

into a field geologist's domain.

The reader is well served by both the science and the history in this book. Its personal style, sometimes critical, sometimes humorous, adds to its readability. It is not a textbook, but rather a history of an exciting and unique period in space exploration and of the role of science in a major national initiative. This book should not be missed by any serious student of space exploration; it will be instructive to the science historian as well.

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## Conceptual Foundations of Modern Particle Physics

**Robert E. Marshak**  
*World Scientific, River Edge, N. J., 1993.*  
673 pp. \$46.00 pb ISBN 981-02-1106-6

This book is most valuable historically because of Robert E. Marshak's important theoretical contributions to elementary particle physics, to teaching and education and to international scientific exchange.

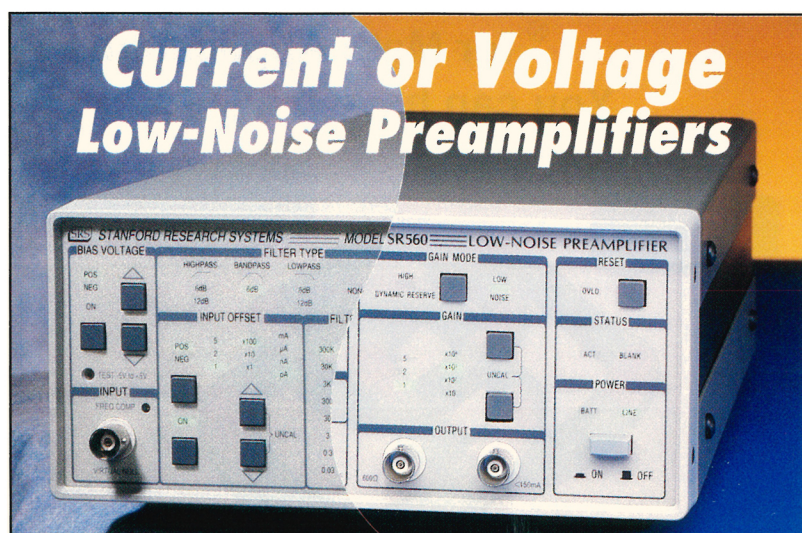
Independently of Shoichi Sakata and Takeshi Inoue (1946), Marshak and Hans Bethe (1947) were responsible for the two-meson hypothesis, correctly distinguishing the weakly interacting  $\mu$  lepton from the strongly interacting  $\pi$  meson. Marshak (1951) went on to propose the detailed balancing experiment by which Bethe and Marshak's prediction of zero spin for the  $\pi^+$  was confirmed. In 1957, together with Peter Signell and Ronald Bryon, Marshak derived a dramatically improved nucleon-nucleon potential, including the spin-orbit interaction. The same year, in defiance of  $\beta$ -decay experiments that were later proved wrong, Marshak and E. C. G. Sudarshan derived from chiral invariance the ultimately correct universal V-A weak interaction. Much of this research by Marshak and collaborators was included in his three earlier texts: *Meson Physics* (McGraw-Hill, 1952), *Introduction to Elementary Particle Physics* (John Wiley, 1961) with E. C. G. Sudarshan, and *Theory of Weak Interactions in Particle Physics* (Wiley-Interscience, 1969) with Riazzuddin and Ciaran P. Ryan, all of which were very useful in their times.

The present volume, *Conceptual Foundations of Modern Particle Physics*,

was completed just before Marshak's death in 1992. It is a remarkably complete compendium of particle theory, whose development Marshak separates into a startup period (1945-60), a heroic period (1960-75) and a period of consolidation and speculation (1975-90). After introducing space-time and global internal symmetries (and their spontaneous symmetry-breaking), he goes on to unbroken and broken gauge symmetries in the strong and electroweak

interactions. He treats chiral gauge anomalies in the standard model, the grand unification of strong and electroweak interactions, and topological conservation laws, and he even includes a chapter on the generation of fermion masses and on preon models of quarks and leptons. Despite excluding supersymmetry and superstrings, this makes for a long book, which probably only Marshak could or would have written.

Anyone who lived through those



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exciting years with Marshak will enjoy his impressively comprehensive digestion of all these conceptual and technical developments in particle physics, over four and a half decades to the time of his death. However, he often digresses into annoying tangential or parenthetical remarks, interesting to the cognoscenti but probably unappreciated by novices. He often gets ahead of himself, using words or concepts that are explained only later, and he tends to repeat

historical and expository developments. The book might have benefited from considerable editing and compression, had Marshak lived to produce a second edition.

I enjoyed Marshak's historical and classic compendium, a feat unlikely to be duplicated by participants surviving those heroic years. In its present form, it is valuable to scholars. A future revision, perhaps by one of Marshak's many accomplished past students, would make an attractive

alternative to modern, more concise textbooks of particle physics.

SIDNEY BLUDMAN

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## Hidden Attraction: The Mystery and History of Magnetism

Gerrit L. Verschuur

Oxford U. P., New York, 1993.

256 pp. \$25.00 hc

ISBN 0-19-506488-7

Magnetism has always been the most mysterious of the natural forces. The word itself, like gravity, long ago entered the English language as metaphor and symbol. But unlike gravity, which is all-pervasive and always attractive, magnetic force appeared doubly mysterious: First, magnetism could repel as well as attract. Second, it was not a universal property of matter; only a few materials, such as lodestone, which was precious for early use in direction-finding, exhibited it. The sheer universality of gravity, by contrast, hid it from scrutiny until long after magnetism's discovery. As a result, the manifestations of magnetic interaction as seen with the naked eye must always have appeared bizarre and, in a certain sense, unnatural.

Thus, magnetism has carried with it a strong sense of the mysterious and even, at certain periods of history, the occult. It could be argued, therefore, that demystifying and eventually controlling and exploiting this remarkable force represents an even greater triumph of human reason and the power of the scientific method than the conquest of gravity by Kepler, Newton and Einstein. Against this background, Gerrit Verschuur has written a history of magnetism, not just as a major force of nature but also as a paradigm of the whole process of scientific discovery.

The sweep of Verschuur's story is breathtaking: from Pliny the Elder to the Cosmic Background Explorer, via such giants of 19th-century science as Oersted and Ampere, Faraday, Maxwell and Hertz. The path is a well-trodden one from a historical point of view, and in a book whose purpose is to tell a story, perhaps the author can be forgiven for relying nearly exclusively on secondary sources: The most frequently quoted work among the references is the *Dictionary of Scientific Biography*.

Still, much as the first impulse of a scientist scanning a review article

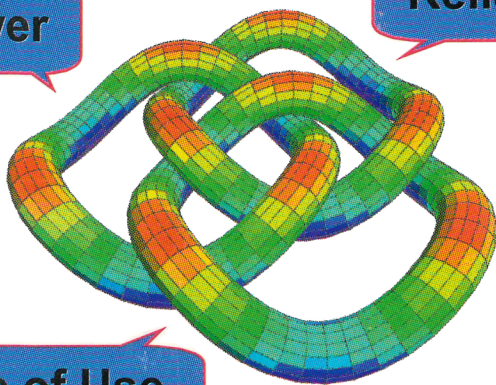
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