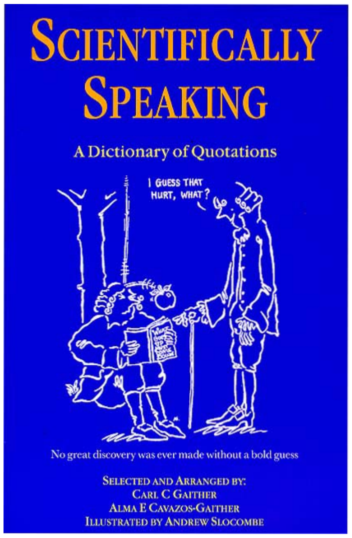
Media Reviews

Scientifically Speaking: A Dictionary of Quotations. Selected and arranged by Carl C. Gaither and Alma E. Cavazos-Gaither; illustrated by Andrew Slocombe. Institute of Physics: Bristol, England; Philadelphia, PA, 2000. 25 cartoons. xiv + 482 pp, paperback, 15.5 × 23.0 cm. \$24.99, £19.99. ISBN 0-7503-0636-X.



IOP has published a critically acclaimed anthology by the eminent crystallographer Alan L. Mackay, *Scientific Quotations: The Harvest of a Quiet Eye* (foreword by 1960 Nobel laureate in physiology or medicine Sir Peter Medawar, 1977; 2nd edition, 1991; for a review see Kauffman, G. B. *Isis* **1978,** *69,* 273–274). It also published a series of inexpensive paperback anthologies by Carl C. Gaither and Alma E. Cavazos-Gaither. To date these are *Statistically Speaking: A Dictionary of Quotations*, 1996; *Physically Speaking: A Dictionary of Quotations on Physics and Astronomy*, 1997; *Mathematically Speaking: A Dictionary of Quotations*, 1998; *Practically Speaking: A Dictionary of Quotations on Engineering, Technology and Architecture*, 1998; *Medically Speaking: A Dictionary of Quotations on Dentistry, Medicine and Nursing*, 1999; *Naturally Speaking: A Dictionary of Quotations on Biology, Botany, Nature and Zoology*, 2000; *Chemically Speaking: A Dictionary of Quotations*, 2000; and the book under review here.

Touted as "the largest compilation of published Science quotations available," *Scientifically Speaking* was designed to be entertaining as well as informative. The quotations have been selected to give the reader a feel for the depth and breadth of science as well as the visions and styles of past and present scientists. It contains hundreds of words of wisdom ranging in length from single sentences to paragraphs. In keeping with the wide scope and eclectic nature of the volume, the authors include academics, artists, astronauts, authors, biblical scholars, clergymen, cosmologists, critics, economists, editors, educators, emperors, engineers, essayists, explorers, financiers, founders of religions, generals, government officials, historians, humorists, inventors, journalists, jurists, linguists, longshoremen, ministers, musicians, mystics, novelists, philosophers, physicians, playwrights, poets, politicians, popes (John Paul II, Paul VI, and Pius XII), presidents and vice-presidents, saints (Augustine, Matthew, and Paul), scientists, sociologists, statesmen, surgeons, theologians, and writers of various nations and times.

The scientists include anthropologists, astronomers, botanists, chemists, embryologists, environmentalists, immunologists, mathematicians, microbiologists, naturalists, paleontologists, pathologists, physicians, physicists, physiologists, psychiatrists, psychologists, statisticians, and zoologists. Chemistry seems underrepresented, but chemists include Adolf von Baeyer, Robert Boyle, Sir Benjamin Brodie, Erwin Chargaff, James Bryant Conant, Marie Curie, John Dalton, Sir Humphry Davy, Otto Eisenschiml, Michael Faraday, Emil Fischer, Joseph Louis Gay-Lussac, Fritz Haber, Antoine-Laurent Lavoisier, Gilbert Newton Lewis, Louis Pasteur, Albert Szent-Györgyi, Vladimir Ivanovich Vernadskii, W. R. Whitney, and Richard Willstätter.

Most of the quotations are provocative and offer food for thought. They appear in 87 alphabetically arranged sections ranging from a single page to 76 pages (a grab-bag section titled "Science") from "Abstraction" to "Understanding" and alphabetically arranged by authors within the sections. The authority for each quote includes the fullest possible information that the editors could find, and whenever they could not locate the original source they indicate where they found the quotation. Occasionally, when they had only the quote but not the source, they listed the source as unknown so that the quote would not be lost. Quotations include both familiar and unfamiliar items so that readers will find their favorites along with those entirely new to them. Errors are extremely few and limited to proper names, e.g., "Humphrey" for "Humphry" (Davy, pp 23, 35, 81, 92, 360, 459) and "Valosis" for "Valois" (Marguerite of, pp 227, 470).

A 37-page alphabetical bibliography is provided for readers seeking further details about the quotations or authors. A crucial factor in the usefulness of a reference work is the index. This book contains two extensive indexes, which facilitate the retrieval of material. One is an alphabetical "Subject by Author Index "(58 double-column pages), which lists authors under sections devoted to subjects and allows the reader to locate all quotations pertaining to a given subject. A brief extract of each quotation is given in this index. An alphabetical "Author by Subject Index" (30 double-column pages) lists authors, some with birth and death dates, along with a key word about the quotation.

As an author and editor, I find it utterly amazing how Gaither and Cavazos-Gaither are able to come up with such high quality anthologies at such a regular and rapid pace. I wish that I knew their secret. I am pleased to recommend their work to general readers with an interest in science as well as to scientists, students, educators, and scholars who have a need for a handy source of quotations.

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The Molecular World: Alkenes and Aromatics. Edited by Peter Taylor and Michael Gagan. The Royal Society of Chemistry and The Open University: Cambridge, U.K., July 2002. 184 pp, paperback, 263 × 210 mm. £17.50. ISBN 0854046801.

The Molecular World is a new series published jointly by the RSC (Royal Society of Chemistry) and the Open University and designed as course books for the Open University's level-2 course in Chemistry. It is thus aimed at a specific readership, but is widely available. The series aims to present chemistry as an integrated subject, demonstrating cross-links between the traditional organic, inorganic and physical branches and illustrating the importance of chemistry in biological and earth sciences and in industry. In this volume this is handled in four distinct sections, with different authors but plenty of cross-referencing, covering, respectively, addition reactions to alkenes, aromatic compounds, the synthesis of pharmacologically important β-amino alcohols, and the petrochemicals industry. The book is unsuitable for the lay reader; knowledge of organic molecular structure (e.g., alkene geometry) and structure drawings ("stick diagrams") is assumed, and only a very brief reminder is given on the use of curly arrows.

The book is well presented, with a range of color illustrations and lots of structure diagrams. Stereochemistry is emphasized in the appropriate places, and reaction mechanisms are generally well-drawn and emphasized. There is a range of "rhetorical questions," whose answers are given immediately, and more testing questions with answers at the end of the chapter. The accompanying CD-ROM was a good feature, although it doesn't work on a Mac, but far more use could have been made of it. Every structure used in the book is included as a three-dimensional model file on the CD. Chapter 3 contained two boxed "computer activity" sections, which were excellent, giving precise references for the three-dimensional models corresponding to the structures under discussion and useful suggestions about how best to use the package. A future edition would be greatly enhanced by more such activities. The CD also contains self-test questions for the first two chapters of the book. These were of a range of types and included feedback: after a second incorrect try some help is given in finding the solution, while correct answers trigger a full explanation.

The book's first, rather short, part is called "Addition: Pathways and Products." I found this section, exclusively on alkenes, disappointing, because of its limited coverage and the number of minor errors. It is dangerous to begin a chapter with definitions and immediately contradict them, but Dr. Taylor defines a nucleophile as "a species possessing at least one nonbonded pair of electrons" and opens the next paragraph "Alkenes generally provide the nucleophilic component of the addition." The section contains no mention of one-step epoxidation, of dihydroxylation, or of hydroboration, to name but a few omitted reactions. Applications, however, particularly in margarine manufacture, are described entertainingly.

The stereochemical implications of the reactions covered are well treated in the text and reinforced by self-test questions on the CD. These, however, make no concession to students' thought processes. From the first question, products are drawn (incomplete, for student completion) in conformations and orientations that bear no resemblance to starting materials. While this is helpful in testing students' understanding of stereochemical conventions, it does rather less to test their understanding of the mechanisms of the reactions involved, and of the link between starting material and product. Some confusion between optical activity and chirality was also revealed.

Part 2 covers the history, structure, and some reactions of aromatic compounds. The treatment is good throughout, and applications in explosives and dyestuffs are highlighted. Electrophilic aromatic substitution and directing effects are well-explained, and there is full coverage of diazonium salts both in dyestuffs and for substitution reactions. Omissions from this section include nucleophilic aromatic substitution and benzyne.

