"has . . . moved from the periphery of society towards the centres of power, and is apparently becoming an organ of the state apparatus, the ruling class, the military-industrial complex, or whatever it is that governs our lives in an advanced industrial country." The balance of the volume is Ziman's attempt to justify this thesis.

Ziman's book is a *tour de force*. He makes reference to a very high percentage of the major works cited in the two standard surveys of science studies: *Science, Technology and Society* (1977), edited by Ina Spiegel-Rösing and Derek de Solla Price, and *A Guide to the Culture of Science, Technology, and Medicine* (1980 and 1984), edited by the present reviewer. When the editors and authors of the latter volume began their project, they lamented the fact that the perspective of a spokesperson for science would not fit into the scheme of the volume. Now there is such a voice. Ziman's introduction to science studies, to what one author has called the "metascientific" disciplines, is an excellent companion to the compendia mentioned. It would also make a fine textbook for an introductory course in a science, technology, and society program.

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Mathematical Chemistry

Perspectives in Theoretical Stereochemistry. I. UGI, J. DUGUNDJI, R. KOPP, and D. MARQUARDING. Springer-Verlag, New York, 1984. xviii, 247 pp., illus. Paper, $19.30. Lecture Notes in Chemistry, vol. 36.

The past several decades have seen spectacular development in the interaction between mathematics and stereochemistry. Enumeration problems in static and dynamic stereochemistry have been linked to permutation groups and their partition into cosets and double cosets, and experimental observations, such as observations of coalescence patterns in dynamic nuclear magnetic resonance, have been interpreted in terms of these abstract mathematical objects.

This book is written by authors who participated in this evolution of mathematical chemistry, coining the term "permutational isomerism," for instance. The book is divided into three parts. The first part discusses the main classical concepts and presents the notions of permutational isomerism and chemical identity group. The second part discusses the mathematical concepts needed for further applications of the chemical identity group. The applications are discussed in the third part, in which a chemical nomenclature and documentation system based on permutational isomerism are proposed.

According to the authors, "There is definitely a need for new types of ideas, concepts, theories and techniques that are usable beyond the scope of customary methodology. This is why the present text was written" (p. vi). The most adequate way to analyze the book is to discuss some of these unconventional ideas and to compare them with previous work.

The chemical identity group is defined in the book as a group of permutations preserving the chemical identity of a compound in which all the ligands are chemically distinguishable. According to the authors, it does not express geometric symmetries. However, it plays the role played by the idealized rotational subgroup of rigid molecules in more conventional approaches. For instance, for an AsF_5 molecule, if the distinction between axial and equatorial sites remains possible with five different ligands, one can speak of an idealized D_3 rotational subgroup, instead of the actual C_1 subgroup. The authors write that, "since there is no such thing as an approximate symmetry," the use of the idealized rotational subgroup is a "logical inconsistency" (p. 46). But when the chemical identity group of the above pentacoordinate As compound is obtained by the authors, it turns out to be isomorphic to D_3. This can only be justified if one assumes at least implicitly that two of the five ligands are axial and three equatorial and that axial-equatorial exchange does not preserve chemical identity. Another assumption (one axial, four basal, for instance) should lead to another chemical identity group. Thus the authors do not in fact avoid consideration of idealized (approximate) geometric symmetries.

Nonrigid molecules are usually described by the point group or rotational subgroup of a configuration corresponding to a minimum of the potential hypersurface and by the Longuet-Higgins group, which includes permutations (and permutation-inversions) depicting feasible operations. The chemical identity group a priori includes dynamical information (such as inversion operations for nonrigid ternary amines), and from this point of view it is similar to the Longuet-Higgins group. Hence the chemical identity group ignores the symmetry properties of the polytopes situated in potential wells. This seems to be adequate only when the depth of the wells is vanishingly small.

The discussion of the so-called Dieter group is another unconventional aspect of the book. The authors define this group as the chemical identity group of an arbitrary system Q of permutational isomers. The physical meaning of such a group when Q is actually arbitrary is not obvious. However, when the system Q contains exactly all the isomers that can be reached from a given one by arbitrary sequences of a fixed mode of rearrangement, then it is easy to realize that the Dieter group reduces to the Longuet-Higgins group (disregarding the effect of inversion about the center of mass). The Dieter group of a system Q of interconverting permutational isomers is also defined as the chemical identity group of the common intermediate X or ensemble of intermediates X of these interconversions, although it is not demonstrated explicitly that these two concepts coincide.

