

fact mainly consists of a number of quite comprehensive, well-documented reviews (the discussion, incidentally, is presented in narrative form). Perhaps the reader, having more time than was available to the participants at the meeting, will be in a better position to mull over and derive inspiration from the mass of detail that is presented.

While proving invaluable to the clinician interested in all aspects of the biology of the placenta, the book, then, also has much to offer the basic research worker who wishes to broaden his or her outlook. It is divided into four sections. The first, on biochemistry, contains a general review of metabolic pathways and their regulation followed by other reviews relating to the placenta, including an up-to-date account of its endocrine functions by Dorothy B. Villee. The second section, headed Cell Replication, includes papers on the development of the placenta and on the biology of the cancer cell. A paper on trophoblastic neoplasia includes a full account of the earlier cytogenetic studies but does not mention the recent evidence (published in 1977) for the androgenetic origin of hydatidiform moles. The remaining two sections deal with immunology and aging, respectively, and include commendable contributions from W. D. Billington ("The placenta and the tumour: variations on an immunological enigma") and Harold Fox (on the placenta as a model for organ aging).

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Astronomical Phenomena

Active Galactic Nuclei. Papers from a NATO Advanced Study Institute, Cambridge, England, Aug. 1977. C. HAZARD and S. MITTON, Eds. Cambridge University Press, New York, 1979. viii, 318 pp., illus. \$32.50. Cambridge Astrophysics Series.

Stimulated by the discovery of quasars in the 1960's and by rapidly accumulating, multifaceted observational data, research on the subject of active galactic nuclei has become one of the most exciting and vigorous fields of modern astrophysics. It encompasses such phenomena as the quasars, Seyfert nuclei, BL Lacertae objects, and powerful radio or x-ray emitters. If quasars are at their cosmological redshift distances, they must be capable of prodigious outputs of energy (of order 10^{47} erg sec⁻¹) from regions of space light-months across. The

other sources named above are also extremely energetic, and they appear to be associated with the nuclei of galaxies of stars. Because of various spectroscopic resemblances, many astronomers believe quasars also lie in the centers of galaxies at earlier epochs in the universe.

As yet, no completely satisfactory theoretical explanations have emerged to account for the energetics of active galactic nuclei. It is generally (though not unanimously) agreed that some form of gravitational accretion involving massive black holes must be responsible, but the details of the accretion process and the source of accreting material are still open to speculation. Also, the conversion of gravitational energy into observed continuous or emission-line radiation and the resulting implications for the physical and dynamical gas conditions are not satisfactorily understood.

These are some of the issues that led to the convocation of a NATO Advanced Study Institute in August 1977. The volume reviewed here contains keynote lectures presented at that institute. Two speakers' rules are in evidence: discussion of the local versus cosmological redshift controversy is kept to a minimum and observational data are examined only as they facilitate the discussion of theoretical implications for classes of objects. The presentations may be divided into two groups. Papers in the first group (by Hazard, Osterbrock, Baldwin, McKee, O'Dell, Weedman, Netzer, Perry, and Wolfe) are primarily of a review nature and summarize and interpret existing observational data, including radio, infrared, optical, ultraviolet, and x-ray continuous radiation as well as emission and absorption features. The theoretical interpretations concern the physical conditions in, processes taking place in, and location of the emitting or absorbing gas. In the opinion of this reviewer, these papers constitute one of the best and most comprehensive compilations available on the subject.

The second group of papers concentrates on theories of accretion and energy release for massive black holes in the nuclei of galaxies. Being relatively unfamiliar with this aspect of the research, I especially appreciated Carter's introductory overview. In simple, clear terms he reviews the basic principles of black holes, puts them into perspective with other types of astronomical phenomena, and discusses their possibilities and limitations as power sources in galactic nuclei. The other papers in this group are by Gunn, McCray, Blandford, and Mestel.

The book does not solve the mysteries

of the quasars; that was not the intent. What it does accomplish, admirably, is the presentation of available information and current theoretical views regarding the environments and energy sources of active galactic nuclei. Though there have been some new and exciting developments since 1977 (for instance, suggestions that intrinsic quasar radiation is significantly altered by dust extinction, satellite x-ray and γ -ray observations, and a novel idea about the production of FeII emission), the value of the book is not significantly diminished. I highly recommend it for persons working in the field or for persons with a sound background in astronomy or physics who are looking for an excellent introduction to the subject.

