Book Reviews

Interpretative Study

Organic Chemical Crystallography. A. I. Kitaigorodskii (translated from the Russian). Consultants Bureau, New York, 1961. x + 541 pp. Illus. $17.50.

Here is a book like a breath of fresh air; it is not a textbook, nor does it embellish a shopworn theme. Rather it devotes itself to a thesis and to documenting the evidence for that thesis; and it complements many books devoted primarily to the crystal chemistry of inorganic substances, for it is concerned solely with organic substances. More exactly, the author seeks to understand why a given organic molecule, when crystallizing with other molecules of the same kind, selects that particular packing arrangement which crystal-structure analysis reveals. After much study Kitaigorodskii convinced himself that there was a relatively simple theme here. He states this early in the preface; then in the body of the book he presents, first, a theoretical basis for the theme, and second, a substantiation of it by the use of well-arranged data.

The theme is touched off by this remark: "organic crystals are always so constituted that the projections in one molecule enter the hollows in another." This implies that molecules tend to assume as close packing as possible, this arrangement giving rise to the least free energy, primarily because molecules hold together by means of surface forces. Crystals in which the molecules are held together by hydrogen bonding are, of course, not included here.

The book contains only five chapters. In the first chapter, "The molecule," the discussion is centered on the molecule as a building unit, especially in its dimensional and symmetrical aspects. The internal structure of the molecule is established by the bond lengths and bond angles, but the external geometry, or packing shape, is determined by van der Waals' radii, here called "intermolecular radii." Molecular symmetry is the point-group symmetry of the molecule. (Figure 18 shows a molecule said to have symmetry mm, but it appears to have symmetry $\bar{4}m2$.)

"The elements of lattice theory" (meaning space-group symmetry) is only an introduction to the topic. The crystallographer already knows the material, and the uninitiated will not find here an understandable development of space groups. Either the chapter should have been written differently or it should have been omitted.

Chapter 3, "Theory of close packing of molecules," is the heart of the book. Unfortunately this important chapter is presented in Kitaigorodskii's private nomenclature for line groups and plane groups. The author will certainly lose many who would have become his disciples if he had used international symbols. The reader, if he is willing to grant that the author knows what he is doing, will find the conclusions that result from this important study in a limited number of tabulations and will have to translate only these tabulations into standard symbols. The gist of the chapter is that certain plane symmetries permit a molecule to touch six others in its layer, and thus to assume a "molecular coordination number" of six; other plane symmetries prohibit this.

This and attendant considerations permit a survey of the space groups for suitable candidates for packing molecules in organic crystals in which a molecular coordination number of 10 to 14 is ordinarily achieved. It develops that a molecule abhors space groups with mirror symmetry, unless that molecule itself has one or more mirrors. Some of Nowacki's data on the distribution of organic crystals over the space groups are not in harmony with Kitaigorodskii's results, but it appears that some of these data are from old determinations which have since been proven incorrect.

A packing coefficient, k, can be defined as the ratio of the sum of the volumes of the molecules in a cell to the volume of the cell. (This is not the same as Fairbairn's "packing index," in which the volumes occupied by the atoms are controlled by bonding radii.) This varies from 0.6 to 0.8 for aromatics, and much smaller numbers are unknown.

This part of the book covers only 112 pages. The remaining chapters—chapter 4, "Application of close-packing theory to organic crystals," and chapter 5, "Crystal structure descriptions for organic compounds"—are devoted to a critical and systematic description of the structures of organic crystals. This mass of data substantiates the author's theory.

The book appears to be printed by offset from excellent typing, with justified margins. The lack of italics is noticeable and causes awkwardness in some sentences. There are no bibliographies, and the few citations are chiefly footnotes to descriptions.

In his book, *The Theory of Crystal Structure Analysis*, Kitaigorodskii proved he was a master of crystal-structure analysis. The present (but older) book shows that he is also a leader in interpreting the results of such studies. All crystallographers, particularly those steeped mostly in inorganic crystal chemistry, will profit from reading this original work.

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Factual Descriptions

Larousse Encyclopedia of Geography. vol. 1, *Europe*. Pierre Deffontaines, Ed. Prometheus Press, New York, 1961. 450 pp. Illus. + maps. $17.50.

Rarely are such delicious geographic descriptions aimed at university audiences. Each chapter describes a political state in artful and knowledgeable manner. That the volume is a translation from the French is barely perceptible, except when suspiciously precise distances, such as 164 feet, are used where, in the original, the equivalent

50 meters may well have been only approximate. Although it is understandable in a volume too expensive for frequent revision, there is a significant lack of absolute values in the material concerned with production and trade. Moreover, the information about European cooperative affairs is inadequate.

