Book Reviews

A Collation of Physics

A Festschrift for I. I. Rabi. LLOYD MOTZ, Ed. New York Academy of Sciences, New York, 1977. x, 244 pp., illus. Paper, $25. Transactions of the New York Academy of Sciences, Series II, vol. 38.

Being a physics graduate student at Columbia University in the late '30's and early '40's was pretty heady stuff. New York was still the gateway into the U.S.A., and through the portals of the Pupin Laboratories passed most of the great figures of European physics, some for short pauses, others to stay a while. The incomparable Fermi, newly arrived and temporarily bored with the enterprise of cataloging slow neutron resonances (fission was just on the verge of being discovered), was having fun exploring new fields, from cosmic rays to geophysics, by giving graduate courses in them. Though earning their livings by teaching in the many public and private colleges in the area (and sometimes even in the high schools), a score or more of brilliant young theorists and experimentalists concentrated their research activities around the seminars and laboratories at Columbia.

Presiding over this intellectual smorgasbord was I. I. Rabi. His direct research interests were in the measurement of nuclear moments by use of atomic and molecular beams, but his voracious appetite for good and interesting physics led to the cultivation and encouragement of exploration in all branches of modern physics by the graduate students, postdocs, and visiting research associates at Columbia. This catholicity of interest is well reflected in the volume here under review.

It would, in fact, be difficult to find a wider-ranging set of essays than the 19 contained in this festschrift, or a more distinguished set of authors. What is remarkable is that from an article on superfluid motions by M. Rasetti and T. Regge to one on physical interpretations of general-relativistic theories by P. G. Bergmann they all seem to hang together, perhaps through the common thread of Rabi's continuing emphasis on understanding the physics behind the detail.

Given the vast heterogeneity of subject matter, the editor has obviously decided that the only possibly rational ordering was one determined by the alphabetical sequence of the names of the leading authors. This results in a remarkable randomicity. Thus, following the aforementioned article by Bergmann, the next three are "The hyperfine structure of the ground state of orthohelium in the nonrelativistic approximation" by G. Breit, V. G. Kaveeshwar, and R. P. Singh, "The predicted infrared spectrum of HeH^+ and its possible astrophysical importance" by I. Dabrowski and G. Herzberg, and "Parity-violating electromagnetic interactions of nuclei" by G. Feinberg.

Of course, Rabi's immediate research interests and their direct outgrowths are by no means neglected. There is a modestly low-key but very informative history of the formative years of Rabi's Columbia researches in "Recollections of a Rabi student of the early years in the molecular beam laboratory" by S. Millman, together with "The fine structure constant" by V. W. Hughes, "Some history of the hydrogen fine structure experiment" by W. E. Lamb, Jr., and "The electric and magnetic dipole moments of the neutron" by N. F. Ramsey, as well as an (historically early) exhibition of analytical virtuosity in "The Majorana formula" by J. Schwinger, in which the mysteries of angular momentum formalism are rescued from the mystique of formal group theory and restored to physically familiar quantum language.

More recent indications of Rabi's abiding interest in the theoretical frontiers are to be found in the group of papers on particle theory by some of its foremost expositors: "Vector and tensor gauge particles in SL(6,c) theory" by C. J. Isham, A. Salam, and J. Strathdee, "Algebraic incompatibilities between Arnowitt-Nath gauges and supersymmetrized gravity" by Y. Ne'eman, and "The problem of mass" by S. Weinberg. And going from the ultramicroscopic to the cosmic, we have "A diamond as big as the Ritz" by E. Flowers, A. Ray, M. Ruderman, and E. Spiegel and "A few specializations of the generic local field in electromagnetism and gravitation" by J. A. Wheeler, with brief stopoffs in the nuclear, the atomic, and the macro-matter domains—"Notes on the statistical distribution of single population level spacings and level widths" by J. Rainwater, "Quantization of the damped harmonic oscillator" by H. Feshbach and Y. Tikochinsky, and "About liquids" by V. F. Weisskopf. Finally, there is a brilliant essay on the early history of radioactivity studies in "Radioactivity's two early puzzles" by A. Pais.

Altogether, a veritable feast. One might well ask what is the specific Rabi imprint, except for quality, on such a variegated and apparently unstructured collection. The answer lies in the common denominator of what Rabi imbued in his students of that era. "You're not going to get either fame or fortune out of physics," he insisted to us. "You'll work hard and long hours. There is only one reason for going into physics and this is if, above all other activities you can think of choosing, physics is the most fun." *Fun* is the common denominator of Rabi's festschrift, as it has been of his life in physics.

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Protein Evolution

The Evolution of Metalloenzymes, Metalloproteins and Related Materials. Proceedings of a symposium, Sussex, July 1977. G. J. LEIGH, Ed. Symposium Press, London, 1977. iv, 118 pp., illus. Paper, $7.70.

This slight paperback contains six contributions presented by British scientists at a symposium organized by the Inorganic Biochemistry Discussion Group of the Chemical Society at the University of Sussex. Four of the six contributions deal with the evolutionary implications of the variations in the amino acid sequence or conformation of the protein moieties between different organisms rather than with the possible influence of metal binding on the course of protein evolution.

