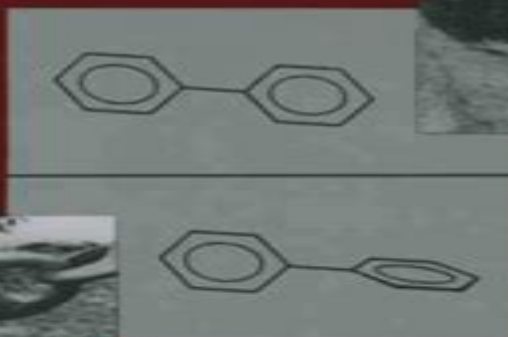


# **Symmetry through the Eyes of a Chemist**

**Second  
Edition**



***István Hargittai***  
***Magdolna Hargittai***

# Symmetry Through The Eyes Of A Chemist

**Jerome A. Berson**



## Symmetry Through The Eyes Of A Chemist:

*Symmetry through the Eyes of a Chemist* Istvan Hargittai, Magdolna Hargittai, 2007-08-29 We have been gratified by the warm reception of our book by reviewers colleagues and students alike Our interest in the subject matter of this book has not decreased since its first appearance on the contrary The first and second editions envelop eight other symmetry related books in the creation of which we have participated I Hargittai ed *Symmetry Unifying Human Understanding* Pergamon Press New York 1986 I Hargittai and B K Vainshtein eds *Crystal Symmetries Shubnikov Centennial Papers* Pergamon Press Oxford 1988 M Hargittai and I Hargittai *Fedezziikf6l a szimmetri6t Discover Sym try in Hungarian Tank6nyvkiad6 Budapest* 1989 I Hargittai ed *Symmetry 2 Unifying Human Understanding* Pergamon Press Oxford 1989 I Hargittai ed *Quasicrystals Networks and Molecules of Fivefold Sym try* VCH New York 1990 I Hargittai ed *Fivefold Symmetry* World Scientific Singapore 1992 I Hargittai and C A Pickover eds *Spiral Symmetry* World Scientific Singapore 1992 I Hargittai and M Hargittai *Symmetry A Unifying Concept Shelter Publi tions Bolinas California* 1994 We have also pursued our molecular structure research and some books have appeared related to these activities vi Preface to the Second Edition I Hargittai and M Hargittai eds *Stereochemical Applications of Gas Phase Electron Diffraction Parts A and B* VCH New York 1988 R Gillespie and I Hargittai *VSEPR Model of Molecular Geometry* Allyn and Bacon Boston 1991 A Domenicano and I Hargittai eds *Accurate Molecular Structures* Oxford University Press Oxford 1992

*Symmetry through the Eyes of a Chemist* Magdolna Hargittai, Istvan Hargittai, 2010-02-28 It is gratifying to launch the third edition of our book Its coming to life testi es about the task it has ful lled in the service of the com nity of chemical research and learning As we noted in the Prefaces to the rst and second editions our book surveys chemistry from the point of view of symmetry We present many examples from ch istry as well as from other elds to emphasize the unifying nature of the symmetry concept Our aim has been to provide aesthetic pl sure in addition to learning experience In our rst Preface we paid tribute to two books in particular from which we learned a great deal they have in uenced signi cantly our approach to the subject matter of our book They are Weyl s classic *Symmetry* and Shubnikov and Koptsik s *Symmetry in Science and Art* The structure of our book has not changed Following the Int duction Chapter 1 Chapter 2 presents the simplest symmetries using chemical and non chemical examples Molecular geometry is discussed in Chapter 3 The next four chapters present gro theoretical methods Chapter 4 and based on them discussions of molecular vibrations Chapter 5 electronic structures Chapter 6 and chemical reactions Chapter 7 For the last two chapters we return to a qualitative treatment and introduce space group sym tries Chapter 8 concluding with crystal structures Chapter 9 For the third edition we have further revised and streamlined our text and renewed the illustrative material