Each chapter is written by a noted French geographer. While the present is described, the style resembles geography 40 years ago. In other words, chapters are concerned with the features, natural and cultural, which one might investigate to demonstrate the ancient notion that the environment rigidly governs what life shall be like in a country. Of course, geographers almost universally have abandoned any notion of proving such a theme, but here is a case where descriptive geography is cast in the remnant mold—devoid of theory, strangely focused only on facts, and bereft of the satisfaction of leading the reader to significant demonstrable relationships. Accordingly, to some readers the materials will appear to be shallow—the kind of information that is commonplace or public record, hardly the product of substantial reasoning. An occasional lapse may even give cause to wonder if geographers really are done with "environmental determinism"; in one example, Norway is linked to developments in meteorology, oceanography, and Birkeland's nitrogen fixation process with these words, ". . . in this country of rugged rocks and noble mountains reflected in the fjords, thoughts turn naturally to the sky and the sea."

Maps and pictures are often unsatisfactorily reproduced; the special color plates are delightful, but some are separated by dozens of pages from the appropriate chapter; color maps, inserted with each clutch of countries, are garish and virtually useless; the statistical and atlas appendices are helpful, but the latter is wholly inadequate for finding an unusual place name.

What *is* valuable here is that much factual information about each country of Europe is available in pleasantly assimilable form. Disappointingly, this book does not represent, although its title encompasses all of geography applied to Europe, a field now greatly invigorated by a renewed focus on scientific purposes.

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Incisive Selection

Sexuality and the Genetics of Bacteria. François Jacob and Elie L. Wollman. Academic Press, New York, 1961. xv + 374 pp. Illus. $10.

It seems a shame that a book, originally published in French, need, like one in Chinese, be translated for an English-reading public. This necessity did, however, allow Jacob and Wollman to enlarge their *La Sexualité des Bactéries*, published in 1959, into *Sexuality and the Genetics of Bacteria.* The result is not a complete treatment of bacterial genetics but rather a fine description of some of the ways in which bacterial sexuality, now well understood, has illuminated the genetics of bacteria. Since the work of Lederberg in the mid-1940's, bacteria have come to be among the best-known organisms genetically, through a dazzling series of what most would call elegant experiments. (Jacob and Wollman use this cliché only three times; although they may be a bit verbose, they do not often deviate from the usages of good English.) This knowledge has been put to general biological use in the illumination of mechanisms that regulate gene action—pointing the ways in which the now central problem of biology, differentiation, will be solved —and in the analysis of the nature of the prophage, a representative of the new class of genetic entities, the *episomes*, whose recognition, in bacteria at least, is becoming widespread.

The approach of this book is that of the authors in their laboratory—experimental, pragmatic in the best tradition of science in France. Jacob and Wollman are not strictly molecular in their approach, but this book demonstrates how they contributed to the birth of this new level in biology. The authors leave many questions unanswered, historical, theoretical, and factual; how could they otherwise review a new field incisively and with taste! As André Lwoff said, with true elegance, in his preface to the French edition, the authors have engaged their adversaries on the passionate battlefield of microbial genetics. But they have remained above the struggle and can count themselves among the most inspired, most penetrating, and most fortunate practitioners of their art.

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Specialized Techniques

Lehrbuch der Angewandten Geologie. vol. 1, *Allgemeine Methoden.* A. Bentz, Ed. Enke, Stuttgart, Germany, 1961. xii + 1071 pp. Illus. DM. 145.

This massive compendium gives broad but concise summaries of techniques and methods used in a wide area of specialized geologic fields. The largest and generally most satisfactory section, nearly half of the book, is devoted to the techniques of geophysical measurement and exploration. The remainder is divided about equally between methods of field investigation and mapping; mineralogy, petrology, and geochemistry; paleontology; and soil studies. A complementary volume, announced for early publication, will treat the geology of fuels and metallic and industrial minerals; ground water and hydrology; and engineering geology.

The general coverage in volume 1 is unusually complete. Each section outlines the planning of field work, describes available equipment, and discusses techniques of collection, presentation, and analysis of the data. Though the book emphasizes techniques, it does so largely without sacrificing the geologic fundamentals essential to evaluation of the results. The incorporation of numerous specific problems, drawn from the experience of the writers, helps to clarify the descriptive text, as do the many illustrations.

The book is the product of some 39 contributors working under the editorship of Bentz. As in most such collective efforts, the quality and comprehensiveness of the various sections is somewhat uneven, and the work may be criticized for failing to always integrate material from related fields and to adequately show how different techniques may complement each other in certain problems. Beyond these relatively minor, and perhaps unavoidable shortcomings, the book succeeds remarkably well as a compilation of the techniques of modern geologic practice.

The text contains an encyclopedic volume of information, for the most part very clearly presented, and in this country the volume should be very useful as a reference work. An extensive bibliography, mostly drawn