After his immigration, first to Germany and then to Bohemia, Tycho's preoccupations—aside from the difficulties of suitably relocating himself and his family—were to publish the works that would guarantee his fame and to defend his priority in what he seems to have regarded as his chief claim to fame: the Tychonic system, a transformation of the Copernican system that kept the Earth at rest in the center while the Sun revolved around it carrying the accompanying planets. Similar schemes had occurred to more than one thinker of the time, but Tycho regarded one of them, Nicolai Reymers Ursus, as an out-and-out plagiarist and pursued him with lawsuit and counter-publication until his prey escaped by death. Ironically, Tycho's chief reason for acquiring Kepler as an assistant was to have him prepare an *Apologia contra Ursum*. Once more, Tycho's egoistic striving had consequences that went far beyond what he had envisaged, blinkered as he was by the limitations of time, place and social context.

Thoren's biography is likely to remain the definitive work on Tycho for a long time to come. And it makes a very good read.

Introduction to the Theory of Neural Computation

John Hertz, Anders Krogh and Richard G. Palmer
Addison-Wesley, New York, 1991. 327 pp. $44.25 hc
ISBN 0-201-50395-6

The growing interest in neural computing is based on the hope that computational architectures resembling in some sense the structure of our brain can perform tasks that are difficult for conventional computers and algorithms but that appear easy for the brain. Among those tasks are the abilities to deal with information that is fuzzy, noisy and inconsistent, to learn from examples and to operate independently of a specific program. These hopes are almost certainly bound to be disappointed unless one understands at least some of the brain's basic functions.

Introduction to the Theory of Neural Computation can be viewed as a first guided tour through many of the concepts, ideas and models that have evolved in this field over the last one or two decades. It starts with the pet of theoretical physicists, the Hopfield model—a fault-tolerant associative memory—and some of its various extensions. The book continues with single- and multi-layer feed-forward networks, the type most widely used in technical applications, including supervised learning. The book's next topic deals with various aspects of unsupervised learning in a variety of network architectures. The last chapter, reflecting the background of the authors, shows how methods of statistical physics can be applied to studying models of neural networks.

The title of the book is somewhat misleading because there is nothing like *the* theory of neural computation. Some of the topics covered have a quite elaborate theoretical background; others do not. Those theories that exist are described as simply as possible but are not oversimplified. This is one of the strong points of the book. The book's other virtue is its quite complete coverage of the various attempts to understand the computational capabilities of different types of networks. Even those readers who do not have much background in mathematics can understand almost any chapter. Thus, the book is a pleasure to read. Although parts of some of the chapters have the character of a warehouse catalog, they provide a good and complete reference to the literature.

Because the aim is to provide those interested in artificial networks with some basic knowledge of the field, the book contains only a few basic facts about the biological aspects of neural networks. Nevertheless those who are primarily interested in biological networks also may find useful information and thoughts.

This first guided tour through a rapidly evolving and fascinating field has been accomplished successfully. I recommend this book highly to those who want to do more in this field beyond playing around on a personal computer.

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Electroweak Interactions: An Introduction to the Physics of Quarks and Leptons

Peter Renton
Cambridge U. P., New York, 1990. 596 pp. $110.00 hc
ISBN 0-521-26603-3; $37.50 pb
ISBN 0-521-36692-5

The great success of the "standard model" as a compact intellectual foundation for understanding elementary particle interactions has encouraged the writing of a number of expository textbooks during the past decade. Peter Renton's book is a recent addition to a collection of graduate-level texts that includes Lev B. Okun's *Leptons and Quarks*, Ian J. R. Aitchison's *An Informal Introduction to Gauge Field Theories*, Kerson Huang's *Quarks, Leptons and Gauge Fields*, Chris Quigg's *Gauge Theories of the Strong, Weak, and Electromagnetic Interactions*, and *Quarks and Leptons* by Francis Halzen and Alan D. Martin. *Electroweak Interactions*, the longest and most comprehensive of these books, is somewhat mistitled because it also includes a fairly extensive discussion of quantum chromodynamics, the physics of strong interactions.

Renton's book is based on a course of lectures given to first-year postgraduate students at Oxford, most of whom were experimentalists in high-energy physics. His text is, however, written entirely from a theoretical perspective, albeit starting from a very basic level. The first 145 pages are devoted to a general overview of particle interactions and symmetries and to a summary of nonrelativistic quantum mechanics, special relativity, angular momentum, group theory and the basic concepts of the field theory of elementary particles of spin 0, $\frac{1}{2}$ and 1. The introduction includes a derivation of propagators in configuration and momentum space, while fundamental issues in perturbative field theory, such as higher-order calculations and renormalization, are addressed in a later section.