Part 3 is entitled "A First Look at Synthesis." In practice the section gives an introduction to medicinal chemistry, describing briefly neurotransmitters, receptor-substrate interactions, and β-amino acid agonists of natural neurotransmitters. The early discussion is marred by an incorrect structure drawing of salbutamol. The synthesis of pseudoephedrine is then planned and discussed in useful detail, and excellent general principles are identified and emphasized. I particularly liked the definition of a "readily available starting material," a concept that troubles so many students, as "a chemical obtainable from a commercial supplier at a cost within the laboratory budget." Although one might quibble about calling a yield of 41% "good" and of 71% "excellent," the section as a whole is excellent with its emphasis on planning step-by-step and on taking stereo- and regio-chemical considerations into account when working out what starting material would be needed to obtain the desired product.

When dealing with β-amino alcohol synthesis, questions arise about the regioselectivity of nucleophilic attack on epoxides, aziridines, and bromonium and aziridinium ions. Clear explanations are given, quite separately, for sterically and electronically controlled regioselectivities. The failure to contrast the two control mechanisms and their relative importance in different situations is a shame in an otherwise admirable discussion. The last chapter in this part of the book introduces "the twelve principles of green chemistry," although these are not well-explained, and emphasizes considerations of waste, solvent use, and atom economy refreshingly early in the students' education. Plenty of self-study questions are given, but the CD-ROM self-test questions cover only the first two parts of the book.

The book closes with a case study entitled "Industrial Organic Chemistry." This is the only part freshly written for this book, and it contains no self-study questions. After outlining the different types of chemical industries and their relative size, both financial and in production scale, the study focuses on the petrochemical industries: their feedstock, methods of extraction and conversion, and the uses for their major output chemicals. These are briefly contrasted with the specialty and fine chemicals sector. The book closes with a page on alternative sources of organic raw materials.

Overall, this is a useful alternative text for first- (and Scottish second-) year undergraduates. The industrial and medicinal aspects introduce a wider relevance, which may be lacking in some more traditional courses; however, because the range of chemistry covered falls short of many undergraduate curricula, it is unlikely to find widespread recommendation as

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"the" course text. With financial pressures constantly squeezing students' budgets, I wonder how many will pay £17.50 for a fairly small volume of "background reading."

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Kirk-Othmer Concise Encyclopedia of Chemical Technology, Fourth Edition. Jacqueline I. Kroschwitz and Mary Howe-Grant (Editors). Wiley-Interscience: New York, NY, 2001. Figs., tables. xxxvi + 2196 pp., paperback, 21.2 × 27.7 cm. $325.00. ISBN 0-471- 41961-3.

A premier reference to all aspects of the chemical industry, the *Kirk-Othmer Encyclopedia of Chemical Technology*, which has gone through four editions: (1) 1949–1960; (2) 1963–1971; (3) 1978–1984; and (4) 1991–1998, has been called the *Bible* and *Britannica* of chemical technology, The majority of the contributors to the 4th edition are industrial or consulting chemists. Academics and theoretical chemists are definitely in the minority, although they wrote a proportionately larger number of the single-author articles. Furthermore, the contributors are primarily American; they include two Nobel laureates, George A. Olah and the late Glenn T. Seaborg, and prominent authorities in their respective fields, such as Robert H. Wentorf, Jr. of the General Electric Research & Development Center; John J. Mooney of the Englehard Corporation; and Kevin G. Ewsuk, Jill Glass, Carol Phifer, and Mark L. K. Phillips of Sandia Laboratories.

The compact one-volume desk reference under review here contains all of the approximately 1,300 articles by more than 1,500 contributors from the 27-volume (25 volumes, one supplement volume, and one index volume) 4th edition of the *Kirk-Othmer Encyclopedia of Chemical Technology* ($360.00 per volume; $10,000 for CD-ROM version), abridged and condensed by professional science or chemistry writers, reviewed for accuracy by the original authors or other authorities, and updated where necessary. The goal of the condensation is to retain basic information as well as key portions of the more advanced material and to present it in a form that is even more convenient, more accessible, less voluminous, and much less expensive than the full encyclopedia.

The condensed articles retain not only the text but also the illustrations, tables, graphs, and key references. The 4th edition of the full encyclopedia contains updated articles from the 3rd edition as well as more than 150 new articles, including Aeration (Biotechnology); Aeration (Water Treatment); Antiaging Agents; Antiviral Agents; Biosensors; Blood, Artificial; Cell Culture Technology; Chemometrics; CAD/CAM; Databases; Nonlinear Optical Materials; Renewable Energy Resources; Sol-Gel Technology; and Space Processing. The concise version incorporates all this updated, revised, and new material. New topics that appeared in the Supplement Volume of the full *Kirk–Othmer Encyclopedia* are incorporated into the *Concise Encyclopedia* in their appropriate alphabetical order. These cutting-edge articles include Aerogels, Bioremediation, Lithographic Resists, Molecular Modeling, Molecular Recognition, Nanotechnology, Smart Materials, Sonochemistry, and Water-soluble Polymers.

This nearly 2 million-word version, like the 15 million-word larger work, provides both SI and common units; carefully selected key references for each article; and numerous tables, graphs, diagrams, and charts, as well as complete indexing and cross-referencing, making data retrieval simple. The abridgement, which required several years of intensive effort, covers every important industrial area, such as agricultural chemicals, drugs, cosmetics, fats, waxes, polymers, plastics, and water supply and purification**.** It can be used as a first source of chemical information, serving as a collection of abstracts or an index, providing basic data, and directing the reader to the full work or to references cited for additional information.

Competitors in the comparable price range are nonexistent. The authoritative *Ullmann's Encyclopedia of Industrial Chemistry* (5th edition; 37 volumes; $14,100; 6th CD-ROM version, $1,150 for owners of the print version). The much cheaper *McGraw-Hill Concise Encyclopedia of Science and Technology* (2,450 pp, 1998, $150 HB) does not deal exclusively with chemistry. This one-volume abridgement of the Kirk-Othmer "bible of chemical technology" captures the essence of the original in a useful reference comparable to a handbook or dictionary from which the comprehensive, authoritative, and lucidly presented material become instantly available. It is an extremely attractive, reasonably priced reference book for chemists, chemical engineers, students, and scientists seeking answers to questions on any aspect of chemical technology.

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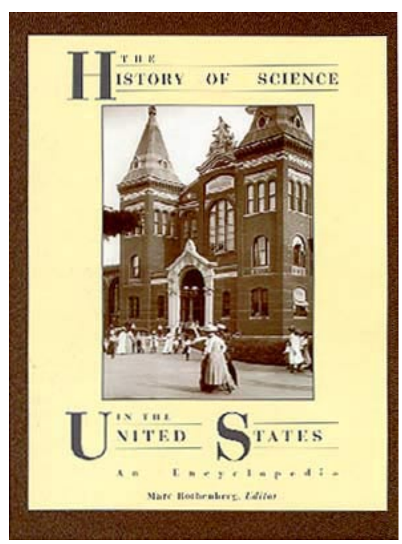
The History of Science in the United States: An Encyclopedia. Marc Rothenberg, editor. Garland Publishing, Inc.: New York and London, 2001. xx + 615 pp, hardcover, 22.0 × 28.4 cm. $150.00. ISBN 0-8153-0762-4.



Since World War II the history of science has grown tremendously and has become a mature discipline. Yet the essentials of the subject have not been available to students, scholars in other disciplines, and the public at large. A series of interdisciplinary encyclopedias, "Garland Encyclopedias in the

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History of Science," published by Garland under the general editorship of Marc Rothenberg, was initiated to provide concise historical information and to summarize the most recent research in a form accessible to persons without a scientific or mathematical background. Four books were published as volumes in the now dormant series: John Lankford, ed., *History of Astronomy: An Encyclopedia*, 1996; Robert Bud and Deborah Jean Warner, eds., *Instruments of Science: An Historical Encyclopedia*, 1997; Gregory A. Good, ed., *Sciences of the Earth: An Encyclopedia of Events, People, and Phenomena*, 1998; and *The History of Science and Technology in the United States: An Encyclopedia*. In addition, Garland published two other history of science encyclopedias that were not officially part of the series: Gary B. Ferngren, Edward J. Larson, and Darrel W. Amundsen, eds., *The History of Science and Religion in the Western Tradition: An Encyclopedia*, 2000; and Wilbur Applebaum, ed., *Encyclopedia of the Scientific Revolution*, 2000.

The volume reviewed here, almost a decade in the making, was the idea of Clark A. Elliott of the Pusey Library of Harvard University, who contacted individual authors in 1992, but circumstances forced him to abandon the project, leaving Rothenberg to complete it. Rothenberg, who received his doctorate in 1974 from Bryn Mawr College's Program in the History and Philosophy of Science, has been on the staff of the Joseph Henry Papers Project at the Smithsonian Institution since 1975 and has been the editor since 1985. He is the author of numerous articles and books, including the *History of Science and Technology in the United States: A Critical and Selective Bibliography* (2 vols., Garland Publishing, 1982, 1993).

The focus of a given volume in the series, each of which was independent of the others, was a specific science (for example, astronomy), a topic that transcends disciplines (for example, laboratories and instruments or, as in the present volume, science in the United States), or a relationship between science and another cultural aspect (for example, science and religion). The same title could appear in a number of volumes, possibly with a different author, as individual volume editors or co-editors approach a subject from a different viewpoint.

