

invention involved firing a normal bridge wire with a 15-kV capacitor rather than the typical 6-volt battery. The necessary improvement in timing accuracy was accompanied by an improvement in safety due to the elimination of the more sensitive primer explosive.

After the war, Alvarez was swept up in Lawrence's passion to build a large deuteron accelerator for the production of plutonium for nuclear weapons. For once Alvarez himself did not look at the data, which would have convinced him that there was plenty of uranium to be converted, much less expensively, to plutonium in nuclear reactors. In an important and engaging passage in the book he recalls recognizing that he had drifted far from experimental physics, and recasting himself as research assistant to two of his own research assistants. This discipline and redirection have obviously borne fruit—in Alvarez's work on particle physics with hydrogen bubble chambers, for which he won the 1968 Nobel Physics Prize, and in his continuing commitment to technical work, and avoidance of management or of ceremony.

Learning from Don Glaser at the Washington APS meeting in 1953 of his 1-cm-diameter ether bubble chamber, Alvarez immediately laid plans with his colleagues to build a large liquid hydrogen bubble chamber. A 1.5-inch glass chamber worked; followed by a 2.5-inch "dirty" chamber that showed good tracks despite boiling at its walls; followed by a chamber of 4-inch diameter. It is typical of Alvarez that he drafted a "prospectus," titled "The Bubble Chamber Program at UCRL" (April 1955), for the project to build what became a 72-inch liquid hydrogen chamber. The success of the hydrogen bubble chamber and the physics done with it at Berkeley and elsewhere are now history.

From his experience, Alvarez has drawn some advice for our society: "In my considered opinion the peer review system, in which proposals rather than proposers are reviewed, is the greatest disaster to be visited upon the scientific community in this country. No group of peers would have approved my building the 72-inch bubble chamber." How would a young scientist get financial support without peer review of progress? "I think he would do it the same way I did; I apprenticed myself to Ernest Lawrence, a man with such a good track record that any proposal he made was automatically funded without peer review." (I believe, however, that a mixed strategy would be desir-

able, with the opportunity for judging both the proposal and the proposer.)

In Alvarez's long and broad history, it is striking to observe how some of his best and most practical ideas were only very much later brought to fruition by his own efforts, despite his early patents' being available to profit-minded industry at relatively low cost. The stabilized optical system for binoculars or cameras that he invented in 1963 while his wife, Jan, lay ill with malaria in Kenya has only in the last few years been sold (by a company of which Jan is president) as a stabilizing zoom lens for shoulder-mounted video cameras, although working systems existed 20 years earlier. The same lag took place with the variable-power lens he invented and demonstrated to Polaroid more than 20 years ago, which only appeared on the consumer goods market (in the Polaroid Spectrum camera) in 1986.

The life of an inventor (even one who is in the Inventor's Hall of Fame, and who won the Collier Trophy in Aviation and many other awards) may be fun, but it is not always profitable: Alvarez realized the first profit from any of his 40-some inventions just a few years ago.

The most recent work for which Alvarez is known is the result of a collaboration with his geologist son Walter and Berkeley radiochemists Frank Asaro and Helen Michel: the demonstration that the boundary between the Cretaceous and Tertiary geological strata contains very large enhancements of stable iridium in a rock stratum a few millimeters thick, and the claim that this enhancement represents evidence of the deposition of dust from the impact of a meteoroid some 10 km in diameter—an impact that largely depopulated the Earth. (See Alvarez's article in *PHYSICS TODAY*, July, page 24.) This work soon led others to perceive the potentially large climatic change that could be caused by smoke from fires started by a large-scale thermonuclear war—the "nuclear winter."

Alvarez's book is a fine supplement to his legacy of invention, organizational innovation, students and results in physics. One puts it down with regret.

Concepts of Particle Physics, Volume 2

Kurt Gottfried and Victor F. Weisskopf

Oxford U.P., New York, 1986.

