for ensuring the public's safety. But this is a somewhat distorted view of the past. After all, the most important safety device, the containment shell, was invented in 1948 to house a secret military reactor, the Submarine Intermediate Reactor. And the Advisory Committee on Reactor Safeguards (which itself was a creature of the in-house establishment) realized that containment shells would not ensure zero external release of radiation for very large commercial reactors. The fact that reactor safety then became probabilistic, not deterministic, was also recognized within the nuclear community, although I would agree that the acceptability of a technology whose safety is probabilistic was an issue largely raised by the intervenors.

Whether or not the current US hiatus in building nuclear plants adds to the public's safety, given the various risks imposed by other sources of energy, is still moot: In short, one can argue whether or not the interventions by public interest scientists have really added to our well-being.

This book is too detailed to be read easily by either reactor physicists or political scientists. But for those interested in the history of nuclear power, particularly old-timers like myself who are amused at becoming objects of historical scrutiny, Balogh's story is both revealing and frustrating.

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Physics: Imagination and Reality

P. R. Wallace
World Scientific, River Edge, N. J., 1991. 567 pp. $64.00 hc
ISBN 9971-50-929-6

The teaching of physics as a liberal art, usually the province of a few mavericks scattered throughout higher education, seems to be in vogue of late. Liberal arts physics courses present physics—especially its 20th-century achievements—as a part of the scientific worldview that is a defining feature of the civilization we call "Western." This book is the product of one of the mavericks: Phillip Wallace is a respected senior theoretical physicist from Canada who long taught such a course at McGill University.

While the book clearly traces its origin to the author's course, it is not burdened with the usual textbook paraphernalia of exercises and study questions, and offers numerical examples only where there is an important point to be made. Although it is generally written in lucid and readable prose, the book's pace is quite uneven, in places reverting to little more than extended lecture notes. While it assumes adeptness at no more mathematics than the usual high school algebra and geometry, the text occasionally demands that the reader make full use of these skills.

The author has committed himself to the rapid introduction of contemporary topics after giving the reader a minimal preparation in classical physics. Thus he completes classical mechanics and electromagnetism in the first 70 of 540 pages, while thermodynamics and statistical mechanics claim 50 more pages midway. Other classical concepts appear *en passant* as needed: For example standing waves on a string first appear as an introduction to Schrödinger's hydrogen solution.

The treatment of relativity is one of the book's stronger points. In discussing the special theory, Wallace takes pains to emphasize the distinction between what an observer sees and the picture reconstructed by correction for signal transit time. This distinction is not always fully appreciated by physics majors (or even, lamentably, by their teachers). The general theory is explained well, although the author omits some of the more up-to-date confirmations of its validity, such as the annual variation in the period of atomic clocks and transit-time delays revealed in studies of millisecond pulsars. This section concludes with an excellent treatment of stellar evolution and the compact objects that represent the endpoint of this evolution.

The introduction to quantum theory is fairly conventional, but it takes the curious approach of introducing indeterminancy through Heisenberg's relations without explicitly mentioning the probability interpretation of the wavefunction.

On the most current topics, Wallace wisely tailors his emphasis to what is likely to interest the student rather than the teacher. Thus cosmology is covered in considerable detail, while particle physics as well as the author's current specialty of condensed matter theory get shorter shrift.

A careful attention to history is the hallmark of the most successful books of this type, and Wallace clearly understands this. But it is also possible to be a slave to history: For the lay reader, the Gell-Mann–Nishijima scheme and the SU(3) particle classification schemes described in Wallace's book shed little light on the far simpler quark model that followed from them.

The author's style has one feature that seriously mars his treatment of several topics. He seems addicted to the unexplained forward reference. Thus he derives the gravitational red shift from the quantization of light long before he introduces light quanta, and he makes similar use of the uncertainty relations and the Planck length. For most readers, a simple note that a particular topic will be treated in detail later suffices to alleviate any confusion but Wallace does not always take the trouble to do this.

All in all, this book is a modest but worthy addition to the growing selection of texts in this area. An instructor who contemplates teaching a course on liberal arts physics to a superior group of students, and who shares the author's preferred list of topics, would do well to consider it.

