indexes. The treatise concludes with a 20-page summary of uses—from floating airships and balloons with helium to treating cancer with radon.

Mention that orange radiation from krypton 86 has supplied a new primary standard of length (internationally adopted in October 1960), calculation of atomic weights and isotopic masses on the scale carbon $12 = 12$ (internationally adopted in 1961), and description of a helium-neon laser (invented in 1961), are examples of the all-inclusiveness and up-to-dateness of this treatise.

Someone has said that any new book is likely to contain at least eight errors; this reviewer reports on finding only one so far—on page 239: refractivity is represented as $(1 - n)$ instead of $(n - 1)$! It is obvious that these books are well organized, professionally written, effectively edited, carefully proofread, and neatly printed. This authoritative treatise on inert gases will be extremely useful to students as well as to specialists in research and industry.

Absorption Spectra in the Ultraviolet and Visible Region. A Theoretical and Technical Introduction. Vol. 1, 413 pp.; Vol. 2, 408 pp. L. Láng, J. Szőke, G. Varsányi, M. Vizesy, eds. Academic Press Inc., New York, 1961. $18.00 each. *Reviewed by Nicholas Chako, Queens College.*

THE enormous amount of experimental work on absorption spectra of chemical compounds, scattered in dozens of journals published in many countries, has led to a great deal of duplication and some confusion, owing to differences in the presentation of material and use of scales (units).

A systematic and coherent compilation of such data and recordings would be of great value to scientific workers in this and related fields. With this purpose in mind, the authors are bringing out several volumes of data and graphs of absorption spectra of a large number of chemical compounds adapted to a uniform scale.

Most of the material included in the two volumes is new. It has been collected for the most part from studies carried out under the auspices of the Hungarian Academy of Sciences and to a lesser degree by the Polish counterpart. The present work supplements collections in other handbooks. The principal data given in the tables for each compound are: the optical density in log scale over a broad range of wave lengths, varying from approximately 200mμ to 600mμ, for different solvents in various concentrations; the cell thickness; and the type of recording apparatus. Accompanying the data are graphs of absorption spectra indicating the variation of log ϵ (ϵ = extinction coefficient) versus λ, which in most cases ranges from 200 to 600mμ. A few compounds in the vapor state also have been included, showing the band structure and the relative intensities of vibration bands. The data list the background absorption close to the band, its maximum value, and the ratio of intensities of the background to the band maximum of loglog scale against wave number.

To facilitate the interpretation of the data, the authors have included: a short discussion of the theory of absorption spectra (molecular spectra); lists of the names of the compounds and their chemical formulas; a double entry of author and graph index; a list of journals in which the original work appeared; and the institutes taking part in this extensive project.

On the basis of its coverage, this collection is indeed an important contribution to this branch of spectroscopy.

States of Matter. By E. A. Moelwyn-Hughes. 100 pp. (Oliver and Boyd, Edinburgh) Interscience Publishers, Inc., New York, 1961. $3.50. *Reviewed by D. J. Montgomery, Michigan State University.*

ZEALOTS are hard to like, but I'll have to take my chances: *States of Matter* shall be my paradigm. All this is a little more dramatic than either author or reviewer intended. What I am driving at is a conviction, shared with many, that communication of the workings of science is imperative, and a conviction, shared with not so many, that it is possible and worthwhile. Moelwyn-Hughes (and more culpably his publishers) does not attain the ideal, and in fact falls far short of the goal; yet what counts is that a large proportion of the *physics* of matter in the aggregate is brought out succinctly and lucidly for nonspecialists, without cheapness or degradation.

A brief account of current ideas on the somewhat arbitrarily chosen principal states of matter is presented in terms of intermolecular forces. Interactions developed as ion-ion, ion-dipole, dipole-dipole, et cætera, are treated in a catalog hardly unique; but the interactions come to life, with functional laws and appropriate numerical values placed side by side. The subject is developed, naturally and simply, with powerful insight. A sample: all physicists know that one of early triumphs of quantum theory was Einstein's theory of specific heats of solids; but how many know that the same model gives an excellent prediction of the dependence of vapor pressure on temperature for monatomic solids (p. 19)?

There are many shortcomings in *States of Matter,* some grievous, some venial. As is usual in a book covering many topics, the treatment seems brilliant until a topic comes up in which the reader himself has worked; then the inadequacies appear. Although the grammar and typography surpass usual American standards, they fall considerably below traditional British ones. Occasionally statements are misleading, even naive. The publisher's blurb is ungrammatical, insipid, and inaccurate. The price is defensible in view of the hard binding, but so high that a large portion of the potential and much-needed audience will never be reached.

Let me return to my ax-grinding. Moelwyn-Hughes has addressed the general scientist interested in the

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 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