

maintenance" (such as Geiger tubes).

Although I would have liked a more thorough discussion on the theory of photoionization of molecules and complex atoms, research workers in plasma physics, astrophysics and aeronomy will find the present survey quite helpful. It should prove useful as a supplement in senior-graduate-level courses on spectroscopy, atomic physics and astronomy.

References

1. G. L. Weissler, in *Handbuch der Physik*, Springer-Verlag, Berlin (1956), Vol. 21, p. 304.
2. J. A. R. Samson, in *Advances in Atomic and Molecular Physics*, Academic Press, New York (1966), Vol. 2, p. 178.
3. U. Fano, *Phys. Rev.* **124**, 1866 (1961).

* * *

The reviewer teaches courses in collision theory and atomic structure at the Harvard College Observatory; his research includes the theory of autoionization and dielectronic recombination.

Progress reports on particles

HIGH ENERGY PHYSICS, Vol. 1.
E. H. S. Burhop, ed. 499 pp. Academic Press, New York, 1967.
\$22.00

by Wendell G. Holladay

This is the first volume of a projected three-volume work in which over 20 authors will cover important aspects of the physics of particles and their interactions at high energy. The material in volume I and the listed contents of the other two volumes indicate that a systematic treatment of general theoretical schemes, such as quantum field theory, and properties of the analytic S matrix will not be given; rather, developments in high-energy physics (with emphasis on physics) will be reviewed in a series of topical monographs written by experts on the individual topics. This fact suggests that the reader of these volumes will benefit by first learning the general language of theoretical particle physics and the properties of the quantum numbers associated with the particles from some of the advanced textbooks devoted to such expositions. This is not to say that *all* the material in such textbooks will have to be mastered, for the articles in volume I are rea-

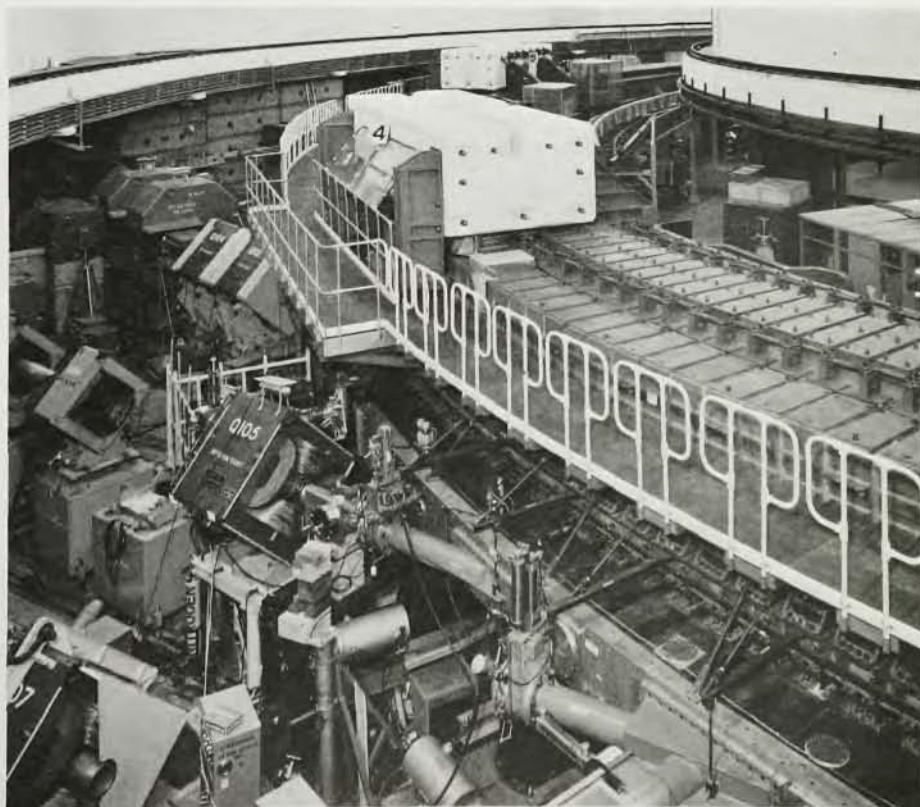
sonably self contained in that they do not depend very much on one another and present new ideas and methods as required, albeit with brevity in most instances.

