to the realization of the *Adventures* would be his general impatience. The storyteller, fortunately, has prevailed.

The present volume belongs to a relatively new genre that attempts to get behind the scenes to describe some of the idiosyncrasies, the weaknesses, and the strengths of segments of the scientific community. Laura Fermi's delightful book *Atoms in the Family* is exemplary; she has provided one perspective on researchers' lives outside the laboratory, thereby partially satisfying the public curiosity rendered acute by the relatively recent glitter of science. A companion volume to this is Emilio Segrè's *Enrico Fermi, Physicist*, which is along more traditional lines but has the sparkle derived from the writer's "being there" as a collaborator over an extended period, starting from earliest times. A somewhat different, in parts more specialized, approach is taken in James Watson's famous dramatization of the events leading to one of the great discoveries in biology, *The Double Helix*. Ulam reaches for all three objectives: to describe some of the nontechnical background in several scientific fields; to sketch a few biographies; and to summarize some developments in mathematics and thermonuclear physics. The reader is made privy to the ambitions, frustrations, successes, and bits of professional gossip associated with an interesting collection of superior minds.

The *Adventures* form a natural sequence of four parts: the early years as a student, then the postdoctoral phase and academia in America, followed by the extended Los Alamos period, and, finally, back to the university in 1967.

Most scientists are aware of the brilliance emanating from Budapest in the 1920's and early 1930's created by Szilard, Teller, von Neumann, and Wigner. But except among their confreres, the Polish school of mathematics, developed at Lwów and Warsaw, has until now remained relatively obscure. Ulam is changing all that, and such names as Banach, Kuratowski, Mazur, Sierpinski, and Steinhaus, along with Tarski and Kac, who immigrated here, will begin to have a more familiar ring. It was probably Stefan Banach who, in that formative period, played the central role for the budding mathematician Ulam, whose *modus vivendi*, but for imminent events that were to upset the great globe itself, might well have been *otium cum dignitate*.

The American scene for Ulam is identified with John von Neumann. It was von Neumann who arranged an invitation for Ulam to Princeton's Institute for Advanced Study, thus continuing a series of meetings, started in Europe, that was to lead to a deep friendship. Eight years later, it was von Neumann who suggested to Ulam the possibility of participation in the Los Alamos venture. The wartime period was, strangely enough, a relatively quiet time for the mathematician slowly turning physicist without abandoning his love for abstract mathematics. The war over, Ulam had a brief interlude at the University of Southern California (and an episode of near tragedy) before returning to Los Alamos to renew acquaintance with Enrico Fermi and, of more interest, Edward Teller. Some commentary is given on the Teller-Ulam collaboration in thermonuclear studies. Because the work is classified the reporting is necessarily of a peripheral nature and does not provide much illumination concerning the contributions of each. Later historians may obtain a clearer picture.

Ulam has a feeling for words, and they reveal an intense compassion on exceptional occasions. Perhaps the most moving descriptions are the accounts of last visits with Fermi and with von Neumann, which remain vivid more than two decades later. The last chapter, "Random reflections," will be of particular in-

terest to the professionals. Here is a short summary of new directions and aspirations at a technical level that gives the lie to the oft-expressed supposition that the fertile imagination goes first, usually by age 30.

The writing has an engaging quality, conversational, if not chatty, rather than studied. One gets the impression that the manuscript was, at least in part, created in recording sessions. Less satisfying is the fact that sometimes a sequence of episodes is not smoothly joined, so that on occasion the author's unabashedness makes the treatment seem more discrete than discreet. Maxwell Evarts Perkins would no doubt have enjoyed coping with the manuscript. A collection of 25 photographs lends a personal touch in another dimension.

The book captures the spirit and tenor of scientific interaction in a succinct and piquant manner. It will not, however, meet the historiographer's criteria for a well-documented publication; the author remarks that he has never kept notes or a diary of any kind. But no one will deny that here is a fascinating kaleidoscope of an exciting time.

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Agglutinins and Precipitins

Receptor-Specific Proteins. Plant and Animal Lectins. EDWIN R. GOLD and PETER BALDING. Excerpta Medica, Amsterdam, and Elsevier, New York, 1975. xiv, 440 pp., illus. $51.95.