Two of the chapters on protein structure, that by K. K. Rao and D. O. Hall on the chemistry and evolution of ferredoxins and hydrogenases and that by R. P. Ambler on cytochrome c and copper protein evolution in prokaryotes, are expectably good, although neither adds much to other recently published reviews by these authors. In both, data are discussed in relation to the generally ac-

cepted dogmas of protein evolution. The trouble is, of course, as Ambler points out, that our concepts of protein evolution are so much tied up with the supposition that more ancient extant organisms have "perpetuated themselves unchanged since early times" that we tend to ignore the high probability that macromolecular similarities between different prokaryotes are due to a continual but sporadic natural genetic transfer of information. This is suggested by R. R. Eady in a chapter on the structure and evolution of nitrogenase in which he discusses the artificial construction of new N_2-fixing bacteria by episomal transfer of the *nif* genes from *Klebsiella pneumoniae* to several other bacteria and the ability of the two proteins (Mo-Fe protein and Fe protein) responsible for overall nitrogenase activity from different sources to cross-react. Unfortunately we know little of the amino acid sequence homology of these moieties, or of the required oxygen depletion systems, without which both proteins are quickly inactivated.

The fourth chapter on proteins, on homology in protein structures by J. Williams, is somewhat idiosyncratic, for it discusses the subject in the light of the old ideas of protein families based on considerations of structure rather than sequence. The author also appears to be somewhat confused about homology and analogy in the evolutionary sense. Nevertheless, the questions he raises about the wisdom of assuming that evolution is always parsimonious are valid and should not be overlooked.

The other two chapters, on the evolution of metal-binding sites in proteins by T. G. Blundell and on the structure and evolution of superoxide dismutases by C. J. Brock and J. I. Harris, address the subject of metal binding in proteins. Blundell deals with zinc binding by most insulins to give hexamers and with its probable importance in the storage of these peptides in pancreatic B cells. Changes in the amino acid sequences in certain insulins (guinea pig) and related proteins, insulin-like growth factors and relaxins, which have similar confirmations to the zinc-binding moieties, prevent the formation of such hexamers. Brock and Harris draw attention to the overall evaluation of the two diverse superoxide dismutases, those containing either manganese or iron and those having both copper and zinc. The latter enzymes are only present in higher eukaryotes (animals, fungi, and plants). Here again, the authors suggest that the unexpected occurrence of superoxide dismutase in anaerobes could be a result of genetic transfer, but it seems equally likely that the enzymes could act as a guard against any superoxide in the environment.

All in all, this is a useful collection of work in progress, with enough information to give food for thought but little really new. It is reasonably well produced, but there are many spelling mistakes (none of them "fatal"), and pp. 111 and 112 are in the wrong order. My only real quibble is that most of the authors refer to details published elsewhere, often in rather difficult-to-obtain reports of other symposia. I hope that in the future they will be encouraged to include essential data in the chapters they write even if it means some repetition.

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Ecology of the Carabidae

Carabid Beetles in Their Environments. A Study on Habitat Selection by Adaptations in Physiology and Behaviour. HANS-ULRICH THIELE. Translated from the German. Springer-Verlag, New York, 1977. xviii, 372 pp., illus. $44.20. Zoophysiology and Ecology, vol. 10.

The holometabolous insect family Carabidae includes about 40,000 described species, with more being described almost daily. The group probably originated in the early Mesozoic, and in the course of time it has managed to occupy most of the ice-free areas of the world. Structural differences within the family are numerous, but not striking: it is easy to recognize a carabid as such, and difficult to identify taxa of less inclusive rank. This moderate structural divergence and marked diversity are accompanied by striking ecological divergence. Because of these features, along with the ease of sampling carabid faunas of fields and forests by means of pitfall trapping and the potential usefulness of carabids in biological control of noxious insects and as indicators of environmental quality, the group has attracted a substantial amount of work. Nonetheless, fewer than 100 species have been studied in detail, and most of these are western European.

Foremost among those investigating the ecological aspects of carabids is the author of this book. The book was written because the author believed it was time to integrate the information that has accumulated about the way of life of carabids. (His bibliography includes 595 publications, 88 percent of which were written during the past 18 years, mostly in German and English.) Because the book is comparative both in method and interpretation, it is a contribution to systematics as well as to ecology.

The objectives of the book are to describe how species are adapted to their environments and how the adaptations have evolved; to determine what factors limit species to particular microhabitats; to document the principle that the first step in the differentiation of a species is physiological; and to show to what extent the study of carabids can contribute to the more inclusive fields of ecology, ethology, and evolutionary biology.

By examining genetically determined responses to environmental factors, which he classifies as abiotic (temperature, humidity, light, and chemical and physical attributes of the substrate) and biotic (competition, parasites, predators, and so on), and behavioral—that is, endogenous—factors (especially circadian and annual rhythms), the author demonstrates the varied ways of life of carabid beetles and establishes that these basically structurally generalized animals as a group are highly adaptable. Further, he suggests that the basis for their adaptability is threefold: a generally flexible system of response to abiotic factors (for example, of 47 central European species studied in detail for preference with respect to light, humidity, and temperature, more than half were eurytopic for at least one of these parameters; only 36 percent were stenotopic for all three); a generally omnivorous diet; and a combination of marked dispersal capability in adults of many species with the tendency to form populations that remain for extended periods following colonization of new areas.

On the basis of field observations and limited laboratory experiments, Thiele concludes that abiotic factors determine the microhabitat a given species occupies and that competition is not a limiting factor. His analyses of adaptations form the basis for consideration of evolutionary processes.

Thiele's pragmatic approach to the latter topic produces only a very general model, and no group of species is fitted to it in detail. Simply described, Thiele's model is based on allopatric speciation, with a recently dispersed isolate in a new area facing new environmental conditions and undergoing physiological change to meet the new circumstances. Survival in the new area is made possible by the flexibility of physiological responses to abiotic factors. Eventually change takes place, and with it speci-