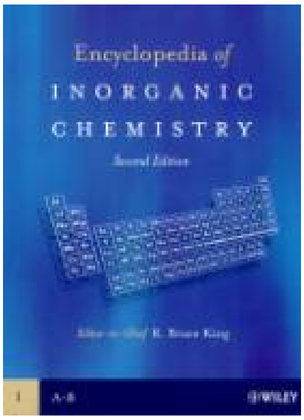
The Chemical Educator, Vol. 11, No.1, Media Reviews, © 2006 *The Chemical Educator*

Media Reviews

Encyclopedia of Inorganic Chemistry, Second Edition. R. Bruce King, Editor-in-Chief. John Wiley & Sons, Ltd.: Chichester, England; Hoboken, NJ, 2005. 10 volumes. cccxx + 6,333 double-column pp. 22.5 × 28.5 cm.; hardcover, \$5,450.00; £2,850.00; €4,399.00. ISBN 0-470-86078-2. Order from John Wiley & Sons, Ltd., The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, England; Phone +44 1243 779777; email: cs-books@wiley.co.uk; Internet: http://www.wiley.com/eic2.



During the first four decades of the 20th century inorganic chemistry languished in the doldrums until the post-World War II period ushered in the resurgence in the field that the late Sir Ronald S. Nyholm called the “renaissance of inorganic chemistry” [1]. Inorganic chemistry encompasses an amazing variety of structurally diverse substances—molecular, ionic, coordination, organometallic, and nonmolecular compounds of the roughly hundred elements now known (with the exception of those compounds of carbon that are the province of organic chemistry) as well as special materials such as metallobiomolecules, semiconductors, superconductors, ceramics, and minerals. Their great structural diversity also makes them extremely important as fine chemicals, catalysts, industrial feedstocks, and advanced materials. Inorganic chemistry also plays a significant role in life processes because of the action of metalloenzymes and the importance of metals in protein and nucleic acid structure.

We have long had available multi-volume treatises on the elements and their compounds. These include *Gmelins Handbuch der anorganischen Chemie* [2], J. Newton Friend's *Textbook of Inorganic Chemistry* [3], Joseph William Mellor's *Comprehensive Treatise on Inorganic and Theoretical Chemistry* [4], Paul Pascal's *Nouveau Traité de chimie minérale* [5], and Nevil Vincent Sidgwick's *The Chemical Elements and Their Compounds* [6]. More recently, modern comprehensive monographs on specialized aspects of inorganic chemistry have been published. These include Sir Geoffrey Wilkinson, Robert D. Gillard, and Jon A. McCleverty's 7-volume *Comprehensive Coordination Chemistry* [7], Jon A. McCleverty and T. J. Myers’s 10-volume *Comprehensive Coordination Chemistry II* [8], Sir Geoffrey Wilkinson, F. Gordon A. Stone, and Edward W. Abel's 9-volume *Comprehensive Organometallic Chemistry* [9], and Edward W. Abel, F. Gordon A. Stone, and Sir Geoffrey Wilkinson's 14-volume *Comprehensive Organometallic Chemistry II* [10]. Perhaps the multi-volume set that came closest to the volume under review here is M. Cannon Sneed, J. Lewis Maynard, and Robert C. Brasted's projected 11-volume *Comprehensive Inorganic Chemistry* [11], but only eight volumes were published, and it was more of a textbook by a limited number (15) of authors than a true encyclopedia. However, despite the increased activity in the field during the past half-century, inorganic chemistry lacked a modern comprehensive encyclopedia. Thus, when the first edition of the *Encyclopedia of Inorganic Chemistry (EIC-1)* [12] appeared in 1994, it filled a real gap in the literature.

During the decade since the publication of *EIC-1* such significant, exciting progress in many areas of inorganic chemistry has taken place that a new edition (*EIC-2*) became necessary and timely. Such areas of development include metalloenzymes, nanostructures, chemical structure and bonding, and computational methods based on density functional theory. The encyclopedia has grown from eight to ten volumes, an increase of more than 30 percent (6333 vs. 4819 pp).

Once again, R. Bruce King, who served as Editor-in-Chief of the first edition, has reprised this role in *EIC-2*. He has also served as Editor for General Principles, Theoretical and Computational Methods. In addition, he has contributed articles on Polyhedra, Quasicrystals, and Symmetry Point Groups. King received his B.A. degree from Oberlin College in 1957 and was an NSF Predoctoral Fellow with F. Gordon A. Stone at Harvard University from which he received his Ph.D. degree in 1961. After a year at Du Pont and 4-1/2 years at the Mellon Institute, he joined the faculty of the University of Georgia, where he has been Regents' Professor of Chemistry since 1973. His American Chemical Society awards include those in Pure Chemistry (1971) and Inorganic Chemistry (1991). His research interests range from synthetic organometallic and organophosphorus chemistry to applications to inorganic chemistry of topology and graph theory and nuclear waste treatment.

Together with an Editorial Board of four prominent American chemists and an International Advisory Board of 12 chemists from ten countries, including 1987 Nobel chemistry laureate Jean-Marie Lehn of the Université Strasbourg, King has assembled an outstanding group of 391 contributors from 24 countries to produce what should be a definitive reference source for some time to come and "a work that correctly portrays the relevance and achievements of modern inorganic chemistry" (p viii). Editors from *EIC-1* who have served as Subject Editors for *EIC-2* are Robert H. Crabtree of Yale University, who contributed 10 articles (Inorganic and Coordination Chemistry, and Transition Elements), Charles M. Lukehart of Vanderbilt University, who contributed one article (Organometallic Chemistry; Catalysis, Solid State Chemistry, Materials and Nanomaterials), and Robert A. Scott of the University of Georgia (Bioinorganic Chemistry). David A. Atwood of the University of Kentucky, who contributed eight articles, has replaced Richard L. Wells of Duke University (Main Group Elements), King and Lukehart have replaced the late Jeremy K. Burdett of the University of Chicago (Physical and Theoretical Methods and Solid State), respectively. Many of the new topics for *EIC-2* were from the area of Inorganic Materials.

