really known; in fact, it is not yet known for sure that only two-body forces will suffice to describe all of the properties of many-nucleon nuclei. In addition, because the usually assumed two-nucleon potentials are rather cumbersome functions of internucleon displacements and relative spin orientations, the microscopic theory poses a severe challenge to analysis.

In fact, a substantial portion of *Microscopic Theory of the Nucleus* is devoted to meeting this challenge. Analytical techniques for making calculations to compare with measurements are developed and explored with considerable thoroughness. This aspect makes it a valuable *how to do it* reference, but it also implies a strong orientation toward the serious research-motivated student of nuclear structure physics. Obversely, it implies equally forcefully that there is little here readily available to the reader whose primary reason for picking the book up is to acquire some qualitative conception and understanding of the ideas, successes, gaps, and failures of the microscopic theory of the nucleus.

In the Preface, the authors assert that "... this volume is intended to be usable by anyone who has had a conventional one-year course in quantum mechanics." Personally, I am a bit skeptical of this assertion. It might be applicable to a second-year physics graduate student who has just completed a (somewhat unconventional) first-year graduate course in quantum mechanics. The point is not that there is all that much mystery to quantum mechanics as a scheme for axiomatizing our description of nature, but rather that early in the book the authors introduce, and use, sophisticated formalisms (e.g., second quantization) and computational methods (e.g., diagram analysis) in order to describe calculational techniques required for a quantitative understanding of the microscopic theory. I doubt that many first-year courses in quantum mechanics prepare students to move comfortably among these formalisms and computational methods without resorting to considerable supplementary study.

This book is the third in a series of three volumes, each of which is supposed to be independently usable and useful. I am not personally acquainted with the first two volumes, but I feel sure that some familiarity with at least some of the notions and concepts developed and discussed in those volumes would be very helpful to the reader of the third volume.

The exposition of the microscopic theory as presented in this volume is excellent for its purpose, namely to provide a rather comprehensive and detailed theoretical reference to the subject for persons involved in research on nuclear structure. To my knowledge it may also be unique, for I know of no other work that treats this matter so thoroughly.

Richard K. Osborn (BS, MS, Michigan State University; PhD, theoretical physics, Case Institute of Technology, 1951) spent six years at Oak Ridge National Laboratory, dividing his time equally among the Physics Division, the Applied Physics Division, and ORSORT. During that same period he was also a lecturer in physics at the University of Tennessee. In 1957 he joined the nuclear engineering staff at the University of Michigan. Dr. Osborn's research activities have been quite varied, with interests in nuclear physics, reactor physics, kinetic theory, noise analysis, and the interaction of photons with electrons and atoms.

Isotopes and Radiation in Soil-Plant Relationships Including Forestry

Author	International Atomic Energy Agency
Publisher	Unipub, Inc.
Pages	110
Price	$21.00
Reviewer	Wallace H. Fuller

The International Atomic Energy Agency publication entitled *Isotopes and Radiation in Soil-Plant Relationships Including Forestry* is a proceedings of the symposium on the use of isotopes and radiation in research on soil-plant relationships including applications in forestry, jointly organized by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations, held in Vienna, December 13-17, 1971. This is the latest of several symposia organized by these two agencies on the same subject since 1964. A new feature on the program in 1971 is the inclusion of papers on forestry.

The thrust of the program with its 54 papers, which brought together 226 eminently qualified participants, is toward the plant chemist concerned with food, fiber, and tree production. And why not! Those in the physical sciences of chemistry, soils, and water will also want to have this excellent review readily available as a research tool. Each author featured is prominently known and well-published in his subject-matter field. Theory as well as application is often presented in these papers on isotope use in research. Such topics as ion uptake and translocations, chemistry and analytical methods, soils and water regime, soil fertility, and plant nutrient availability, to name a few, are reviewed in depth and in light of the most recent information.

Although most authors point out new and productive areas for future investigation by expanding on their own research, a few appeared so wrapped up in a presentation of their own studies that their reports will capture only a limited audience.

Isotopes and Radiation in Soil-Plant Relationships Including Forestry can be recommended to a wide range of scientists, researchers, teachers, and field personnel in the life sciences, forestry, agronomy, soils, water, and crop production, to biochemists and botanists as well as plant and nuclear chemists and water physicists, with an assurance that the readers will benefit greatly from the multi-authored presentation.

Wallace H. Fuller, born in Alaska, grew up in the Pacific Northwest, where he obtained the BS and MS in soils and soil chemistry. He completed the PhD at Iowa State University in soils and biochemistry. After five years as research associate at Iowa State University, he was called to the USDA, Beltsville, Maryland, to undertake research in biochemistry, nuclear chemistry, and microbiology of soils as they relate to food and fiber production. Since 1948 he has been on the faculty of The University of Arizona, Tucson, where in 1956 he moved from associate professor and biochemist to professor, biochemist, *and head of agricultural chemistry and soils.*

Dr. Fuller has published over 100 scientific articles and papers in national and international journals. He has co-authored or contributed chapters to seven scientific books. The areas of agricultural biochemistry, soil-plant relationships, and phosphorus chemistry have occupied most of his research effort. The use of radioisotopes in biology is of long standing, since he was one of the first to be trained in isotope use by the U.S. Atomic Energy Commission. Most of his contract research with the AEC over 20 years was in the field of uranium fission fallout and its relation in the food chain.