When the system Q consists of only two permutational isomers connected by a given isomerization, then it may be verified that the Dieter group is the Pechukas group expressing conservation of nuclear symmetry along a path of steepest descent.

Hence the definition of the Dieter group includes two important groups related to molecular symmetry, the Longuet-Higgins and the Pechukas groups. It is unfortunate that these properties of the Dieter group are not fully discussed in the book.

The Dieter group is intended by the authors to be predictive; they write that if it "is trivial, then no non-trivial mechanism is possible" (p. 38). This proposition seems questionable because it excludes any non–self-inverse mechanism having a connectivity of 1. Indeed, for a pair of isomers connected by such a mechanism the Dieter group reduces to the identity operation.

The Dieter group has been worked out explicitly in the book for Berry rotation and Turnstile rotation mechanisms. In one case the set Q has been chosen to consist of two isomers connected by a Berry rotation mechanism; in the other case it consists of the six isomers on a cycle of six consecutive Turnstile rotation steps. This choice is justified by the authors on the basis of the periodicity of the permutations (two for the Berry rotation, six for the Turnstile rotation). This looks completely arbitrary since both rotations can be described by any permutation of the coset associated to the isomer obtained in one step of both

mechanisms. Therefore the periodicity of permutations is not a good criterion for the construction of Q and the Dieter group. In my opinion, a good criterion—if it exists—has not yet been discovered except when the Dieter group is the Pechukas or the Longuet-Higgins group.

Hyperchirality, a controversial subject, is discussed at length in the book. It is well known that, in a family of permutational isomers, two enantiomers have point groups with identical permutational expressions. It is possible, however, for two isomers that are not enantiomers to have this property. Ten years ago Dugundji, Marquarding, and Ugi proposed that such isomers be called hyperchiral isomers. Their attempt to predict observable consequences of these purely algebraic properties has been refuted; the discussion of the subject in the book dwells upon the formal aspects of the problem, but it does not provide evidence in favor of characteristic properties of hyperchiral isomers or against the idea that hyperchirality is merely a mathematical artifact.

The book also contains various detailed illustrations as well as a clearly written appendix that outlines mathematical material.

Does the book really open perspectives in theoretical stereochemistry? It adopts an unconventional—and sometimes provocative—point of view, but the methods and concepts that are developed in it are often rather similar to previously developed ones.

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Scattering Phenomena

Electron-Molecule Collisions. ISAO SHIMAMURA and KAZUO TAKAYANAGI, Eds. Plenum, New York, 1984. xiv, 570 pp., illus. $85. Physics of Atoms and Molecules.

For the formal theorist, electron-molecule collisions offer the basic unrestricted many-body problem with the added spice of a multicentered, nonspherical target having several degrees of freedom. In a chapter with a nice historical flavor, Takayanagi provides a superb introduction to the basic theory. He provides a context for the other chapters by bringing into a coherent whole all of the pieces familiar to the graduate reader (such as potential scattering theory, expansions of nonspherical potentials, the concept of cross sections, simple experimental systems, and Born's approximation). The same ability to bring life to a subject that Takayanagi displays is seen throughout the book. Notable in this respect are Shimamura's elegant exposition of the otherwise dry and daunting theory of angular momentum and Herzenberg's explication of resonance effects in vibrational excitation by the use of familiar potential well scattering theory.

Drop a single electron into the electronic mixture that is a molecule and it can catalyze fascinating reactions, often tickling the molecule's atoms into jumping from one bound, attractive well into another or onto a curve in which the atoms inevitably slide apart. The study of the weak and temporary interactions that bind the electron to the neutral molecule long enough for such reactions to take place efficiently is the major challenge of the field and the common thread in the book. The foundation in scattering, angular momentum, and resonance theory and in experimental technique that has been laid in earlier chapters particularly complements a chapter by Hall and Read, who discuss the bewildering variety of negative ion states from a spectroscopic point of view. Compton and Bardsley take us on a tour of the particle zoo that results when the molecule is tickled into self-destruction: electrons and positive, negative, and neutral atoms (or even other molecules), which are often unpredictably excited. Both of these chapters provide not only a concise survey of what is known, but also a generalist's view of how it became known and might be understood.