The team of editors reviewed the articles that had appeared in *EIC-1* and in most cases invited authors to update their articles to reflect those developments during the decade since the appearance of *EIC-1*. Whenever the author of the original article in *EIC-1* was unavailable for updating or when recent advances indicated new topics for which coverage was needed, new articles were commissioned.

The authors, whose names, affiliations, and article titles are listed in Vol. 10, are all prominent authorities who were selected for their expertise in the subjects of their articles. In King's words, "Our authors are among the most active research workers in the areas of the subject that they have reviewed and have well justified international reputations for their scholarship" (p viii), for example, Robert J. Brotherton (Boron: Inorganic Chemistry), George B. Kauffman (Coordination Chemistry: History), David L. Kepert (Coordination numbers and Geometries), 1996 Nobel chemistry laureate Sir Harold W. Kroto (Carbon: Fullerenes), Marc S. Robillard and Jan Reedijk, based on Stephen J. Lippard's *EIC-1* article (Platinum-Based Anticancer Drugs), Amitabha Mitra and David A. Atwood, based on Robert C. West's *EIC-1* article (Polysiloxanes and Polysilanes), Michael T. Pope (Polyoxometalates), Dennis H. Rouvray (Periodic Table: Historical Aspects), Gabor A. Somorjai (Surfaces), andJay R. Winkler (Long-range Electron Transfer in Biology).

For ready reference *EIC-2* is alphabetically arranged from "Ab Initio Calculations" to "Zwitterion," with 285 signed main articles (with their contents clearly listed at the beginnings and with numbered sections, subsections, and sub-subsections) dealing with individual topics in a self-contained manner but with frequent reference to other articles; more than 860 short entries defining or explaining important concepts or providing valuable data; and more than 340 cross-reference entries to help to locate specific topics. In any article cross-reference to definition entries is indicated by italics, while cross-reference to other main articles is indicated by bold italics. In some cases a list of related main articles is given at the end of the article, followed by extensive, up-to-date literature references, some as late as 2004 and many to review articles and seminal papers to guide the reader to sources of more detailed information. A particular subject can be located either directly, by consulting the appropriate alphabetical place, or from the detailed (121 double-column pages) index in Vol. 10.

In commissioning the main articles in *EIC-2*, they were grouped into eight areas, with some articles appearing in different areas:

- **General Principles** (41 articles) reflect major advances in computational and theoretical inorganic chemistry and include articles on the electronic structures of clusters, main group compounds, and organometallic compounds as well as articles on molecular orbital theory, luminescence, photoelectron spectroscopy, and short-lived intermediates. Several general articles on physical and spectroscopic methods were deleted to generate space for expansion of coverage to new and rapidly developing areas.
- **Inorganic and Coordination Chemistry** (57 articles) involves more sophisticated ligands, a wider set of applications, and computational and combinatorial methods. Increased sophistication in structural determination permits the study of more complicated coordination compounds without losing information at the molecular level.
- **Organometallic Chemistry** (93 articles) features articles emphasizing historically significant and recent discoveries in the organometallic chemistry of the 27 transition metals comprising groups 3-11 of the periodic table and of the lanthanides and actinides alphabetically arranged under each metal or grouping of related metals. Several topical articles summarize advances in the synthesis, structure, bonding, and chemical reactivity of important classes of organometallic complexes, including applications to catalysis, organic synthesis, and materials chemistry.
- **Main Group Elements** (122 articles) features mostly updates of articles from *EIC-1*, which have been rewritten to include references since 1994, and the sections have been changed to include new developments since that time, resulting in a coverage of every main group element that can be used both for introducing each element as a new subject in teaching and as a resource for understanding the latest research.
- **Transition Metals** (152 articles) have been incorporated into organic, physical, and biophysical chemistry and are being increasingly used in allied fields within solid-state physics and biochemistry.
- **Bioinorganic Chemistry** (56 articles) contains articles that are either new or extensively updated to reflect major

advances such as new technologies in structural biology, molecular biology, biological imaging, and other areas in combination with the genomic revolution and the bioinformatics tools that have accompanied it. Many articles provide representations of crystallographically determined molecular structures that aid in understanding the chemistry underlying the biological function. Metals in medicine, including heavy metal toxicity, roles in disease progression, inorganic therapeutics, and inorganic imaging agents are discussed in separate articles.

- **Solid-State, Materials and Nanomaterials** (49 articles) includes updated articles on the inorganic chemistry of important classes of inorganic solids, such as common binary or ternary elemental compositions, as well as updated reviews of selected properties, electronic structures of inorganic solids, and common synthesis strategies for preparing inorganic solid materials. New articles on the synthesis and properties of nanomaterials obtained by self-assembly processes are also provided.
- **Catalysis** (30 articles) includes articles on metal-mediated reactions applicable to organic synthesis; stoichiometric or catalytic nucleophilic addition to metal carbene, alkene, allyl, arene, diene, or dienyl complexes effecting C-C or C-(nucleophile) bond formation with controlled regio- or stereoselectivity; asymmetric organometallic catalysis, including chiral poisoning strategies and combinatorial methods of catalyst generation; methods for immobilizing organometallic complexes on insoluble phases; and other new developments.