Now for the contents of volume I. There are five articles that may be read in any order. Victor F. Weisskopf presents a perceptive introduction to particle physics by considering the relation of the present status of knowledge in the field to a question raised by Isaac Newton: What are the reasons behind the permanent features of the structure of matter? Gregory Breit and Richard D. Haracz then devote 160 pages to a discussion of certain features of nucleon-nucleon scattering. Here the intricacies of writing the scattering matrix in terms of phase parameters are exposed in detail. An unusually thorough discussion is given of the search procedures by which the parameters are obtained from the data. Results of the latest searches by the Yale group as of September 1965, are compared with earlier searches and with the data. The authors give particular attention to the intermediate energy region from 10 to 340 MeV and to the determination of the pion-nucleon-coupling constant in the one-pion exchange term. References to the literature are extensive.

The tables listing references to measurements of physical quantities at various energies and angles will be especially useful to workers in this field.

The approach to pion-nucleon interactions in the article by James Hamilton is quite different from that taken by Breit and Haracz on the nucleon-nucleon interaction. Hamilton's aim is to *calculate* the pion-nucleon-scattering amplitudes by using crossing symmetry, unitarity and causality as manifested in partial-wave-dispersion relations. The explicit dynamical assumption is that the principal interaction is produced by exchange processes involving known particles. This approach, which has been most thoroughly explored by Hamilton and his colleagues, is presented in detail in this review. Some impressive results have been obtained, but the ultimate viability and validity of the point of view exploited by Hamilton remain in doubt.

The electromagnetic form factors of the nucleon is the subject of the article by Thomas A. Griffy and Leonard I. Schiff. Two principal aspects of this problem are discussed. The first is a detailed exposition of the way in which the form factors are extracted from electron-scattering measurements. A review of the efforts to



NIMROD, the 7-GeV proton synchrotron at Rutherford Laboratory, England. The two beam lines emerging from the magnet have both focusing and bending magnets.

THIS BANANA WILL SPLINTER LIKE SHATTERED GLASS

The raised hammer will soon divulge the side of a banana you would never have imagined—it will shatter into a thousand pieces. Frozen solid in liquid nitrogen, the fruit becomes glass hard. We don't know how this action contributes to the technology of freezing foods, but we do know how to make the refrigerators to freeze it.

The potential which cryogenics offers in studying the characteristics and varying behavior of numerous materials, has hardly been explored. Yet, numerous phenomena have been observed which have resulted in practical applications benefiting our expanding communications, military support, industrial processes, bio-medical studies, food technology, metallurgy, materials processing and a host of other areas.

Here at Ashton, we are responsible for the development and manufacture of Norelco refrigerators capable of producing "cold" over temperatures ranging from near absolute zero to ambient. They range from pocket to room-size—for specialty applications and even volume production... to suit any task. Applications criteria are established by those seeking information on how to improve a process. Where we shine is in cryogenic engineering, because we know it best and are without peer in finding workable solutions to your problems or applications.

Please write for more information.

Where the Imaginative Action is in Cryogenics



Norelco®
**CRYOGENIC
DIVISION**
NORTH AMERICAN PHILIPS COMPANY, INC.
Post Office Box 2200, Ashton, Rhode Island 02864

calculate the form factors is the second major topic. The conclusion is drawn that adequate fits to the experimental results have been obtained in terms of the known vector mesons ρ , ω and φ , but these fits are not displayed.

The final article, by Paul T. Matthews, discusses unitary symmetry. Here the elements of the theory of Lie groups are neatly discussed. One can learn "all about" the groups $U(1)$, $SU(2)$, $SU(3)$, $SU(4)$, $SU(6)$, $SL(2, C)$, $U(2, 2)$ and $U(6, 6)$. Matthews presents the important physical conclusions related to invariance of physical theories under these transformations.

The authors of these progress reports have made major contributions to their subjects, of which they speak with authority. The writing is uniformly good, but only those possessed of unusual gifts should expect to read all parts of these articles without difficulty. This volume and presumably the remaining volumes will be especially useful as reference works to those interested in following developments in these fields. An author and a subject index add to the value of the book.

At least one common thread runs through these articles. They all show how it is that when so much is known, so much remains to be known. In this time of rising costs, it appears useless to deplore it, but volume I is not inexpensive.

* * *

Wendell G. Holladay is professor of physics at Vanderbilt University, where he carries out research on the mechanisms of particle interactions at high energy.

