Book Reviews

Toward a Unification of Nuclear Physics

Nuclear Structure. Vol. 2, Nuclear Deformations. AAGE BOHR and BEN R. MOTTELSON. Benjamin, Reading, Mass., 1975. xviii, 748 pp., illus. $37.50.

Nuclear structure physics has become a vast subject of bewildering variety, lacking a small set of dominant problems about which research and progress can be centered. There are many different kinds of nuclei and a remarkable range of properties and excitations by which they can be studied. A study of a class of reactions such as single-nucleon transfer will exaggerate the single-particle aspects of nuclear behavior; a study of electric-quadrupole gamma transitions will focus on one mode of collective excitation; in some processes hydrodynamical behavior is exhibited whereas in others the nucleus behaves as a Fermi gas; symmetries—rigid-body symmetries, which operate in the space in which we live, as well as symmetries in abstract spaces of many types—are often significant; some features of nuclear behavior follow statistical laws, both at high excitation energy, which is not surprising, and in the ground-state domain, which is. Many of these phenomena, moreover, show up in the same nucleus, and often the same nuclear property or reaction can be understood in several ways, the relationship between them then becoming a matter of interest. With interest in heavy-ion reactions and nuclear physics at higher energies increasing, we can look forward to even greater variety and complexity.

The great work of Bohr and Mottelson beginning in the early 1950's was directed toward a partial unification of the subject, and the "unified model," in which the nucleus was represented in terms of the rotation of an intrinsic structure, was astonishingly successful in correlating and "explaining" an enormous range of experimental results. The first two chapters of this book, on rotations and on some aspects of intrinsic structure, give an extensive, and of course entirely authoritative, account of the interplay between the rotational and the instrinsic degrees of freedom. It is good to be reminded of the great precision with which the macroscopic concept of rigid-body rotation is applicable to a system in which the number of particles is small, the interactions are fairly strong, and there is no fixed center of force.

The final chapter, which takes up more than half the book, is directed toward a further unification, through a systematic development of nuclear vibrational motion, considered especially in terms of the fields produced by collective distortions of the average nuclear density. Here, of course, the variety and complexities mentioned above imply a great variety of modes and couplings, and the book introduces a notation and point of view that make it possible to treat them in a uniform way. The methods used connect well with methods used in other many-body domains (plasmas and metals, for example), which is quite appropriate since nuclear behavior itself exhibits such connections. It seems probable that the point of view extolled in this chapter will prevail, and those who are interested, for example, in giant resonance and similar phenomena may as well begin to talk in these terms. It remains to be seen, however, to what extent the present treatment of collective modes will lead to major advances in understanding. It is not clear to the reviewer that the almost direct transcription of nuclear data into theoretical terms, which is involved here, will be successful in establishing all the important collective modes, or that all the significant behavior can in any case be described in terms of a small number of such modes.

The book, with its precursor volume, can serve as a textbook, reference book, and research companion, as well as being a good source for those working in other many-body domains who wish to learn how their own subjects relate to nuclear physics. The writing is graceful, the discussion is for the most part satisfying, and the examples are enlightening. At many points reference is made to analogs found in other domains of physics.

It is not a criticism to say that the book is by no means a complete account of nuclear structure or of nuclear theory; it could not be, nor was it intended to be. One need not be much concerned that little attention is paid to the methods and results of conventional theoretical spectroscopy or to abstract-space symmetries, for there are many sources for the first of these, and the subject of symmetries has recently fallen into some disfavor (though it may revive with new experimental results on multi-particle transfer and new theoretical techniques). It does seem unfortunate, though, that so little consideration is given to the question *why* nuclei exhibit simple behavior and to the connection of such behavior with the properties of the nucleon-nucleon force (or at least of the effective interaction between nucleons in a nucleus, which is also reasonably well known). In fact, my only real criticism of this important book is that it does not often enough seek a more fundamental basis for the beautiful concepts with which it deals.

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Polymer Chemistry

Molecular Behaviour and the Development of Polymeric Materials. A. LEDWITH and A. M. NORTH, Eds. Halsted (Wiley), New York, and Chapman and Hall, London, 1975. xii, 554 pp., illus. $37.50.

C. E. H. Bawn, whose retirement after decades of major accomplishment is commemorated in this book, wrote one of the early comprehensive texts on modern polymer chemistry. That text was the first overview of the subject seen by this reviewer, and its style and insight have kept it on my shelves for 25 years, albeit now also in honored retirement.

The present book, a festschrift by colleagues mainly from the United Kingdom, was presumably not conceived as a text. But it might well serve that purpose for the graduate student or fresh Ph.D. who has dutifully read the chapters on polymers in his organic and physical chemistry books and now finds himself drawn to this science.

In 14 chapters that virtually span the subject, broad and authoritative reviews are given of topics in polymerization kinetics and the structure and properties of materials from the phenomenological and molecular points of view. With very few exceptions, a conscientious attempt is made to survey the historical development of the subject. Of the 17 contributors, six are listed as having predominantly industrial research affilia-

tions, and they provide a useful and interesting perspective on technologically desirable properties and the development of industrial capacity for producing different polymers. There is, however, virtually no material that directly concerns biologically significant macromolecules, which are understandably if regrettably the almost exclusive preoccupation of academic polymer specialists.

The half-dozen chapters on particular classes of polymers and catalysts are probably of special interest to organic or synthetic polymer chemists, that is "real" chemists. The other eight chapters should reach a broad audience of physical chemists and physicists concerned with physical properties and their molecular interpretation.

