

two-pion mode of the long-lived K meson without invoking a violation of CP invariance. There are several appendixes giving some of the details of the phenomenological analysis and theoretical background of K^0 -meson physics. In total the book is more in the nature of a review than a text.

It is difficult to discern for what audience this book is intended. It may be useful for those who are working in the field as an overall view of the subject and summaries of certain relevant articles. However, the unwary should be warned that there are some rather important errors of principle in the discussions of theoretical foundations. Students should be especially cautious of accepting such statements as, "... if all interactions are C-invariant, the K_+^0 state could decay only to states with $C = +1$..." (page 4). Semileptonic states that are not eigenstates of C have apparently been overlooked by the author in this statement, as in "A neutral 2π state with specified angular momentum l is an eigenstate of C with eigenvalue of $C = (-1)^l$..." (page 5). An l -odd state of two neutral pions does not satisfy this condition. In section 3.2, the discussion of choice of phases for defining decay amplitudes is very misleading. For example, on page 45 it is stated that "... the phase of r has no absolute physical significance ..." but the following appears on page 47: "In Appendix D we show that r is essentially real ..." Another significant error that caught my eye was: "We shall also see that the *only* CP-noninvariant effect which can be predicted with any assurance ... is an interference effect" (page 77). The charge asymmetry in the semileptonic decay of the K_L^0 is not an interference effect. Although the observation of this effect occurred so recently that it is mentioned in this book only in a note added in proof, the prediction dates from the beginnings of the subject.

The unfortunate thing about these fundamental errors is that they tend to shake the reader's confidence in the author's treatment of the foundations of his subject; and the foundations comprise one of the very few aspects that are likely to have any lasting value because the field is undergoing continuous and rapid change. The rapidity of change is illustrated by the need to incorporate in proof, as noted above, mention of the important experiments on charge asymmetry in semileptonic decay of the K_L^0 .

Even more significant is the unfortunate timing of the book in regard to measurements of the rate $K_L \rightarrow 2\pi^0$. The experimental conclusions concerning this rate that are quoted in the book have since been called into serious question as the result of additional, presumably more accurate, experiments. At present the discrepancies are not resolved and a reliable rate is not known, yet very strong conclusions are drawn throughout this book on the basis of the early experimental results. Therefore some firmly stated conclusions may be wrong, or they may be based on the wrong reasons. An example would be the author's use of the $K_L^0 \rightarrow 2\pi^0$ rate to rule out certain cosmological explanations of the $K_L \rightarrow 2\pi$ phenomenon (page 27). Another example is the statement (page 58) "... the $\pi^+\pi^-/\pi^0\pi^0$ ratio in K_2^0 decay proves that

CP noninvariance cannot be restricted to the leptonic channels only," and there are many others.

The book includes a good selection of topics relating to the subject and a reasonably broad coverage of the theoretical ideas. The detailed discussion of the experiments appears to be a paraphrasing of the original experimental papers without any critical evaluation, as one might expect since the author is a theorist. Sometimes this paraphrasing goes further into the details of the experiment than would appear to be relevant.

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Robert G. Sachs, director of the Enrico Fermi Institute of the University of Chicago, is a theoretical physicist. He has been an active participant in the theoretical interpretation and phenomenological analysis of the K^0 -meson system with particular reference to its use for testing CP invariance.

Beginner's nuclear physics

NUCLEAR MATTER AND NUCLEAR REACTIONS. By Ken Kikuchi and Mitsuji Kawai. 334 pp. North-Holland, Amsterdam (Interscience, New York), 1968. \$16.00

by JOHN L. GAMMEL

The blurb on the dust jacket says that this book will be useful as a textbook for senior or first-year graduate courses. Therefore, an obvious book with which

it may be compared is M. A. Preston's *Physics of the Nucleus* (Addison-Wesley, Reading, Mass., 1962). Investigation reveals that these books overlap to a considerable extent. A unique feature of Kikuchi and Kawai's book is their 100-page account of high-energy reactions, treating cascade processes in nuclei (rather like direct reactions except that many occur one

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after the other in the same nucleus) and spallation (evaporation processes from highly excited nuclei formed in high-energy collisions). The rest of the book contents (nuclear matter according to L. C. Gomes, John D. Walecka and Victor Weisskopf, general scattering theory, models of finite nuclei, compound-nucleus formation, the statistical model and direct reactions) may be found in Preston. Preston's book strikes me as more detailed (it is, after all, twice as long); one may compare figures 18.8 in Preston and 4.9 in Kikuchi and Kawai to confirm this impression.