Each of the volumes was concerned with the historiography of the history of science, that is, the recognition that there is never an undisputed version of past events. Thus the authors of the articles in the volumes were asked to provide not only accurate, balanced entries but also to include information on how historical interpretations have changed over time and to express their own opinions on these issues. The introductions to each volume discussed the historiographic issues facing scholars in the particular area dealt with in the volume.

The present volume contains more than 450 signed and cross-referenced entries, ranging in length from 200 to 5,000 words and each with concise, selected, up-to-date bibliographies and guidance to the most significant publications and most important manuscript collections. Written by 247 contributors (mostly from academe, foundations, government agencies and commissions, as well as 16 independent scholars, of course, mostly Americans but at least half a dozen who are foreigners), and arranged alphabetically from astronomer and meteorologist Cleveland Abbe to Zoological Parks and Aquariums, they provide basic, factual information, a review of the topic's significance for the history of science in the United States, and analysis of historiographic issues, including controversies among historians, when appropriate. Although the primary emphasis of the volume is on the history of science, the history of invention, technology, engineering, and medicine are included where the boundaries among the disciplines overlap.

A wide range of topics is included, but the history of institutions and universities, journals, government and other agencies and projects, scientific disciplines, and subdisciplines is emphasized. Special attention is paid to the history of medicine and technology and the relation between science and technology and science and medicine. Current issues such as AIDS, Big Science, Ethics and Social Responsibility in Science, Gender—In Science, Human Genome Project, Literature—Relations to Science and Technology, Native Americans—Relations to Natural World, Nuclear Weapons, Public Health, Sex and Sexuality, Sociobiology, and Women in Science merit separate entries.

Pseudosciences are not neglected; separate entries are devoted to Theory of Hollow-Earth, Phrenology, Unidentified Flying Objects, and Witchcraft. Two major summary essays, "Science in the United States during the Colonial Period (to 1789)" and "Science in the United States from1789 to 1865," each almost seven pages long, show the richness of the literature for the history of science before the Civil War. Disciplines of special interest to chemists are Agricultural Chemistry (1 pp), Chemistry (4-1/2 pp), Chemical Engineering (2 pp), and Polymers. Analytical, organic, and physical chemistry as well as biochemistry are not discussed in separate entries.

The same institutions, organizations, or individuals sometimes appear in more than one entry but with different perspectives or contexts. In some cases the same author wrote several entries and integrated them so as to provide multiple and complementary contexts for a given individual or institution. In other cases different authors provide somewhat different perspectives that reflect historiographic differences. The authors were chosen on the basis of their close familiarity with the subjects. As cases in point, Judith R. Goodstein of Caltech wrote the entry on the California Institute of Technology, and Seymour H. Mauskopf, Dexter Award winner in the history of chemistry, wrote the entries on Parapsychology and Joseph Banks Rhine, who worked at Duke University where Mauskopf is professor of the history of science.

Individuals selected to be the subject of biographical entries are deceased scientists whose main contributions were involved in the development of the institutional infrastructure of American science, who were key figures in the rise or growth of disciplines, or who were the most important scientists in terms of discoveries. Because it was a significant factor in American science, every effort was made to include topics that highlight the patronage system of science.

The numerous biographies include many women as well as European-born persons who contributed to American science. Chemists featured in separate biographical entries include Roger Adams, Rachel Littler Bodley (the inspiration behind the formation of the American Chemical Society), Wallace Hume Carothers, Carl Ferdinand Cori, Gerty Theresa Radnitz Cori, John William Draper (English-born first president of the ACS), René Jules Dubos, Charles Thomas Jackson, Gilbert Newton Lewis, Willard Frank Libby, John Locke (not the philosopher), Edward Williams Morley, Robert Sanderson Mulliken, Arthur Amos Noyes (but not William Albert

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Noyes), Charles John Pedersen, Joseph Priestley, Ellen Henrietta Swallow Richards (the first woman to receive a degree from MIT, but not the first Nobel chemistry laureate Theodore William Richards), Count Rumford (Benjamin Thompson), Benjamin Rush, Benjamin Silliman, Jr., Benjamin Silliman, Sr., William Meredith Stanley, William Howard Stein, Edward Lawrie Tatum, and Harvey Washington Wiley.

The list of topics included is not exhaustive, but information on many individuals, institutions, and other subjects not included among the entry list or multiple entries dealing with the same topic can be found by referring to the extensive (21 three-column pages) index. Errors are virtually nonexistent; the only one that I discovered was Hoffman for Hoffmann (Roald, pp 118, 321, and 603).

This encyclopedia, which examines all aspects of science in the United States, belongs in all academic and public libraries and will be useful to students, historians, scientists, general readers, or anyone interested in the development of science in the U.S.

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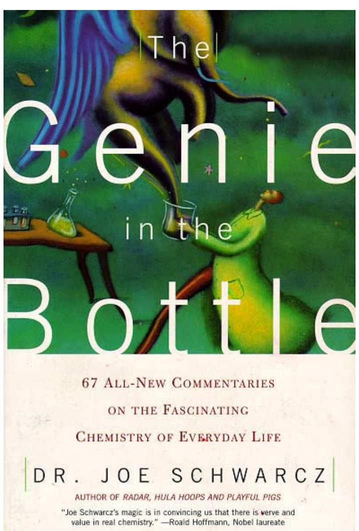
The Genie in the Bottle: 64 All New Commentaries on the Fascinating Chemistry of Everyday Life. Dr. Joe Schwarcz; 15 cartoons by Brian Gable. Henry Holt: New York; ECW Press: Toronto, Canada, 2000. 311 pp, paperback, 14.0 × 20.7 cm. $16.00, Canada $16.95. ISBN 0-8050-7138-5.



Today the public is constantly bombarded with information overload, Internet scare stories, and misinformation. The Office for Chemistry and Society is a unique effort of Montréal's McGill University to educate the public about science in general and chemistry in particular. It attempts to sort the wheat from the chaff, the hype from the truth, the sense from the nonsense, the fact from the myth. It is directed by Hungarian-born Joe Schwarcz, the well known popular science writer, Senior Adjunct Professor of Chemistry, and the author of this witty, entertaining, and enlightening book, which successfully advances the office's objectives.

Schwarcz has hosted a weekly radio show on chemistry (CJAD) in Montreal since 1982 and has been a commentator on the Canadian Discovery TV channel since 1995 and a columnist for the *Montreal Gazette* since 1997. He has also written for *The Washington Post*. The recipient of the Chemical Manufacturers Association Catalyst Award (1986) and the American Chemical Society's James Flack Norris Award (1990) and James T. Grady-James H. Stack Award for Interpreting Chemistry for the Public (1999), he has made more than 600 presentations to conferences, universities, schools, and interest groups and more than a thousand presentations on TV and radio.

Schwarz drolly begins his volume's preface by detailing his encounter with a salesman peddling a filter purported to remove chemicals from tap water with the declaration, "It was a dark and stormy night," the famous—or infamous, if you prefer—first sentence of minor Victorian novelist Edward George Earle Bulwer-Lytton's *Clifford* (1830), plagiarized repeatedly by the beagle, "Snoopy" in the late Charles Schulz's comic strip, "Peanuts," and well known to followers of the "Bulwer-Lytton Fiction Contest" (http://www.bulwer-lytton.com). Schwarcz's purpose in writing this book, the same as that of *Radar, Hula Hoops, and Playful Pigs* (W. H. Freeman: New York, 1999), his previous attempt at demystifying science, is "to provide a few scientific glimpses into the workings of our complex world. My hope is that by offering explanations for a variety of common phenomena I can help the reader develop a feel for how the scientific method functions, and at the same time, lay down a solid foundation for critical thinking." In my opinion he has not only admirably succeeded in attaining this goal, but he has simultaneously produced an effective and practical antidote for the current epidemic of chemophobia and anti-scientific attitudes that permeate our current society.

The essays range in length from 3 pages ("The Magic of Secret Inks") to 9 pages ("Sticky Chemistry," adhesives). The first of the book's five sections, "Health Matters" (74 pp), deals with a variety of commonplace topics, including the effect of stress on the body and of sunlight on the skin, the thalidomide disaster, echinacea, St. John's wort, ginkgo, chitosan and its degradation product glucosamine, grapefruit juice, gamma-hydroxybutyrate (GBH, the date rape drug), water chlorination ("probably the most important public health measure in the history of the world"), jimson weed (*Datura stramonium*), bufotenin (toad venom), aspirin, arthritis remedies, Vaseline, fragrances, and mercury poisoning. In his treatment of alternative herbal remedies Schwarcz presents a balanced evaluation of their benefits and risks.

"Food Matters" (49 pp), the book's second section, is concerned with various aspects of food, which he considers "probably humankind's first medicine." Among the foods, confections, condiments, and supplements discussed are peppers, margarine, licorice, cocoa, chocolate, flaxseed, sugar, nuts, and a host of others. Their effects on nutrition, weight, trace element and cholesterol levels, metabolism, and general and specific body chemistry are duly noted.