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Dinosaur Biology

The Hot-Blooded Dinosaurs. A Revolution in Palaeontology. ADRIAN J. DESMOND. Dial, New York, 1976. 238 pp., illus. $12.95.

When I first saw the death of the dinosaurs in the Walt Disney movie *Fantasia*, I was greatly saddened. The poor creatures seemed so human. Years later I realized that Disney had taken some artistic liberties in his animated classic, for his reptiles demonstrated all sorts of mammalian behavior, including parental care, for which there was no paleontological evidence. Well, it now turns out that Disney may have presented a fairly accurate picture of dinosaurs, given what Adrian Desmond tells us about the wondrous archosaurs in *The Hot-Blooded Dinosaurs*.

The Hot-Blooded Dinosaurs is about both dinosaurs and the study of dinosaurs. The style is light, one of suspense and discovery. The book contains much historical material, often presented as asides rather than in tight chronological order. The historical notes range from informative and entertaining to somewhat distracting.

The main theme of the book is that the advanced archosaurs, that is, dinosaurs, pterosaurs, and their pseudosuchian ancestors, were warm-blooded or endothermic. Relying primarily on the work of John Ostrom, Robert Bakker, and Armand de Ricqlès on dinosaur ecology, energetics, posture, gait, and bone histology, Desmond presents the case that the dinosaurs were active, terrestrial creatures with a mammal-like physiology. As part of this scenario, a dinosaurian ancestor for the birds is seen as warm-blooded and intelligent long before its lineage acquired feathers or flight.

The author links endothermy with high intelligence and this in turn with complex behavior. The dinosaurs are perceived to have complex group behavior and parental care presumably denied cold-blooded ectotherms. The author asserts that "if an adult [reptile] remains near the young, its limited intelligence cannot overcome the temptation to eat them" (p. 171) and that "unlike solitary lizards, many dinosaurs were gregarious" (p. 130).

Although Desmond's perceptions of dinosaurs as vigorous, dynamic creatures seem reasonable, his major thesis, that they were therefore necessarily endothermic, is more difficult to accept. New data on crocodiles, which are ectothermic archosaurs and, with the birds, the closest living relatives to the dinosaurs, undermine Desmond's position. It is now known that crocodiles have a behavioral repertoire that rivals in complexity that of birds (see A. C. Pooley and C. Gans, *Sci. Am.* **234**, No. 4, 114 [1976]). Adult crocodiles cooperate in feeding activities. Parents help their hatchlings escape the egg and nest; a mother collects hatchlings and transports them to the water in her mouth. Complex behavior of the type posited for dinosaurs evidently does not require endothermy in the archosaurs.

Desmond's thesis is a victim not so much of the information explosion as of a dogmatic adherence to an extremist view. Vertebrates are presented as either strict ectotherms or strict endotherms. We are told, "The dinosaur adopted a mammal-like pose because it had a mammal-like physiology. It could not have been otherwise" (p. 121). But it could have been otherwise, and Ricqlès, whose work on bone histology is used by Desmond to support his thesis, has presented a more tempered and open view. In his recent review on the evolution of endothermy (*Evol. Theory* **1**, 51 [1974]) Ricqlès states, "If the origins of perfect 'warm-bloodedness' (endo- *and* homeothermy) are looked for among the primitive representatives of lineages of warm-blooded modern vertebrates, one cannot ask for a sudden appearance among them of all the associated features that one can find among living, modern warm-blooded animals." In Ricqlès's opinion "the big dinosaurs had a peculiar physiology by any standard, one which can hardly be regarded as 'typically reptilian' but must be better understood as something of its own."

A catchy title, coffee-table format, and simple glossary (where words like "fossil" and "physiology" are defined) suggest that *The Hot-Blooded Dinosaurs* was designed to be read by the nonpaleontologist. On the other hand, well over 100 authors are cited and almost 100 genera are mentioned in less than 200 pages of text. This documentation will interest the amateur or professional paleontologist with some familiarity with the names. It may overwhelm the layman.

While Desmond's assertiveness sometimes exceeds the data, his enthusiasm does succeed in vitalizing the dinosaurs. I'll believe a ceratopsian hen cared for her chicks!

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Haploid Transcription

Gamete Competition in Plants and Animals. Proceedings of a symposium, Lake Como, Italy, Aug. 1975. D. L. MULCAHY, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1975. x, 288 pp., illus. $27.50.

The source of the interest in the subject of this volume can best be described by quoting from the paper by J. Cohen: "A man ejaculates some 350,000,000 sperms and a bull 1,000,000,000; of these multitudes *one* may be used for fertilisation, occasionally two or even, on occasions so rare as to make world headlines, six. It is usual among animals to produce very many more sperms than could ever be used in fertilisation and biologists have come to accept this monstrous overproduction as normal." Overproduction, especially of male gametes, is normal for plants, too. That only one of many million sperm finally fertilizes the egg raises the question of whether this is an accident or the result of some selection process, which would necessarily entail a high degree of competition among gametes.

The majority of the 28 papers in the book concern botanical systems, which seems to reflect the fact that haploid transcription is a relatively rare phenomenon among animals, whereas there is extensive evidence for haploid transcription in plants. The evidence for and against the existence of a haploid effect in animal spermatozoa is well reviewed by R. A. Beatty, who concludes that "there is perhaps no absolutely certain example of a haploid effect in animals." Cohen, on the