system and rudiments of stellar cosmology), "energy" (mechanics, heat and electricity), and "matter and change" (atomic and nuclear physics, chemistry).

The level is elementary and no mathematical preparation is required, but the contents are definitely up to date. Wherever possible, a historical approach is used, including occasional anecdotes, and the experimental basis of the proposed concepts is described. The explanations at a high pedagogical level, are very clear, concrete and complemented by numerous excellent pictures. Care has been exercised to relate them to everyday life. Practical orders of magnitude are shown in order to help the reader visualize the units. Adequate remarks are introduced about the scientific method, the aims of science and technology, and their public understanding. The advantages of the international metric system are stressed.

Each chapter is concluded with a list of references to more detailed introductory physics books and with an abundant collection of questions and problems, some of which provide an opportunity to stress points of importance and enable the student to check his knowledge, while others will require the instructor's guidance.

The student may be allowed to read this text by himself with hardly a risk of going astray. (The reviewer spotted only one place where confusion might arise: on page 215, in fig. 14-11, the plus sign is placed on the wrong side of the conductor, and might be interpreted as representing a flow of positive charges into the paper while, as explicitly stated, the electron flow goes that way.) However, as is to be expected from a book on such a level, the critically-minded student will find occasional questions to ask his instructor, e.g., why (page 26) a force-free pendulum tends to swing along a fixed path with respect to the stars rather than with respect to the Earth (an appeal to Newton's unmentioned first law).

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The reviewer, who is now a scientific advisor for the Centre de Recherches Routières in Sterrebeek, Belgium, was formerly a teacher at the University of Elisabethville in the Congo.

Models of chemical affinity

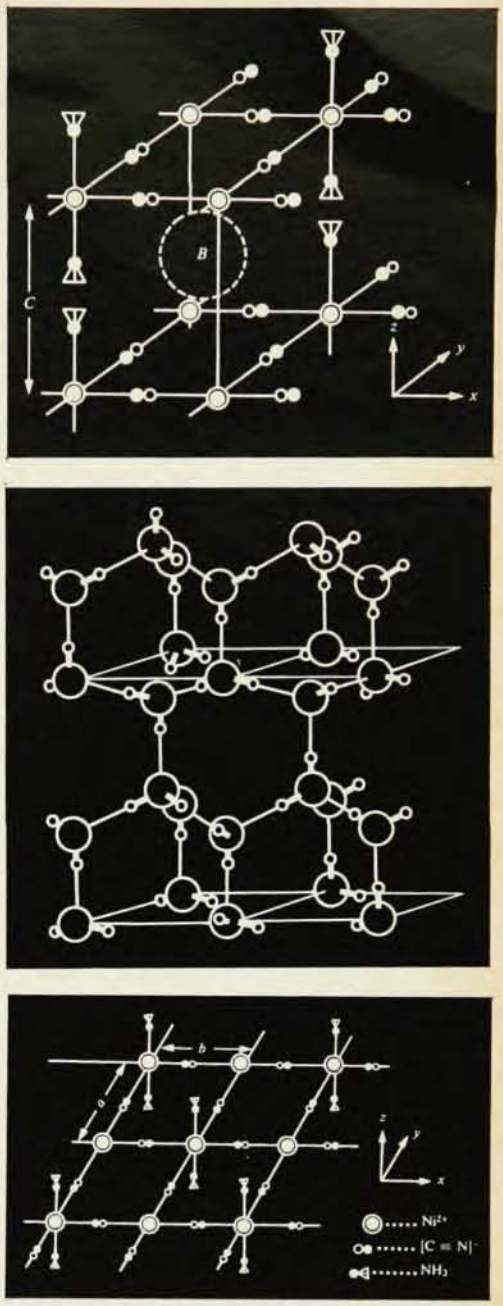
ELECTRONIC STRUCTURE AND CHEMICAL BONDING. By Donald K. Sebera, 298 pp. Blaisdell, New York, 1964. Paper $3.50.