432 pp. \$45.00 hc

ISBN 0-19-503393-0

The second volume of *Concepts of*

Particle Physics develops in much greater detail the material on modern fundamental-particle theory and phenomenology outlined in the last two-thirds of its predecessor (for a review of volume 1, see *PHYSICS TODAY*, January 1985, page 99). However, its primary role is to provide intellectual justification for many of the ideas presented in the brief overview of particle physics that constitutes volume 1, while still sparing the reader the algebraic and functional "technology" now demanded of toilers in the vineyards of particle physics. This is not a manual in experimental principles and techniques for particles and fields. Both volumes are addressed not only to the broader physics community, but also to advanced undergraduates and beginning graduate students interested in careers in particle physics.

The passive reader will not find here a "royal road" to understanding the fruits of the last 20 years of revolution in high-energy physics. Kurt Gottfried and Victor Weisskopf, both distinguished contributors to nuclear and subnuclear theory, have expressly committed themselves to what they call the "oral tradition" in physics; but it is not a nonmathematical tradition, and they make no bones about that. While the book sacrifices rigor to allow greater-than-usual access by the broad community of physicists, and while it uses analogies with pre-field-theoretical physics liberally and effectively, nevertheless the arguments that form its essential content remain anchored to the mathematical substrate of "real" physics.

The aim is to liberate some of the central notions of quantum chromodynamics and electroweak theory not from mathematics, but from the necessarily long and sequential logic of quantum field theory. By drawing heavily on ideas familiar from electromagnetism and condensed matter physics, the authors make the subject accessible to those who appreciate and enjoy "physics in the round," and enrich, for the novice in elementary particles, the connections of this subfield with the whole of physics.

The prerequisites for both volumes are a solid understanding of electromagnetic theory, quantum mechanics and special relativity, and a well-developed tolerance for deferred proofs or for an occasional *deus ex machina* of the "for a complete treatment see..." variety. The books' contents thus are within the reach of virtually the entire population of contemporary postbaccalaureate physicists. (More speculative topics such as lattice QCD, technicolor, super-



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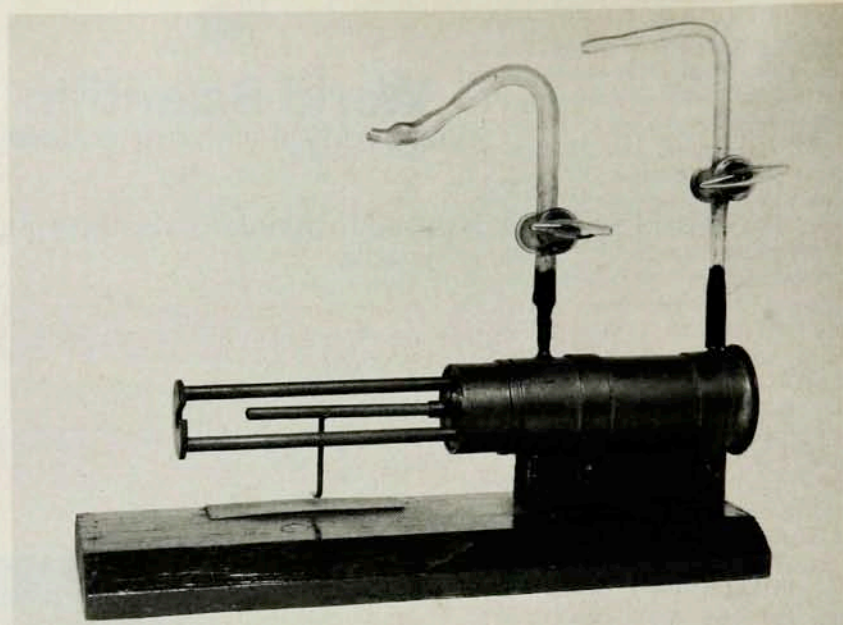
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fields and superstrings are omitted, except for a brief note added in proof, thus minimizing prerequisites.)

