sufficient background to "make the current literature and review articles accessible to the reader." He succeeds admirably in this endeavor. The downside is that there is very little material related to the substructure of the nucleons. The book has numerous references to and illustrations of experimental results. Problems do not appear at the end of each chapter, but rather are scattered throughout, and they are directly related to the development in the text.

Aside from the usual misprints—not excessive—I have few quibbles. A number of facts are presented without adequate explanation. An example is the weak spin-orbit force of the Λ–N interaction, which is mentioned early in the book; this spin-orbit splitting is barely referred to in the description of hypernuclei in the book's last chapter. Also, in the depiction of the double charge exchange of pions, the explanation of the behavior of the cross section at low energies is not given. There are also a very few statements that could be misconstrued, such as blaming isospin nonconservation on the electromagnetic interaction and not mentioning quark mass differences or QCD effects.

However, these are minor reservations. Overall this is an excellent treatment of the basic scattering theory required to understand nuclear physics experiments and their results.

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Space Sailing

Jerome L. Wright
Gordon and Breach, Philadelphia, 1992. 258 pp. $24.00 pb ISBN 2-88124-842-X

The pressure exerted by solar radiation on a perfectly reflecting perpendicular surface is about $9\times10^{-6}\ \mathrm{N/m^2}$ at 1 AU. A sail made from Kapton film 2 microns thick with a 0.1-micron-thick aluminum coating would weigh about $3\ \mathrm{g/m^2}$. The acceleration of the sail itself from light pressure would then be about 3 mm/sec^2. This is about half the acceleration due to the Sun's gravitational field.

Solar sailing was repeatedly invented in the pre-Sputnik years by, for example, Frederik Tsander, Russell Saunders and Richard Garwin. Among its potential applications are spiralling out from low Earth orbit to geosynchronous orbit in tens of days or to escape in about 100 days. Solar sails can increase the number of satellites that maintain a constant longitude, which could be important when geosynchronous orbits become crowded (as proposed by Robert L. Forward). Transporting freight and passengers between orbits by "sailing ships" could be much cheaper than using chemical rockets. Yet I know of no report of any attempt to deploy solar sails in space.

In the early 1980s Jerome Wright became interested in the possibility of using solar sailing to rendezvous with Halley's Comet during its 1986 passage. This proposal was enthusiastically received by the Jet Propulsion Laboratory. Wright led a group that developed solar sailing technology in considerable detail for this mission. The group settled on the heliogyro design, which looks like a huge helicopter, with 12 rotating blades 7340 meters long held out by centrifugal force. The total surface area of the blades was 0.625 km^2, and the overall weight was estimated to be 4 tonnes (about twice the weight of the simple film sails without the operations module or the payload). The group studied and dealt with the problems of deployment, dynamics and space environment conditions (radiation, micrometeorite damage and so on). In the end, none of these hazards did them in. Space shuttle cost overruns demanded their funds, and NASA cancelled the Halley rendezvous mission.

This book also reflects enthusiasm for even more imaginative applications of space sailing. Wright outlines K. Eric Drexler's design for fabricating by vapor deposition in space aluminum films that are two orders of magnitude lighter than the 2-micron Kapton films. He discusses Forward's designs for sailing to Alpha Centauri with the aid of massive solar-driven lasers.

It is sad that the space shuttle, which has disastrously increased the cost of going into orbit, still has political power enough to displace much imaginative space science and engineering. Wright's book has captured some of the charm and creativity that should be the guiding characteristic of our space program.

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Surface Science: An Introduction

John B. Hudson
Butterworth–Heinemann, Boston, 1992. 321 pp. $59.95 hc ISBN 0-7506-9159-X

At the 1976 March meeting of the American Physical Society, Robert Schrieffer remarked in an invited talk on surface physics that "if you stay in the field a while, it's a form of masochism to continue." While he soon moved to one-dimensional systems, the field of surface science has thrived, even garnering two entire categories for March meeting abstracts. Nonetheless, remarkably few books have appeared that are suitable introductions to the subject.

Many instructors who offer special-topics courses have adopted Andrew Zangwill's *Physics at Surfaces* (Cambridge U. P., New York, 1988). When Robert L. Park reviewed that text in *Science* (30 September 1988, page 1839) he lamented the short shrift given to many experimental techniques in the book's mere 450 pages. Hence, John Hudson's book—just over 300 pages long—can hardly be expected to cover everything. And, not surprisingly, Hudson, a distinguished experimenter, emphasizes topics on which he did research during his long tenure as a materials engineer at Rensselaer Polytechnic Institute. The book developed from a course Hudson taught variously over two decades to graduate and advanced undergraduate students in physics, chemistry and engineering.

In some sense, because problems appear at the end of each of its 17 chapters, this is the first real *textbook* on surface science. (The questions typically require the student to use the information and formulas to gain a quantitative feel for specific systems.) To hold down the book's price, Hudson himself produced the many figures not taken from other publications. He has put an impressive amount of time, thought and care into this volume.

The book is divided into four parts. The first and longest provides a general introduction and deals in depth with the thermodynamics of surfaces and surface mobility. The acknowledged "special debt" to John Blakely's "pioneering book," *Introduction to the Properties of Crystal Surfaces* (Pergamon, Oxford, UK, 1973) is most evident in this part. (Unfortunately, the book contains little on progress since the early 1970s in the statistical mechanics of surfaces. One can now interpret thermodynamic measurements in terms of microscopic interactions between atoms using powerful tools from statistical mechanics and computational physics.) The second part considers interactions between gases and surfaces, with particular emphasis on beam scattering and chemical rates. In the third section, on energetic-particle probes of surfaces, Hudson deals with the topics