by M. E. Straumanis

The author of this fine book has been an Assistant Professor of Chemistry at the Wesleyan University in Middletown since 1958. Already in the introduction ("models of nature") he points out and emphasizes that our understanding of nature is based on models, which we build and which are more or less appropriate for the qualitative and quantitative description of natural phenomena. This limited understanding arises from the fact that we feel and recognize the outer world only through our senses, and, therefore, our knowledge about this world must be imperfect. Hence, there are phenomena which cannot be described by models at all. This is also the reason why it is so difficult to describe and understand chemical bonding. The modern ideas concerning bonding are based upon the wave-mechanical model of the atom developed by Heisenberg and Schrödinger in 1926. However, even this model is not the best for a quantitative description of the bonding occurring in various chemical compounds and solids.

The purpose of the book is to present the theories of bonding in such a form that they can be easily understood. The author prefers, therefore, the pictorial method, reducing the use of mathematics to a minimum. The models proposed and based on the present knowledge are explained by some 160 figures in the text.

The book starts with a concise description of the Bohr atom model on 28 pages. The chapter contains only as much in an elementary form as is necessary for the understanding of chemical bonding. Atomic structure and properties are discussed in the next chapter (also 28 pages). Then comes "ionic bonding" (19 pages). In the introduction to this chapter it is said that ". . . the properties of some substances can be described only by assuming a mixture of more than one kind of bonding force." This statement applies, for example, in the case of the nitrides of titanium, zirconium, and hafnium, the bonding



CRYSTAL MODELS from: Electronic Structure and Chemical Bonding. Top: structure of Ni $(CN)_2 \cdot NH_3$•clathrate. Middle: ice. Bottom: layer structure of $Ni(CN)_2 \cdot NH_3$. Symbol definitions in bottom drawing apply also to top one. Originals are black on white. These drawings are not grouped together in book.

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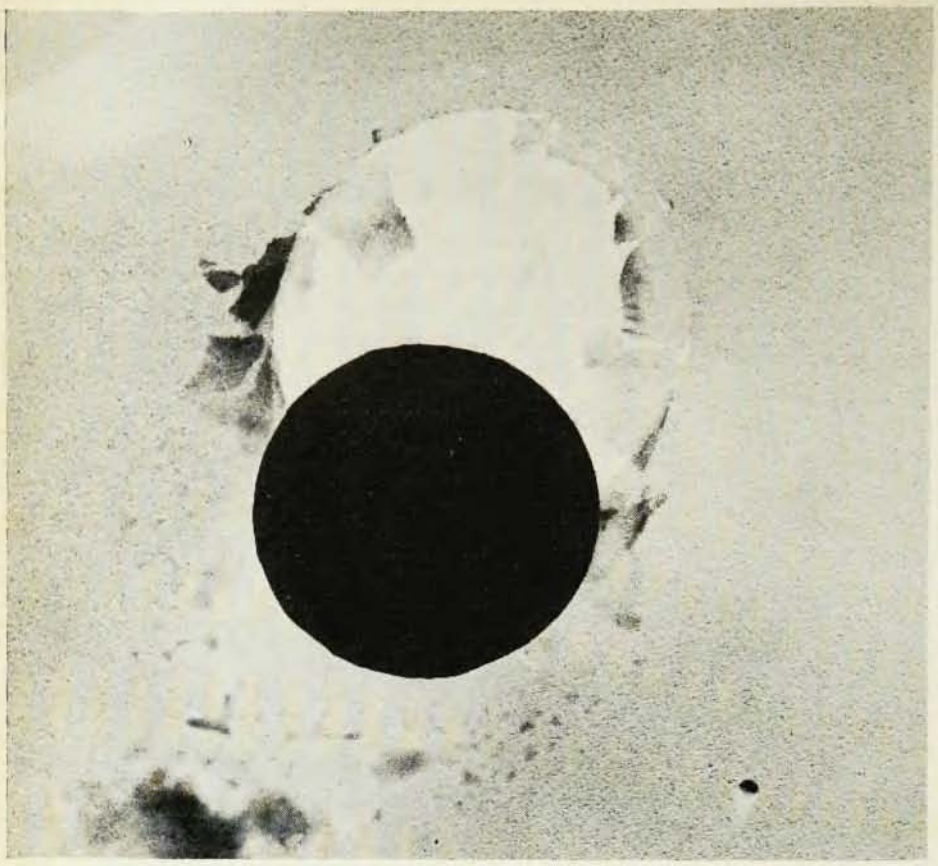
Martin E. Straumanis, who was professor of chemistry at the University of Latvia for many years, is now research professor of materials at the University of Missouri at Rolla.