Knowledge of a phenomenon includes knowledge of the rate at which things happen (that is, the probability or cross-section for a process) as well as knowledge of the states and products that are produced. The novice scientist, and perhaps also the expert, is well served by two chapters laying out the major experimental and computational techniques in some detail. Trajmar and Register provide a very readable (to a theorist like myself) description of all the major experimental techniques and the physics involved in the extraction of data therefrom. For the computational physicist, electron-molecule collisions offer one of the best opportunities to humble even the most advanced modern computers. Buckley, Burke, and Noble show how the scattering theory is molded, and approximated when necessary or useful, into powerful computational methods applicable to all of the processes discussed elsewhere. Like the others, these chapters provide not only the accessibility of a textbook but also the exhaustive bibliography of a good review article. I know of no better answer to the "What's your field like?" question of the potential graduate research student than to hand him or her this book.

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Reprints of Books Previously Reviewed

The Invention of the Modern Hospital, Boston, 1870–1930. Morris J. Vogel. University of Chicago Press, Chicago, 1985. Paper, $6.95. *Reviewed* **214**, 1338 (1981).

Powers of Ten. A Book about the Relative Size of Things in the Universe and the Effect of Adding Another Zero. Philip and Phylis Morrison and the Office of Charles and Ray Eames. Scientific American Library, New York, 1985 (distributor, Freeman, New York). Paper, $19.95. *Reviewed* **221**, 1281 (1983).

Books Received

Effective Lagrangians in Quantum Electrodynamics. Walter Dittrich and Martin Reuter. Springer-Verlag, New York, 1985. vi, 244 pp. Paper, $14.60. Lecture Notes in Physics, vol. 220.

Electron Impact Ionization. T. D. Märk and G. H. Dunn, Eds. Springer-Verlag, New York, 1985. xii, 384 pp., illus. $58.50.

Elements of Petroleum Geology. Richard C. Selley. Freeman, New York, 1985. xiv, 449 pp., illus., + plates. $44.95.

Elliptic Problem Solvers II. Garrett Birkhoff and Arthur Schoenstadt, Eds. Academic Press, Orlando, Fla., 1984. xiv, 573 pp., illus. $39. From a conference, Monterey, Calif., Jan. 1983.

English-Russian Dictionary of Computer Science. V. K. Zejdenberg, A. N. Zimarev, and A. M. Stepanov. E. K. Maslovsky, Ed. 3rd ed. "Russkij Yazyk", Moscow, and Pergamon, New York, 1984. 504 pp. $50.

Entrapment in Escalating Conflicts. A Social Psychological Analysis. Joel Brockner and Jeffrey Z. Rubin. Springer-Verlag, New York, 1985. xiv, 276 pp. $37. Springer Series in Social Psychology.

Environmental Geochemistry and Health. Report to the Royal Society's British National Committee for Problems of the Environment, S. H. U. Bowie and I. Thornton, Eds. Reidel, Boston, 1985 (distributor, Kluwer, Hingham, Mass.). xii, 140 pp. $27.50.

Environmental Science. A Framework for Decision Making. Daniel D. Chiras. Benjamin/Cummings, Menlo Park, Calif., 1985. xx, 655 pp., illus. $33.95.

Enzymes in Organic Synthesis. Pitman, London, 1985 (U.S. distributor, CIBA Pharmaceutical Co., Newark, N.J.). viii, 248 pp., illus. $35. Ciba Foundation Symposium 111. From a symposium, London, May 1984.

Voltage and Patch Clamping with Microelectrodes. Thomas G. Smith, Jr., *et al.*, Eds. American Physiological Society, Bethesda, Md., 1985 (distributor, Williams and Wilkins, Baltimore). viii, 260 pp., illus. Paper, $39.50. From a workshop, Hayman Island, Australia, Sept. 1983.

Water, Earth, and Fire. Land Use and Environmental Planning in the New Jersey Pine Barrens. Jonathan Berger and John W. Sinton. Johns Hopkins University Press, Baltimore, 1985. xx, 228 pp., illus. $25.

Water Quality Management. A Review of the Development and Application of Mathematical Models. M. B. Beck. Springer-Verlag, New York, 1985. viii, 107 pp., illus. Paper, $10.50. Lecture Notes in Engineering, vol. 11.

Western Forests. Stephen Whitney. Knopf, New York, 1985. 672 pp., illus. Paper, $14.95. The Audubon Society Nature Guides.

Wetlands. William A. Niering. Knopf, New York, 1985. 640 pp., illus. Paper, $14.95. The Audubon Society Nature Guides.