

quired in quantum field theory, where the number of particles is indefinite, may require for description a much more general space, as is suggested already by Feynman's path-integral formulation of quantum field theory and by the theory of dispersion relations, to choose only two examples.

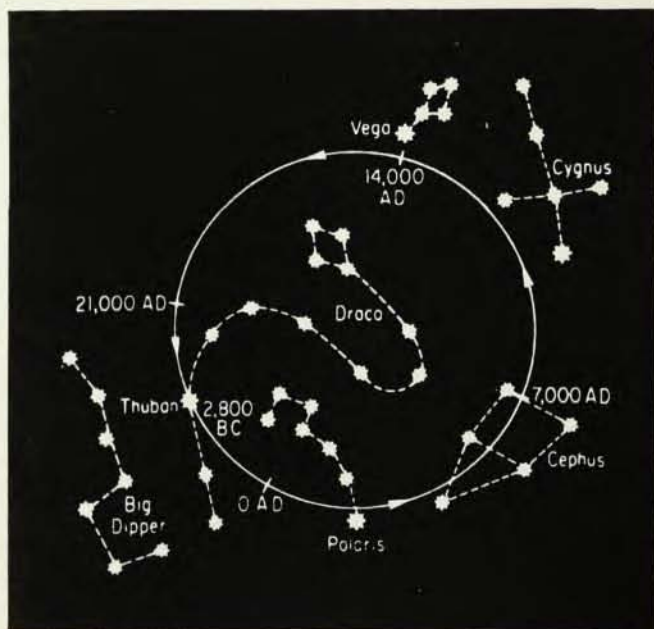
It may be relevant to pause here and put the question whether there *exists* a philosophy of elementary particles, as opposed to elementary particle theory itself. Is this merely a distinction without a difference? Most physicists of my acquaintance hold to the position that every physicist is his own philosopher. In practice this usually means that he thinks that one or another widely used approach is especially promising this year, be it quarks, bootstraps, analytic continuation in the mass, or what have you. But the idea of a commitment to any philosophical system, he finds quite unnatural and repugnant. Modern theory usually adopts an easy opportunism, applying its forces against the weak parts of the membrane which separates us from the secrets of nature and it is intended to lead to rupture, or "breakthrough." As this possibly unfortunate metaphor may suggest, the procedure has nothing much to do with philosophy. However, there is a reflective, creative, constructive ground to physical theory, and on this ground it may

meet with philosophy—though not always happily. At the end of a physics colloquium on the philosophy of science, the speaker, a young philosophy instructor, was asked, "What have physicists to learn from philosophers?" The modest answer, "Nothing; but philosophers have much to learn from physicists," won him the approval of the audience. (Of course, the next year the philosophy department fired him.) The editors of this volume are aware, as they show in their foreword, of the profound distrust that physicists display toward tentative and speculative suggestions. An eminent physicist once remarked to me, "The trouble with far-out ideas is that there is so much territory far-out." However, as the editors note, "The fact that this book is the first of its kind in the literature explains, to some extent, its inherent defects."

Among the less excusable defects are the mistakes which several authors (I must assume they are philosophers) make in their physics. On page 87, it is suggested that all weakly decaying elementary particles "become stable when the strong interaction is 'turned on'." When one reads this kind of nonsense, it strongly suggests that the rest of the article is also a waste of time, and it is. On page 134, there is the sentence: "The discovery of the antiproton (and later the antineutron) overthrew the as-

sumption, which had a certain foundation (smacking of classical atomism), that the existing heavy elementary particles (proton and others) always remain heavy particles and cannot transform into lighter particles (and conversely light particles always remain light particles)." While this sentence may not be totally false, it is about 99% misleading (as well as being almost unreadable). Among the other defects of the collection of papers, is a tendency to repetitiveness. The inexhaustableness of nature at providing novelty at ever deeper levels of experience, is apparently exceeded only by the inexhaustability of dialectical materialists in remarking upon it. One may also be excused from paying careful attention after the third exposition, in essentially identical terms, of parity violation and CP invariance and what may be learned from them.

