include good summary discussions of the basic principles of isotope applications, including isotope dilution, tracer kinetics and activation analysis. The treatment is not extensive but touches on the major factors in these areas. The introductory material for the applied part discusses the problems of radioisotope work, including statements regarding chemical effects, isotope effects, etc.

The laboratory exercises include standard experiments on GM counters, scintillation counting, liquid scintillation, combustion of carbon compounds, exchange kinetics and various analytical techniques. The book is particularly distinguished by the soil-plant experiments comprising the last fifty pages. These are quite good and represent a distinct contribution to relatively simple but practical experiments. These include experiments such as adsorption of phosphate in soils, adsorption of cations, the fixation of CO_2 and separation of photosynthates by paper chromatography, CO_2 fixation of the higher plants, autoradiography, uptake of ions by plants, the effect of placement of fertilizers, and radiation damage.

Four appendices are included (located between the two major sections of the book). These include a somewhat abridged table of maximum permissible concentrations, how to put on and take off rubber gloves, radioactive waste control, and criteria of optimum operating conditions for a proportional counter. A bibliography of 11 volumes is included following these appendices. Unfortunately, essentially no references are given to the sources of specific procedures. An interesting selection of 'mental exercises' is given which represent typical laboratory problems.

This book is certainly to be recommended to those who work with radioisotopes in agricultural problems and particularly to those who are responsible for teaching courses in this area. It is a very useful addition to the growing collection of valuable materials available from the Agency.

Ralph T. Overman

P. O. Box 367
Oak Ridge, Tennessee

About the Reviewer: As former Chairman of the Special Training Division of the Oak Ridge Institute of Nuclear Studies, Dr. Ralph T. Overman has probably taught more people about uses of isotopes than anyone else. He had advised groups from Japan to Lebanon about setting up schools for isotopic use training. He is a Fellow of ANS and a member of our Editorial Advisory Committee.

He recently opened his own consulting office in Oak Ridge.

Solid State Charged Particle Detectors. By Niels J. Hansen. Pergamon Press, New York, 72 pages. $4.25.

This book presents in a short but complete form all the basic information necessary to the user of solid-state radiation detectors.

A quick review of the principal types of radiation detectors in current use (ionization chambers, scintillation counters, etc.) is given in the introduction, to place the solid-state detectors in their proper context.

The basic principles of solid-state theory, necessary for the understanding of the operation of the detectors, are discussed in the first two chapters. A very clear picture is given of the Single Electron Theory of Metals and the Band Theory of Solids. The author completely succeeds in giving a concise explanation of the more fundamental concepts involved without sacrificing rigor or accuracy.

The third chapter studies the structure of the different types of solid-state detectors available at present and establishes the fundamental relationships between detector parameters: resistivity, capacitance, depletion depth and applied bias. Drifted detectors are separately treated at the end of the chapter.

The mechanisms of interaction of charged particles with matter is briefly discussed in the fourth chapter of the book.

With considerably more detail, the operation of solid-state detectors is analyzed in chapter five. This chapter has three parts: Part A deals with junction detectors and Part B with drifted detectors. In both cases the processes involved in the collection of charge are studied, and the influence of the reduced range β_0 on the pulse shape is shown. Part C is a general discussion of the operation of the different types of detectors previously studied.

Only the most relevant information about the associated electronics is presented in chapter six.

The importance of the concepts of charge equivalent noise, charge-sensitive-amplifier configuration, and the influence of pulse shaping on signal-to-noise ratio is stressed and discussed with greater detail in chapter seven. Here, the contribution to the width of the peaks due to phenomena taking place in the detector itself and to noise generated in the following amplifying system is considered with some detail.

Finally, chapter eight deals with the applications of solid-state counters in Nuclear Spectrometry. The advantages and limitations of Junction and Drifted devices when used as spectrometers for electrons or heavier particles are shown, and a special consideration is given to the use of

solid-state detectors in energy measurements of fission fragments. The use of drifted detectors in gamma-ray spectrometry is not discussed in this book.