The periodic table (with the group numbers 1 to 18 as recommended by the International Union of Pure and Applied Chemistry (IUPAC) rather than the older Mendeleev I-VIII numbers and with the symbols for elements 104-111 being those endorsed by the Nomenclature Committee of the American Chemical Society) appears on the inside front cover of each volume, while four columns of Common Abbreviations appear on the back endpapers. Each volume contains the Preface; Introduction and Synopses (pp ix-xix), and table of Contents, which lists alphabetically with page numbers all the main definition articles in the entire set (pp ix-xxxii). The encyclopedia is extensively illustrated with photographs, concise tables, line drawings, diagrams, figures, equations, reaction schemes, and computer-drawn structural formulas. For the first time, illustrations in color are included. Volume 10 contains a double-column list of Abbreviations and Acronyms (pp 6077-6087). The emphasis on recent developments ensures that the *EIC-2* will remain topical for many years.

An electronic version will be published on Wiley InterScience in spring, 2006 and will be a vital resource for inorganic research and teaching. CrossRef will permit direct linking to the original literature. Regular updates will ensure that EIC-2 will include cutting-edge developments. One can subscribe to the online version either by a one-time fee for continuing access or annually for one calendar year.

In King's words,

> We believe that the *Encyclopedia of Inorganic Chemistry*, as well as providing a lasting source of information, will provide the stimulus for many new discoveries since we do not believe it possible to read any of the major articles without generating ideas for new research (p viii).

I agree fully with his evaluation.

This excellent, up-to-date, comprehensive, easy-to-use, definitive, and modestly priced reference work provides more information than is available in single-volume works without being so large as to be beyond the reach of all but a few well-endowed academic and industrial libraries or affluent individuals. It should be of interest and use not only to inorganic chemists but also to organic, physical, and analytical chemists; biochemists; chemical engineers; materials, earth, and environmental scientists; physicists; biologists; and anyone seeking information on and ideas for new research in one of the most active fields of chemistry today.

References and Notes

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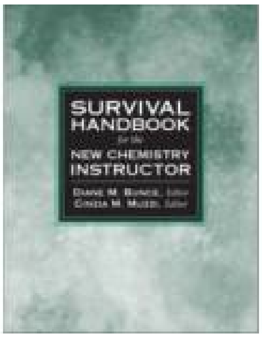
S1430-4171(06)01999-1, 10.1333/s00897060999a

Survival Handbook for the New Chemistry Instructor. Diane M. Bunce and Cinzia M. Muzzi, Editors. Pearson/Prentice Hall: Upper Saddle River, NJ. Paperback, US $23.60. ISBN 0-13-143370-9.



This book is one of several in the Prentice Hall series in educational innovation. It has grown out of two symposia that were presented in 2001 and 2002 to answer the need for a collation of all the ideas, tips, and facts that a successful new instructor eventually discovers about teaching chemistry, but could just as easily have been passed on to them at the beginning. Gain without the pain, one might say.

Twenty-four authors (all but one based in the US) have guided the reader through most of (if not all) the pointers a new chemistry instructor should consider. Some of the nineteen chapters are written by recent “survivors” and others are from the seasoned contingent. This strikes a good balance so as to provide ideas on which to reflect, rather than a list of teaching tips for the novice. It is quite feasible to read the book straight through, but I am sure that you will want to refer to certain sections periodically. I read it in the context of being a longstanding, out-of-shape instructor who was looking for some self-improvement. I read it chapter by chapter while riding a stationary bike in the gym!

The sequence of chapters has been well chosen. Ideally, one would start reading the book when the first opportunity to teach presents itself, covering the basics and must-dos at the beginning and then expanding the background material as the experience progresses. Because it is quite common to teach in one or two contract positions before being offered a permanent appointment, the job-seeking advice comes towards the end, coupled with some tips to maintain professional development. The main themes presented include: matching goals and outcomes in your first class, creating the right environment to accommodate all learning styles, constructing a syllabus, selecting the textbook and other course materials, using the library in your course, responding to the students’ needs for effective learning, spotting the successes and failures related to the demographics of your students, innovative approaches to teaching, using group-learning, conceptual questioning, deciding what to test, assessing their learning, identifying teaching resources, landing an academic job, teaching in a community college, and developing in your career.

The references included in each chapter cover much of the chemical education literature and also some of the foundation material typically covered in a general introductory course on teaching and learning in higher education. In that context, I would also consider it to be a useful book to recommend as prerequisite reading for a graduate course in chemical education. Happily, graduates might even be able to buy their own copy at US $23.60.

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S1430-4171(06)11000-6, 10.1333/s00897061000a

Nanochemistry: A Chemical Approach to Nanomaterials. By Geoff Ozin and André Arsenault, Royal Society of Chemistry Publishing, September 2005. xlii + 628 pp, hardcover, £ 39.50, $89.95 U.S. ISBN 0-85404-664-X.

“It is what is in your head that counts, not that you know where to look it up in a book,” writes Geoffrey Ozin quoting Linus Pauling in the introduction to his recent text *Nanochemistry: A Chemical Approach to Nanomaterials.* The book, written together with André Arsenault, a recently Ph.D. graduate from Ozin's research group at the University of Toronto, aims indeed to open the reader's mind—clearly thinking of the new generation of chemistry students—and provide them with a general introduction to nanochemistry. Ozin defines nanochemistry as "… the utilization of synthetic chemistry to make nanoscale building blocks of different size and shape, composition and surface structure that can be useful in their own right or in a self-assembled structure."

