Magnetism in amorphous materials

Magnetic Glasses

K. Moorjani and J. M. D. Coey
536 pp. Elsevier, New York, 1984. $127.00
Reviewed by Jeffrey W. Lynn

The field of structurally amorphous materials has witnessed an explosive growth in the last two decades due to the development of rapid quenching techniques (quenching rates of 10^6 K/sec and higher) that can make a wide range of metallic systems amorphous. These techniques allow one to fabricate materials with novel and exciting physical properties that not only challenge our fundamental concepts of condensed matter physics but also have important commercial applications.

The magnetic properties of amorphous systems are worth studying from two points of view. First, their intrinsic magnetic behavior is often of fundamental importance. Second, magnetic phenomena provide superb investigative tools—such as the introduction of magnetic impurities—for exploring the essential physics of these materials outside the realm of magnetism. Thus the magnetic properties permeate all aspects of amorphous systems.

Magnetic Glasses, written by two well-known researchers in the field, Kishin Moorjani and Michael Coey, is at present the most comprehensive and up-to-date reference book on this topic. The text provides a good discussion of the basic physical concepts essential for an understanding of these materials, and it could be used in its own right as an adequate introduction to the fundamentals of magnetism. However, the real usefulness of the work is contained in the well-written and thorough discussions of current concepts and research. In addition, each chapter includes an extensive list of references to the literature. An overall bibliography, as well as author, subject and chemical formula indexes complete the book.

There is a chapter on the magnetic properties of insulating glasses, a topic dating from ancient times. The principal area that the book addresses, however, is the magnetic properties of metallic glasses, such as the transition metal–metalloid systems (for example, Fe–B) and the rare earth–transition metal materials (for example, Tb–Fe), which have attracted great interest recently. Among these materials are numerous examples of ideal isotropic ferromagnets, spin glasses, random-anisotropy materials, and reentrant magnets, to name a few systems of current concern. The physics of these systems of course overlaps with that of crystalline systems, so the discussions are pertinent to the interests of a wide range of researchers. For those investigators directly interested in amorphous magnetism, *Magnetic Glasses* is an essential reference.

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Chemistry of Atmospheres: An Introduction to the Chemistry of the Atmospheres of Earth, the Planets, and Their Satellites

Richard Wayne
361 pp. Oxford U. P., New York, 1985.
$39.95 hardcover; $19.95 paper

There are two strong reasons for teaching university courses in atmospheric chemistry. First, the subject has now become a hard science: Principles have become clear, intellectual and practical questions abound, and the topics are amenable to theoretical and experimental investigations. Second, many students can be motivated to become good physicists and chemists by exposure to principles and applications of spectroscopy, reaction kinetics, photophysics and photochemistry in the context of the atmosphere of the Earth and other planets.

The noted photochemist Richard Wayne, from Oxford University, transmits the excitement and educational stimulation of atmospheric chemistry and physics in his new book *Chemistry of Atmospheres*. Indeed, he developed much of the book through teaching the subject to Oxford undergraduates. Those who are now teaching such courses know that atmospheric chemistry motivates students powerfully but that there are few books on which to base a course. Wayne's book is excellent, perhaps the best now available, at least for the study of gas phase atmospheric chemistry.

The scope of the topics covered in this book is broad and impressive. Wayne introduces and explains chemical and physical principles clearly and concisely, both in the introductory chapters and in the advanced topical discussions. He clarifies important concepts in thermodynamics, light scattering and the interaction of radiation with matter using examples well selected from atmospheric applications. For example, he makes clear the distinction between photodissociation and predissociation. The clarity and effectiveness of Wayne's exposition are all the more appreciable because he covers such a wide range of topics: the role of biological and microbiological processes in supplying gases to the atmosphere, photochemistry and chemical kinetics, the chemistry of ionized gases, the processes that give rise to ultraviolet and visible light emission from atmospheres, and the evolution and change of atmospheres on geological and human time scales.

Deficiencies of the book are the lack of material on condensed phase processes, such as the aqueous chemistry of clouds, and the absence of study problems and examples. As to the examples, one can compensate to some extent by consulting the fine references to books and research papers that Wayne provides. For help with condensed phase atmospheric chemistry, an increasingly important topic, one might consult John Seinfeld's *Atmospheric Chemistry and Physics of Air Pollution* (Wiley, New York, 1986) or the new book by Barbara Finlayson-Pitts and James Pitts, *Atmospheric Chemistry* (Wiley, New York, 1986).

Altogether, this book is a pronounced

success. It is beautifully printed and well written; it demonstrates Wayne's lively and broad intelligence. He makes palpable the growing excitement of atmospheric chemistry as a field. For those of us who cannot send our students to Wayne's lectures at Oxford or cannot attend ourselves, this book is a useful and welcome substitute.

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Masks of the Universe

Edward Harrison
306 pp. Macmillan, New York, 1986. $18.95 hardcover; $9.95 paper

The mythopoeic role of science is one that most professional scientists find disquieting. As custodians of modern rationalist models of the Universe and its origins, we have cast the ancient creation myths into the shadows. Edward Harrison argues that we do so at some peril, for myths address real human needs in a manner essential to civic comity.

Harrison locates modern cosmology in a historical sequence, boldly extrapolated to the very dawn of our race. The "universe" of any era is no more than a mask impersonating the unknowable face of the Universe. "Myth" is simply a word we use to designate a discarded mask.

He does not reject the notion of progress. For example, he clearly prefers the reasoned and humane monotheism of Zoroaster, Judaized in the Psalms, to the our-god-can-lick-your-god tribal chauvinism of the Pentateuch. Progress, however, is far from monotonic; between the eminently sane medieval and modern cosmologies there intervened the pathological "witch universe" of the Renaissance.

Harrison wields this example to scourge Karl Popper's "falsifiability" as a litmus test for true science. He finds it too impoverished to exclude witchcraft, and too rigid to admit cosmology or biological evolution.

Harrison considers it unlikely that people are ever fully enmeshed in the universe of their time. The Neolithic hunter, after some minimal effort to placate any spirits that might frustrate his efforts, probably lived by his wits, much as we pay scant heed to the Hubble shift in our day-to-day lives. Wherever a mask fails to satisfy our needs, something will fill the vacuum. The refusal of modern science to endow life with purpose has assured the survival of much of the medieval worldview.

Notwithstanding its vast scope, *Masks of the Universe* remains primarily a science popularization. Nearly half of the book deals with the contemporary era. Though the treatment is often superficial, Harrison does develop just enough relativity and quantum theory to underpin his cosmology. In this he is remarkably complete—inflationary, De Sitter and steady state universes, grand unified theories, the 3-K background and x-ray binaries all get their due. He sets little store, however, by grand metaphysical schemes, such as Hugh Everett's many-worlds hypothesis or an "implicate" universe in which every detail is fixed by the need for self-consistency. These, he feels, reflect vain hopes that the true face of the Universe lies nearly within our ken.

All of science and human history makes for a rather broad canvas, and Harrison is the first to concede that his reach sometimes exceeds his grasp. In his own words, his reconstruction of Neolithic life is probably "fictitious" and his anthropological and psychological generalizations are "sophomoric."