"Chemistry Here, There, Everywhere" (81 pp, the longest section) opens with the essay that gives the book its title, *The Genie in the Bottle*. According to Schwarcz, "Chemistry is like a genie. It can do a great deal of good if you use it the right way, but if you are thoughtless, the consequences can be dire" (p 20). The essay uses the author's meeting with Barbara Eden, star of the TV sitcom series *I Dream of Genie*, whom he met at a Vancouver trade show (That guy really gets around!), as a takeoff point for a detailed discussion of hydrogen peroxide,

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whose catalytic decomposition was used to produce the jet of smoke that issued from the bottle from which she mysteriously appeared.

The section also deals with such products of everyday life as superabsorbent polymers, calcium carbide, acetylene, neoprene, nylon, acid–base indicators, inks, cheese, dyes, teflon, chlorofluorocarbons (CFCs), asbestos, thallium poisoning, soaps, drain cleaners, borax, silicones, Nutty Putty, plastics, hydrogen, helium, fuel cells, and adhesives.

"Learning from the Past" (44 pp), the fourth section, uses a primarily historical approach to introduce a variety of scientific topics and the persons who contributed to them. These include spectroscopy, the periodic table, genetic modification, Lavoisier's chemical revolution, childbed fever, mesmerism, biotechnology, magnetic resonance imaging (nuclear magnetic resonance—one of the most important diagnostic advances in medical history—that was rechristened because the public associates the word "nuclear" with radioactivity), and the tragedy of elixir sulfanilamide (The sweet but poisonous diethylene glycol was used as a solvent to make it palatable to children).

"Silly Stuff" (28 pp, the shortest section) debunks such pseudoscientific or anti-scientific claims as spoon bending, psychic surgery, biodynamic farming, goat-gland transplants, spiritualism, and anti-SLS diatribes (the mistaken contention that the synthetic detergent sodium lauryl sulfate is carcinogenic).

The reader is instantly drawn into each of the essays by their humorous, ingenious, or catchy titles such as: "A Different Twist on Licorice," "Berry Good News" (the antioxidant effect of blueberries), "Out of the Blue, in Prussia" (Prussian Blue, one of the earliest known pigments), "The Poop on Methane" (explosions of natural gas formed from manure), "The Man who Lost His Head Twice" (Lavoisier), and "pHooey to pHake Health Claims" (the healthy body's buffering ability). Furthermore, in contrast to most popular books on science, many of the essays bear the authoritative stamp of a first-person experience and include sentences such as: "I think I was about twelve years old when I attended my first university lecture." "On Wednesday, June 21, 2000 I achieved a personal best. I surpassed my own record for eating chocolate in a twenty-four-hour period." "Summer did not really begin until the day my mother made cold sour-cherry soup from the first freshly picked tart cherries of the season." "'Those peas look really yucky!' my little daughter whined as she pushed her plate away." "A friend and I were talking, and the conversation turned to the subject of online auctions and all the neat things you can buy." "Other patrons of the Gymtech Health Club, where I regularly pound the treadmill, may think I'm a little batty." "I used the most sophisticated smell-detecting instrument available to humankind: my wife's nose." "As a youngster I had become interested in magic as a hobby." Thus in addition to learning lots of practical science, especially chemistry, we learn much about Schwarcz's family, friends, and personal life.

As one who has written popular articles on chemistry and science for newspapers and magazines, I read the volume with admiration and envy. I kept asking myself "Where did Dr. Joe unearth all these curious and little known facts?" (Of course, a popular book is not expected to include formulas, equations, or references). For example, did you know any of the following? The name "aspirin" was created by combining "spiric acid," as salicylic acid was originally known, with "a" for "acetyl." French chemist Hippolyte Mège-Mouriès first developed margarine in the 1860s in response to Napoléon III's offer of a prize for a cheap butter substitute. Victor Hugo's *Les Misérables* contains the sentence, "Comrades, we will overthrow the government, as sure as there are fifteen acids intermediate between margaric acid and formic acid." Nuns are good subjects for studies on aging, because they tend to have similar lifestyles and abide by the study's protocol. Zygology is the science of joining things together. An 18th-century Prussian-born conjuror called Dr. Katterfelto linked disease to microbes some 80 years before Pasteur.

Schwarcz has a way with words and an amazing talent for creating vivid images to elucidate scientific facts and concepts. As a case in point consider this analogy:

Fats, also referred to as triglycerides, have a molecular structure that resembles a comb with three teeth. The teeth are the fatty acids, and the spine to which they are attached is a three-carbon molecule called glycerol. These fatty acids are composed of chains of carbon atoms of varying lengths, so numerous triglycerides are possible (p 104).

I admit to purloining this striking analogy for use in a recent local newspaper article on soap for National Chemical Week, the theme of which is "Chemistry keeps us clean."

Numerous examples of Schwarcz's sly humor abound. One will suffice: "I remember having my tonsils out under chloroform anesthesia in 1953. Luckily, that was before it was a carcinogen" (p 60). He even slips in whimsy to drive home obvious facts: "Far more California beach bunnies contract [skin] cancer than Montreal nuns" (p 32).

At the risk of appearing to be a pedantic killjoy, I must report that the only disappointing aspect of this otherwise excellent book is the excessive number of errors—misspellings of proper names: "Berkley" for "Berkeley" (Sir William, p 62), "Guiness" for "Guinness" (p 74), "Humphrey" for "Humphry" (Davy, p 135), "X-Lax" for "Ex-Lax" (p 159), "Dipple" for "Dippel" (Johann Konrad, pp 168–170 and 172), "Adolph" for "Adolf" (Baeyer, p 205), "Van der Waals" for "van der Waals" (pp 218–219 and 221), "Kirchoff" for "Kirchhoff" (p 229), "Semmelweiss" for "Semmelweis" (pp 243–245); *"acetobutylium*" for *"acetobutylicum*" (*Clostridium*, p 260); omission of diacritical marks: "Mège-Mouriès" (pp 103–104), "Wöhler" (p 154), "Le Châtelier" (pp 155–156), "Theodore" for "Théodore" (Swarts, p 204), and Francois" for "François" (Rouelle, p 238); errors of fact: "Danish" not "Icelander" (Niels Finsen) and the Nobel Prize that he won in 1903 was for "physiology or medicine" not "medicine" (p 30), Swedish" not "German" (Scheele, p 58), "1892" not "1982" (discovery of calcium carbide, p 154), phenolphthalein was first synthesized (by Baeyer) in 1871 not 1880 (p 158), uranium-235 occurs in natural uranium to the extent of 0.72 not one percent (p 176); grammatical errors: "their" for "his or her" (everyone, p 48), "they" for "he or she" (everyone, p 129), "like" for "as" (p 186, line 1; p 240, line 20), and A.D. should precede not follow numerical dates (p 180 and 196). And, contrary to widespread belief, Paul Revere never actually cried, "The British are coming!" (The colonists all considered themselves British, p 172). None of these minor mistakes should prevent you from enjoying this delightful volume. Incidentally, the subtitle on the cover of the American edition (but not the Canadian edition) incorrectly reads "67" rather than the correct "64 all new commentaries."

In my liberal use of quotes I've tried to give you a glimpse not only of the content but also of the flavor of this unusual

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book. But don't take my word for it. Try it for yourself. I heartily recommend it to scientists, chemists, educators, and anyone interested in the multifaceted ways in which science impacts our quotidian lives. I'm eagerly looking forward to Dr. Joe's third book, *That's the Way the Cookie Crumbles*, which should be in print by the time that you read this review.

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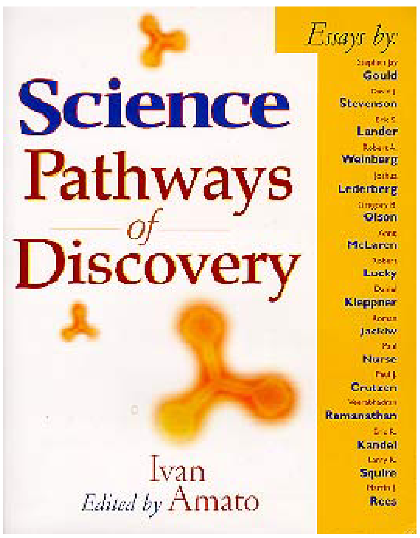
Science Pathways of Discovery. Ivan Amato, Editor. John Wiley & Sons: New York, 2002. Illustrations and tables, v + 247 pp, hardcover. 19.5 × 24.1 cm. $27.95; £20.95. ISBN 0-471-05660-X.



In anticipation of the third millennium, a dozen brilliant, fascinating, and provocative essays by 16 of the world's most distinguished and articulate scientists, many holders of endowed chairs at leading universities, each an undisputed authority in his or her field, and including four Nobel laureates, appeared in the second issue of each month of the year 2000 in *Science* magazine. Best known as one of the most prominent, prestigious, and influential periodicals featuring technical research reports and reviews, this weekly magazine of the American Association for the Advancement of Science (AAAS) also includes news, essays, and commentary written by journalists, scientists, and policymakers, and the breakthroughs that it reports are regularly cited by newspapers and TV programs.