The book walks its talk: in 593 pages organized in 13 chapters, it describes the chemical methods required to make materials where "size and shape are as important as structure and composition." The resulting "bottom-up" approach is what the authors identify as the new way of thinking about the structure/activity relationships governing the behavior of functional materials. Materials self-assembly is the heart of materials chemistry, the authors contend, and it has introduced an entirely new way of thinking about how to make materials: the spontaneous organization of building blocks into assemblages that are unconstrained by scale due to molecular forces that operate at length scales beyond the molecular, between the building blocks and over different scales.

"In a self organizing system of materials" Ozin and Arsenault continue "a particular architecture forms spontaneously with a structural design which is determined by size and shape of the individual nanocomponents" *and* by the "map of bonding forces between them." In the glorious European tradition of science teaching, Ozin (a native of London who studied at Oxford) refers extensively to the historic development of materials chemistry. Thus, for instance, Harting's work with biomineral formation (1873) and the classic 1917 *Of Growth and Form* of D'Arcy Thomson on the same topic find plenty of space in this textbook, showing how the effort "to apply physico-geometrical principles to explain morphogenesis" in the study of natural materials has been a constant driving force of scientific thought, of which modern materials chemistry is clearly a continuation.

Indeed, it is the discovery that organics direct the growth of inorganics that brings about a revolution in the preparation of artificial, functional materials: Dick Barrer shows how quaternary allylammonium cations dictate assembly of microporous allumino/silicates; Charlie Kresge explains how to extend the length scale well beyond molecular scale; and Edith Flanigen demonstrates how to go beyond aluminosilicates.

The subsequent central point of the book resides in the importance of defects as "without defects materials would not be useful," imperfection providing them with interesting properties and ultimately with function. Photonic crystals, supported metal catalysts, and sol-gel materials are celebrated examples. In this discussion, however, the authors fail to include David Avnir's seminal work on the application of fractal geometry to chemistry and on doped sol-gel materials (including recent work with metals doped with organic molecules); probably the most successful example of materials in which a dramatic number of different functions is dictated by imperfect and tunable geometry.

Two excellent features of the book make it a useful, *practical* tool for teachers of materials chemistry, to this reviewer's joy. Ozin emphasizes his close ties with industry that "resulted in numerous inventions and technology transfer" and this is reflected in the presence of 20 outline experiments at the end of the book; in addition, questions and problems are inserted at the end of each chapter. The book, after all, emerges from a thorough assembly of Ozin's lecture notes at the University of Toronto.

Finally, the presence of some two hundred pictures, some of which interestingly are taken from the Wikipedia.org free online encyclopedia, make the reading of this rather long textbook easier and more pleasant. As materials chemistry spreads through every domain of modern chemical research and into all sectors of the industry, chemistry practitioners would do well to find the time to read this seminal book.

A research chemist at Italy's CNR based in Palermo, Mario Pagliaro works using many materials chemistry concepts to solve a number of practical problems ranging from sensing and catalysis to chemical light upgrading. One of his latest research papers, "Better Chemistry Through Ceramics: The Physical Bases of the Outstanding Chemistry of Ormosil" (DOI: 10.1021/jp055697v), shows the impressive possibilities opened to chemistry by the principles highlighted in the book reviewed above.

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S1430-4171(06)11001-5, 10.1333/s00897061001a

Candid Science IV: Conversations with Famous Physicists. By Magdolna Hargittai and István Hargittai. Imperial College Press: London, England, 2004; distributed by World Scientific Publishing Co.: Singapore; River Edge, NJ; London, England. Illustrations. xvi + 711 pp; 16.5 × 24.8 cm.; hardbound. $118.00; £87; ISBN 1-86094-414-0; paperback. $58.00; £43; ISBN 1-86094-416-7.

The 36 portraits on the book cover appear in the order of their profiles in the book.

As Contributing Editor of the History feature of *The Chemical Intelligencer*, Springer-Verlag's popular but unfortunately short-lived quarterly magazine for the culture of chemistry and related sciences, I have a personal as well as professional interest in István Hargittai's series of fascinating collections of interviews, vignettes, and quotations of famous scientists.

During his six-year tenure (24 issues, 1995–2000) as Editor-in-Chief of *The Chemical Intelligencer*, Hargittai, sometimes with his wife Magdolna ("Magdi"), interviewed more than 120 eminent scientists, more than half of whom were Nobel laureates. A number of these interviews did not reach the pages of the magazine, and I hoped that these, along with the many that were published in *The Chemical Intelligencer* and, beginning with 2001, in *Chemical Heritage: Newsmagazine of the Chemical Heritage Foundation*, could appear in print in a handier and more permanent form. The first five volumes of this critically acclaimed book series, each containing three-dozen interviews, have appeared [1–4], and three of them have been reviewed in *The Chemical Educator*. Furthermore, according to István, the series "may extend to a seventh volume eventually" [5].

During the early decades of the 20th century, physics centered on the collective efforts of a relatively small number of European scientists. However, by the end of World War II the balance had shifted to a large and growing scientific establishment in North America, augmented by European, largely Jewish, refugees (According to Eugene P. Wigner, "Hitler did something very good for science in the United States," p 14), enriched by accelerated government support in response to a perceived threat from the USSR exemplified by the launch of Sputnik on October 4, 1957. During this "golden age" physics flourished in both scope and diversity, with new tools and techniques providing practical applications to modern everyday life. It contributed to the foundations for the nuclear and information revolutions and advances in astronomy, biology, chemistry, and other fields**.** Unlike chemistry, which has been experiencing recruitment problems lately, the number of U.S. citizens beginning graduate school in physics rose by 47 percent from 2003 according to the American Institute of Physics [6].

