

Bookshelf

accessibility of lectures on QED to a general audience, and initially chose not to deliver these lectures at his native Caltech. Rather, he chose New Zealand as his testing ground, giving the New Zealand physics community the dubious honour of being the guinea-pigs for these lectures.

They were delivered in 1979 as the Sir Douglas Robb lectures at the University of Auckland. Although the book is an excellent self-contained description of QED, watching an unedited Feynman reveals his style and enthusiasm for his subject in a way which is impossible in print. Some of Feynman's examples and descriptions in these lectures, even though not as refined as in the published version, provide fascinating insight into both the material of QED and into Feynman's character.

They are on four VHS video tapes available in NTSC Format from tot@lafn.org Friends of Tuva, Belvedere, CA 94920

or in PAL Format from bqedtapes@phy.auckland.ac.nz

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Also available from Friends of Tuva is a memorable video of Feynman giving the 1986 Dirac Memorial Lecture on 'The Reason for Antiparticles' (see November 1997, page 28).

The Rise of the Standard Model - Particle Physics in the 1960s and 1970s, Edited by Lillian Hoddeson, Laurie Brown, Michael Riordan and Max Dresden, Cambridge University Press, ISBN 0 521 57082 4 (hbk) 0 521 57816 7 (pbk)

The Rise of the Standard Model - Particle Physics in the 1960s and 1970s - was the title of a seminar held at SLAC, Stanford, in June 1992, featuring many distinguished speakers who have made major contributions to the Standard Model edifice. Although the proceedings have only just been published, over the intervening five-year period the Standard Model has remained unchallenged, so fortunately, the value of the book has in no way diminished.

The Standard Model of basic physics takes the six quarks found in Nature and groups them into three pairs - up/down, strange/charm and beauty/top, with each pair assigned a lepton (electron, muon, tau) and an associated neutrino. These three quark/lepton families all interact via the electroweak force, while the quarks interact among themselves through the strong 'colour' force.

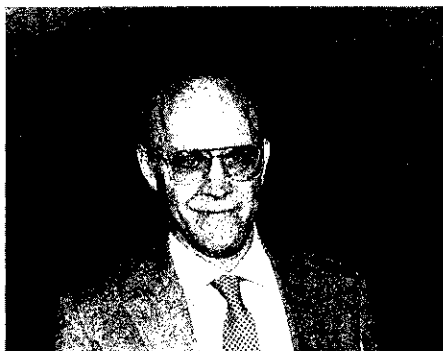
In the 1960s, the exploitation of particle symmetries and the discovery of the quark model laid the foundations of the Standard Model.

To understand and interpret these new ideas, a host of diligent field theorists strove to understand the forces at work between quarks, searched for a synthesis of electromagnetic and weak interactions, and attacked the underlying problem of renormalization, for only when renormalization was assured could field theory calculations be done confidently.

Despite heroic efforts, by the end of that experimentally fruitful decade the research spotlight had turned away from field theory. As David Gross says in his contribution, 'Field theory was in disgrace; S-matrix theory was in full bloom.'

However the early 1970s soon saw this rectified. Renormalization was shown to be OK, and, after years adrift, innovative ideas of spontaneous symmetry breaking suddenly found themselves on firm ground. Almost at the same time, the subtle properties of 'Non-Abelian' field theory (when the order in which the operators are placed is significant - AB does not produce the same outcome as BA) showed how a gentle close-range inter-quark force becomes a virtually unbreakable bond as the distance between the quarks increases. The paradox of quarks is that although they roam around relatively freely deep inside protons and neutrons, they cannot be prised out of their subnuclear prisons.

Soon after these theoretical breakthroughs came the 1973 discovery of neutral currents at CERN, underlining the electroweak synthesis of electromagnetic and weak interactions, and the 1974 'November revolution' discovery of the J/psi at Brookhaven and SLAC and its interpretation in terms of a fourth quark, charm. Later in the



David Gross - 'Field theory was in disgrace.'

decade came the discovery of particles from the third quark/lepton family, an experiment using polarized beams at SLAC (Stanford) which revealed more about the structure of electroweak effects, and evidence for the gluon carriers of the inter-quark force at DESY. Underlying these experimental advances were the development of particle colliders and their attendant instrumentation, and of new beams, such as those of neutrinos.