***Symmetry Through the Eyes of a Chemist*** Istvan Hargittai, Magdolna Hargittai, 2014-01-15 *Symmetry Through the Eyes of a Chemist, 3rd Ed* Magdolna Hargittai, Istv N. Hargittai, 2009-05-12 *Symmetry through the Eyes of a Chemist* Magdolna Hargittai, Istvan Hargittai, 2009-02-28 It is gratifying to launch the third edition of our book Its coming to

life testifies about the task it has fulfilled in the service of the community of chemical research and learning. As we noted in the Prefaces to the first and second editions, our book surveys chemistry from the point of view of symmetry. We present many examples from chemistry as well as from other fields to emphasize the unifying nature of the symmetry concept. Our aim has been to provide aesthetic pleasure in addition to learning experience. In our first Preface we paid tribute to two books in particular from which we learned a great deal; they have influenced significantly our approach to the subject matter of our book. They are Weyl's classic *Symmetry* and Shubnikov and Koptsik's *Symmetry in Science and Art*. The structure of our book has not changed. Following the Introduction, Chapter 1, Chapter 2 presents the simplest symmetries using chemical and non-chemical examples. Molecular geometry is discussed in Chapter 3. The next four chapters present group theoretical methods: Chapter 4 and based on them discussions of molecular vibrations; Chapter 5, electronic structures; Chapter 6, and chemical reactions; Chapter 7. For the last two chapters we return to a qualitative treatment and introduce space group symmetries. Chapter 8 concluding with crystal structures; Chapter 9. For the third edition we have further revised and streamlined our text and renewed the illustrative material.

Symmetry through the Eyes of a Chemist Istvan Hargittai, Magdolna Hargittai, 2007-08-29. We have been gratified by the warm reception of our book by reviewers, colleagues and students alike. Our interest in the subject matter of this book has not decreased since its first appearance on the contrary. The first and second editions envelop eight other symmetry-related books in the creation of which we have participated: I. Hargittai ed. *Symmetry Unifying Human Understanding*, Pergamon Press, New York, 1986; I. Hargittai and B. K. Vainshtein eds. *Crystal Symmetries*, Shubnikov Centennial Papers, Pergamon Press, Oxford, 1988; M. Hargittai and I. Hargittai eds. *Fedezsi kiadvány a szimmetriáról*, Discover Symmetry in Hungarian, Tankönyvkiadó, Budapest, 1989; I. Hargittai ed. *Symmetry 2: Unifying Human Understanding*, Pergamon Press, Oxford, 1989; I. Hargittai ed. *Quasicrystals, Networks and Molecules of Fivefold Symmetry*, VCH, New York, 1990; I. Hargittai ed. *Fivefold Symmetry*, World Scientific, Singapore, 1992; I. Hargittai and C. A. Pickover eds. *Spiral Symmetry*, World Scientific, Singapore, 1992; I. Hargittai and M. Hargittai eds. *Symmetry: A Unifying Concept*, Shelter Publications, Bolinas, California, 1994. We have also pursued our molecular structure research and some books have appeared related to these activities: vi. Preface to the Second Edition, I. Hargittai and M. Hargittai eds. *Stereochemical Applications of Gas Phase Electron Diffraction*, Parts A and B, VCH, New York, 1988; R. Gillespie and I. Hargittai eds. *VSEPR Model of Molecular Geometry*, Allyn and Bacon, Boston, 1991; A. Domenicano and I. Hargittai eds. *Accurate Molecular Structures*, Oxford University Press, Oxford, 1992.

Candid Science VI Istvan Hargittai, Magdolna Hargittai, 2006. *Candid Science VI* concludes the series by narrating the conversations with famous scientists from the biomedical sciences, chemistry and physics. There are 31 Nobel laureates and 11 other luminaries among them. The scientists are in the field of biomedical sciences, chemistry and physics.