Whereas Magdi acted only as editor for the previous volumes, in this fourth volume she shares authorship with István. The Hargittais, who have clearly done their homework in preparing for the interviews, seek to uncover the stories behind the most important achievements in twentieth-century physics directly from some of its most distinguished participants. The interviewees tell us about their backgrounds; families (Many were raised in poor circumstances and belonged to the first generation in their families to attend a university); lives, both personal and professional; childhoods, influences, and career choices (Some possessed chemistry, electronic, or lego sets or were inspired by Paul de Kruif's *Microbe Hunters,* Bernard Jaffe's *Crucibles,* or other books); motivations; aspirations; heroes (scientific or otherwise); mentors and influences; selection of co-workers; hardships and triumphs; *modus operandi*; philosophies; hobbies and nonscientific interests ("I have never had time for anything else but physics and have never done anything worth mentioning outside physics." Daniel C. Tsui, p 625); and, of course, their seminal discoveries.

Usually the Hargittais' interviews are by-products of their scientific and family travels, and some were squeezed into programs of scientific meetings or the centennial celebrations of the Nobel Prizes in 2001 in Stockholm. They contacted their interviewees in advance, set up a date, recorded the conversation on audiotape, and sent the transcripts for correction and change to the interviewees. They are not investigative reporters but fellow scientists (physical chemists) who never try to deal with topics with which the interviewees seem uncomfortable. They tactfully asked them to ignore questions they do not want to discuss. In return, the interviewees are often candid and frank in their responses to questions that the Hargittais do ask. In István's words,

> Acting in this way rather than looking to reveal some "dark secrets," has been helpful in getting closer to our interviewees in a human sense than it might be possible by a more aggressive approach (p x).

Therefore the titles of the books in this series are most appropriate, as are their subtitles. Their contents are more like candid, informal conversations rather than formal interviews. In reply to the Hargittais' serious questions a number of the interviewees answer with humor. According to Teller, Wigner, who was known for his politeness, told the mechanic who repaired his car poorly, "Go to hell, please" (p 411), and Russell A. Hulse states,

> We had the classic "two-body problem," which is how physicists sometimes jokingly refer to a two-career couple's problem trying to stay together (p 676).

Most of the scientific subjects are discussed either by their originators or most prominent authorities. They include, *inter alia*, astronomy; astrophysics; radioastronomy; the fullerenes; Higgs,' W, Z, and Ω particles; quarks; Grand Unified Theory; gravitation; quantum mechanics; extraterrestrial intelligence; astrophysics; the superconducting supercollider; the GALLEX experiment; non-conservation of parity; the Big Bang theory; dark matter; the solar neutrono problem; microwave background radiation; chemistry of interstellar space; antiprotons; Michael Frayn's play *Copenhagen*; Schrödinger's cat; quasicrystals; black holes; the Orion project (a bomb propelled spaceship); paranormal phenomena; fractals; and phase transitions.

Among related topics are found discussions of government and public service, gender bias and feminism, Nobel politics, research planning, the Great Depression, serendipity, discovery and patenting of discoveries, teaching, nepotism, administration, the McCarthy era, war research, religious beliefs and the reconciling of science and religion, history of science, aging, authorship of articles, the scientific establishment, experiment vs. theory, science and nationalism, missed opportunities, the public image of physics and science, science literacy, greatest challenge (for John N. Bahcall, it was persuading his wife to marry him!, p 259; for Jocelyn Bell Burnell it was "combining an academic career with family" p 648), comparisons between universities and research institutes, the role of imagination in science, compulsory retirement and its effect on their work, feelings on being "scooped," the social responsibility of scientists, work in progress, their legacy, and advice to young people.

The collection begins and ends with recollections. The first conversation (pp 3–19) deals largely with Wigner's account of persons from the earlier years of 20th-century physics, a clear link with the past. It is not a *bona fide* interview but rather a summary of a series of conversations that István had during Wigner's visit to the University of Texas in 1969, while István was a Visiting Research Associate there. The last entry (pp 689–697), a summary of a conversation with David Schoenberg that includes direct quotes about his contacts with Russian physicists Peter Kapitza (1894–1984) and Lev Landau (1908–1968), should introduce Western scientists to their counterparts in the East and turn their attention to the future. This coda to the volume also includes the first two paragraphs from Kapitza's "Star Wars" letter of June 25, 1950 to Georgii M. Malenkov notifying the Communist official about the possibility of an antiballistic missile.

The earliest-born physicist is the late Australian Marcus L. E. Oliphant (b. 1901), co-discoverer with Ernest Rutherford of tritium and helium-3, leading participant in the Manhattan Project and the establishment of radar during World War II, and co-founder of the Australian National University. The youngest interviewee is the German-born John D. MacArthur Professor of Physics at the Massachusetts Institute of Technology, Wolfgang Ketterle (b. 1957), who shared the 2001 Nobel Physics Prize "for the achievement of Bose-Einstein Condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates."