By the end of the 1970s, betting against the Standard Model dried up, but it nevertheless remained to uncover the heavy W and Z particles which carry the weak force (accomplished at CERN in 1983) and to find the sixth - 'top' - quark (at Fermilab in 1994-5). These final Standard Model landmarks are outside the time frame of the Stanford meeting, which was confined to the 60s and 70s. Nevertheless the book provides a valuable compendium of Standard Model history, with first-hand accounts of milestone discoveries and breakthroughs, and of development work, all rich in detail, opinion and anecdote. It is not possible to list all the 38 contributions, and dangerous to select just a few.

The chronology of experimental discoveries is clear. Less apparent is the crucial role played by the underlying theory. As Steven Weinberg declares in his contribution 'Changing Attitudes and the Standard Model' - 'The rise of the Standard Model was accompanied by profound changes in our attitudes toward symmetries and towards field theory.'

These profound changes did not happen overnight. Silvan Schweber says in his perspective, 'The formulation of the Standard Model is one of the great achievements of the

human intellect... It will be remembered - together with general relativity, quantum mechanics, and the unravelling of the genetic code - as one of the outstanding intellectual advances of the 20th century. But much more so than general relativity and quantum mechanics, it is the product of a communal effort.' This the book clearly shows, in dogged perseverance and in inspired breakthroughs in theoretical understanding, in the tireless development and construction of new facilities, and in diligent experiment.

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Bruno Pontecorvo, Selected Scientific Works, Recollections of B. Pontecorvo, Società Italiana di Fisica, ISBN 88 7794 115 4

The centenary of the Italian Physical Society is marked by this volume to honour the memory of Bruno Pontecorvo (1913-93), an Italian physicist who went on to gain worldwide fame. Pontecorvo's suggestions led to many advances, particularly in neutrino physics. Many of the landmark papers are included in the book, including the idea of experiments with neutrino beams, on the distinction between different types of neutrinos, and on the possibility of neutrino masses and oscillations. Also included are descriptions of his early nuclear physics work in Rome and Paris. These papers are complemented by contributions from physics notables including N. Cabibbo, V. Dzhelepov, L. Lederman, L. Okun and J. Steinberger.

A limited number of copies, normally \$45 (Lit 70000), are available at the special price of \$30 (Lit 50000) from Società Italiana di

Fisica, Il Nuovo Cimento, Via Castiglione 101, 40136 Bologna, Italy fax +39 51 581340, <http://www.sif.it>

Image and Logic - A Material Culture of Microphysics, by Peter Galison, University of Chicago Press, ISBN 0 226 27916 2 (hbk) 0 226 27917 0 (pbk)

This immense scholarly work (950 pages) covers the evolution of particle physics detectors and associated instrumentation during the 20th century. Having painstakingly sifted through a mountain of source material, the author has compiled a rich compendium of recent science history. Galison is Mallinckrodt Professor of the History of Science and of Physics at Harvard and came to particle physics prominence with his analysis of the 1973 saga of the discovery of the neutral currents, finally published in his 1987 book 'How Experiments End'.

His new book traces the changing face of particle physics detector technology, particularly the shift from cloud and bubble chambers, recording visible tracks, to electronic instruments working with digital track information.

Innovative technology supplants the outdated as remorselessly as new generations succeed their parents: new detectors for old. However Galison prefers to construct elaborate metaphors:

'.....two subcultures of instrumentation formed a wordless creole: On one side is the image tradition of photographic practices aiming at noninterventionist objectivity - producing homomorphic representations of nature. On the other side is the logic tradition of electronic practices aiming at manipulative persuasion - producing

homologous representations of nature. Out of the two, I will argue historically, sociologically and philosophically, came a wordless pidgin that evolved into a wordless creole....'

