and rivalries and of the discipline-specific emergence and maturation of institutions, societies, journals, educational patterns and career models. The book's title builds on the term coined by Alvin Weinberg in 1961 and incorporated as an essential tool of analysis into the discipline of the history of science by Derek J. de Solla Price in 1969. It was selected by Nye to delineate the volume's time period and "coherence for the history of physics and chemistry," since, as she says in her preface, "after 1940 things changed more dramatically than after 1919."

The historical account, supported by meticulous scholarship, sketches the interconnection of physics and chemistry (continuities and disjunctions) in essays structured around disciplinary organization, the axes of national and international hegemony, atomism, electromagnetism, thermodynamics, the practice of organic chemistry, radiation and quantum theory. The university as the main site of scientific activity, the introduction of the teaching laboratory and the emergence of science in the United States are seen to have been crucial for worldwide professionalization of both disciplines.

In this ambitious synthesis of cognitive and social disciplinary history, Nye examines with sharp historical perception the two mainstream 19th- and 20th-century paths for the study of matter, those associated with both the conceptual and the experimental exploitation of the chemical and physical atom. Each tradition generates its own language, visual imagery, conventions and conceptual constructions, thus fostering its own disciplinary distinctiveness. This emphasis mirrors current trends in cognitive psychology that seek to correlate linguistic and developmental patterns in individuals and in society, trends that explore language acquisition's actuation of significant changes in the structure and scope of cognition. (See, for example, Merlin Donald's *Origins of the Modern Mind*, Harvard U. P., 1991.)

As here interpreted, the Daltonian, experiment-extravagant philosophy of chemical atomism is maximized in the establishment of quantitative, equivalent-weight relationships (stoichiometry), chemical periodicity, theories that lead to structural organic chemistry and molecular architecture, the ionic theory of solutions and the electron theory of chemical kinetics (reaction rates). By contrast, the Newtonian mechanical philosophy (masses under the influence of forces), with its corpuscles and physical atoms, makes headway mainly, although majestically, on the merits of explanatory success in the Laplacian vision of the nature of substance and activity, the kinetic theory of gases, the electromagnetic view of nature in terms of waves and a world unionized by imponderable ether(s), electric discharge in rarefied gases and the dynamical/probabilistic/statistical thermodynamics of molecules and reversible processes.

The more recent territorial spaces on which the microscience of chemistry and the macroscience of physics reconverge (not at the level of views on atomism but in their professional working areas) are treated in some detail. Domains in which the reciprocity of chemistry and physics are conspicuous include the thermochemistry and thermodynamics of reversibility and irreversibility, the Clausius–Maxwell–Boltzmann search for a dynamical, probabilistic, statistical theory of molecules and molecular processes, the seminal interpretations emerging from within physical chemistry, the application of electron theory to organic reaction mechanisms (chemical kinetics and molecular physics), structural organic chemistry in relation to quantum wave mechanics and the nuclear science of radioactivity, transmutation and atomic disintegration.

There is something refreshing about getting beyond the chemical revolution, about setting aside the broad sweep of chemistry's history by restricting attention to an in-depth study, and therefore clarification, of the developing disciplinary identities of chemistry and physics that are alive and vacillating in our own times. Nye has achieved this in a work that fills a great need; I recommend it highly.

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Superconductivity of Metals and Cuprates

John R. Waldram
IOP, Philadelphia, 1996.
410 pp. $180.00 hc ($60.00 pb)
ISBN 0-85274-335-1 hc
(0-85274-337-8 pb)

John Waldram, of the Cavendish Laboratory, has written a book on superconductivity that should be very useful to serious students of the subject. *Superconductivity of Metals and Cuprates* is comprehensive, spanning a spectrum that includes phenomenology and history, microscopic theory, high-temperature superconductivity and applications.

The sections on the macroscopic wave function, describing the superfluid behavior of the electrons, the Ginzburg–Landau model and the Josephson effects, are quite physical and are presented without microscopic theory. They are quite profound, however, and contain unique physical insights. And, because they require a fairly substantial understanding of statistical physics, they will challenge even well-prepared students. The sections on the Bardeen–Cooper–Schrieffer theory will require effort on the part of either the students or the instructor in working out the details so as to achieve a full understanding of the material. On the other hand, many issues are discussed qualitatively that are simply not treated elsewhere except in the most technical theoretical presentations. Especially noteworthy are the treatments of electron–phonon coupling, the relationship of the order parameter to the microscopic theory and the nonlocal form of the BCS theory.

High-temperature superconductivity is an enormous challenge to textbook writers, because it is a moving target. Waldram has made a heroic effort to cover the current understanding and present in a fair manner the various positions on many questions. Particularly strong are the considerations of electronic structure issues, properties of the normal state and such issues as the spin gap and the pseudogap. There are no details, but the essential physical ideas are outlined, and the references should provide a clear path into the various subfields for the interested reader. The sections on superfluid and Ginzburg–Landau properties of the high-temperature superconductors are not as useful as those devoted to microscopic matters. Possibly as a consequence of timing—the subject has matured quite recently—the great advances in the understanding of vortex physics are not treated in a manner commensurate with their importance.