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Crystalline Solids

Disorder in Crystals. N. G. PARSONAGE and L. A. K. STAVELEY. Clarendon (Oxford University Press), New York, 1978. xxviii, 926 pp., illus. \$69. The International Series of Monographs on Chemistry.

Disorder in Crystals deals with an extremely interesting and broad subject in solid state physics. Though the authors explicitly exclude nonstoichiometric systems and systems with lattice defects, the book includes topics as divergent as molecular crystals (both ionic and van der Waals), inclusion compounds, alloys, superionic conductors, ferroelectricity, and magnetism. This is done in order to show that crystals with positional, orientational, or magnetic disorder—or perhaps a combination of these—have numerous aspects in common. In the past few years several reviews have been published on one or another of these topics, yet nobody has attempted such an extended presentation. One of the successes of the book is certainly that it tells a reader who is familiar with, say, disorder in ionic conductors that it is similar to disorder phenomena in other crystals.

Parsonage and Staveley claim that a look at magnetic systems, which have been most thoroughly studied in the past, may be particularly helpful in revealing similarities with other disordered systems. This is undoubtedly true, and the study of magnetic systems has turned out to be a mainspring in the study of many disorder problems in the last few years. A second main line of the book is the idea that disordered phases can only be understood if they are contrasted with

the partially or fully ordered phases, usually occurring at lower temperatures, higher pressures, or both. This immediately requires the inclusion of order-disorder phase transitions, the concept of an orientational order parameter, and so on.

These ideas are introduced in the first two chapters, one on thermodynamics (which is less rewarding than most of the other chapters) and the other on statistical mechanics. The emphasis is on models, such as the Ising model, developed in connection with magnetic systems and referring to continuous or second-order transitions. Simple concepts, such as mean-field theory or Landau theory, receive a very brief treatment and unfavorable judgment. However, though such theories are mostly unsuccessful in dealing with critical exponents, they often provide very useful approximate answers concerning discontinuous transitions, which are ultimately displayed in practically all molecular crystals.

Experimentally, the book is based on structural information and specific heat measurements to a large extent, on NMR spectroscopy to some extent, and on other techniques to a lesser extent. Many extremely interesting systems are discussed. Each discussion begins with a consideration of the system's phase diagram and the various structures involved (many illustrations support the presentation) and then goes on to consider the conditions that lead to the occurrence of a disordered phase, how a transition comes about, and so on. Often families of similar compounds are grouped into clearly arranged tables, which summarize the respective structures, entropy of transition, activation energies, and so on.

The book contains more than 2500 references, up to 1976. This alone makes it a valuable source of information.

One of the most important issues in a book like this is the proper description of disorder. Here the authors distinguish between two different limits: either a discrete number of possible arrangements of a given object or, at the other extreme, an infinite number of possible arrangements, all equally probable. According to the authors, most systems are Ising-like, with a discrete number of possibilities. They support their view with examples of entropy changes at the order-disorder transition. In my opinion it is dangerous to base such a discussion mainly on entropy changes. Reliable crystallographic data should always be included. Likewise, the discussion of orientational disorder should have embraced smoothly varying, angle-dependent density distributions.

Some avoidable misunderstandings are created by the authors' use of the notion "free rotation" both for quantum mechanical free rotation (for example, parahydrogen in its rotational ground state) and for high-temperature rotational diffusion in shallow potentials (for example, CH₄ phase I). Also, the possibility of positional disorder in plastic crystals seems to be overemphasized, for pronounced translational diffusion close to the melting point is also found in atomic crystals.

A few recent developments are treated only briefly or omitted altogether. In the case of orientational order and disorder, for example, this applies to topics like the detailed shapes of rotational potentials, rotation-translation coupling, tunneling spectroscopy with neutrons, short-range correlations, and models treating "steric hindrance" in analogy to the dimer problem.

On the other hand many small or large problems connected with disorder are raised. Reading the book, one learns about numerous open questions, many fascinating disordered systems and phase transitions, and surprising connections between systems that look entirely different at first glance. The book is primarily intended for chemists and crystallographers. However, as a solid state physicist, I found it enjoyable and stimulating to read.

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