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Weak Chaos and Quasi-Regular Patterns

G. M. Zaslavsky, R. Z. Sagdeev, D. A. Usikov and A. A. Chernikov
Cambridge U. P., New York, 1991. 253 pp. $75.00 hc
ISBN 0-521-37317-4

With the growth of interest in and understanding of dynamical systems has come a rise in the number of books devoted to the subject. The present volume is one more addition to this swelling throng. It devotes its attention primarily to Hamiltonian systems and, within the general framework of Hamiltonian systems, to questions of the origin of chaos in such models.

Hamiltonian dynamical systems can be well understood in two limiting regimes. At one extreme lie the "hyperbolic" dynamical systems. These systems are completely chaotic, but due to the presence of certain well-understood geometrical structures in the phase space of the problem, one can make predictions about the decay of correlations and the insensitivity of the motion to perturbation of either the initial conditions or parameters of the model. At the opposite extreme lie the integrable systems. In these systems, the motion is completely regular, and by introducing action-angle variables, one can solve the equations of motion explicitly.

Between these two extremes the situation is far less understood. One major advance occurred in the 1950s and 1960s through the work of Andrei

Kolmogorov, Vladimir Arnold and Jürgen Moser (which became known as the KAM theory). They showed that if one starts with an integrable system that is nondegenerate in an appropriate sense and makes a small perturbation of that system, then there is a set of large volume in the phase space on which the motion remains as regular as it would be in the completely integrable case. The set of trajectories to which the KAM theory does not apply is of small volume but large importance. In particular, it typically has a very complicated shape and forms a sort of web that for arbitrary, small perturbations of an integrable system can nonetheless extend for unlimited distances through the phase space. Using this observation, Arnold was able to construct an example of a small perturbation of a completely integrable system with trajectories that wandered arbitrarily far from their starting point. This phenomenon, now known as Arnold diffusion, forms the centerpiece of this book.

The authors of the present volume have all been involved in elucidating the appearance and importance of this mechanism for producing chaos in various physical settings. Therefore, they are well qualified to survey this field, and in my opinion, the strongest sections of the book are those in which the authors explain how Arnold diffusion arises. They describe how separatrices (which are special orbits in the integrable problem) split up under perturbation and give rise to a tangled network that permeates the phase space and through which chaotic trajectories of the system may pass. They also describe approximate methods for calculating the extent of this web and the rate at which trajectories diffuse through it.

Preceding this description is a brief introduction to Hamiltonian dynamics. This serves as a useful brushup for someone already familiar with the area, but I suspect it is too brief to be of much help to someone unfamiliar with the subject. The authors then describe the formation of the stochastic web. This material is fairly standard and can be found in other books (albeit with different emphases), such as Allen Lichtenberg and Michael Lieberman's *Regular and Stochastic Motion* (Springer-Verlag, New York, 1983).

The book then goes on to treat a rather special topic, the existence of certain special Hamiltonian systems in which the stochastic web forms a quasiperiodic structure in the phase space. The only place in which these topics seem to be covered, aside from the original literature, is in the review article "Weak Chaos and Structures" (*Soviet Scientific Reviews C* **8**, 83, 1989) by the authors of the volume presently under review. The discussion of these structures and of similar phenomena in related models, such as three-dimensional fluid motion, takes up about half of the book. In these sections the authors discuss the relationship of these classical mechanical models to quasicrystals, and they draw an interesting relationship between the distribution of elliptic and hyperbolic periodic orbits in chaotic dynamical systems and the density of states in condensed matter physics. However, the real relevance of these particular quasiperiodic patterns for understanding the origin of chaos in Hamiltonian systems remains unclear to me because they appear to be rather unstable under perturbation of the parameters of the model, while the occurrence of chaos in such systems is a robust effect.

The book is generally well produced, with a large number of lovely figures of quasiperiodic webs. In addition, the final chapter contains very interesting pictures of similar quasiperiodic patterns found in nature and art; however, the scientific connection of this chapter with the rest of the book is rather tenuous.

Because of the somewhat specialized nature of much of the material, I would not recommend this book to someone wishing for an introduction to chaos in Hamiltonian systems. Rather, I expect it will be of most interest to specialists looking for a source for this material outside the original literature—the only other place much of it can be found.

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NEW BOOKS

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