Why doesn't someone start a loose-leaf *Physics of the Nucleus* (in several volumes perhaps)? If someone felt that he could add to the thing, he could suggest revisions here and there and maybe add a few pages. Every few years the thing would have to be edited anew. No doubt the *Encyclopedia of Physics* works something like that. But I am not thinking democratically—let 1000 *Physics of the Nucleus* bloom! Here you have another blossom—you judge whether or not it is prettier than the rest.

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The reviewer is a theoretical nuclear physicist at Los Alamos Scientific Laboratory.

Relativity insights

ASSUMPTION AND MYTH IN PHYSICAL THEORY. By H. Bondi. 88 pp. Cambridge Univ. Press, Cambridge, Mass., 1967. \$2.95

by LAWRENCE SKLAR

This slim volume contains the four Turner Lectures, delivered at Cambridge University in 1965, by the noted astrophysicist of the University of London, Hermann Bondi.

The first lecture, "The Limits of Theory Making," is a chatty, rather diffuse essay in philosophy. Here we learn that Bondi admires Karl Popper but, unless I misread Popper, Bondi somewhat misunderstands his views. Bondi believes that disproved theories can remain useful, and he doubts the usefulness of all-encompassing "unified field" theories (but sees, at least, something plausible suggested by Eddington's later work). Bondi further believes that theories have accreted unfortunate "myths" to themselves that distort

both our understanding of the theory and its influence on later science.

The second talk, "Relativity: Its Myths and Pre-suppositions," begins with a series of deep and insightful remarks on the nature of relativity in the special theory and the relation and indebtedness of this concept to the relativity of Galileo and Newton. Bondi points out the respects in which the Einsteinian theory is a return to, rather than a departure from, Newtonian theory. The essay continues with an elegant exposition of the fundamentals of the special theory by means of the k calculus. The lecture concludes with as lucid a brief treatment of the clock paradox, rightly styled by the author as the "so-called clock paradox," as I have seen in print. The treatment is a persuasive argument for the heuristic powers of the k calculus.

Lecture 3, "Gravitation," gives us a breathless, nonmathematical introduction to general relativity, but without the expository novelty of lecture 2. As if this were not enough to encompass in 15 pages, the section concludes with an attempted popular exposition of the recent work of Ezra T. Newman and Roger Penrose on gravitational waves. The author is dismayed that gravitational waves fail to have their energy concentrated on a thin shell of a wave front and even more disturbed that, according to this work, the present observed gravitational field of an object is a function of its past history as well as its present (or recent) state. What is worse, the influence of the remote past appears not to fade away, even asymptotically, in the remote future. One awaits a more detailed exposition of these curious results in a form suitable for nonspecialists.

Lecture 4, "The Origin of Inertia and the Universe," advances into the status of Mach's Principle in general relativistic theories. The author is perceptive and subtle, but, as in the third essay, the limitations of the lecture format make his treatment far too cursory. I suspect that most of what he says will be fully intelligible only to the already well initiated. Again our appetites for more are whetted by mention of the Hoyle-Narlikar attempt to formulate an action-at-a-distance version of general relativity.

In summary, this "ceremonial" lecture series is hardly the ideal format for presenting subtle ideas of physics



BONDI

and cosmology to a lay audience. Bondi does as well as one could possibly expect in these circumstances. One lecture is a model of popular science exposition. Two others, while too hasty and brief really to do the job they set for themselves, inform the sophisticated reader and at least tempt the layman to look further. Only the introductory lecture is, quite pardonably, too chatty to really serve any function at all, at least when it is removed from the intimacy of the lecture hall onto the cold printed page.

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The reviewer, an associate professor of philosophy at the University of Michigan, specializes in the philosophy of physics.

Low-pressure techniques

VACUUM SYSTEM DESIGN. By N. T. M. Dennis, T. A. Heppell. 223 pp. Chapman & Hall, London (Barnes & Noble, New York), 1968. \$8.00

by J. H. SINGLETON

The uses of vacuum in industrial applications and in the laboratory are exceedingly diverse and require a wide variety of techniques. The intent of this book, as described on the jacket and in the preface, is to provide a guide to available vacuum equipment and to the design and operation of vacuum systems in the entire range, cov-