We believe that the work of Niels J. Hansen will prove to be very valuable to all those performing nuclear measurements that involve the use of solid-state detectors. Practically all the information needed by the user is contained in this book. Even those who have no, or very little, solid-state-physics background will profit by the reading of this work since most of it is self explanatory and written in a very readable way.

It will also be very useful for people engaged in the design of electronic instrumentation associated with solid-state detectors, since it is a quick reference source for all the fundamentals of these, nowadays, so-popular devices.

A good list of references is given at the end of the book for anyone who wishes to dig deeper into the subject.

In conclusion, *Solid State Charged Particle Detectors* is a book that was probably expected by many and that, we are sure, will be welcomed by many who are interested in having a clear and concise picture of these useful devices. This work certainly achieves this end.

Angel M. R. Ferrari

Tennelec Instrument Company, Inc.
140 E. Division Road
Oak Ridge, Tennessee

Received January 28, 1965

About the Reviewer: Angel M. R. Ferrari received his degree of Licenciado en Fisica from Instituto de Fisica de San Carlos de Bariloche, Argentina, where he studied with a fellowship awarded to him by Argentina's Atomic Energy Commission.

He spent two years (1960-1961) in the United States as an IAEA fellow, one of them as a research participant at the Instruments and Control Division at Oak Ridge National Laboratory.

Back in Argentina, he taught Nuclear Instrumentation in Bariloche for two years. At present, he is with Tennelec Instrument Company in Oak Ridge designing electronic instruments for nuclear applications.

Ionic Bombardment: Theory and Applications. Proceedings, in English, of an International Symposium of the Centre National de la Recherche Scientifique, Bellevue, France, Dec. 8, 1962. Published by Gordon and Breach Science Publishers, New York, N. Y., (1964). 359 pages. $19.50.

For the busy reader who wants a more denotative title, this one might be extended to read "Experiments Related to Effects of Bombarding Various Materials With Several-keV Ions, Together With a Couple of Theoretical Papers." Alternatively, the greater part of the book could adequately be entitled "Sputtering and Associated Phenomena." The subtitle should include: "previously published in French as *Le Bombardement Ionique, Theories et Applications.*"

The symposium reported here was convened by Prof. J. J. Trillat, Director of the X-ray Laboratory of the CNRS. Prof. Trillat has been a pioneer in the observation of surface phenomena caused by ionic bombardment. Explicitly, he has developed techniques for studying surfaces, during bombardment, by means of electron microscopy and electron diffraction. Since most surfaces change dramatically during such bombardment, it is not surprising that the book contains many pages devoted to photographs of diffraction patterns and electron micrographs. Such illustrations constitute almost a quarter of the book, about half of them being from CNRS.

The abundance of such illustrations is a major clue that this is not basically a physics book. Indeed, the conferees represented a substantial number of disciplines (or at least departments), and their center of gravity lay somewhere near metallurgy. A physicist recognizing this fact can approach the book in a much more receptive manner.

Sputtering (ejection of target atoms) is the most prominent effect of low-energy ion bombardment. Nearly all of the world's sputtering-physics groups (there are only a few) were represented: Wehner (USA), Kistemaker (Netherlands), M. W. Thompson (UK), and W. J. Moore (USA). The subject matter presented by these groups was for the most part little different from that found in reports of conferences on high vacuum or on ionization phenomena in gases. However, their insights into the work of the other conferees, as brought out in the discussions, appeared to constitute rather fruitful cross-fertilization and may have been one of the more valuable features of this novel interdisciplinary gathering. A similar comment might be made about the contributions of the radiation-damage group from Oak Ridge and of D. E. Harrison, one of the world's few practicing sputtering theorists.

Sputtering experiments have become quite sophisticated in the past few years. They have dealt with nearly all properties of the sputtered atoms and have covered systematically a broad range of incident ions and target materials. In addition, several related phenomena have been observed and examined: secondary electron emission, positive and negative ion emission, photon emission (characteristic of beam ions or of target atoms or ions)