**Shaping Space** Marjorie Senechal, 2013-03-22. This second edition is based off of the very popular *Shaping Space: A Polyhedral Approach* first published twenty years ago. The book is expanded and updated to include new developments.

including the revolutions in visualization and model making that the computer has wrought *Shaping Space* is an exuberant richly illustrated interdisciplinary guide to three dimensional forms focusing on the surprisingly diverse world of polyhedra Geometry comes alive in *Shaping Space* as a remarkable range of geometric ideas is explored and its centrality in our culture is persuasively demonstrated The book is addressed to designers artists architects engineers chemists computer scientists mathematicians bioscientists crystallographers earth scientists and teachers at all levels in short to all scholars and

educators interested in and working with two and three dimensional structures and patterns **Inorganic Chemistry** Gary Wulfsberg, 2000-03-16 Both elementary inorganic reaction chemistry and more advanced inorganic theories are presented in this one textbook while showing the relationships between the two **Bimodal Oxidation** Robert

Bakhtchadjian, 2019-11-15 This book is devoted to the problems of oxidation chemical reactions and addresses bimodal reaction sequences Chemical reactions of oxidation occurring under certain conditions and in multicomponent systems are complex processes The process of the oxidation essentially changes in the presence and contact of the solid substances with reactants The role of solid substances and the appearance of this phenomenon in oxidation reaction are discussed The reader will understand the driving forces of this phenomenon and apply it in practice Written for chemists physicists biologists and engineers working in the domain of oxidation reactions Key Selling Features Covers the historical background modern state of the art and perspectives in investigations of the coupling between heterogeneous and homogeneous reactions Discusses the feasible pathways of the coupling of heterogeneous and homogeneous reactions in oxidation in man made and natural chemical systems Addresses the abundance peculiarities and mechanisms of the bimodal reaction sequences in oxidation with dioxygen in recent decades Discusses the existence of the bimodal reaction sequences in chemical systems investigations in atmospheric chemistry and heterogeneous photocatalysis Presented in a simple concise style accessible for both specialists and non specialists **Advanced Mineralogy** A. S. Marfunin, 2012-12-06 All existing introductory reviews

of mineralogy are written according to the same algorithm sometimes called the Dana System of Mineralogy Even modern advanced handbooks which are certainly necessary include basic data on minerals and are essentially descriptive When basic information on the chemistry structure optical and physical properties distinguished features and paragenesis of 200 400 minerals is presented then there is practically no further space available to include new ideas and concepts based on recent mineral studies A possible solution to this dilemma would be to present a book beginning where introductory textbooks end for those already familiar with the elementary concepts Such a volume would be tailored to specialists in all fields of science and industry interested in the most recent results in mineralogy This approach may be called Advanced Mineralogy Here an attempt has been made to survey the current possibilities and aims in mineral matter investigations including the main characteristics of all the methods the most important problems and topics of mineralogy and related studies The individual volumes are composed of short condensed chapters Each chapter presents in a complete albeit

condensed form specific problems methods theories and directions of investigations and estimates their importance and strategic position in science and industry

**In Our Own Image** Istvan Hargittai, Magdolna Hargittai, 2012-12-06 The title of our volume refers to what is well described by the following two quotations God created man in his own image and Man creates God in his own image 2 Our approach to symmetry is subjective and the term personal symmetry reflects this approach in our discussion of selected scientific events We have chosen six icons to symbolize six areas Kepler for modeling Fuller for new molecules Pauling for helical structures Kitaigorodskii for packing Bernal for quasicrystals and Curie for dissymmetry For the past three decades we have been involved in learning thinking speaking and writing about symmetry This involvement has augmented our principal activities in molecular structure research Our interest in symmetry had started with a simple fascination and has evolved into a highly charged personal topic for us At the start of this volume we had had several authored and edited symmetry related books behind 3 us We owe a debt of gratitude to the numerous people whose interviews are quoted 4 in this volume We very much appreciate the kind and gracious cooperation of Edgar J Applewhite Washington DC Lawrence S Bartell University of Michigan R