The interviews flow naturally as related conversations often serve to introduce the next one. For example, Rudolf Mößbauer follows John N. Bahcall, reflecting their common interest in cosmic neutrinos; Wolfgang Ketterle follows his mentor David E. Pritchard; Laszlo Tisza, whose 1944 article was one of the forerunners of the Bose-Einstein Condensation, follows Ketterle, one of its discoverers a half-century later; and Joseph H. Taylor and Russell A. Hulse, the discoverers of double pulsars, follow Antony Hewish and Jocelyn Bell Burnell, the discoverers of pulsars.

Versatility is a prominent characteristic among many of the interviewees, a number of whom have switched areas several times in the course of their careers. Some, such as Leon M. Lederman, began as chemistry majors; Edward Teller studied chemical engineering; Freeman J. Dyson and John C. Polkinghorne were mathematicians; and Mildred S. Dresselhaus was a musician.

In most cases the interviewees' human feelings shine through their words. Nobel laureates describe how the prize affected their lives, research, and careers. Most are modest and admit the role of luck in their good fortune. According to Wolfgang Ketterle, "You have to be in the right place at the right time, working with the right people, and you also need a little bit of luck" (p 386).

Many of the physicists worked on the Manhattan Project, and their beliefs about the decision to use the nuclear bombs against Japan are varied:

> I am proud that I participated in the Manhattan Project and if anything, I often w onder how many more lives could have been saved, had w e done the bomb a year or so sooner (John A. Wheeler, p 426);

> The fire bombing of Tokyo w as so close to genocide, killed so many people, that it seemed to me much more of a horror than the atomic bombs (Philip W. Anderson, p 595).

None of the interviewees were in favor of the ill-conceived "Star Wars"project**:**

> It's flaw ed from the beginning to end….[President Reagan] bet the entire planet, and no one has the moral right to bet the entire planet on that kind of confrontation. I w ould rather live w ith the Russians than risk a nuclear w ar….It w as destabilizing the w orld. Ronald Reagan w anted to make sure that he w on the Cold War before he w as out of office. For this he w as ready to risk a w ar (Arno A. Penzias, pp 278, 280).

> The Soviet Union w as already dow n in 1983. It w as collapsing of itself (Philip W. Anderson, p 592).

Several scientists discuss their differences with other scientists and competitors. For example, according to Valentine L. Telegdi,

> [Leon M. Lederman] tried to defame our experiment. He tried to tell people that w e never did our experiment, and that I invented our results, that I faked them! (p 171).

Telegdi also states,

> Edward Teller suffers from a disease that has not been uncommon among Jewish people in the past two or three hundred years; he thinks that he is the messiah (p 185).

A number of other interviewees expressed negative feelings about Teller.

On the whole, however, most interviewees are well acquainted with each other and are mutually supportive, and their names crop up frequently in each other's interviews. Some offer suggestions as to Nobel-caliber scientists whose candidacy was overlooked, either because of the three-person rule for sharing a prize or for other reasons. For example, Owen Chamberlain wished that Clyde Wiegand had shared the award with him and Emilio Segrè (p 303), Kenneth G. Wilson thinks that Michael Fisher should have shared the 1982 award with him (p 529), and Jocelyn Bell Burnell has no regrets that she did not share the 1974 prize with her mentor Antony Hewish: "You can actually do extremely well not getting the Nobel Prize and have a lot of fun, too. And I have received lots of other prizes" (p 653).

According to Mößbauer,

> In Germany a Nobel laureate is a very special person. In the United States the number of Nobel prize winners is so high that I was just one of them (pp 263–264). Scientists and their opinions matter very little in politics today (p 271).

Also, in David E. Pritchard's opinion,

> The Nobel Prize would really cramp my style, which is that I like to investigate anything, for instance the UFO Alien phenomena (p 362).

In an "inside story" related by Yuval Ne'eman,

> In 1969, Isidor Rabi—who seemed to have some information about the Nobel affair—told me that the Nobel Prize for Gell-Mann alone was a way out for the Nobel people who were having pressure exerted on them by the British, who were strongly for [Abdus] Salam and either uninterested or even antagonistic in my case (p 50).

The question about differences between physics and chemistry elicited various responses:

> The physicists at ETH considered chemists a lower form of life (Valentine L. Telegdi, p 164).

> Chemistry is a matter of care, observation, and hard work. Physics begins with hard work and very often leads nowhere but is always exciting (Marcus Laurence Elwin Oliphant, p 310).

> Physics is much more of a macho thing than chemistry, at least in the U.S., but still once you're doing the work, it is all right to be a woman" (Dresselhaus, p 552).

I also learned many surprising or little known facts: Although Murray Gell-Mann presented his Nobel address, he never submitted it for publication (p 49); Valentine L. Telegdi picked up his wife on a Zürich street (p 164); the Hiroshima [U-235] bomb was not tested but the plutonium implosion bomb was" (p 301); radar was independently discovered by at least four different countries including England, the United States, France, and Germany (p 327); Leo Szilard liked to be homeless, never had a home, and lived in hotel rooms (p 461); and "[former] Secretary of State [George] Schultz is a Princetonian, a relatively intelligent man, except that he has a tiger tattooed on his behind" (Philip W. Anderson, p 593).