COURTESY C. L. HEMENWAY, DUDLEY OBSERVATORY

MICROMETEORITE SPHERULE shown on a sheet of collecting material. Diameter of sphere is about one micron. From: Meteors, Comets, and Meteorites.

of which is ionic and to a small extent metallic (in all probability 2–3%), according to the investigations of this reviewer. Then follows chapter 5: "The new uncertain physics" (7 pages), so called because it explains the de Broglie relationship (light as wave and as particle) and Heisenberg's uncertainty principle. The explanation of the "wave-mechanical model" of elementary particles is given on the next 29 pages; no mathematics is used, only figures and diagrams. The largest chapter of the book (47 pages) is devoted to the "covalent bond." Then follow the chapters: Resonance and molecular orbital theory (30 pages); Complex compounds (31 pages); The metallic bond and semiconductors (34 pages); and "Weak forces—weak bonds" (33 pages). In this last chapter, forces, previously known as van der Waals forces, polarization phenomena (dipoles, HF, H_2O, ice), hydrogen bonding and clathrate compounds are discussed. The last consist of a host lattice, in the cavities of which other molecules are entrapped, for example, xenon in water under high pressure and below 0°C: $Xe\,(H_2O)_6$.

There are some inconsistencies in the text, for instance concerning electrical conductivity of metals on page 235, as compared with the second footnote on page 243. There are also some misprints, for example, in eq. (3.1) on page 50. In some places "bonds" is written instead of "bands" (pages 252, 256, 259).

Nearly all main bonding problems are covered by the book; they are well discussed in an elementary manner. Besides, at the end of each chapter (except 5) references for further studies are given. The book is recommended to all who are interested in an elementary presentation of bonding problems.

However, the reviewer doubts whether chemistry freshmen, especially those without secondary school courses in chemistry and physics (see preface) are sufficiently able to understand the book.

Solar system irregulars

THE PHYSICS AND ASTRONOMY OF METEORS, COMETS AND METEORITES. By Gerald S. Hawkins. 134 pp. McGraw Hill, New York, 1964. Paper $2.50.

by E. J. Opik

Published in the series in Undergraduate Astronomy, of which the author is consulting editor, one would have expected to see a concise textbook, with clear definitions of the basic notions and precise explanations of how the more advanced knowledge has been arrived at. We are presented instead with an impressionistic sketch of modern developments, to which the author has solidly contributed himself, which may appeal to co-workers in the field but which may baffle the undergraduate who will need guidance, probably from the author himself.

The statements are usually correct and the material presented is of a wide scope for so short a monograph. However, misstatements and faults of presentation are also rather numerous, some of which are quoted or corrected below.

Radiation pressure is not the driving force in comet tails (page 2). A micrometeorite is not necessarily an object "that completely melts" during passage in the atmosphere (page 4). More meteors are not necessarily seen at lower altitudes (page 6); the author has overlooked that the greater volume covered is opposed by the greater distance and faintness of the objects. *I* in Öpik's equation (1.1, page 7) is not "ergs/sec" but *visual* ergs/sec involving luminous efficiency. Contrary to statements on pages 16-18, almost all the heating of the meteoroid is due to reflected air molecules. On page 17, the deceleration equations lack the *minus* sign, and on page 18, the dimensionless coefficient of efficiency, τ, is given the dimension of "ergs sec^{-1}". The rather sophisticated figure 2.2 is inadequately explained, and its promised "open circle" (page 20) is missing. On page

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E. J. Öpik is a member of the department of physics and astronomy at the University of Maryland and the staff of the Armagh Observatory in Northern Ireland. Meteoritics is one of his specialties.