The entire physics

THE MANY-BODY PROBLEM IN QUANTUM MECHANICS. By N. H. March, W. H. Young, S. Sampanthar. 459 pp. Cambridge U. Press, London, 1967. \$14.50

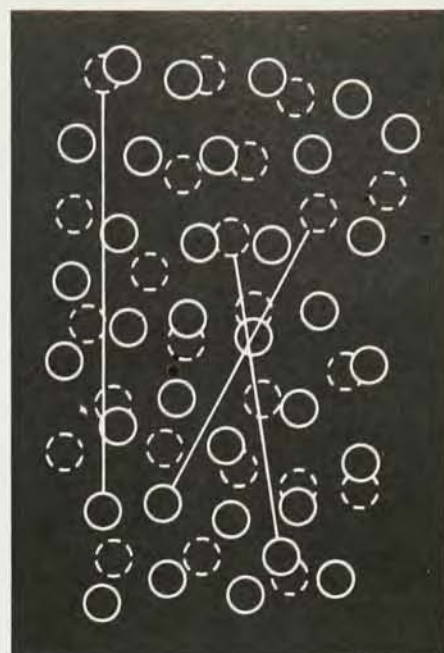
by John L. Gammel

The authors' aim is to provide an account of the methods used in the many-body problem and the physics that emerges within a single cover. It is difficult to believe that they will succeed absolutely because, after all, the many-body problem = λ (physics),

where $0 \leq \lambda \leq 1$; but I suspect that $\lambda \approx 1$. It would be very difficult indeed to include all of physics in a single cover!

It does not take much looking to find one method not contained in the book. If one looks through the author index he does not find the names of Cyril Domb, Michael Fisher and Stanley Rushbrooke. Surely these people have contributed to the many-body problem. What is missing? Well, what is missing is a reference to Ising (Lenz cannot be found either). Nothing is said about the Ising model. Is nothing to be learned about the many-body problem from the Ising model? The answer is, Yes: There is much to be learned. In particular it is to be learned (as George Baker has recently) that the statement on page 207 is wrong. Namely, "we can conclude that the Goldstone approach, if rearranged in a series in powers of the density (or the number of interacting particles), appears to be rapidly convergent. Thus the Brueckner-Gammel theory can be considered reasonably well established. . . ." The series is not only not rapidly convergent; it diverges. The source of the trouble is easy to locate. Hans Bethe and others have calculated the three-body cluster terms, and these appear small. But the four-body cluster terms have not been calculated, and just as the binding energy of He^4 is large compared with the binding energy of T or He^3 , so the four-body cluster terms may be large compared with the three-body cluster terms. Baker tells me there is only one way to save the theory; namely, Brueckner was correct in the beginning; one must expand in powers of the K matrix for fixed density. One needs several terms in the expansion, and he must also do Padé approximants.

However, it is not really fair to judge the completeness or accuracy of the book in this way. Concerning completeness, the term "many-body problem" has come to stand for a certain body of knowledge that for some strange reason excludes considerations based on the Ising model, which is relegated to statistical physics. Concerning accuracy, Baker's conclusions are controversial (it is somewhat unfortunate that the appearance of these books, however valuable, on the many-body problem at a rate approaching one per month tends to obscure the fact that much



MANY-BOSON SYSTEM in Feynman theory. The possible sites for maxima and minima in the probability amplitude are shown with three typical correlations existing between them.

remains to be done about the many-body problem).

To form a fairer notion of the completeness, we may compare it to other similar books such as D. A. Kirzhnits's *Field Theoretical Methods in Many Body Systems* (Pergamon Press, Long Island City, New York, 1967). Green functions do not dominate the material in this book to the same extent that they do in Kirzhnits's book. The authors state that Green functions are "the most powerful many-body method yet devised," but devote only 67 of 410 pages to the method. The reviewer finds it a relief that the authors establish contact between the Green-functions method and the perturbation methods initiated by Brueckner.

In some respect the book is similar to Kirzhnits's: Everything is developed from elementary quantum mechanics. Although the Rayleigh-Schrödinger and Brillouin-Wigner perturbation methods are discussed, the main treatment is based on the time-dependent approach, and so inevitably the apparatus of quantum field theory appears. The analogy with quantum field theory is not pushed to quite the limit reached in Kirzhnits's book.

In distinct contrast to Kirzhnits (who omits these topics), the authors discuss superconductivity and many-