lurgy have been adopted by other fields such as ceramics and polymers. This is, in a way, appropriate because physical metallurgy has itself evolved from and is nurtured by solid-state physics and chemistry.

Peter Haasen, the author of the present book, has himself evolved from such a background and is in the midst of a productive career in physical metallurgy. He is the director of the Institute of Metal Physics, Göttingen University and is well known for his studies of the mechanical properties of materials, especially studies of dislocation motion in covalently bonded crystals.

Haasen has now written a very good intermediate-level textbook on physical metallurgy, covering a well designed treatment of physical metallurgy. He states that the main aim of *Physical Metallurgy* is ". . . a discussion of the principal object of metallurgy, namely the mechanical hardening of metals . . . ." In pursuing this goal he treats various aspects of physical metallurgy, including microstructures and how they are studied, thermodynamics of solids (including a physicist's approach to phase diagrams) and a number of chapters on defects in crystals. These subjects form the background for the final portion of the book, which includes a treatment of the hardening of materials—work hardening, transformation hardening, alloy hardening—followed by a shorter discussion of the reverse process of recrystallization.

Haasen, however, does not give all the topics equal weight. For example, he mentions the importance of microstructure quite early in the book, in conjunction with a section on grain boundaries, but he does not emphasize this aspect of physical metallurgy throughout the book. The emphasis of the book is on relating properties—mechanical properties—to dislocation structure(s).

The level of presentation of these subjects is quite high, well above those found in many books, mostly qualitative or phenomenological, used in American universities. The treatment does assume, however, some background in solid-state physics—a suggested reference being Charles Kittel's well known book *Introduction to Solid State Physics* (3rd edition, Wiley, New York, 1966)—but Haasen includes enough material in the text to make it reasonably self-contained. These factors make the book more suitable for a second course in physical metallurgy or perhaps for a graduate course for physics or chemistry students first entering physical metallurgy. Haasen, however, does not treat corrosion, a subject that is usually included in introductory books on physical metallurgy and is of importance to the use of metals and alloys, although he does include a discussion of the question of oxidation.

This is a minor point, though, because the book is written at a relatively high level, is quite readable, and should serve as a very useful book on the subject. Graduate students may find it more challenging than present texts, but for those starting out in physical metallurgy the effort of reading it will be amply rewarded.

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## Electrical Interactions in Molecular Biophysics: An Introduction

**R. Gabler**
352 pp. Academic, New York, 1978.
$25.00

The purpose of this book is to provide the reader with introductory discussions on the subject of electrical properties of biological molecules and the origin of electrostatic forces between them. Raymond Gabler assumes no previous knowledge of the subject by the reader. He makes great efforts to explain, using easy-to-understand language, the meaning of existing concepts and theories about electric charge, dipole moment and polarizability and also the mechanism by which these quantities contribute energies that may attract or repel neighboring molecules.

Roughly, this book consists of two parts. The first part describes basic concepts of electrostatics and dipoles. The second provides detailed discussions of electrostatic interactions between biological molecules utilizing the concepts and theories discussed in the first part of the book. The discussions of electrostatics and dipole moments are rather elementary and by no means complete. However, Gabler's intention is obviously to discuss the basic concept behind theories. He explains derivations of fundamental equations step by step so that the reader will have a clear understanding of the meaning of the theory. Many textbook authors ignore these discussions and, in that sense, Gabler takes a unique approach to the problem. Therefore, the book is valuable to the reader who does not have a background in electrostatics. Many biochemists and biologists are not familiar with the concepts of dipole moment and dielectric constant. One of the reasons for this is the lack of good introductory books on this subject. This book will certainly serve the purpose of introducing these concepts to those readers.

The second part of the book describes various types of electrostatic interactions between biological molecules. Gabler lucidly explains the origin of attractive and repulsive forces due to charge–charge, charge–dipole and dipole–dipole interactions. He further discusses the origin and physical nature of hydrogen bonds and van der Waals forces, which are sometimes loosely understood by biological scientists. In the discussion of the Debye–Hückel theory for electrolytes, he takes great pains in deriving the Poisson equation starting from Gauss's theorem. This may be very useful for many readers in understanding the meaning of this important equation.

Gabler's book is very easy to read and his description of the development of theories systematic and clear. Discussions are careful, thorough and tactful. He uses mathematical equations whenever their use facilitates the understanding of theories; the extent of this use, however, is quite reasonable. As stated before, he does not assume any previous knowledge by the reader and often discusses, in detail, elementary topics such as *p*H and chemical formulae of simple molecules. Some readers may wish to simply skip these discussions and move on to the next section. For advanced readers, this book may not provide satisfaction because the author did not intend to do so. On the other hand, the book may be very helpful for undergraduate-, as well as graduate-course instructors. It is often difficult to find a book that describes derivations of basic equations of theories. For teaching, explanation of basic concepts and meaning of equations are most important to students. This book will be very valuable for these purposes. Gabler supplies sufficient numbers of references for each subject and they will be convenient for interested readers. He gives no exercise problems and thus this book may not be most suitable for use as a textbook. However, this can be an excellent reference book to supplement standard textbooks.