Science had previously featured significant scientific achievements by selecting discoveries as "Breakthroughs of the Year," for example, embryonic stem cell research in 1999. Floyd E. Bloom, editor-in-chief of *Science,* considered these annual retrospectives "both temporally and substantively shortsighted." Therefore he began a "Pathways of Discovery" series, "unlike anything that had been in the magazine before," as part of the its "yearlong special coverage of the transition into the next millennium." The series was coordinated by Ivan Amato, a freelance print and radio science writer, Associate Editor of *Science News*, recipient of the 1995 American Chemical Society's James T. Grady-James H. Stack Award for Interpreting Chemistry for the Public and the 2001 Foresight Prize in Communication, and author of *Stuff: The Materials the World Is Made Of,* a *New York Times* Notable Book of 1997 (BasicBooks: New York, 1997) and *Pushing the Horizon*, an institutional history of the U.S. Naval Research Laboratory.

In introducing the series, Bloom stated:

In the millennium we are about to leave, humanity's knowledge of its place in the universe has moved from St. Thomas Aquinas's view that knowledge was of two types—that which man could know and that which was "higher than man's knowledge" [as quoted by Alan Lightman, New York Times Magazine, September 19, 1999, p. 94] and not to be sought through reason—to the belief begun with Newton's Principia that our universe and all within it are indeed knowable.

According to Johann Wolfgang von Goethe, "Die Geschichte der Wissenschaft ist Wissenschaft selbst" (The history of science is science itself). Thus the essays published in *Science* and collected in this volume provide historical overviews and penetrating insights of the past 500 years of discoveries, survey cutting-edge developments of recent events in the most crucial and exciting areas of science, and offer speculations on the future for each field of inquiry. A 15-page general graphical timeline of major events and discoveries, replete with apposite quotations from some of science's greatest luminaries, and ranging from the prescientific era to 2001, provides context and precedes the essays, each of which includes a more focused timeline of discoveries pertinent to the particular scientific area. Each essay includes references or lists of further readings, some with Web sites, as recent as 1999.

The breadth and scope of the collection and the credentials of the authors can be glimpsed from the following:

(1) "Deconstructing the 'Science Wars' by Reconstructing an Old Mold" (19 pp) by evolutionary biologist, paleontologist, prolific essayist, and passionate New York Yankees fan Stephen Jay Gould (Alexander Agassiz Professor of Zoology and Professor of Geology at Harvard University), who died of cancer on May 20, 2002 at the age of 60, relates an unusual historical tale about some anatomically suggestive and deceptive fossils. First described by Danish naturalist Olaus Worm in 1655, they were called hysteroliths (from the Greek word for womb) or vulva stones because of their appearance, which was similar to the female genitalia. His story illustrates how scientific fact and interpretation evolve within social and cultural contexts that feed back into those very facts and interpretations. In so doing he sets the stage for the topical essays that follow by considering the approach that characterizes the scientific way of understanding our world. He undermines much of the foundation for the current so-called "science wars" raging between the "realists," who maintain that science moves progressively toward objective truth, and the "relativists," who assert that all claims of truth, including those of science, depend on the cultural context in which they are made. He concludes, "Science advances within a changing and contingent nexus of human relations, not outside the social order and despite its impediments."

In numerous ways the essays that follow show that realists and relativists are both correct, and the purported dichotomy is a false one. Each essay embarks from a different perspective, but each is replete with discussions of concepts, personalities, breakthroughs, setbacks, and eventual discoveries, and each gives deep, awe-inspiring perceptions into how scientists ask

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questions and seek answers about ourselves, our world, or our universe.

(2) "Planetary Science: A Space Odyssey" (16 pp) by David J. Stevenson (George Van Osdol Professor of Planetary Science at the California Institute of Technology) conducts readers on a nearly 500-year-long journey that has revealed an exotic and magnificent menagerie of planets and moons in our solar system. As planetary scientists extend their discoveries beyond our cosmic neighborhood, he reminds them that other inhabited worlds may exist there, and he speculates on how life arose and where else it might be in the universe.

(3) "Genomics: Journey to the Center of Biology" (16 pp) by Eric S. Lander and Robert A. Weinberg (both members of the Whitehead Institute for Biomedical Research and Professors of Biology at the Massachusetts Institute of Technology) recapitulates the pathways that led in 2000 to the near completion of the sequence of the human genome and the new science of genomics. They maintain that "Biology enters this century in possession, for the first time, of the mysterious instruction book first postulated by Hippocrates and Aristotle."

(4) "Infectious History" (18 pp) by Joshua Lederberg (former President of Rockefeller University, Sackler Foundation Scholar heading the university's Laboratory of Molecular Genetics and Information, and 1958 Nobel laureate in physiology or medicine) describes the most intimate, rewarding, and tragic intertwined history of humanity and microbes. As he tells what is partially a horror story and partially a celebration of microbial diversity, he suggests that we discard the oversimplified Manichean view of microbes ("We good; they evil") and argues that long-term human survival may require us to embrace a more microbial point of view.

(5) "Designing a New Material World" (17 pp) by Gregory B. Olson (Wilson–Cook Professor of Engineering Design at Northwestern University and founder of the materials design firm, Ques Tek Innovations) briefly reviews the history of the ever-enlarging ability of people to transform available raw substances into more useful materials. However, he devotes most of his essay to the pathways that converge into today's multidisciplinary field of materials science and engineering. He contends that the emerging "systems approach," in which research teams approach materials from all angles, including their atomic structure, is starting to transcend traditional empirical discovery, resulting in an "Age of Design" marked by the systematic invention of unprecedented made-to-order materials. In this way, he predicts that materials scientists will participate in a form of transmutation beyond the dreams of the ancient alchemists.

(6) "Cloning: Pathways to a Pluripotent Future" (15 pp) by Anne McLaren (Principal Research Associate at the Wellcome/CRC Insitute of Cancer and Developmental Biology in Cambridge, England and the only woman author in this collection) follows the pathways that connect the origin of the cell theory of life in the 1830s to the new, unfolding era of cloning science and technology as well as to work on stem cells, which can be made to differentiate into different tissues. McLaren concludes that "The twenty-first century will see many deep ethical conflicts, but it will also see unprecedented biomedical advances that will benefit all humankind."

(7) "The Quickening of Science Communication" (15 pp) by Robert Lucky (Corporate Vice President of Applied Research at Telcordia Technologies) examines the ways in which new communications technologies have changed the practice of science. It reflects on how new scientific discoveries such as the laws of electromagnetism have steered the evolution of communications technology. It considers how the awesome convergence of the Internet, increasing computational power, and communications bandwidth may evolve in the next few decades.

(8) "One Hundred Years of Quantum Physics" (15 pp) by MIT faculty members Daniel Kleppner (Lester Wolfe Professor of Physics and Director of the Center for Ultracold Atoms) and Roman Jackiw (Jerrold Zacharias Professor of Physics) relates how quantum theory, "the most precisely tested and most successful theory in the history of science," originated and developed, how it changed the world, and how it might continue to evolve.

(9) "The Incredible Life and Times of Biological Cells" (14 pp, the shortest essay) by Paul Nurse (Director General of the Imperial Cancer Research Fund (ICRF) in London, Head of the ICRF's Cell Cycle Laboratory, and 2001 Nobel laureate in physiology or medicine) bridges Lander and Weinberg's essay on genomics (Chapter 3) and McLaren's essay on cloning (Chapter 6). Nurse recapitulates the ontogeny of the cell theory and traces the pathways that led to the ascent of the cell to its current central role in biological understanding. He explores the molecular complexities and processes that he and others have discovered while investigating the lives of cells, and he focuses on the mechanisms and controls of cell reproduction that ultimately permit growth, development, and evolution to occur. He concludes with speculations on the ways in which future discoveries should provide further understanding of how cells function.

(10) "The Ascent of Atmospheric Sciences" (14 pp) by Paul J. Crutzen (Professor Emeritus of Atmospheric Science at the Max Planck Institute for Chemistry and 1995 Nobel laureate in chemistry) and Veerabhadran Ramanathan (Professor of Atmospheric Sciences at the Scripps Institute of Oceanography and Director of the institute's Center for Atmospheric Sciences) chart some of the pathways by which the field has evolved from its beginnings in the 17th century into a multidisciplinary high-tech activity, replete with new, sophisticated instrumentation, computers, information technology, and measurements, including satellites and aircraft, that routinely generates globally consequential knowledge. They concentrate on the two environmentally crucial issues of atmospheric ozone and global warming.

(11) "Neuroscience: Breaking Down Barriers to the Study of Brain and Mind" (21 pp, the longest essay) by Eric R. Kandel (University Professor at Columbia University, Senior Investigator at the Howard Hughes Medical Institute, and 2000 Nobel laureate in physiology or medicine) and Larry R. Squire (Research Career Scientist at the Veterans Affairs San Diego Healthcare System and Professor of Psychiatry at the University of California, San Diego) describes how brain research has migrated from the peripheries of biology and psychology to assume a central position within these disciplines. The multidisciplinary field of neuroscience that resulted from this process now encompasses an immense range of subjects from genes to cognition and from molecules to minds.