On the positive side, the nonspecialist will find interesting articles on "The structure of elementary particles," by D. I. Blokhintzev and on "Modern astronomy and the physics of the microworld," by V. A. Ambartsumyan. And for anyone who is fascinated by the problem of what really lies at the heart of matter (and this presumably includes all physicists) this book provides some ideas which will be new and will provoke thought, if not in agreement then in rebuttal.



PRECESSIONAL PATH of the north pole among the stars. From: *Exploring the Physical Sciences*.

Emphasis on development of some major concepts

EXPLORING THE PHYSICAL SCIENCES.
By W. J. Poppy and Leland L. Wilson.
376 pp. Prentice-Hall, Englewood Cliffs, N.J., 1965.

by Jacques E. Romain

In this introductory general course in physical science, meant as a one-semester college course, no attempt is made, of course, to cover the whole domain of physics. The topics selected, which seem appropriate, were chosen so as to place the primary emphasis on the development of some major concepts. They fall into three broad categories: "Space" (earth, solar

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).

* * *

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

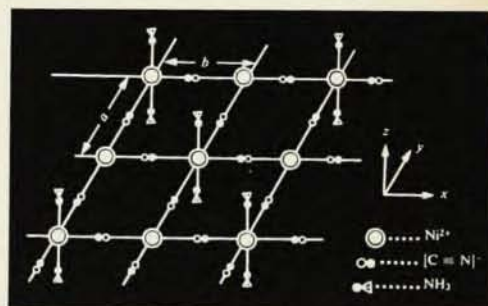
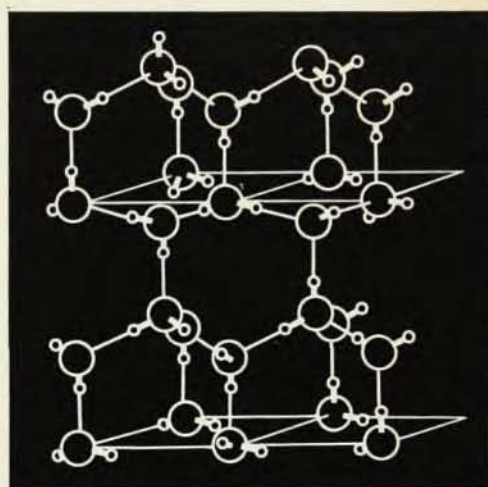
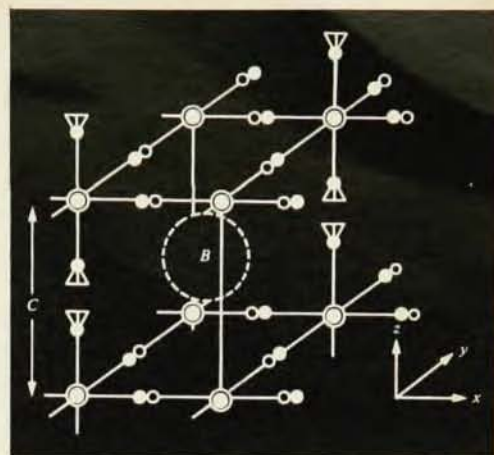
ELECTRONIC STRUCTURE AND CHEMICAL BONDING. By Donald K. Sebera, 298 pp. Blaisdell, New York, 1964. Paper \$3.50.

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



CRYSTAL MODELS from: Electronic Structure and Chemical Bonding. Top: structure of $\text{Ni}(\text{CN})_2 \cdot \text{NH}_3 \cdot \text{clathrate}$. Middle: ice. Bottom: layer structure of $\text{Ni}(\text{CN})_2 \cdot \text{NH}_3$. Symbol definitions in bottom drawing apply also to top one. Originals are black on white. These drawings are not grouped together in book.

than one kind of bonding force." This statement applies, for example, in the case of the nitrides of titanium, zirconium, and hafnium, the bonding

* * *

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.