crystals, and can be understood as an introduction to physical concepts in atomic, molecular, and solid-state science. The guiding principle throughout the text is the increasingly complex behaviour of electrons from stable states in the H atom to 'bistability' in H_2^+, 'hexastability' in C_6H_6, and 'polystability' in crystals. Emphasis is on spectroscopy, and maser and laser techniques are treated in detail. The chapter on crystals also contains an introduction to band theory (metals and semiconductors), lattice dynamics, and neutron scattering, the latter especially sound.

As expected, macroscopic properties can be related to microscopic theory where electronic mechanisms are involved, and where, in the case of crystals, symmetry arguments can be employed. In the remaining 36 pages, the author makes an attempt to arrive at a similar level of interpretation for mechanical properties of crystals based on the concept of planar force constants. Peierls stresses (using the Frenkel–Kontorava model for a dislocation) and fracture strengths (for brittle fracture) are calculated, and a lattice dynamical foundation of acoustic emission is presented. It becomes clear that an atomistic interpretation of the mechanical properties of engineering materials will remain a very difficult task for a long time to come. The last figure of the book shows a photograph of the oil tanker Martha R. Ingram on January 11th, 1972, after complete fracture amidships....

The book is intended for advanced students of physics, chemistry and engineering (nuclear, electronic, chemical, mechanical). It does not provide many empirical facts but lays down, with patience and sometimes in considerable detail, the formal aspects of physical principles used. The first three chapters also contain exercises and excellent references for further reading.

In the best humanistic tradition, the author tries to open perspectives and to remind the reader of the beauty and universality of the human mind, be it primarily directed towards science, engineering or arts. For this reason alone one would hope that Caglioti's book will be translated.

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Manual of optical mineralogy. By D. SHELLEY. Pp. xiii+239. Amsterdam: Elsevier, 1975. Price (cloth) Dfl 65.00, (paper) Dfl 26.95.

The ability to use a polarizing microscope is an essential skill for every student of geology and to help to instill this, several texts have been written on the subject, some devoted entirely to principles whilst others provide in addition the data on individual mineral species so essential to the practising petrographer. This new text falls into the latter category with more than two-thirds of the book given over to mineral data and descriptions.

The book begins with an introduction to general crystallography, dealing briefly with symmetry, Miller indices and some of the physical properties of minerals. Structure, unit cells, and axial ratios receive curt treatment, though the whole of this section is generally dealt with more fully in standard texts on mineralogy.

Chapter 2 is devoted to the polarizing microscope, components, accessories, basic adjustments and care of the instrument – though the advice that benzene be used as a cleaning agent should perhaps be tempered by a health warning! Chapter 3 discusses the optical properties of minerals with the aid of numerous diagrams whilst Chapter 4 covers laboratory techniques, sample preparation, RI determination, orientation, interference figures, optic sign, $2V$, extinction angles, pleochroism and use of the universal stage. A very short Chapter 5 outlines routine laboratory procedure and should perhaps have been appended to Chapter 4.

The greater part of the book appears in Chapters 6 and 7 as mineral data and descriptions. Tables of minerals according to RI, birefringence, colour and optic sign are followed by individual descriptions of 127 minerals giving composition, crystal system, colour, optical properties, orientation diagrams, occurrence, and distinguishing features. Photographs of some minerals illustrate this section and, though good, are relatively infrequent compared with other texts. Typographic errors are few, and most, though not all, diagrams are good.

Comparisons between this text and its older rivals will doubtless be made by both teachers and students. Resemblances are inevitable, though clearly the author has made good use of recent standard texts on mineralogy which postdate most rivals. This comparison will also extend to cost, and students will wonder why this textbook is twice as expensive as some others. This book would provide a useful alternative at half this price, but the cost will doubtless deter many students and professionals may find the mineral data too selective. As the book is so clearly aimed at geologists, the title should perhaps have reflected this.

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Surface Science. Vienna: International Atomic Energy Agency, 1975. Vol. 1: pp. 503; price $31.00. Vol. 2: pp. 302; price $19.00.

I have a strong prejudice against multiauthor volumes such as these; in general, the contributions are very uneven in quality, very rarely sustain a coherent theme and represent a poor substitute for the scholarly monographs of less frenetic times. I can well imagine that previous discussions (*Theory of Condensed Matter*, *Theory of Imperfect Crystalline Solids and Electrons in Crystalline Solids*), at the Trieste International Centre for Theoretical Physics have been homogeneous and successful but to take on *Surface Science*, in the same breath as it were, was altogether too ambitious.

Having said that, there is some good material here for the selective reader. Selectivity is necessary for one has a déjà-vu impression of much, something which conveys the uncharitable thought 'have a theoretical suitcase, will travel!' To continue with my prejudices just a little further, one might ask, rhetorically of course, whether the balance of the material is right if a major intent of the Trieste Schools were to provide stimulus and help to students from the developing countries. Would it not have made more sense to see the articles in *Applied Surface Science* have more prominence? Parson's article on *Electrode reactions and Corrosion*, Tabor's on *Friction*, and Dowden's on *Applied*

Catalysis are all very good and Dearnaley's contribution on ion implantation and that by Makin on static electrification have much to offer newcomers to these topics.