(12) "Piecing Together the Biggest Puzzle of All" by Martin J. Rees (Royal Society Research Professor, Fellow of King's College in Cambridge, England, and Astronomer Royal at the Royal Observatory at Greenwich) relates how astronomers have systematically revealed the biography of the universe

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from a simple fireball 12 billion years ago to our complex cosmic habitat. Among various up-to-date topics, Rees discusses neutron stars, black holes, and the possibility of multiple universes that emerge from quantum fluctuations. He concludes, "Fundamental questions about our universe that were formerly in the realm of speculation are now within the framework of empirical science."

Many of the essays make difficult reading for non-specialists or laypersons. The volume, however, contains something for everyone (most contain material of interest to chemists). I heartily recommend it to anyone concerned with the genesis, development, and major achievements of the past half-millennium's scientific enterprise.

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Orgo Cards: Organic Chemistry Review. By Steven Q. Wang, M.D.; Babak Razani, Ph.D.; Edward J. K. Lee; Jennifer Wu, M.D.; and William Berkowitz, Ph.D. Barrons Educational Series, 250 Wireless Blvd, Hauppauge NY, 11788, 1-800-645-3476. $18.95 U.S.; $26.50 Canada. ISBN: 0-7641-7503-3.

This set of organic chemistry flashcards was written by a set of medical students and an organic chemistry professor as an attempt to summarize the vast amount of material traditionally taught in college organic chemistry with the goal that organic chemistry could be better learned and mastered for both college organic chemistry courses and subsequent standardized exams, such as the MCAT. The cards contain a thorough presentation of all the major functional groups present in organic molecules and march through the material in much the same way that a textbook would.

Each functional group is introduced via its physical properties, chemical properties, nomenclature, and spectral properties. The spectroscopy section provides the characteristic infrared bands as well as proton and carbon NMR shifts for each functional group. Most of our students won't learn spectroscopy until they are well into the course, and it is only after this that we introduce spectroscopy as a part of the physical properties of a particular functional group; however, if these cards are used for review purposes, the inclusion of this material from the beginning is useful.

After the introductory card for each functional group, there is a card for each common synthesis and reaction of each functional group. These cards contain a representative reaction, key points about the reaction, notes about competing or similar reactions as well as a reaction mechanism. The mechanisms are described in prose and written out with molecular drawings and electron-pushing arrows and are well done. Like our textbooks, there is a section on carbohydrates and amino acids. The cards conclude with a "synthetic map," which looks to me as if it connects all the functional groups in a continual reaction scheme, but which would be far too complex for our students to understand. The cards also contain a summary chart of spectroscopic values, pK_a values, and an index.

These cards certainly go a big step farther than the "reaction flashcards" that I encourage my students to write as my course progresses. They are a compact source of perhaps everything that should be memorized in organic chemistry or perhaps learned for the MCAT; however, I feel extensive use of them would encourage rote memorization of the subject material and take time away from the learning that occurs when one writes out reactions with one's own hand (even one's own flash cards), and solves new problems. The material has only been mastered when a learned reaction mechanism or thought process can be applied to a new situation. I would be hesitant to recommend these cards for my own students as I would worry that the students wouldn't work at many problems and instead would just memorize the cards. As a review tool, however, especially for those taking a chemistry GRE or MCAT examination, the cards are very useful.

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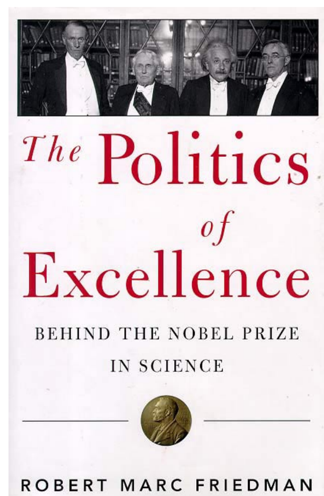
The Politics of Excellence: Behind the Nobel Prize in Science. Robert Marc Friedman. Times Books, Henry Holt and Company: New York, 2001. xv + 379 pp, hardcover. 16.0 × 24.2 cm. $30.00. ISBN 0-7167-3103-7.



The Nobel Prize represents the highest recognition that scientists, writers, statesmen, and other individuals can receive and the only one with which the general public is familiar. Through the years interest in this international award has continued unabated. In 2000 Ron Howard's film, "A Beautiful Mind," based on Sylvia Nasar's best-selling book and starring Russell Crowe as 1994 Nobel economics laureate John Nash, garnered four academy awards.

In the year 2001, which marked the centennial of the awarding of the first Nobel prizes, a spate of books and articles [1] about this *ne plus ultra* of awards appeared. *The Politics of Excellence*, which presents an unprecedented detailed behind-the-scenes study of the prizes in chemistry and physics, is one of the best, most readable, and most meticulously documented of these.

In 1974 the Nobel Foundation decided to grant qualified scholars access to its previously secret archives that were more than fifty years old, thus allowing an "inside view" of the world's most prestigious award. For the chemistry and physics prizes data on the nominators and nominees are available in handy paperback book format [2]. Elisabeth Crawford, a

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sociologist and historian of science who has carried out research in these archives, has criticized the awards on a number of grounds, such as the neglect of entire fields not provided in Nobel's will [3], the priority assigned to experimental investigations, the advanced age of some of the laureates, and the influence of politics and culture, in addition to science, on the prizes [4]. As one of the few professional historians of science researching modern Swedish science, Robert Marc Friedman, now professor of the history of science at the University of Oslo, Norway and formerly of the University of California, San Diego, was invited in 1980 to work in the archives, resulting in his first article on the Nobel Prize in 1981 [5]. During the ensuing two decades he has subsequently received support for his studies of the prize from research foundations in the United States, Sweden, and Norway.

Friedman has also made use of numerous other archival sources such as the private archives of the members of the Nobel committees, who play such crucial roles in the selection process, and collections of unpublished papers in Sweden, Norway, Finland, Denmark, England, and the United States. In his own words, his book "explores the history of why and how various people used the Nobel Prize to further their own scientific, cultural, and personal agendas (p ix)."

Friedman has investigated how the selection process proceeds and if the awards are conferred in at least the spirit if not the letter of Nobel's will. The archives show that from their inception the awards have reflected the changing priorities, arrogance, racism, hostility, sexism, inconsistencies, politics, ambitions, open and hidden agendas, biases, rivalries, vanities, pettiness, prejudices, and narrow personal, scientific, and cultural self-interests of committee members who evaluate nominations. The devil is in the details, and unfortunately dynamite magnate Alfred Bernhard Nobel (1833–1895) provided few of these in his will. The selection process was made difficult by the ambiguous directions that prizes should go to persons who "shall have conferred the greatest benefit on mankind" [3] with no further details as to how these persons should be selected. Friedman concludes that the process is nowhere near as impartial or objective as is generally believed. He maintains that often "success or failure in winning a prize has not depended upon a timeless, fixed standard of excellence" but has often been based more on the "changing priorities and agendas of committee members, as well as their comprehension of scientific accomplishment" (p ix).

A large portion of the book is devoted to numerous detailed and fascinating case studies of both successful and unsuccessful candidates, which are examined in the context of the national and international events that influence the selection of the awardees. On several occasions the committee denied recognition of true brilliance while rewarding mediocrity.

In his "Introduction" (9 pp) Friedman presents a succinct summary of the history of the prizes, the state of Swedish society at the turn of the 20th century, and the history and nature of the organizations involved in the selection of the prizes—the Royal Swedish Academy of Sciences (founded in 1739), which awards the chemistry and physics prizes, the venerable but conservative Uppsala University (founded in 1477), where most of the academy's chemists and physicists were educated and where many of the committee members were professors, and the more recent and progressive Stockholm Högskola (founded in 1878), now Stockholm University, another source of committee members. The pettiness and hostility between academics from the latter two institutions often stymied collective action, a theme that becomes apparent as Friedman's story unfolds. The chapter is typical of the rest of the book in viewing almost everything in the context and *milieu* of Swedish and international society rather than as isolated events.

Friedman has divided his book into five parts and 14 chapters, the titles of most of which are quotations from committee members or others involved with the prizes. Each chapter also has a catchy, clever, or amusing subtitle, quite unusual in a scholarly tome.

- Part I, "Permanent Battles Will Surely Be Waged for Every Prize" (4 chapters, 58 pp, the longest part), deals with the period 1897, the year that Nobel's will was made public, to 1914, the advent of World War I.
  In Chapter 1, "The Stupidest Use of a Bequest That I Can Imagine!" (13 pp)—a statement made by Stockholm Högskola chemist and oceanographer Otto Pettersson—Friedman describes Nobel's will, the early difficulties in interpreting its intentions, and the award selection process. Chapter 2, "Coming Apart at the Seams" (14 pp), examines the earliest prizes awarded in chemistry and the search for consensus in the selection process, which sometimes yielded results that left much to be desired. By 1907 few candidates stood head and shoulders above others; nominators provided little consensus as to whom might be most deserving. Committee members necessarily had to rely on their own insight and understanding in selecting winners, and they frequently found it difficult to agree among themselves on who should receive the prize. Even when nominators could provide mandates for particular nominees, from the very beginning, members of the committee, who presented their recommendations to the Royal Swedish Academy of Sciences, and the academy's members came to regard the prizes as theirs to dispose.
  Chapter 3, "Sympathy for an Area Closely Connected with My Own Specialty" (14 pp), examines the bias toward experimental work to the neglect of mathematical and theoretical work in awarding the early physics prizes. For example, Albert Abraham Michelson, the first American to win a science prize, was awarded the 1907 physics prize based on scanty support from nominators "for his optical precision instruments and the spectroscopic and metrological investigations carried out with their aid" largely because measurement was a specialty of committee member Bernhard Hasselberg. Michelson's more important attempt to measure the Earth's movements in the ether was ignored.
  Chapter 4, "Each Nobel Prize Can Be Likened to a Swedish Flag" (15 pp), examines cases in which the Academy, in its preference for "local heroes," ignored the committees' recommendations. It also describes how, in an atmosphere of peaceful European obsession with competition in the arts and sciences, the prizes and the attendant ceremony, with its glitter and pomp, quickly became a display of the Oscarian monarchy and a symbol of Swedish national identity. Because of the dark, cold weather prevailing on December 10th, the anniversary of Nobel's death, attempts were even made to change the date of the award, which had become virtually a national

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holiday, to the summer, when attendance would be better. Friedman reminds us how, from the start, the Nobel Prize functioned as a Swedish institution that became enmeshed with Swedish cultural and scientific concerns.