Volume 2 makes frequent reference to parallel material in the first volume. Nevertheless, physicists with backgrounds in subnuclear phenomena dating from the late 1960s or later, and with exposure to a reasonable dose of flavor-SU(3), could start with volume 2 with little discomfort (except for what a few minor misprints and some disagreements over matters of taste could produce).

Perhaps the value of these two volumes will be best measured by how much they help to diminish the perceived intellectual distance between "big" and "small" physics, and by whether they reignite the flame of excitement that brought many of us into physics (or is keeping us here)—a flame that seems to thrive on the marvelous unity that emerges in physics at every turn. In my judgment this pair of volumes, like the *Feynman Lectures*, is a work that belongs in the hands of every physicist, even though, unlike the Feynman volumes, it covers but one vital corner of the vast frontier of our discipline. These books may inspire leaders in other subdisciplines to write similar works and thereby bring the frontiers of physics closer to the center. Gottfried and Weisskopf have set a fine standard for such an endeavor.

TIMOTHY D. SANDERS
Occidental College, Los Angeles



Apparatus used by Ernest Rutherford to discover the proton.
(Reproduced from *The Particle Hunters* by permission of the Cavendish Laboratory, Cambridge, UK.)

fundamental forces, conservation laws, the particle generations. The descriptions are filled out with brief discussions of experimental techniques: cosmic rays, traditional accelerators and accelerator experiments, particle colliders and collider experiments. In the first few chapters the authors provide the theoretical foundations for all of this with mostly qualitative presentations of special relativity and quantum mechanics.

The level of theoretical discussion is somewhat uneven. Readers who had taken a serious class in elementary physics or chemistry could learn much about particle physics from the book, but they would not be able to follow the explanations of subjects such as isospin or the eightfold way. (I confess that on some days when I'm puzzling over a possible discrepancy in the hadronic decays of the tau lepton, I'm not sure I understand isospin of strongly interacting particles.) Novices in particle physics reading the book on their own would have to let some subjects go by without understanding.

The instructor choosing this book as a text in an introductory particle physics course could either supplement the difficult parts or simply tell the students to ignore these. I would not recommend the book in a first course for students who intend to become professional particle physicists. They require a more systematic introduction to the advanced courses. But I might well use the text for teaching physics students intending

to specialize in other fields and for engineers and chemists who want to get a feel for elementary particles.

This book will have a special appeal to its readers when they know that one of the authors, Yuval Ne'eman, is one of the pioneers in the classification of elementary particles. This is particle hunting described by the hunters.

MARTIN L. PERL
Stanford Linear Accelerator Center

The Particle Hunters

Yuval Ne'eman and
Yoram Kirsh

Cambridge U. P., New York,
1986. 272 pp.
\$49.50 hc ISBN 0-521-30194-7;
\$13.95 pb ISBN 0-521-31780-0

The Particle Hunters provides a pleasant introduction to the phenomena, theories and experimental techniques of elementary-particle physics. The book's structure is historical, beginning with J. J. Thomson's electron and Ernest Rutherford's atom, and ending with the discovery of the W and Z⁰ particles and with speculations about the Higgs boson. Along the way, there are anecdotes, quotes and interesting photographs. There are some nice insights; the chapter on accelerators, for example, is entitled "Particle Accelerators—or From Hunters to Farmers."

Most of the text is devoted to describing the known facts and accepted concepts in particle physics: quarks, leptons, hadrons, the four

Field Theory in Particle Physics, Volume 1

B. de Wit and J. Smith
North Holland, New York,
1986. 490 pp.

\$45.00 hc ISBN 0-444-86996-4;
\$23.00 pb ISBN 0-444-86999-9

Quantum Field Theory

Lewis H. Ryder
Cambridge U. P., New York,
1985. 443 pp.

\$80.00 hc ISBN 0-521-23764-5;
\$24.95 pb ISBN 0-521-33859-X

Gauge Theories of Strong and Electroweak Interactions

Peter Becher, Manfred
Böhm and Hans Joos
Wiley, New York, 1984. 306 pp.
\$79.95 hc ISBN 0-471-10429-9

Because all forces among elementary particles may be described by gauge