BOOK REVIEWS

From China with love

J.D. Bjorken

Particle Physics and Introduction to Field Theory. By T.D. Lee. Pp.865. ISBN hbk 3-7186-0032-3; ISBN pbk 3-7186-0033-1. (Harwood: 1981.) Hbk $59.50, Dfl.170; pbk $19.50, Dfl.60.

IN THE spring of 1979 T.D. Lee visited China and within the span of seven weeks delivered a remarkably intense set of lectures on elementary particles and statistical mechanics. The number of lecture hours averaged about three per day, seven days a week, and the size of the audience exceeded 900. Lee reports that ". . . it was very lively. My vocal chords, however, had problems afterward". Parts of the lecture notes have been published in Chinese and the particle physics portion has evolved into this volume.

It is an especially propitious time for such a course to appear. Because of the recent progress in understanding the nature of the fundamental quark and lepton constituents of matter and of the forces they exert on each other, we now are entering what should be a golden age of pedagogy. A few good texts have appeared and more are on the way. The ideal one is yet to be written. But Lee's lectures, as one might anticipate, set a towering standard of excellence. Within 820 pages of lucid text lie most of the important topics in elementary particle theory.

The central element of the new pedagogy is the belief that the strong and weak forces are described by generalizations of quantum electrodynamics called non-abelian gauge theories. A good understanding of this subject requires mastery of a high level of theoretical formalism. This is not easily found in older texts. Lee's lectures help to bridge the gap between the old and the new, concentrating on the theory of the strong force, called quantum chromodynamics or QCD.

But physical insights have not been sacrificed for formalism. The main physical features of the QCD picture of the inter-quark force are that it is relatively weak at short distances, and that at large distances it confines quarks — that is, only certain colour-neutral combinations of quarks and their antiparticles can exist in isolation. Lee beautifully elucidates these concepts, albeit with considerable subjectivity on the confinement question. At present, the confinement problem is not closed. There are several approaches extant, such as lattice QCD, instantons and string models. Only one approach, which makes an analogy of the QCD vacuum state with a perfect dia-electric medium, is developed in the book. This reflects Lee's current research interests, and is a characteristic of the lectures. They are selective, not encyclopaedic.

The weak — or, better, electroweak — force is now also generally believed to be described by a non-abelian gauge theory. Lee's lectures emphasize the older phenomenological foundations, although the prevailing $SU(2) \otimes U(1)$ "standard model" is given a spare but reasonable and up-to-date treatment. Here the computational technology might have been carried further. The physics might have been as well: there is no discussion of the ideas of the grand unification of strong, weak and electromagnetic forces, a topic now inspiring a considerable amount of experimental and theoretical work.

An important link between experiment and the basic gauge-theory concepts is the so-called quark–parton model. This is a simple manifestation of the idea that point-like quark constituents reside within nucleons and other hadrons. The quark–parton model is also an element of the new pedagogy — one which is simple to apply and of great usefulness. It is a good way to learn a lot of physics easily and quickly. Lee develops it well, with relevant examples worked through in physically transparent ways.

But the core of Lee's lectures lies not in the new pedagogy, but the old. There is a concise introduction to quantum field theory, followed by an extended, masterful and definitive section on symmetry principles and the associated conservation laws. This leads to a full discussion of the neutral kaon system — that glory of wave mechanics and source of so many of our deepest insights into nature.

This volume will serve superbly as a comprehensive course in elementary particle theory at the advanced graduate-school level. It is possible to differ with Lee on questions of balance and of selection of material. But the pages are filled with his unique insights, pedagogical clarity and thoroughness. The book is a treasure. □

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A cooperative venture in soil science

Harry Vine

Characterization of Soils in Relation to their Classification and Management for Crop Production: Examples from Some Areas of the Humid Tropics. Edited by D.J. Greenland. Pp.446. ISBN 0-19-854538-X. (Clarendon/Oxford University Press: 1981.) £35, $74.

THIS volume is, with a few added contributions, the report of a "bench-mark soils" project which was based at the International Institute for Tropical Agriculture (IITA) at Ibadan, Nigeria. The core of the book, then, consists of detailed studies of 38 Nigerian soil profiles, in which about 20 specialists in soil science took part.

A major aim of the project was "to provide data that might enable existing soil classification systems used within the tropics to be improved"; this related especially to the American system, which was developed through successive *Approximations* to the massive handbook, *Soil Taxonomy*, issued by the United States Department of Agriculture in 1975. The profiles are discussed from this point of view by F.R. Moormann, who points out a number of difficulties in the published scheme for tropical soils, particularly with regard to weatherable sand-size minerals and to the relative importance of the composition of the clay fraction and evidence of its movement in the profile. A fundamental contribution to the characterization of such soils is made by A.J. Herbillon in a review in which he examines both materials and dynamics.

Underlying the work on this range of profiles was the need, in the Farming Systems Programme of IITA, to discern more definitely what measurable properties of humid tropical soils may be relevant to maintenance of fertility in intensified arable cropping, efficient use of fertilizers and avoidance of erosion. In their review chapter, B.T. Kang and R.L. Fox aptly refer to "misconceptions" that these soils "are quite infertile and have management problems which are encountered nowhere else". On phosphate fixation problems, greatly exaggerated in textbooks, good progress is reported by