metals one had better pay about as much attention to adherent oxide films as to the metal underneath—no matter whether the film is formed chemically or electrochemically. To no metal is the truism more applicable than to tantalum, on which it is possible to produce, by anodic oxidation in various aqueous electrolytes, an adherent oxide film, remarkable in itself, and produced by a process equally remarkable. The success of the new tantalum capacitors amply supports this statement.

The growing importance of tantalum in capacitors is alone enough to justify the present book, which appears to be the first dealing mainly with anodic films. Most of the book is in fact devoted to tantalum and the other "valve" metals, so-called because their oxides, produced anodically as adherent layers, function as "barrier" layers or "Sperrschichte". This "Sperrfähigkeit", discovered for an aluminum anode in 1857, makes possible potential differences between metal and electrolyte that increase with the film thickness as this grows by anodic oxidation. These potential differences can reach several hundred volts before interdicting electrical breakdown occurs. It is instructive to compare the sparse, predominantly qualitative, treatment of this phenomenon in Foerster's *Elektrochemie Wässeriger Lösungen* (fourth edition, pp. 438–446 inclusive) with the much longer, predominantly quantitative, treatment in the book under review. The 40-year-old treatment has merit even today; the quantitative is by no means an unqualified success. But the quantitative treatment had to be tried, and the author is to be congratulated for pointing out the many difficulties and uncertainties it encounters. It has as its main objective an explanation of the growth of the anodic film on tantalum. In this growth, the migration of an anion from the electrode through the film toward the electrolyte is of overriding importance; it is a little disconcerting to learn (p. 17) that the charge on this anion is unknown, which means that the ion itself is unknown.

As regards the "valve" metals, the book is admirably complete. The reviewer found in the entire book no errors worth mentioning. The author is a recognized authority in the field, to which he has made many valuable contributions. And yet the reviewer feels the book could have been improved.

Two matters are important in judging the book. First, the field it covers is very complex, and an easy understanding thereof presupposes a good background in corrosion, in electrochemistry, in solid-state physics, and in inorganic chemistry. It presupposes additionally a knowledge of charge transfer and breakdown in dielectrics, of kinetics of reactions in the solid phase, and of the optical properties of thin films. Second, the anodic films on the "valve" metals differ radically as a class from the anodic films on others, the latter films being primarily of interest in connection with corrosion and similar processes. The reviewer wonders whether it would not have been better to restrict this book to the "valve" metals.

The writing by Dr. Young is uneven; in part he seems to have given us a comprehensive literature survey in early draft. As an example by no means isolated, consider the first sentence of Chapter 17: "Franklin (1957) reported that, contrary to the previous assumption of a flat, parallel-sided oxide layer (but see work by Keller et al., section 16.02), these films have a pronounced cell structure which is very similar to that of the porous films (Figure 17.01)." The reviewer no longer complains of having to tunnel or jump several energy barriers in traversing a sentence; but he does suggest that "these films" should be identified in this, the introductory sentence of a chapter, and that the reference to Figure 17.01 belongs elsewhere inasmuch as the figure deals with *nonporous* films.

Purchase of the book for its strong points is recommended.

Argon, Helium and the Rare Gases. The Elements of the Helium Group. Gerhard A. Cook, ed. Vol. 1, History, Occurrence, and Properties, 394 pp.; Vol. 2, Production, Analytical Determination, and Uses, 427 pp. Interscience Publishers, Inc., New York, $17.50 each. *Reviewed by William F. Meggers, National Bureau of Standards.*

HELIUM was discovered spectroscopically in the sun's chromosphere during the eclipse of 1868 but its terrestrial presence was not established until 1895. By 1900, five additional inert gases (argon, neon, krypton, xenon, and radon) were found to end six successive periods of the modern atomic chart. For nearly two decades, these gases remained scientific curiosities but their concentration, investigation, and application have zoomed ever since it was discovered that argon constitutes one percent of the earth's atmosphere and helium two percent of some natural gas accumulations. The remainder will always be "rare gases" but their unique and useful properties justify their concentration, further investigation, and exploitation.

Since 1940, some 7000 articles and books have already been published about the inert gases, and this is the main reason for preparing this digest of all available information about them. Fifteen experts have written two volumes on argon, helium, and the rare gases in twenty chapters. The first volume (ten chapters) is devoted to their history, occurrence, and all conceivable properties, including chemical, physical, spectral, structural, thermodynamic, gas-, liquid-, and solid-state. The second volume covers the methods of isolating, purifying, and handling these gases; their uses; and methods for the analytical determination of the gases themselves and of their impurities. These books are filled with accurate, comprehensive, interesting reviews, illustrated with graphs, occasional halftones, and plenty of tables and selected references (900 in Volume 1, 750 in Volume 2). Each volume ends with extensive author and subject 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