Thus inflated, the sheer size of the book is thwarting.

Particle Physics and the Schrödinger Equation, by Harald Grosse and André Martin, Cambridge Monographs on Particle Physics, Nuclear Physics and Cosmology, ISBN 0 521 39225 X (hbk) £35 (US\$54.95)

The venerable Schrödinger equation, first written down in 1925, enabled quantum mechanics to analyse energy levels in atomic and molecular structure. The trick was to get the right potential and to solve the resultant differential equations. However for a long time, the equation was confined to atomic and molecular problems.

Despite the success of the simple quark model in the late 1960s, few people thought of treating particles as quark 'atoms'. However the 1974 discovery of the J/psi showed that, for heavy quarks such as charm, the concept of a tightly bound quark-antiquark system could be extremely fruitful. The trick now, just as in the 1920s, is to get the potential right. This thorough book displays how our understanding of the spectra and decays of particles containing heavy quarks has benefited.

Introductory Nuclear Physics, by P.E. Hodgson, E. Gadioli and E. Gadioli Erba, Oxford University Press, ISBN 0 19 851989 3 (hbk), 0 19 851897 8 (pbk)

A comprehensive introduction to nuclear structure and nuclear reactions. This textbook introduces the concepts and historical development of the subject, whilst conveying the questions preoccupying researchers today.

The book gives a full definition of the particles that make up the nucleus, the nuclear forces that govern them and the different models of nuclear structure. Alongside, are explanations of the experimental techniques in use today, including the principles of modern particle accelerators and detectors. In a final section, the authors introduce the applications of their research to nuclear astrophysics and nuclear reactors.

The book is primarily intended as a textbook for undergraduate and graduate students, however it should also be useful as an up-to-date reference source for those working in the field. Each chapter is accompanied by a set of problems.

Books received

Bose-Einstein Correlations in Particle and Nuclear Physics, by Richard M. Weiner, Wiley, ISBN 0 471 96979 6

A collection of 47 reprints, with comments and an introduction, of papers published from 1960-1995.

Hot Electrons in Semiconductors - Physics and Devices, edited by N. Balkan, Oxford Science Publications, ISBN 0 19 850058 0

A collection of 21 authoritative contributions.

The Beginner's Guide to Mathematica Version 3, by Jerry Glynn and Theodore W. Gray, Cambridge University Press, ISBN 0 521 62202 6 £50/\$64.95 (hbk) 0 521 62734 6 £16.95/\$24.95 (pbk)

A tutorial and a reference book covering an important area.

Energy Stabilization of Electrostatic Accelerators, J. Takács, Wiley ISBN 0 471 97039 5

About the 'Cinderellas' of the accelerator world.

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Particle Accelerators provides a much-needed channel of communication for those involved in the research on, and the design, construction and operation of particle accelerators. The journal publishes original articles on a variety of topics in theoretical and experimental accelerator physics, and in accelerator technology. Topics in accelerator physics include particle-orbit theory, collective effects, impedances and wakefields, analytical and computational techniques, as well as new accelerator concepts. Topics in accelerator technology include magnet design, the engineering of radio-frequency and vacuum systems, pulsed and dc high-voltage techniques, applications of cryogenics and superconductivity to accelerators, accelerator instrumentation and shielding, beam transport, and applications of accelerators.

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In Grenoble, France, the ESRF has constructed a state-of-the-art storage ring for 6 GeV electrons operated 24 hrs/day as a high brilliance synchrotron radiation source in the field of X-rays. Financing of the ESRF is shared by twelve European countries. In 1998, 30 ESRF beamlines will be open to the users. The ESRF thus supports scientists in the implementation of fundamental and applied research on the structure of condensed matter in fields such as:

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We are also recruiting: scientists, post-docs, PhD thesis students, engineers and technicians. If you are interested consult our vacant positions on the World Wide Web (<http://www.esrf.fr/>).

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