Crystallographers will be particularly interested in the articles by Andersson and Somorjai who discuss some of the recent LEED analyses of clean surface structures and of adlayer arrangements. Lundquist's *Electrons at Metal Surfaces* is an admirable survey of general interest whereas that on surface spectroscopy (Chiarotti) simply illustrates, by omission, how rapidly photoemission studies have matured. Other topics on surface structures include thermodynamics (Garcia – Molier), a conventional discussion of LEED (Fingerland and Tomasek), nucleation theory (Forty), Brillouin–Wigner theory (Jones) and liquid surfaces (Berry). Properties of surfaces are reflected in discussions by Celli on excitations and Many on transport in the space-charge region.

Overall, the chemist and biologist are not well catered for, hence my complaint about trying to tackle surface science in this way. Not many biologists would think that Schnakenberg's discussion of biological surfaces (biological membranes) is reflective of the immense activity in the field. I was a little more relaxed by the three articles on *Atoms and Molecules of Surfaces* although Brenig's (hydrogen chemisorption) and Gomer's (a brief survey) suffer by comparison with a very nice article by Nahr on atomic scattering.

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Crystal structure and chemical bonding in inorganic chemistry. Edited by C. J. ROOYMANS and A. RABENAN. Pp. x+246. Amsterdam: North Holland, 1975. Price: Dfl 45.00 (US $18.75).

This book contains papers given at a symposium in honour of the 80th birthday of Professor Dr A. E. van Arkel. The contributions contain examples of aspects of the chemical bonding, the crystal structure and the properties of inorganic compounds. The papers mostly give a survey of what has happened within the field up to now.

The historical development of the electrical aspect in chemical bonding is reviewed by Professor Klemm. His article gives a good account of the situation in inorganic chemistry during the nineteen thirties and forties.

P. F. Bongers relates magnetic properties to the chemical bond. The application is concentrated on a few compounds like pyrites, spinels and vanadium oxides. A discussion of *Alkali metal suboxides* by Arndt Simon is limited to the Cs and Rb oxides. The crystal structure and the method of growing crystals have been described in a very detailed way. Interesting examples of intermediates between salt-like and metallic types of bonding are discussed.

The paper given by P. Hagenmuller is an application of electrical and magnetic measurements on vanadium bronzes in order to deduce the valence state of the metal atoms and to find a relation between the properties and the crystal structures of the bronzes.

Stoichiometry, structure and disorder in solid ionic conductors by W. L. Roth is a review of super ionic conductors of two kinds, namely β-alumina and calcia-stabilized zirconia. The influence of defects and disorder is excellently described.

Of great interest is the stability of different coordination of atoms in solids. C. Haas has illustrated the stability of the trigonal-prismatic coordination of transition-metal atoms with respect to the more common octahedral one. He also gives examples of methods used to measure the energy levels of electrons in molecules.

The Madelung part of the lattice energy (MAPLE), has been used as a tool to approach the problem of long-range order. A survey of calculations of MAPLE by R. Hoppe includes many tables with values of several structures.

A very interesting question is the following: why do certain compounds exist when others do not? Miedema, Boom and de Boer demonstrate in the paper *Simple rules for alloying* a model based on energy effects for metallic alloys. The model used accounts for the heat of formation of solid as well as liquid alloys and is primarily applied to binary compounds. The documentation is overwhelming and includes alloys of two transition-metals, transition-alkali (or alkali-earth) metals and *d*-metals–*p*-metals. The exceptions from 'the simple rules' are rather few.

Two main aspects of the ionic model are discussed by W. C. Nieuwpoort, *viz.* the suggested charge distribution in compounds and calculations of the cohesion energies of ion arrangements.

Applications of the crystal field theory are also surveyed. The last paper written by L. Jansen is an extensive review of the *Triple interaction model in ionic solids.* The three-ion exchange-forces theory is described and is in good agreement with the experimental data when coupled to the Hund–Born–Mayer model. The crystal stability of NaCl and CsCl type structures is discussed as well as the sphalerite and wurtzite configurations. Stability of compositions AX_2, polymorphism of solids of compounds with closed *d*-shells and stability of rare-gas compounds are described in a splendid way.

Solid-state chemists with an interest in the relation between physical properties, chemical bonding and crystal structure will find this collection of papers of considerable interest.

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Molecular structure – the physical approach. By J. C. D. BRAND and J. C. SPEAKMAN, 2nd edition revised by J. C. SPEAKMAN and J. K. TYLER. Pp. vi+367, Figs. 120, Tables 69. London: Arnold, 1975. Price £11.00, paper £5.50.

A review of this book by M. Nardelli has been published in the January issue of *Acta Crystallographica*, Section B, page 317.

Molecular structure by diffraction methods. Vol. 3. By G. A. SIM and L. E. SUTTON (Senior Reporters). Pp. xiv+514, Figs. 89, Tables 47. The Chemical Society, 1975, Price £26.00 (US $71.50).

A review of this book by A. Vos has been published in the January issue of *Acta Crystallographica*, Section B, page 318.