Interest on the part of biomedical researchers in the properties and uses of lectins has led to a large body of literature dealing with a diversity of organisms and spanning the areas of virology, microbiology, biochemistry, oncology, and cell biology. Gold and Balding have attempted to unify the literature in a single text. In so doing, they group these proteins under the heading "receptor-specific proteins," a term whose definition they find elusive but which in most cases discussed refers to proteins of a non-immunoglobulin-like structure capable of agglutinating particulate matter or specifically precipitating with soluble substances.

In order to make the monograph readable to a wide audience the authors begin by defining important terms and abbreviations used in the book. The body of the text consists of chapters that discuss receptor-specific proteins of viruses, prokaryotes, algae and related organisms, plants, Protozoa and Porifera, and invertebrates, the Mollusca being accorded a chapter of their own. A chapter on immunoglobulin and immunoglobulin-like proteins of lower vertebrates is included to lend continuity to the discussion of the relationship of receptor-specific proteins to immunoglobulins of higher vertebrates. Each chapter is introduced with a taxonomical account of the group it deals with. This is followed by a historical account of research on the receptor-specific proteins of the group, after which the authors give a brief overview. Gold and Balding often include tables summarizing the properties of proteins discussed. The literature covered for the viral, plant, and mollusk agglutinins and precipitins is extensive, though, as the authors admit, the chapter on plant lectins is incomplete. The coverage extends only into 1973, but addenda to each chapter summarize pertinent research reported through 1974.

The strength of this book lies in its scope. It represents the first attempt to bring together the research literature on agglutinins and precipitins from organisms of different kingdoms and phyla, and it may facilitate exchange of information among researchers oriented toward different groups of lectins or agglutinins.

The weakness of the book lies in its unevenness. The authors include a brief descriptive statement about the relationship of sialic acid to acetylneuraminic acid, but neglect to describe the structural characteristics of the A, B, H, and MN blood group determinants. Similarly, they write a lengthy discourse on the derivation of the term "pili" in the discussion of bacterial agglutinins, but give little explanation of the terms and events presented in a schematic diagram relating the effects of concanavalin A and succinylated concanavalin A on the mobility of lymphocyte receptors. For the most part Gold and Balding represent the findings in the literature with fidelity, but they rarely note or comment on inconsistencies or conflicting reports. For example, there is no discussion of the work that calls into question the validity of the x-ray crystallographic model of concanavalin A advocated by G. M. Edelman, a model that is a central element in their presentation of plant lectins.

Though the authors, particularly Gold, have experience with agglutinins and precipitins from many sources, this large, diverse literature would better have been treated by individuals expert on the particular categories of proteins covered or on their specific structural, functional, or biological properties.

In general, this text is a good source of general information about these proteins, but must be read with a critical eye.

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Atmospheric Physics

Atmospheres of Earth and the Planets. Proceedings of an institute, Liege, Belgium, July 1974. B. M. MCCORMAC, Ed. Reidel, Boston, 1975. viii, 456 pp., illus. $65. Astrophysics and Space Science Library, vol. 51.

This volume is a collection of 32 review papers on atmospheric physics based on lectures presented at what was apparently the last of a series of annual international institutes held at various European sites. The success of these institutes is demonstrated by the number of eminent researchers McCormac, who organized them, managed to attract. I have little doubt that this volume could prove in time to be a minor classic in its field.

The articles cover six major subject areas: physical processes, structure and composition, laboratory measurements of rate coefficients, modeling, optical observations, and the atmospheres of other planets. An introductory summary emphasizes the new developments in each area. The collection will be quite useful to graduate students and others just entering the field and to physicists and chemists who want authoritative and up-to-date summaries of atmospheric physics.

Although most of the articles concentrate on recent advances, the collection is especially remarkable for several in-depth articles on physical processes. J. C. G. Walker gives a basic discussion of vertical structure; D. M. Hunten has written a clear discussion of vertical transport and the concept of eddy diffusion; C. B. Leovy discusses radiative and dynamical heating and cooling; H. Kohl summarizes ionospheric winds and the role of electric fields; R. P. Wayne and F. Kaufman present basic discussions of reaction-rate theory and laboratory techniques respectively; E. E. Ferguson reviews the *D*- and *E*-region chemistry of positive and negative ions; G. Kockarts and J. S. Nisbet develop the concepts of models of the neutral atmosphere and the ionosphere, respectively. Each of these articles is clearly written (or has been skillfully edited).