**Chemical Creativity** Jerome A. Berson, 1999-05-04 Die Wissenschaft ist nichts Abstraktes sondern als Produkt menschlicher Arbeit auch in ihrem Werdegang eng verknüpft mit der Eigenart und dem Schicksal der Personen die sich ihr widmen Emil Fischer Nobelpreisträger Wo liegt der Ursprung chemischer Kreativität Welche gedanklichen Leistungen und Experimentierkunst stecken hinter den bahnbrechenden Erkenntnissen der Chemie Wie haben die Pioniere dieser Wissenschaft die fundamentalen Probleme ihrer Zeit erkannt und gelöst Warum sind sie an anderen vorbeigegangen obwohl die Lösung greifbar nahe lag Wie haben Persönlichkeit Alltag und konkurrierende Wissenschaftler ihre Forschung beeinflusst Diesen Fragen von zentraler Bedeutung für die Arbeit eines jeden Chemikers geht das Buch von Jerome A Berson am Beispiel ausgewählter Chemiker auf höchst fesselnde und informative Weise nach Der Autor versteht es ausgezeichnet durch umfangreiche Zitate dieser Forscher ihrer Zeitgenossen und Schüler die wissenschaftlichen Hintergründe chemischer Erkenntnisse mit den Schicksalen ihrer Entdecker zu verbinden So ist ein detailliertes Bild vom Leben und Wirken Woodwards Hockleys Meerweins und anderer herausragender Wissenschaftler entstanden ein Stück lebendiger Chemiegeschichte das dazu beitragen kann die eigene Forschung erfolgreicher zu machen

**Product Engineering** James Wei, 2007-01-04 The current chemical engineering curriculum concentrates on process the efficient manufacturing in quantity of traditional chemical products such as ammonia and benzene However many chemical companies now invent and manufacture specialty products with particular properties such as pharmaceuticals cosmetics and electronic coatings and their employees need to know how to design the products as well as manufacture them James Wei a famous chemical engineer is writing this book to provide theories and case studies in product engineering the design of new useful products with desired properties The first section relates historical case studies of successful product invention and development by individuals and companies The second part of the book describes the

toolbox of molecular structure property relations A desired product needs to have certain properties for example phase transition or thermal properties and the chemist must find or design a molecular structure with the required properties This section will instruct chemists in the analysis of structure and property information The third section is concerned with the next stage product research and design It will discuss improving the desired product by additives and blending among other strategies It will also cover future challenges in product engineering

*Multi-shell Polyhedral Clusters* Mircea Vasile Diudea, 2017-10-20 This volume presents new methodologies and rationalizes existing methods that are used in the design of multi shell polyhedral clusters The author describes how the methods used are extended from 2D operations on maps to 3D and higher dimensional Euclidean space A variety of structures is designed and described in detail and classified giving rise to an atlas of multi shell nanostructures The book therefore sheds a new light on the field of crystal and quasicrystal structures an important part of nanoscience and nanotechnology The author goes on to show how the recently established methods are used for building complex multi shell nanostructures and how this completes the existing information in the field The atlas of such structures is completed with atomic coordinates included as supplementary material The content of this book gives a useful insight into structure elucidation and suggests new material synthesis

**Electron Crystallography** Thomas E. Weirich, János L. Lábár, Xiaodong Zou, 2006-08-18 During the last decade we have been witness to several exciting achievements in electron crystallography This includes structural and charge density studies on organic molecules complicated inorganic and metallic materials in the amorphous nano meso and quasi crystalline state and also development of new software tailor made for the special needs of electron crystallography Moreover these developments have been accompanied by a now available new generation of computer controlled electron microscopes equipped with high coherent field emission sources cryo specimen holders ultra fast CCD cameras imaging plates energy filters and even correctors for electron optical distortions Thus a fast and semi automatic data acquisition from small sample areas similar to what we today know from imaging plates diffraction systems in X ray crystallography can be envisioned for the very near future This progress clearly shows that the contribution of electron crystallography is quite unique as it enables to reveal the intimate structure of samples with high accuracy but on much smaller samples than have ever been investigated by X ray diffraction As a tribute to these tremendous recent achievements this NATO Advanced Study Institute was devoted to the novel approaches of electron crystallography for structure determination of nanosized materials