- Part II, "Has the Swedish Academy of Sciences… Seen Nothing, Heard Nothing, and Understood Nothing? (2 chapters, 45 pp)—a question asked in the French newspaper *Le Journal* in 1920 concerning Fritz Haber's chemistry prize—deals with World War I, its consequences, and its effects on the awarding of the prizes.

  Chapter 5, "Should the Nobel Prize Be Awarded in Wartime?" (22 pp)—a question asked editorially by the Stockholm newspaper *Aftonbladet*—considers the dilemma faced by neutral Sweden to avoid any semblance of bias in favor of the Allies or the Central Powers. However, neutrality proved to be extremely political. Swedish élites, including most members of the Academy of Sciences, possessed close links with Germany so their definition of neutrality often included a strong German bias. The 1914 prizes were postponed and awarded the following year to Theodore William Richards (the first American chemistry laureate) and the German Max von Laue (physics).

  Chapter 6, "While the Sores Are Still Dripping Blood!" (23 pp), reveals the continuing feuds involved in the selection process during the first "total war," which called on scientists and especially chemists to participate increasingly in the conflict. The award of the 1918 chemistry prize to the German Fritz Haber, who introduced gas warfare in April 1915, "for the synthesis of ammonia from its elements" remained particularly controversial, even years after the armistice.

  Much of the early enthusiasm for the Nobel Prize entailed the Western world's widespread belief that the peaceful competition among the so-called "civilized" nations would bring enduring peace and better social conditions for all. The horrors of the seemingly never-ending war, compounded by the fear of spreading Bolshevik revolutions, shattered this underlying idealism for celebrating the prizes. Yet sufficient less-than-idealistic reasons for interest in the prize quickly became apparent in the ensuing years. Even when leading scientists and journalists understood that the prizes did not and could not function as an impartial and objective selection of the very best, they supported the subsequent growing cult of the prize. Competition continued after the war's end: Nations, regions, institutions, science establishments within nations and particular subdisciplines within science, and individuals all increasingly competed for prestige, authority, and resources. Nevertheless, many who knew better suspended critical judgment on the prizes, knowing full well that a favorable decision could allow them to take advantage of vast media and political interest.

- Part III, "Small Popes in Uppsala" (3 chapters, 58 pp)—a phrase used by 1903 chemistry laureate and extremely influential committee member Svante Arrhenius to refer to three pivotal committee members Allvar Gullstrand, Carl Wilhelm Oseen, and Manne Siegbahn—deals with the physics prize during the period 1920–1933, a time of dramatic change in physics—a veritable golden era.

  Chapter 7, "Einstein Must Never Get a Nobel Prize!" (22 pp)—a remark by Allvar Gullstrand—examines the embarrassment for the Royal Swedish Academy caused by its failure to recognize "the man who became the greatest scientific celebrity since Newton" following the confirmation of his general relativity theory by data collected during an eclipse of the sun in 1919. Einstein had been nominated repeatedly for more than a decade before he finally received the prize in physics in 1921 thanks to political maneuvering by Oseen—and then for his discovery of the law of the photoelectric effect rather than his general or special theory of relativity, which conservative committee members considered too metaphysical and radical.

  Chapter 8, "To Sit on a Nobel Committee Is Like Sitting on Quicksand" (22 pp)—a statement by chemistry committee member Oskar Widman, describes how the machinations of two new committee members, theoretician Oseen of Uppsala and experimentalist Siegbahn of Lund, to invigorate Swedish physics and the opposition that their actions prompted, influenced the prize. In 1923, together with committee members Arrhenius and Gullstrand, they eliminated astrophysics from consideration, thus making it possible for committee members, independently of the nominators, to either advance a candidate toward the prize or eliminate him from consideration. Thus Robert A. Millikan, "a meticulous master of measurement," was awarded the 1923 physics prize, while his Caltech colleague, astrophysicist George Ellery Hale, who had been nominated since 1909 and previously declared worthy of a prize by earlier committees, never won the prize because of internal politics on the committee. Also, committee members withheld the prize as often as possible because the money then reverted to funds, the interest from which could be used for research grants. After he received the 1924 prize (in 1925), Siegbahn, whose actual understanding of physics has been questioned, became more powerful than ever and, together with Oseen, dominated the committee for two decades.

  In Chapter 9, "Clamor in the Academy" (13 pp)—a phrase used by Otto Pettersson to describe the uproar caused by Oseen's attempt to remove Vilhelm Carlheim-Gyllensköld from the committee—Friedman relates how Oseen tried to subdue those who opposed his aggressive domination of the committee. Some candidates who might otherwise not have received prizes, such as French physicist Jean Perrin, Swedish chemist The Svedberg, and English physicists C. T. R. Wison and O. W. Richardson, benefited from the rebellions and counter-measures within the committee and academy. Oseen also created various hurdles for Erwin Schrödinger and Werner Heisenberg's candidacy, despite the obvious importance of quantum mechanics. The Great Depression, the advent of the Nazi regime, and increasing international tensions disrupted the usual patterns of nominations. Friedman argues that during the 1930s the odd omissions, delays, and winners can be ascribed to the committee's internal dynamics and to the politics of the nominations.

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- Part IV, "Don't Shoot the Piano Player, He's Doing the Best He Can" (2 chapters, 32 pp, the shortest part)—an admonition by chemistry committee member Henrik Söderbaum—deals with the quest for a standard for the chemistry prize during the period 1920–1940.

  Chapter 10, "It Can Happen That Pure Pettiness Enters" (11 pp, the shortest chapter), describes the committee's search for consensus in view of the limited numbers of nominations. In a flagrant case of pronounced animus during this period Arrhenius used his influential position to block for a decade and a half the chemistry prize for Walther Nernst, who was nominated annually for a total of 58 times from 1906 to 1921, when he finally received the prize. To be considered for a prize the candidate needed an advocate on the committee, and few factors other than luck and committee preference distinguished winners from losers during the interwar years.

  In Chapter 11, "One Ought to Think the Matter over Twice" (21 pp), we are introduced to committee members The Svedberg and Hans von Euler-Chelpin, who left their stamp on the committee and its decisions. The two received chemistry prizes in 1926 (the 25th anniversary of the prize) and 1929, respectively, and they used their influence to advance their own interests.

  They worked to pull the boundary of chemistry with respect to the prize much deeper into the sphere of biomedical research. The chapter's title represents committee member Ludwig Ramberg's appeal against the biochemical drift of the prize decisions. Ramberg often stood alone in advocating nominees who contributed to basic theoretical understanding of chemical principles, but he stood alone as the others either did not understand or refused to acknowledge the need of advanced physical theory in chemistry. For example, Gilbert Newton ("G. N.") Lewis, longtime head of the University of California, Berkeley's College of Chemistry and one of the 20th century's greatest theoretical chemists, was nominated for the prize numerous times in at least eleven different years between 1922 and 1935. Yet he failed to receive the prize because his pioneering theoretical work was not considered a valid area of chemistry, while less brilliant chemists did so with only a single nomination in a single year.

  Similarly, the Swiss-born Norwegian, Victor Moritz Goldschmidt, the founder of modern geochemistry, who discovered the laws determining the distribution of the chemical elements not only on earth but also in the universe, failed to receive the prize on the grounds that his work was in a "hybrid specialty." However, at the same time, a committee majority favored contributions to the hybrid in which its members increasingly worked, namely, biochemistry. Friedman provides evidence to show that the committee was "far from consensual, impartial, or omniscient" and that "to say that the chemistry prizes awarded between the wars represented a distinct class of excellence is mistaken."

- Part V, "Scandalous Traffic" (3 chapters, 54 pp)—the phrase used by Otto Pettersson to describe the fact that the committees were ignoring Alfred Nobel's intentions and members who had received a prize also received most of the grant money—shows how Nobel's legacy was subverted in the name of science.