Nuclear Structure Theory

Author	J. M. Irvine
Publisher	Pergamon Press, Inc. (1972)
Pages	478
Price	$27.00
Reviewer	G. R. Satchler

Upon first skimming through *Nuclear Structure Theory*, I was very pleased and looked forward to having it close to my desk for reference purposes. However, a more careful reading considerably modified my initial enthusiasm. I now have very mixed feelings.

To put these remarks in context, I should add that I am a practicing nuclear theorist, mainly in the field of nuclear reactions; however, reaction theorists cannot avoid contact with theories of the internal structure of nuclei, the subject of J. M. Irvine's book. This is no book for beginners; the author assumes the reader has had a basic undergraduate course in nuclear physics, but I believe he will need much more—namely some *working* knowledge of the field—before he can feel at home with all of this book. It is a conglomerate of materials at all levels, from the elementary to the sophisticated. Indeed, I have the feeling (and this is reinforced by his own comments in the Preface) that the author's motivation was simply to write a book without giving much thought to his prospective readers. He speaks of it as a "guide-book," but that does not seem completely appropriate. For example, I cannot help contrasting the very elementary discussion of mass spectrometers in Chap. 3 with the leap into the very sophisticated Brueckner theory in Chap. 6.

Perhaps all of this is quibbling. Certainly a useful book could have resulted, and in many ways it has. Part II is a concise (maybe too concise for the uninitiated) summary of the many-body theory of nuclear matter and finite nuclei, while Part III is a similarly concise tour of nuclear models, particularly the shell model with its various extensions. (In this latter part, the somewhat cursory treatment of the collective model is unfortunate, but it is in keeping with the tone of the remainder of the book.) Part I is largely introductory (the two-nucleon system, systematics of nuclear masses and shapes, etc.), while Part IV contains the mathematical apparatus needed for understanding the earlier parts.

A large amount of space is taken up by tables and such, not all of which necessarily serve a useful purpose. For example, there are 52 pages of nuclear energy-level diagrams, covering all nuclei up to $A = 40$ and every tenth one after that. The reproduction of some of these is very indistinct, at least in my copy. Furthermore, such diagrams are constantly being updated and are available in professional data evaluation journals. A more serious criticism of other sets of tables is that they lack a proper explanation. Thirteen pages of two-body interaction matrix elements are given, but I see no mention of the residual interaction used or even what units the numbers refer to. There are 36 pages of coefficients for Nilsson wave functions for a nucleon moving in a deformed potential well, but I did not find any *explicit* definition of these, especially of the phase conventions employed. No doubt those of us who are relatively familiar with this game could figure out these things in an hour or so; the newcomer would have more difficulty. There are other examples, such as Figs. 13.9 through 13.14 and Table 15.1, where the results of calculations are given without any indication as to the input quantities.

Other less important criticisms abound as well! Some of these are minor "misprints" and I know only too well how those can slip by. Others are of more consequence. The notation used is not always clearly defined; for example, although the old hands will know immediately what T stands for in Eq. (2.17), it should be defined for the benefit of those less familiar with the subject. (Incidentally, the usage "isotopic" spin is *passé*; isobaric or just plain iso have become accepted now.) In addition, "equivalent uniform" is not defined on p. 49; in this connection, when he refers on p. 52 to a "radius to half-density" I believe he actually means the equivalent uniform radius—not the same thing.

The optical model is done an injustice on p. 47, where it is said that analyses using it have inherent uncertainties of 25% or so. On the contrary, much more accurate information than that can be obtained. Similarly, it is suggested on p. 50 that analyses of electron scattering data are subject to errors of the same order. Again, quantities like the mean square radius can be found to an accuracy an order of magnitude better than that. The case of ^{40}Ca is mentioned, but only in conjunction with a reference which is 16 years old; work of recent years using comparison methods has yielded quite accurate information on the structure of the density distributions of the calcium isotopes.

Twice it is mentioned that the relativistic Thomas spin-orbit coupling is an order of magnitude smaller than that needed for the shell model, but it is not pointed out that it also has the wrong sign; this is further confused by a sign error in going from Eq. (13.3) to Eq. (13.4)! In addition, the insistence (p. 240) on a constant form for the spin-orbit coupling term in the shell model is rather misleading since much of current usage takes the Thomas form [Eq. (13.3)], suitably renormalized.

Some minor errors I have noticed include that the distance denoted ω in Fig. 4.3 is really $\sim\frac{1}{2}\,\omega$, that the "potential" Eq. (4.15) referred to on p. 51 should be "density" and that, while Table 8.1 and Fig. 8.4 are said to refer to the same calcu-