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## Diffraction from Materials

**L. H. Schwartz, J. B. Cohen**
558 pp. Academic, New York, 1977.
$27.50

Investigations of the interactions of x rays and, to a lesser extent, neutrons and electrons, with matter provide students of materials sciences and related disciplines with their most powerful tools for the analysis of the relationships among structures and properties of solids. *Diffraction from Materials* represents an ambitious effort to provide the reader with a sound theoretical basis for an understanding of such interactions.

The authors, Lyle H. Schwartz and Jerome B. Cohen of the Department of Materials Sciences and Engineering of Northwestern University, are well known

for their investigations of transition metals and alloys and wide ranges of diffraction effects in crystalline materials.

The initial chapters of the text are devoted to crystallography, diffraction theory and x-ray diffraction techniques. Subsequent sections deal in considerable detail with x-ray crystal-structure analysis, dynamical diffraction theory and a variety of topics including thermal diffuse scattering, order–disorder effects and clustering of atoms in crystals, small-angle scattering and scattering by liquids and amorphous solids. In all cases, Schwartz and Cohen have attempted to provide the reader with the mathematical tools needed for the subject under discussion.

The organization of the text permits the convenient use of the introductory chapters for a short, one-semester course for senior undergraduates or first-year graduate students. Alternatively, instructors can base a two-semester course for more advanced students on the contents of the entire volume.

Schwartz and Cohen follow each chapter with a list of references, mostly to standard, readily available texts, and with large numbers of useful exercises and problems. An appendix contains the answers to most of the problems, many of which are worked out in detail.

The organization of the text is satisfactory, and Schwartz and Cohen discuss in adequate detail the many topics covered. So far, so good. Unfortunately, the text is marred by large numbers of errors and by a chatty, often ungrammatical style of presentation that often leads, in my opinion, to ambiguities of interpretation and to serious difficulties for the reader.

For example, on page 239 Schwartz and Cohen discusses the interpretation of an x-ray powder pattern and the indexing of reflections. They state that "systematic absences may then be used to identify the space group as $I\bar{4}2d$." Actually, the systematic absences to which they refer can only identify $I\bar{4}2d$ as one of several possible space groups.

In a discussion of simultaneous diffraction (page 280) we find the statement "... conservation of energy shows that the intensity of the peak being measured will decrease," that is, when simultaneous diffraction occurs. That statement is simply incorrect. Energy is, of course, conserved, but that has little or nothing to do with the observed effects of simultaneous diffraction on the intensity of the peak being measured; the latter may increase, decrease or even remain unchanged.

In one short table (8-1, on page 464) at least nine numerical errors appear. All of these exceed by far errors that might be attributable to variations in published values of physical constants. In two cases, the results implied by the data in the table are physically impossible and are incompatible with the authors' own

Equations 8-42 and 8-43 (that is, the peak displacements due to refractive-index effects are less than half as large as the corresponding peak half-widths).

Schwartz and Cohen inform us on page 403 that "as $\theta$ increases, $F$ decreases and sin $2\theta$ decreases, and both changes lead to a marked decrease in (peak) width with increasing angle". They do, but only for $\theta \leqslant 45°$.

The list of errors, ambiguities and misstatements is long, much too long. I cannot recommend the text for use in classrooms or for more general purposes until it has been subjected to a thorough revision and reprinted.


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## On Aesthetics in Science

**J. Wechsler, ed.**
180 pp. MIT, Cambridge, 1978. $12.50

Are aesthetic considerations part of the process by which scientific hypotheses are selected or rejected? And if so, is aesthetics incompatible with necessary scientific objectivity, or does it increase the validity of the cognitive aspects of science?

*On Aesthetics in Science*, edited by and with an introduction by Judith Wechsler, discusses these questions in depth. The chapters by six scientists offer the reader a view of the interactions between scientific achievements and a sense of aesthetics in fields ranging from atomic structure to the conceptualization of principles of evolution. Consider the following quotations: "When scientists, however, reflect on their own work, the development of concepts, and the theories that expound them, it is evident that intuition and aesthetics guide their sense of 'this is how it has to be', their sense of rightness,"—"There is a domain of thinking where distinctions between conceptions in art and science become meaningless. For here is manifest the efficacy of visual thinking, and a criterion for selection between alternatives that resists reduction to logic and is best referred to as aesthetics."—"In reality, according to Poincaré, the mathematician is guided by an aesthetic sense: in doing a job, the mathematician frequently has to work with propositions which are false to various degrees but does not have to consider any that offend a personal sense of mathematical beauty."

Although each of the authors defines aesthetics in words that are drawn from his own scientific background, it is explicit throughout most of the book, and implicit elsewhere, that aesthetic preferences may, through the choice of models, influence the outcome of a scientist's work. If this