more derivations of equations rather than depending so very heavily on the presentation of final equations. Another example of overemphasis on the rule-of-thumb approach is the rather light treatment given to the x-ray effect in ionization gauges and that given to the significance of the development of the Bayard-Alpert gauge.

The author should be complimented on the overall accuracy of his statements and examples. Some statements do not reflect the latest literature, but these are primarily in the field of ultra-high vacuum. In general, the text is a valuable one not only for the beginner but also for the more experienced worker. I enjoyed reading it and think that this book would be a valuable addition to the library of anyone who devotes much of his time to using or designing vacuum equipment.

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Rutherford of Nelson

The Collected Papers of Lord Rutherford of Nelson. vol. 2, *Manchester.* Published under the direction of Sir James Chadwick. Interscience (Wiley), New York, 1963. 590 pp. Illus. $17.25.

The first volume of Rutherford's *Collected Papers* was reviewed in this journal [*Science* **137**, 1044 (1962)] on 28 September 1962. We now have the second volume, which covers the Manchester period from 1907 to 1919, the most fruitful and the happiest epoch of Rutherford's life. In 1931 he said, "I owe a great debt to Manchester for the opportunities it gave me for carrying out my studies. I do not know whether the University is really aware that during the few years from 1911 onwards, the whole foundation of the modern physical movement came from the physical department of Manchester University." The statement is not modest, but it is truthful and reflects, I believe, Rutherford's personality. What were these foundations of modern physics? The discoveries of "the nature of the α-particle" (p. 134); "the scattering of α- and β-rays and the structure of the atom" (p. 212); "collision of α-particles with light atoms" (p. 547)—in plainer words, the discovery of the nucleus, of the structure of the planetary atom, and of the artificial disintegration of the nucleus.

When these momentous discoveries are followed in the *Collected Papers* they appear in a very different light from the textbook presentation with which every physicist is acquainted. In school we learn one hypothesis and all the facts that buttress the hypothesis and make it into an accepted theory, but to the discoverer there are always innumerable choices and the path to the final result is far from straight and clear.

Every physicist will gain something from the perusal of these papers, not factual information but an education on the qualities needed to be a great investigator. Humble, tedious, and apparently pedestrian investigations are the daily routine, even of a Rutherford, but once in a while this struggle, which tests the endurance and patience of the experimentalist, leads to supreme achievements. Perhaps it will also be a comfort to common mortals to realize that even Rutherford occasionally made mistakes or followed false leads. On the whole, Rutherford's already legendary figure is made much more human by these papers, but his personality does not lose anything in the process. In developing our personal acquaintance with the author we are helped very much by essays written by N. Feather, H. Geiger, E. N. da C. Andrade, and A. B. Wood, for the authors communicate effectively their own experiences in the exhilarating surroundings of the Manchester Laboratory. These essays give an intimate view of Rutherford, of the unique assembly of young talents surrounding him at Manchester, and of their personal relations.

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Solid-State Physics

Quantum Theory of Solids. C. Kittel. Wiley, New York, 1963. xii + 435 pp. Illus. $13.50.

During the last decade very few domains of physics advanced as successfully as solid-state physics. This may be verified by studying Kittel's *Quantum Theory of Solids* and then comparing it with a book which has the same title but was written a generation ago by R. Peierls. The older book is essentially a study in applied quantum mechanics. The new book could perhaps also be called that, but under that guise it presents a very large number of new experimental and theoretical ideas. The most impressive aspect of Kittel's book is the number of advanced theoretical techniques that he presents. Many of these techniques were originally designed to solve problems in other fields, a context in which they sometimes met with indifferent success. Kittel's book demonstrates to those who are inclined to doubt that these methods do extremely well in solid-state physics.

Since the book deals with the most advanced topics in an active field, it is a difficult book to read. But it can be recommended to advanced graduate students and research workers, or to average graduate students who have expert guidance available. It must have been a difficult book to write. Only an author with a truly encyclopedic knowledge could think of doing it. Kittel shows that he has such knowledge.

In addition he shows that he has a strong physical intuition which helps elucidate many difficult passages. However, the task is so hard that uniform success cannot be expected. Every once in a while we find that a close argument on a physical point has been terminated by a reference because a complete account would be too long. And of course, the recapitulation of involved mathematics means a number of misprints. It might be useful to publish a table of such errors at some future date. For this book may very well become a standard reference work for research workers in solid-state physics.

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Crystallography

The Art and Science of Growing Crystals. J. J. Gilman, Ed. Wiley, New York, 1963. x + 493 pp. Illus. $20.

One of the most remarkable trends in contemporary physical science, a trend which is still gathering momentum, is the increased interest in single crystals. Long gone are the days when man's interest in crystals was largely esthetic, or when their chief economic use was as gems; gone, too, are the days when