The date and exact locale of each interview is provided along with a biographical sketch. This volume contains more unpublished interviews than the two previous ones. However, because subscribers to *The Chemical Intelligencer* may be potential buyers of *Candid Science IV*, here is an annotated list of its contents (CI, previously appeared in the same or modified form in *The Chemical Intelligencer*—5; N, Nobel laureate—20; †, deceased—3; F, female—3; J, Jewish—14; H, Hungarian—4; M, interviewed by Magdolna Hargittai—15); I, interviewed by István Hargittai—16; M&I or I&M, interviewed by Magdolna Hargittai and István Hargittai—4):

1. Eugene P. Wigner (18 pp) N J † H I
2. Stephen Weinberg (12 pp) N J I
3. Yuval Ne'eman (32 pp) J I
4. Jerome I. Friedman (16 pp) N J I
5. Martinus J. G. Veltman (30 pp) N M
6. Gerard 't Hooft (32 pp) N M
7. Leon M. Lederman (18 pp) CI N J M&I
8. Valentine L. Telegdi (32 pp) J H M
9. Val L. Fitch (22 pp) N M
10. Maurice Goldhaber (18 pp) J M&I
11. John H. Bahcall (28 pp) J M
12. Rudolf Mößbauer (12 pp) CI N I
13. Arno A. Penzias (14 pp) N J I
14. Robert W. Wilson (12 pp) N I [7]
15. Owen Chamberlain (6 pp) N I
16. Marcus L. E. Oliphant (12 pp) CI † I&M
17. Norman F. Ramsey (28 pp) N M

18. David E. Pritchard (24 pp) I
19. Wolfgang Ketterle (22 pp) N M
20. Laszlo Tisza (14 pp) J H I
21. Edward Teller (20 pp) CI † J H I&M
22. John A. Wheeler (16 pp) M
23. Freeman J. Dyson (38 pp, the longest piece) M
24. John C. Polkinghorne (18 pp) I
25. Benoit B. Mandelbrot (28 pp) J I
26. Kenneth G. Wilson (22 pp) N I
27. Mildred S. Dresselhaus (24 pp) F J M
28. Catherine Bréchignac (16 pp) F M
29. Philip W. Anderson (16 pp) CI N I
30. Zhores I. Alferov (18 pp) N M
31. Daniel C. Tsui (6 pp, the shortest piece) N I
32. Antony Hewish (12 pp) N I
33. Jocelyn Bell Burnell (18 pp) F M
34. Joseph H. Taylor (14 pp) N M
35. Russell A. Hulse (18 pp) N M
36. David Shoenberg (10 pp) J I

However, in addition to these interviewees a number of other scientific luminaries are discussed, such as Enrico Fermi, Albert Einstein, J. J. Thompson, Ernest Rutherford, Richard Feynman, Leo Szilard, Wolfgang Pauli, Murray Gell-Mann, J. Robert Oppenheimer, Marie Curie, George Gamow, Hans Bethe, Werner Heisenberg (and his role in Germany during World War II), Isidor Isaac Rabi, Niels Bohr, John von Neumann, E. Bright Wilson, Jr., and Rosalyn S. Yalow.

Twenty (more than half) of the interviewees are Nobel laureates, and several are recipients of the Wolf Prize in Physics (for example, Lederman, Telegdi, Goldhaber, Wheeler, Dyson, Mandelbrot, and Wilson), the National Medal of Science (for example, Wigner, Weinberg, Lederman, Bahcall, Ramsey, Wheeler, Dresselhaus, and Taylor), and the Templeton Prize for Progress toward Research or Discoveries about Spiritual Realities (Polkinghorne and Dyson).

Only three of the scientists are women (Dresselhaus, Bréchignac, and Burnell) so, despite the increasing acceptance of women in academic, industrial, and governmental laboratories, further advances in the struggle against sexism are needed. All three were married (the first two to scientists who are less famous than they are, and Burnell is divorced), and they explain how they balance marriage and parenting with their careers. According to Taylor,

> Astronomy has been one of the fields traditionally that has more women than other branches in the physical sciences (p 667).

An extremely high proportion of the interviewees (at least 14 or almost 39 percent) are Jewish, so the issues of Judaism, the reasons for the preponderance of Jews among scientists of the first rank, the Holocaust, Israel, and anti-Semitism (Some changed their names to avoid this) are discussed by many of them. According to Israeli scientist and government official Yuval Ne'eman,

> In America they knew [about Auschwitz] but Roosevelt did not let anything like that be published. The BBC too got orders not to mention a word about it. Apparently, they were not very sorry about Jews being exterminated….The British left Palestine on the assumption that we would be conquered and exterminated by the Arabs—or at least that there was a high probability for such a "happy end."…[The Allies' failure to bomb the concentration camps or railway lines] was criminal (pp 44–45).

Ne'eman also thinks,

> The graduate schools in America used to be full of Jews and now they are full of Asians (p 55),

an observation concurred with by Lederman:

> You need certain elements such as strong family tradition, devotion to education, some healthy amount of insecurity to realize that you need to have hard work, and some drive for success. These are common elements of Asian families (p 144).

Although many of the interviewees are not religious, as expected of a diverse group of highly individual persons with strong opinions, they do not always agree on this or other topics. Weinberg, Ne'eman, Telegdi, Bréchignac, Alferov, and Anderson are declared atheists, while Burnell and Taylor are Quakers:

> Quakerism as we practice it in Britain, is a very good faith for a scientist, because it is a denomination that puts less emphasis on holy writings and less emphasis on tradition, and more emphasis on what you've learnt yourself about the nature of God and the nature of the world. It is strong on ecology, the respect for the Earth, the Planet, animals, and life (Burnell, p 646).

In 1979 Polkinghorne resigned his Cambridge professorship and trained for the Anglican priesthood for which he was ordained in 1982 (p 479).

According to Telegdi,

> the true religion of scientists is Shintoism, because Shintoism has two important principles. One is the worship of ancestors; here, I mean Newton, Einstein, and some others. The second principle of Shintoism is the admiration of Nature (pp 181–182).