The central part of the book consists of a very comprehensive and systematic discussion of many scattering and decay processes involving electromagnetic, weak and strong interactions. A list of topics includes electron–proton scattering, Compton scattering, muon decay, electron–positron annihilation, photon and hadron structure functions, neutrino–nucleus scattering, Cabibbo theory, tau–lepton decays, W and Z boson decays, mixing phenomena and many others. For most processes, the author presents the appropriate Feynman diagrams, first-order matrix elements and the resulting cross sections or decay rates. Derivations are not exhaustive but they do show several intermediate steps sufficient for reconstructing the final result; Renton provides a number of technical appendixes that assist the reader in this task. A very nice feature of the book is that the spin and polarization dependence is derived explicitly for many of the interactions listed above.

The last section of *Electroweak Interactions* discusses some of the open or unanswered questions in the

standard model, including the undiscovered top quark, the Higgs mechanism of electroweak symmetry breaking and detailed tests involving radiative effects. The book concludes with a brief account of ideas that extend beyond the standard model, such as left–right symmetric models, grand unified theories, compositeness, supersymmetry and string theory.

The book has some shortcomings. Although the book was published in 1990, experimental results obtained after 1986 are, with very few exceptions, not presented. Its usefulness as a course textbook is somewhat handicapped by a complete lack of problems and exercises. As indicated above, experimental techniques of elementary particle physics are also excluded. However, the book is an extremely valuable compendium of standard-model results and is strongly recommended as a reference to active researchers and to students and teachers of high-energy physics at the graduate level.

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Theory of Coherent Atomic Excitation

Bruce W. Shore
Volume 1: Simple Atoms and Fields
Volume 2: Multilevel Atoms and Incoherence
Wiley, New York, 1990.
1735 pp. $123.00 hc
ISBN 0-471-52417 (set)

Bruce Shore has made many significant contributions to the theory of the interaction of radiation with matter. In this two-volume work, comprising approximately 1700 pages, Shore has attempted to assemble the basic components necessary to construct a theory of the interaction of laser radiation with atoms. The book is written at a level readily accessible to graduate students and researchers in the field. The exposition is clear and well organized, enabling anyone with a knowledge of elementary quantum mechanics and electromagnetism to follow the development of the theory. Owing to the diversity of topics covered, these volumes will become a useful reference to researchers in laser spectroscopy and quantum optics.

The book, which consists of 22 chapters, is divided into six sections, respectively entitled Basic Principles and Definitions; Two-State Atoms; Photons and Radiation; Multistate Atoms; Angular Momentum and Complex Atoms; and Incoherence. To a large extent, each chapter is self-contained, with limited reference to prior chapters. Among the topics covered are elementary quantum mechanics (state variables, probabilities, observables, the density matrix and the Heisenberg and Schrödinger pictures); angular momentum theory, including irreducible tensor operators; dynamics of two-state and multistate atoms driven by one or more laser fields; transitions to the continuum; properties of the electromagnetic field, including a detailed treatment of the multipole expansion of the field; atomic structure; semiclassical and fully quantized descriptions of the atom–field interaction; pulse excitation and pulse propagation; and the interaction of stochastic fields with atoms.

By design, the emphasis of the discussion is on the temporal response of the atoms to the fields. In light of Shore's many contributions to the field, it is not surprising that one of the major strengths of this book is the extensive treatment of the transient response of two- and multi-level atoms to incident radiation fields. The section on incoherence also provides an excellent introduction to stochastic processes as applied to atom–field interactions. It is interesting to find in a book at this level a derivation of the density-matrix equations of motion that uses an irreducible tensor basis. Equally surprising and welcome is a discussion of recently discovered pulse shapes for which an analytic solution to the two-state problem can be obtained.

This book can be invaluable as a general reference. Choose almost any topic and you can find the basic theory and bibliography associated with that topic. On the other hand, I do not believe the book to be an appropriate text for a graduate course unless it is supplemented by additional material. Rarely is the development motivated on physical grounds. Someone not already familiar with the subject matter would have difficulty speculating on the relative importance of the various calculations. One gets the feeling that topics are not followed to their logical conclusion in terms of the experimental implications of the results. There is no reference to experiments in the book. Even the excellent and extensive bibliography would be of limited use to a beginning student unless he or she had some guidance from someone experienced in the field.

As a final note, I might add that Shore typeset and prepared all the figures for this text. This extraordinary undertaking has resulted in a