The section on fluctuations ignores the fact that the field was really fully developed in the context of conventional rather than high-temperature superconductors. Although conventional superconductors have large coherence lengths and essentially no critical fluctuations, Gaussian fluctuations have a great effect on precursive electrical conductivity, precursive diamagnetism, tunneling effects and other phenomena, and they are by no means as unimportant as Waldram asserts.

The comparison of the properties of the cuprates with the BCS theory is an excellent summary of a large number of experimental studies; all of the appropriate caveats are affixed to discussions of such matters as tunneling, microwave response and evidence of non-s-wave character, among other controversial subjects. Waldram does a fine job in reviewing the experimen-

tal facts and discussing the pros and cons of various interpretations. In this chapter, and in the following chapter on alternative theories of cuprate superconductivity, general themes are presented effectively, and the author guides us through alternative theories without becoming an advocate or outspoken critic. These sections will be particularly useful as an introduction to what is an enormous and very complicated literature, and they should be useful reading, even when some of the unresolved issues are settled.

Finally, the discussion of applications, although included for completeness, could have been omitted without serious loss. This area has also been a moving target, and the chapter is too brief to do the subject justice.

In examining any book on superconductivity, there are inevitable comparisons with the recently revised and updated modern classic in the field, *Introduction to Superconductivity* by Michael Tinkham (McGraw-Hill, 1996) (reviewed in PHYSICS TODAY, October 1996, page 74). I believe Tinkham's book is more accessible to readers who have less background in statistical and quantum physics and is much more detailed in its treatment of many general topics and of many issues that are the object of intense contemporary research. On the other hand, Waldram's book contains many profound physical insights and provides a comprehensive introduction to a wide variety of topics. It is also written from a different perspective, and it ventures more widely into questions that are not yet settled. It certainly should be read by serious students of the subject.

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The Origin of the Concept of Nuclear Forces

Laurie M. Brown
and Helmut Rechenberg
IOP, Philadelphia, 1996. 392 pp.
$79.50 hc ISBN 0-7503-0373-5

The Origin of the Concept of Nuclear Forces presents a detailed account of the evolution—between 1932 and 1950—of the understanding of nuclear forces. The prologue sets the stage: a historical account of the developments that led to the discovery of the neutron.

The real history begins with that discovery in 1932 and with various theories picturing the neutron as a composite object made of a proton and an electron. It continues with Enrico Fermi's theory of beta decay and Wolfgang Pauli's proposal of the neutrino. It then follows researchers' attempts to understand nuclear forces in terms of this new theory and of composite particles. The authors, Laurie Brown and Helmut Rechenberg, present the experimental results from 1930s cosmic-ray experiments and their applications to efforts to understand nuclear forces. Here, as throughout the book, the authors intersperse parts of letters and interviews with leading participants. There are also pictures of physicists who were part of the story and, sometimes, some fascinating comments on aspects of their lives.

The second and third parts of the book (parts B and C) detail the origin of Hideki Yukawa's meson theory of nuclear forces, its dissemination from Japan to the US and European communities, the subsequent erroneous identification of the muon as what was then called a "mesotron" and the attempts to create a convergent field theory of nuclear forces based on Yukawa's meson. The story includes the realization, as the properties of the cosmic-ray particle were studied, that the "mesotron" could not be Yukawa's particle. This period saw many advances in field theory, including the developments for spin 1 and spin ½ particles. The concept and generalization of what constitutes an elementary particle also date from this period.

Part D includes relevant developments in physics during the wartime years (1939–44) in both East and West. The period after World War II saw the resolution of the mesotron (muon) puzzle with the discovery of a second meson. Also, a neutral meson was very desirable for an understanding of the close equality of the strong proton–proton and neutron–proton forces. The discovery of the π^0 thus helped the charge independence, or isospin invariance, of nuclear forces. The discovery of V particles (strange hadrons) is detailed.

The story ends in 1950, since everything necessary to a concept of nuclear forces was then in place. However, in an epilogue, the authors trace, cursorily, developments after 1950, including quantum electrodynamics renormalization theory, the discovery of the "particle zoo," the importance of symmetries, quantum chromodynamics and the standard model of strong and electroweak forces.

The authors deliver on their promise to trace the origin and development (both experimental and theoretical) of the concept of nuclear forces up to 1950. The book not only describes theories that led to a better understanding of nuclear forces but also details the twists and wrong turns taken along the way, twists and turns that often led to conceptual developments useful in physics at a later time.

There are ample footnotes and references at the end of each chapter and at the end of the book. It would have been helpful to have the appropriate page numbers for the references listed at the end of the book. I found very few misprints and only one photograph where the subjects and names are mixed up. The book is well written and a pleasure to read. Although it obviously will be of most interest to physicists or historians of science—and thus there are some equations—most of the text would be easily understandable by a nonphysicist interested in a detailed history of our understanding of nuclear forces.

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