to achieve excellence into an outstanding center of research. We see how Raman often lacked the delicate touch and the management style needed to mobilize persons of lesser stature in order to achieve institutional objectives. The transformation of a second-rate institution into a center of excellence required higher authorities who were enlightened and a director who had a healthy appreciation of human attitudes as well as patience with mediocrity in the interest of long range goals. In their absence, Raman's resignation as the Director of the Institute was the unfortunate outcome. Despite this setback, Raman, with his passion for research, was able to conduct first-rate science, continuing on as a professor of physics. During that phase of his career he developed the Raman–Nath theory of ultrasonic diffraction of light, the concept of the soft mode underlying phase transitions in crystals, the existence of hypersonic sound waves revealed by Brillouin scattering and the "geometric" theory of Fresnel diffraction.

With the passage of years in the limelight of public adoration, Raman did not often critically examine his intuitions and initial inspirations. This landed him in disputes such as the Born–Raman controversy regarding the nature of lattice vibrations and the controversy with Kathleen Londsdale on the origin of "extra" reflections in Laue diffraction and the structure of diamond. Despite novel and clever contributions by Raman and his collaborators, an inflexibility crept in and the outcome was bitter. Venkataraman's critical assessment of these incidents allows readers to appreciate the true dimensions of Raman's many-sided scientific greatness while recognizing his human limitations.

Venkataraman rounds off the biography with an extensive discussion of Raman's career after he retired from the Indian Institute and established the Raman Research Institute. We get insight into Raman's scientific thinking and style, his aesthetic motivations and scientific curiosity which continued unabated to the very end of his life.

This book will inspire young readers with its portrayal of Raman's strong passion for science and the way he pursued it in the face of great odds. It will satisfy historians of science with its careful exposition of scientific ideas and its lively descriptions of contemporary social and political events. And it will please practicing scientists with its record of a master at work.

Tests of the Standard Theory of Electroweak Interactions

Christian Kiesling
Springer-Verlag, New York, 1988. 212 pp. $67.30 hc ISBN 0-387-17513-X

The "standard" electroweak model of Sheldon Glashow, Steven Weinberg and Abdus Salam elegantly unified the phenomenological Fermi theory of the charged-current weak interactions (as generalized to include parity violation, heavy particles and mixing effects) with quantum electrodynamics, and promoted it to a mathematically consistent fundamental field theory. The new class of neutral-current interactions predicted by the unification has played a crucial role in establishing the theory as correct to first approximation and in guiding the search for new physics. Following the discovery of neutral-current interactions by the Gargamelle collaboration at CERN in 1973, a series of impressive experiments uniquely determined the form of the neutral-current neutrino–quark interactions in agreement with the standard model predictions, ruling out a number of competing theories.

A third generation of high-precision experiments in the 1980s, combined with the discovery by the UA1 and UA2 groups at CERN in 1983 of the W and Z bosons at the predicted mass and their subsequent study, has allowed a precise quantitative test of the theory down to distance scales on the order of 10^{-16} cm. A fourth generation of even more precise experiments, spearheaded by the new electron–positron colliders LEP (at CERN) and SLC (at SLAC), will soon improve the accuracy of these tests by an order of magnitude. Results of these tests will complement the direct search for new particles in the pursuit of new physics that is generally believed to underly the standard model.

Christian Kiesling, who is the spokesman for the CELLO experiment at PETRA and a member of the group building the H1 detector for HERA, has produced a very nice book that describes the status of the field on the eve of this fourth generation of experiments. *Tests of the Standard Theory of Electroweak Interactions* is devoted almost entirely to the weak neutral current and to the properties of the W and Z bosons. It describes the structure of the standard model, the theoretical background and expectations for each class of experiment, the experiments themselves, the analysis and results and their implications.

The best and most extensive coverage (nearly half of the volume) is devoted to the author's own specialty, electroweak studies in electron–positron annihilation. There is an excellent discussion of the theoretical expectations for $e^+e^- \to \mu^+\mu^-, \tau^+\tau^-$ and quark pairs; of the existing experiments at PEP, PETRA and TRISTAN; and of the results and their implications. The treatment is quite up to date (as of August 1988), and represents a nearly final summary of the energy range below the Z mass, since relatively few results are expected in the future.

