states of matter. He has deliberately set out to be simple and direct. It is striking that in so doing he has displayed a skill and interest in communication that is largely suppressed in textbooks, including his own. Why, as scientists or perhaps merely as specialists, are we unwilling to bare the beauty of our subjects? Formalism is used to cloak rather than reveal the elegance of our subject matter. The run-of-the-mill technical writer falls into obscurity through ineptness and misguided gamesmanship; the best writers may do the same through diffidence. Well, Moelwyn-Hughes, a Cambridge chemist, has given us an indication, at least, that it doesn't have to be that way.

Annual Review of Nuclear Science, Volume 11. Emilio Segrè, Gerhart Friedlander, Walter E. Meyerhof, eds. 513 pp. Annual Reviews, Inc., Palo Alto, Calif., 1961. $7.00. *Reviewed by H. H. Bolotin, Michigan State University.*

THIS addition to the *Annual Review of Nuclear Science* series offers articles of topical interest ranging from the latest developments in the fields of neutron-capture gamma rays, heavy-ion accelerators, and nucleon-nucleon scattering, to the more "applied" articles on industrial uses of isotopes, accelerator shielding, and detection of nuclear explosions. In general, they are well written and constructed, and adhere to good review form, giving a fairly broad grasp of the subject without delving into the fine details which usually are the concern of specialists.

A particularly fine review of neutron-capture gamma rays is presented by G. A. Bartholomew. A review of this topic has been warranted for some time and it is fortunate that the need has been filled so ably.

Of great current interest is the topic of detection of nuclear explosions. The article by Latter, Herbst, and Watson outlines various aspects of detection, discusses their feasibility and application, and provides a basis for understanding and evaluation of the various inspection systems which have been and may be proposed. The articles on heavy-ion accelerators by E. L. Hubbard and on nuclear effects of cosmic rays in meteorites by J. R. Arnold and the review of nucleon-nucleon scattering theories by Moravcsik and Noyes are extremely well presented and informative.

Indeed, from a general standpoint, it is difficult to find fault in this volume. The authors and editors have performed their function very well, and in many respects, their efforts have produced a volume which is among the best in the series.

Electromagnetic Structure of Nucleons. By S. D. Drell and F. Zachariasen. 111 pp. Oxford U. Press, New York, 1961. Paperbound $2.00. *Reviewed by Eugene Guth, Oak Ridge National Laboratory.*

BEFORE 1932, only one nucleon, i.e., the proton, was known. Practically nothing, however, was known about its structure. Sometimes it was implied or even stated that all or most of the mass of the proton—and of the electron—was of electromagnetic origin, perhaps with a little gravitation mixed in. Poincaré, in 1906, pointed out that the electron, in a classical sense, cannot be stable but must be held together by an attractive force, counterbalancing the repulsive electromagnetic force. Naive souls thought that the "radius of the electron" being of the order e^2/m_ec^2, the "radius of the proton" should be of the order e^2/m_pc^2, i.e., about 2000 times smaller than the electron radius. As early as 1921, Pauli, in his well-known "Theory of Relativity" article, written for the *Mathematical Encyclopedia,* warned that there is no experimental evidence for either of these radii. Now, 40 years later, we have two nucleons (and two antinucleons) and we know a lot about the structure of the nucleons and still practically nothing about the structure of the electron—except its spin and Zitterbewegung.

Scattering experiments, this most powerful tool—first applied by Rutherford and his associates, Geiger and Marsden, yielding the discovery of the nuclear atom—did the trick. They showed that the "radius of the proton and of the neutron" must be of the order of 10^{-13} cm (= 1 fermi). Moreover, they proved the existence of a strong, short-range attractive interaction between the nucleons, the still mysterious nuclear force. The existence of this nuclear force was known, however, even before the scattering experiment inferred by Wigner in 1932 from the stability of the alpha particle.

Clearly, from p-p and n-p scattering we cannot learn about the *electromagnetic structure* of the nucleons. However, we can assume the validity of quantum electrodynamics for point electrons and study the interaction between electrons and nucleons. The first results were obtained by Fermi and Rabi and their associates who studied the interaction between a neutron beam and an electron gas target. Unfortunately (or perhaps fortunately), most of the interaction obtained this way was explained by Foldy, without invoking the electromagnetic structure of the nucleons. However, experiments of improved accuracy are being planned (Maier-Leibnitz in Munich), which would throw light on the electromagnetic structure of nucleons. Thus, all our present knowledge comes from scattering of fast electrons on protons and on deuterons, the latter case giving information on the neutron after the effect of the proton has been subtracted. This roundabout procedure is necessary because of the nonexistence of a neutron gas target. Moreover, this subtraction implies considerable nondefinitive theory.

Chapter 1 explains the precise meaning of the electromagnetic form factors. Chapter 2 discusses the different types of experiments which have given information on these form factors. From the observed angular distribution of electrons scattered by the nucleons, it is possible to derive the distribution of charge and current inside these nucleons so that we obtain two form factors for each nucleon. Among

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other things, the authors point out the information to be gained about neutron structure from electron production of pions on protons. Chapter 3 brings the recent dispersion-theoretic approach to the analysis of the form factors. The authors state: "The theoretical development here has the two goals of serving as a first introduction to the dispersion methods for physicists at the graduate level and of indicating clearly the various approximations made at present in implementing the dispersion theory approach." It should be emphasized, however, that a fruitful reading of even the first chapter of this booklet presupposes a knowledge of field theory about corresponding to Mandl's or even Thirring's book. Readers who know already the fundamentals of dispersion theory will profit more from reading Chapter 3 than those who want to learn it just from reading this chapter. Chapter 4, finally, discusses the fascinating questions of the validity of quantum electrodynamics at short distances and how such deviations, if found, affect the nucleon form-factor analyses.

The authors are well-known experts in the topics they discuss. They always try to be "physical" in a very technical field. The booklet is heartily recommended to all theorists with sufficient background, and to experimentalists who are willing to do some pre-study to acquire some background. They will profit, but perhaps not as much as a full-fledged theorist. The reviewer has only one regret: had this book been published a year later, the authors could have included a discussion of the new (ω, ρ, η) resonances found in the scattering of mesons by mesons. For recent summaries, we would like to refer to the *Proceedings of the Aix-En-Provence International Conference on Elementary Particles*, which have just been published, and to current issues of the *Physical Review Letters*!

The Encyclopedia of Spectroscopy. George L. Clark, ed. 787 pp. Reinhold Publishing Corp., New York, 1960. $25.00. *Reviewed by I. Fankuchen, Polytechnic Institute of Brooklyn.*

ENCYCLOPEDIAS are among the treasures of scholars. This volume, however, falls far short of the standard of a good encyclopedia; it does not truly live up to its title. The section on x-ray crystallography, for example, is unexpectedly scanty and uneven in its coverage; thus, only three pages are devoted to the entire subject of x-ray diffraction or crystal spectra and then only to its application in quantitative analysis.

Unfortunately the proofreading was not done carefully. In the x-ray articles closely examined by this reviewer, there are many garbled equations—too many to list, but enough to justify a warning that equations should be checked before use.

Some words are used incorrectly. Thus theta, the Bragg angle, is referred to repeatedly as "the angle of incidence", a term generally reserved for the