

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 $e^2/m_e c^2$, the "radius of the proton" should be of the order $e^2/m_p c^2$, 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 anti-nucleons) 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 non-definitive 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