Other reactions are covered adequately but more succinctly. The chapter on neutrino interactions provides a good overview of neutrino–electron scattering and of the various neutrino–hadron experiments, which were so crucial in establishing the standard model. The theoretical treatment is somewhat sparse, but nevertheless gives a reasonable summary of the relevant techniques and uncertainties. Neutral-current effects in electron–quark and muon–quark interactions also played an essential role in excluding many alternative theories. The famous SLAC polarized eD asymmetry measurement, the CERN muon–carbon asymmetries and the observation of parity violation in heavy atoms are described clearly and in reasonable detail, although the coverage stops prior to the high-precision results on cesium transitions obtained in 1988 at the Joint Institute for Laboratory Astrophysics in Boulder. The discussion of the discovery and properties of the W and Z bosons is primarily of historical interest.

There is a short description of the determination of the standard model parameters and of standard model tests. While the discussion is adequate, a more extensive treatment of the implications for the search for new physics would have been useful. For example, there is almost no discussion of the limits on extra Z bosons that are obtained from the neutral-current data.

Tests of the Standard Theory of Electroweak Interactions is a well-written overview of the status of the weak neutral current as of 1988, shortly before the beginning of a new generation of experiments. It fills an important void in the literature for a coherent and reasonably up-to-date summary of all aspects of the subject. The volume is strongly focused on its topic; despite its title, the book has no

treatment of other aspects of weak interactions, such as the charged current or *CP* violation. The book's major drawback is that it contains virtually no discussion of future prospects. On the whole, however, this book is a useful introduction and reference for advanced students and researchers in the field.

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Introduction to the Structure of Matter: A Course in Modern Physics

John J. Brehm and William J. Mullin
Wiley, New York, 1989. 912 pp. $52.65 hc ISBN 0-471-60531-X

Concepts of Modern Physics

Arthur Beiser
McGraw-Hill, New York, 1987. Fourth Edition. 616 pp. $39.95 hc ISBN 0-07-004473-2

Essentials of Modern Physics

T. R. Sandin
Addison-Wesley, Reading, Mass., 1989. 575 pp. $42.75 hc ISBN 0-201-09256-5

Modern Physics

Hans C. Ohanian
Prentice-Hall, Englewood Cliffs, NJ, 1987. 543 pp. $41.95 hc ISBN 0-13-596123-8

Among textbooks intended for an introductory presentation of physics, none are more diverse in character than those bearing in their title the words "modern physics." This diversity partly reflects the large differences in the preceding general physics courses and the depth and length of each author's treatment.

Introductory general physics courses may span either two or three semesters and may use texts that include chapters on modern physics and relativity. The modern physics continuation may extend for an additional one or two semesters.

The text by John J. Brehm and William J. Mullin is suitable for a one-year combined treatment of modern physics and quantum mechanics. The other three texts are written for one-semester courses. Whatever the exact nature of preceding physics instruction, all four texts reviewed here give a calculus-based presentation suitable for students of science and engineering.

A good benchmark against which to compare the two-semester textbook by Brehm and Mullin is *Introduction to Modern Physics* by John D. McGervey, (Academic Press, Cambridge, Mass., 1983). This textbook has been used successfully in our physics department for the past three years.

The first four chapters in Brehm and Mullin's text—Relativity, Photons, Introduction to the Atom, and Matter Waves—follow the same sequence as those in the McGervey text, but require twice as many pages. In discussing wave packets McGervey introduces the Fourier transform of the wave function to present the momentum representation while Brehm and Mullin mostly talk around the subject.

The usual material on the Schrödinger equation in one and three dimensions is covered in both texts. In treating the harmonic oscillator, Brehm and Mullin generate the Hermite polynomials to obtain the general solution while McGervey introduces the more elegant technique using raising and lowering operators. Brehm and Mullin neglect scattering of a plane wave by a spherically symmetric potential, a topic treated by McGervey.

In the treatments of the one-electron and many-electron atoms, Brehm and Mullin's slower pace and extensive use of the vector model and Grotian diagrams make the material more readily digestible. McGervey discusses in detail both time-independent and time-dependent perturbation theory. Rather than treating these topics explicitly, Brehm and Mullin compute radiative transition matrix elements in a more-or-less *ad hoc* manner.

Chapters 10 through 16 (the last chapter) in each text cover "specialty" topics. Both texts do a commendable job on quantum statistics, waves in the presence of a periodic potential and elementary band theory. Brehm and Mullin again use their slower paced presentation to advantage. Although brief, the discussions of superconductivity, BCS theory, the Josephson effect and related matters are notably better in Brehm and Mullin's book.

Discussions of nuclear properties and nuclear reactions in each text differ only in the introduction of minor features that appear in one text but not the other. The final chapter in each book deals with elementary particles, and both are remarkably similar in format and con-