cepts to the general public, probably accounts for this omission.

Given the growing tendencies of the Federal Government to reduce the amount of information it releases to the public and to impose restrictions on the flow of information from nongovernmental sources, particularly in the realm of science and technology, this book is most timely. It is a valuable source of data and ideas on a topic that concerns all scientists and engineers, both as professionals and as citizens.

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High-Energy Astrophysics: An Informal Introduction for Students of Physics and Astronomy

M. Longair

412 pp. Cambridge U. P., New York, 1981. $49.95 cloth, $19.95 paper

From the early 1900s until about fifteen years ago, the field of high-energy astrophysics consisted of the study of cosmic rays. The problems encountered in the attempts to measure them and explain their origins and propagation stimulated a great deal of research, and although some questions remain, especially in regard to the origins of cosmic rays, many interesting results have been obtained. In the last ten to fifteen years, however, the ability to make x-ray and γ-ray observations from above the atmosphere has led to a number of exciting discoveries of highly energetic astrophysical phenomena. In our own galaxy, x-ray observations have indicated the existence of well over a hundred compact stars (primarily degenerate dwarfs and neutron stars, and perhaps one or two black holes), in which accretion of matter into the extremely deep gravitational potential results in energies of the order of 100 MeV per nucleon. Satellite observations have also detected many extragalactic sources of high-energy photons, especially active galactic nuclei such as quasars and Seyferts. Models for these phenomena usually involve black holes with masses from a million to a billion times the mass of our sun. Further, the high-energy astrophysics of the hot big-bang model provides a great deal of information about particle physics and field theory. In short, future prospects have expanded dramatically over those envisioned when cosmic rays occupied the entire field.

In *High Energy Astrophysics*, Malcolm S. Longair has chosen to introduce the field by means of the rather large body of cosmic-ray studies. His descriptions of the physical processes involved are clear and concise. Further, his book provides a welcome updating of the knowledge of cosmic rays in both observations and theory found in previous texts. It is well organized, and the references and suggested further readings are exhaustive. Because the book has been prepared from a series of lecture notes, its style is somewhat different from the tone of the usual text: Longair has included a sprinkling of personal remarks and opinions. As a textbook for advanced undergraduates or for beginning graduate students, this personal quality conveys the author's keen interest and excitement and should prove very encouraging to students.

A serious shortcoming of the book is its neglect of the more recent developments in the field. The author devotes only a few pages each to cosmology and galactic x-ray sources. Further, in view of the fact that Longair, Astronomer Royal for Scotland and Director of the Royal Observatory at Edinburgh, has concentrated his research efforts on extragalactic radio sources, the rather minor treatment this subject receives (one chapter—and that in the context of cosmic-ray sources) is surprising. In summary, the clarity of the book and the ease with which it can be read should make it valuable as an introduction to high-energy astrophysics, even while it might be desirable to augment it with more recent work.

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A Search for Structure: Selected Essays on Science, Art, and History

C. S. Smith

410 pp. MIT Press, Cambridge, Mass., 1981. $30.00

From Art to Science: Seventy-Two Objects Illustrating the Nature of Discovery

C. S. Smith

118 pp. MIT Press, Cambridge, Mass., 1980. $25.00

Look through the side of a glass of beer at the foamy head. The apparent chaos of bubble cells of different sizes and numbers of faces actually reveals great structure upon close scrutiny. The faces meet at 120°—a consequence of the liquid seeking the minimum area consistent with the volumes of the individual cells. Topological laws that relate the number and types of vertices, edges, and faces imply that there will be an average of $5\frac{1}{7}$ edges per face. Together these local and global constraints assure that at least some of the faces must be curved, which, in turn, indicates a pressure difference between neighboring cells. In the presence of diffusion, then, the system is unstable: One by one some bubbles shrink and others grow until your beer head falls flat.

This application of physics and topology comes from the first essay in *A Search for Structure*, a collection of 14 papers culled from the nearly 200 written by the distinguished materials scientist and generalist Cyril Stanley Smith. The first is the only strictly scientific essay in the book, however; the others deal with more general topics associated with science, art and history.

The structure of the beer foam is governed by both local and global constraints, or "forces." Smith's primary thesis is that structure in other fields such as art and history also results from interplays of forces acting on different levels. These fields therefore share common patterns of structural hierarchy—patterns that are manifest in the material world as well.

He states that aesthetic pleasure comes from simultaneous recognition of structure on many such levels. Further, as science deals less and less with simple, isolated systems, and more and more with systems possessing many levels of hierarchical structure, aesthetic judgments will become more important. They will be quite preponderant, for instance, in solid-state physics, where one must consider not only an electron's spin, but also its interaction with the nucleus, the resulting orbital structure, the crystalline structure and the placement of any doped atoms, as well as the large-scale structure of the material. Smith maintains that the concept of symmetry has been overemphasized in science; its main value lies instead in giving meaning to its absence, *dis*symmetry—the prerequisite for hierarchy.

In art, too, any particular work is affected by the basic levels, the medium, as well as by the cultural environment and the prevailing aesthetics. The dynamics and morphology of a field of art can be likened to those in a crystal: Just as a fault in a crystal begins as a localized discontinuity, so too, major changes in artistic styles begin with small enclaves of artists and propagate throughout the entire system, to result in paradigm shifts, in the words of Thomas Kuhn. At times Smith's analogies are a bit simplistic; yet they yield new insights.

Smith's interests in the history of materials science (the precursor to solid-state physics) has taken him to many fine art museums, where he can "read" the history of an artifact by scientifically analyzing its makeup. For instance, he shows a figure of a 19th-century