**Science of Crystal Structures** Istvan Hargittai, Balazs Hargittai, 2015-09-09 A volume which includes entries on quasicrystals icosahedral packing other packing considerations extended structures data treatment and data mining is presented by luminaries from the crystallography community Several of the contributions are from the schools of such trend setting crystallographers as J Desmond Bernal and Aleksandr I Kitaigorodskii Internationally renowned scientists contributed such as Tom L Blundell Johann Jacob Burckhardt John L Finney Jenny P Glusker Nobel laureate Herbert A Hauptman the 2014 Ewald Prize winner A

Janner Aminoff Prize winner Isabella Karle Nobel laureate Jerome Karle Buckley Prize winner Alan L Mackay Ewald Prize winner David Sayre Vladimir Shevchenko and J Fraser Stoddart A few frontier topics dominate the selected material Pioneers of the direct methods describe the phase problem and how it was solved including the mathematical approach and the utilization of experience with gas phase electron diffraction The reviews by Herbert Hauptman Jerome and Isabella Karle and David Sayre reach to the present day in assessing the possibilities of X ray crystallography Another focus topic is the investigation of systems that are outside the so called classical system of crystals They include quasicrystals imperfect and very small crystals supramolecular species crystal structures without lattice clusters nanomaterials among others Application of synchrotron and cryoprotection techniques the free electron laser flash technique and others are mentioned in addition to X ray crystallography The relationship between structural and materials properties are examined and uncovered The broader topics of the so called generalized crystallography include polymers clusters polydisperse chain assemblies and giant icosahedral fullerenes There are some key contributions related to the structural investigation of biological macromolecules

The Martians of Science István Hargittai, 2008 Hargittai tells the story of five remarkable Hungarians Wigner won a Nobel Prize in theoretical physics Szilard was the first to see that a chain reaction based on neutrons was possible initiated the Manhattan Project but left physics to try to restrict nuclear arms von Neumann could solve difficult problems in his head and developed the modern computer for more complex problems von Karman became the first director of NASA's Jet Propulsion Laboratory providing the scientific basis for the U S Air Force and Teller was the father of the hydrogen bomb whose name is now synonymous with the controversial Star Wars initiative of the 1980s

**The Basics of Crystallography and Diffraction** Christopher Hammond, 2009-05-07 Crystallography and diffraction are widely used throughout science for studying structure However many students find these subjects difficult The aim of this book is to show through relevant examples and without relying on complex mathematics that the basic ideas behind crystallography and diffraction are simple and easily comprehensible

*Microphone In Hand: Interviews, Forewords, Reviews: Revelations From A Scientist And About A Scientist* Istvan Hargittai, 2025-05-05 This book offers a panoramic view of science through the perspective of Istvan Hargittai an internationally renowned Hungarian researcher and educator in physical chemistry He has had worldwide collaboration in molecular science symmetry studies and science history bridging East and West during these experiences He has talked with hundreds of luminaries of science and mathematics in physics chemistry biology medicine pharmacology and materials science among them one hundred Nobel laureates but here Hargittai himself was the interviewee in 23 conversations They have appeared in the print media radio and television in diverse international forums These conversations cut across political systems and geographical areas and reflect his scientific experience in European countries the United States and Russia spanning over 4 decades and his life experiences over 8 decades His scientific and writing output has included numerous books in structural chemistry symmetry the American and Soviet nuclear projects James D Watson



Edward Teller emigration candid conversations with famous scientists 4 great cities of science the culture art and nature of scientific discovery the traits of scientific discoverers and the Nobel Prize Some of the greatest scientists of our time wrote forewords to his books and commented on his writings and other achievements Reviews of his books have appeared in Nature Scientific American Physics Today Chemistry and Industry Lancet The Mathematical Intelligencer and elsewhere This volume dips into all these aspects of a scientific life and career and offers education through entertainment for a broadest possible readership interested in what science is and what and how it does

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