Other declarations include:

> I am a religious person, not observant, but religious (Penzias, p 282).
>
> American scientists find it more difficult to speak about their being atheists if they are than European scientists (Pritchard, p 365).
>
> I consider myself a very moral person but I do not need a religion for that (Hulse, p 684).
>
> I don't argue with [scientists who believe in creation]. I'm amazed at how much emphasis the world places on religion when there is little evidence for any of it (Wilson, p 294).

And in response to why physicists are among the most religious scientists and biologists among the least:

> Physics is a less dogmatic science and biologists tend to be very dogmatic (Dyson, p 459).

In response to the question about future trends, John A. Wheeler ominously predicted,

> I think that in the first part of the next century we are going to have an enormous war bigger than any war we've ever had. I do not know how it is going to develop (p 429).

On the other hand, Philip W. Anderson, opined,

> My wishful thinking is that physics will spread out more toward complexity, geophysics, cosmology, and astrophysics, and most of all, biology (p 600).

The interviews include one or more portraits, many photographed by István or Magdi. The volume contains 158 illustrations, not only formal and informal photos of interviewees both as adults and as children, their families, colleagues, and students, but also of equipment, experiments, medals, sculptures at the Fermilab, Fitch's parents' ranch, a lego model of the first excited spin-two states of even-even nuclei, radar scope photographs, Ketterle's scientific "family tree," and fractal curves.

The Hargittais' questions are printed in italics, and the much longer responses appear in Roman type. Three of the interviewees (Wigner, Oliphant, and Teller) are now deceased, underscoring the importance of acquiring such oral histories promptly. István corresponded with Teller up to a few weeks before his death on September 9, 2003, and he includes excerpts from two letters that clarify Teller's feelings about his widespread characterization as "the father of the hydrogen bomb," a designation that he detested:

> I was always against our becoming the first to deploy the hydrogen bomb. I only wanted to have the possibility of the H-bombs as a deterrent for wars, and this has worked so far (August 13, 2003, p xi). I was not an unsuccessful scientist but my scientific research suffered from my work on weapons (August 17, 2003, p xii).

A name index (10 double-column pages with boldface page numbers referring to interviews) but no subject index is provided. For the first time in the series a cumulative index of interviewees (three double-column pages) for all four volumes to date is included.

In view of the length and scope of the book, the number of errors is small and limited to readily detected proper nouns, "typos," or grammatical errors made by the interviewees themselves—"College" for "Collège" (pp 33 and 395); "Neguib" for "Naguib" (General, pp 39 and 704); "regards" for "regard" (p 156); "Melon" for "Mellon" (Carnegie, p 195, twice); "Coppenhagen" for "Copenhagen" (p 239); "van der Graff" for "Van de Graaff" (p 259); "Mossbauer" for "Mößbauer" (pp 267 and 268); "University Emeritus" for "University Professor Emeritus" (p 405); "Earnest" for "Ernest" (Lawrence, pp 412 and 413); "*Encyclopedia*" for "*Encyclopædia*" (*Britannica*, p 430); "Whisky" or "whisky" for "Whiskey" or "whiskey" (Scots and Canadians spell it without the "e," whereas the Irish and Americans spell it with the "e," p 430, five times); "if" for "it" (p 462); "I" for "me" (p 537); "their" for "its" (p 559); "Hershel" for "Herschel" (Carolyn, pp 646 and 702); and "Russel" for "Russell" (Hulse, p 654, twice).

In the words of 1978 Nobel physics laureate Arno A. Penzias, who wrote the preface,

> The manifest diversity of life experience might seem to thwart attempts at all but the most general categorizations. In place of a rigid roadmap, the compilers of this volume have wisely allowed the diversity to manifest itself in an artfully threaded series of anecdotal excursions—much as a reader might get from a personal conversation with the Hargittais themselves. Accordingly, chronology and sub-disciplines play secondary roles herein, as the thread of conversation often serves to introduce the next (p vi).

I heartily agree with Penzias' evaluation, and I recommend this handy volume, admirably suited for complete reading or browsing, not only to historians of physics and of science but also to practicing scientists, especially beginning ones, as well as to students, who will surely benefit from these inspiring stories by some of physics' leading luminaries.

References and Notes

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2. Hargittai, I. *Candid Science II: Conversations with Famous Biomedical Scientists*;Hargittai, M., Ed.; Imperial College Press: London, England, 2002. For a review see Kauffman, G. B. *Chem. Educator* **2003,** *8,* 90–93; DOI 10.1333/s00897030663a.

3. Hargittai, I. *Candid Science III: More Conversations with Famous Chemists*; Hargittai, M., Ed.; Imperial College Press: London, England, 2003. For a review see Kauffman, G. B. *Chem. Educator* **2004,** *9,* 52–55; DOI 10.1333/s00897030763a.

4. Hargittai, B.; Hargittai, I. *Candid Science V: Conversations with Famous Scientists;* Imperial College Press: London, England, 2005.

5. Hargittai, I., email to G. B. Kauffman, June 6, 2005.

6. Bhattacharjee, Y. Data Point. *Science* **2005,** *309,* 1671; http://www.aip.org/statistics/trends/reports/ed.pdf (accessed Jan 2005).

7. Much of this interview is concerned with Wilson's father, E. Bright Wilson, Jr., and his popular book, from which many scientists of my generation, including me, first learned about research (Wilson, Jr., E. B. *An Introduction to Scientific Research;* McGraw-Hill Book Co.: New York, 1952).

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S1430-4171(06)11002-4, 10.1333/s00897061002a