  Chapter 12, "Dazzling Dialects" [*sic*] (12 pp)—an evaluation by Otto Pettersson's son, Hans, of Oseen's tactics in blatantly reserving and then withholding prizes to divert money to special funds from which committee members could receive grants for their own research (the correct phrase is actually "dazzling dialectics")—deals in detail with this practice and the resentment that it engendered.

  Chapter 13, "Completely Lacking an Unambiguous, Objective Standard" (26 pp, the longest chapter), shows the prize's becoming a means of bestowing authority and prestige on potential scientific leaders, which became increasingly important as the era of "Big Science" began to emerge. The cases of two candidates, one of whom received the prize and one who did not, show that the committees used sliding scales of criteria that suited their immediate concerns.

  Siegbahn evaluated and lobbied for Ernest O. Lawrence, whose cyclotron had been used to create numerous isotopes but no specific breakthrough. Rather than following committee precedence and waiting for a major discovery from this new instrument, Siegbahn, who was building his own cyclotron with help from Lawrence's team in Berkeley, pushed to get Lawrence the 1939 physics prize. Once he had won the prize, Lawrence received a $1 million grant from the Rockefeller Foundation; he then urged the foundation's support for a similar grant to Siegbahn.

  On the other hand, the Jewish Austrian physicist Lise Meitner, who was the intellectual leader of the team of German chemists Otto Hahn and Fritz Strassmann and played a prominent role in the nuclear fission of uranium that ushered in the Atomic Age, was nominated for the chemistry and physics prize over eight years. Nazi racial policies drove her from Germany to Sweden, where she worked in the laboratory of Siegbahn, who disliked her and her vastly superior knowledge of nuclear physics. Politics made it impossible for Hahn to acknowledge their continuing collaboration, and, in a tragic miscarriage of justice, Hahn alone received the 1944 chemistry prize in 1945. And although Meitner was the first to explain the physical process involved, Siegbahn maintained that fission has little to do with physics although nominators stated that fission was the most important discovery during the past decade in physics. Siegbahn was hoping to lead Sweden's emerging nuclear commitment—and even promised a Swedish atomic bomb if he received enough funding. The absurd and dishonest assessment was a means to ensure that Meitner did not receive a prize, which would have allowed her to threaten Siegbahn's leadership in Sweden. Friedman concludes that by "the mid-1940s Nobel prizes were not awarded on the basis of recognizing merit; instead, they had become to a great extent instruments in the politics of science."

  Chapter 14, "The Knights Templar" (17 pp)—how America treated its Nobel laureates according to The Svedberg—recounts the transformation of the prize, prominent in the past, to an international icon as Americans set the tone for the post-World War II infatuation with the Nobel, which Friedman calls "Nobel fever." He considers the prize as diplomacy—Artturi I. Virtanen (1945 chemistry) and P. M. S. Blackett (1948 physics) and the prize as alliance—Wendell M. Stanley

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(1946 chemistry), Glenn T. Seaborg and Edwin M. McMillan (1950 chemistry), and John D. Cockcroft (1951 physics).

Friedman does not limit his studies of the prizes to the first half-century—the period for which the official Nobel archives are accessible. By drawing on correspondence found in archives, he shows that no magic dates exist after which the process of deciding who should receive a prize has become purely objective and impartial. He concludes that although the selection process has been improved, for example, by inviting a larger number of nominators representing broader geographical and disciplinary interests, it never achieves the objectivity and consensus that the public assumes. In short it has remained "a highly subjective and personal 'politics of excellence'."

In "Further Reflections" (11 pp) Friedman outlines why and how the prizes assumed such a prominent role in world culture. He debunks the widely held belief that the prestige of the prize reflects the fact that the Royal Swedish Academy of Sciences has chosen the recipients so well. In fact, a cult of the prize arose during the very first years, well before any record could be achieved. The will to believe in the prize and to elevate it to mythical status developed almost independently of the selection of prizewinners. The mass media owes more to the history of changing and varied uses than to providing a unique population of the alleged very best.

Widely venerated as a mark of genius, the prizes have been regarded by various nations and groups as a sign of their national, educational, or cultural superiority. They were intended to be international in scope [3], but from the very inception of the prizes the Royal Swedish Academy of Sciences based its decisions on the recommendations of its five-member committees for the two fields (chemistry and physics). Until 1921 German scientists received almost 50 percent of the awards, possibly because Swedish scientists had much stronger connections to German science than to American and British science.

Of course, Germany was the leading scientific nation, but, as Friedman shows in a number of cases, loyalty to German colleagues at times broke a committee deadlock or uncertainty. Since the end of World War II, in line with U.S. hegemony in the sciences and other fields, Americans have received the largest proportion of prizes. But here again, as the record for the years after the war reveal, some committee members clearly hoped to use the prize to improve relations with what they considered critically important scientific communities.

The ancient Olympic Games were revived in 1896, the year of Nobel's death and a year before his will was made public. The Nobel Prize has long been considered an impartial Olympics of science and culture, yet today the Olympics themselves have been tainted. Green Bay Packers coach Vince Lombardi's purported dictum, "Winning isn't only the most important thing, it's the only thing," reigns supreme and unquestioned in sports, and nations work themselves into frenzies over athletic competitions. Apparently, this attitude is spilling over into scientific awards, including the "crème de la crème"—the Nobel Prize.

Friedman reflects on the influence that this growing obsession with "winning" the game of science has had on the soul of science in recent times. He reminds us of older traditions in science that valued research as a moral activity. Shouldn't science be more than a race for discovery and for The Prize?

Also, although science has increasingly become a collaborative, cumulative enterprise involving large research teams, Friedman is concerned that the highly publicized focus on a pantheon of individuals may present a distorted picture of how science actually advances. While not denying the role of genius and individual insight, he shows that most prizes awarded to one or two individuals unfairly give credit that several scientists deserve to share.

Many fans of the Nobels simply want some way of defining individual heroes, but, as this book so well demonstrates, winning a prize makes for a flawed criterion for creating a hall of fame for science. In any given year several candidates could be found who deserved a prize; which ones should receive it had to be a subjective judgment in which a range of concerns and interests could enter over and beyond purely scientific ones. Friedman concludes with reflections on what the role of the prizes should be in honoring the contributions of scientists in the 21st century.

The book includes three appendices—A. "Winners of the Nobel Prize in Physics and Chemistry, 1901–2000 (5 pp); B. physics and chemistry "Committee Members, 1900–1951," which includes years of service, affiliation, and field of specialization (The concentration of power in the hands of a relatively small number of individuals is underscored by the fact that during this half-century a total of only 15 men [no women] served as committee members for each field [2 pp]); and C. "Money Matters," the prize amounts in Swedish kronor, U.S. $, and U.K. £, and variations in the funds, 1901–1940 (2 pp). The reader is not distracted by reference numbers in the text, but complete documentation is given in 72 pages of notes. A detailed index (19 double-column pp) facilitates location of material.

The book's errors are few and comparatively minor, considering its length and detail. Most involve proper names, for example, Sonja Kowalevski for Sofia Kovalevskaia (pp 8 and 369), Edward for Edvard (Hjelt, pp 28, 54, and 368), Marcelin for Marcellin (Berthelot, pp 29 and 31), Le Ronsignal for Le Rossignol (Robert, Fritz Haber's co-worker, p 106), Morely for Morley (of Michelson–Morley fame, p 124), Bridgeman for Bridgman (pp 229, 248, and 363), and Semonov for Semenov (pp 255 and 375). Typos include "past" for "passed" (p 90), "ammoniac" for "ammonia" (p 107), "alliotropic" for "allotropic" (p 174), "dissention" for "dissension" (p 181), while an alpha particle consists of two neutrons in addition to two protons (p 225).

Friedman's book cogently demonstrates that "excellence is not an unambiguous concept, not even in science" (p ix). Although he is often critical, his book should not be construed as an attack on science or the Royal Swedish Academy of Sciences. Instead, he asks us "to reflect upon the meaning of such prizes in a culture characterized by intense competition for resources, indecorous commercialism, and hype. As a new century dawns, and the scientific community adjusts to a post-cold war era, how should we rethink and reclaim Alfred Nobel's legacy?" (p x).

I am pleased to recommend this excellent and modestly priced survey of the 20th century's most prestigious science prizes, both to the public in general as well as to scholars interested in chemistry, physics, scientific institutions, and science and its history.

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2. Crawford, E.; Heilbron, J. L.; Ullrich, R. *The Nobel Population 1901–1937: A Census of the Nominators and Nominees for the Prizes in Physics and Chemistry;* Office for History of Science and Technology, University of California: Berkeley, CA; Office for History of Science, Uppsala University: Uppsala, Sweden, 1987.
3. According to Nobel's will, written by hand in Paris and dated November 27, 1895, about a year before his death, "The whole of my remaining realizable estate shall be dealt with in the following way: The capital shall be invested by my executors in safe securities and shall constitute a fund, the interest on which shall be annually distributed in the form of prizes to those who, during the preceding year, shall have conferred the greatest benefit on mankind. The said interest shall be divided into five equal parts, which shall be apportioned as follows: one part to the person who shall have made the most important discovery or invention in the field of physics; one part to the person who shall have made the most important chemical discovery or improvement; one part to the person who shall have made the most important discovery within the domain of physiology or medicine; one part to the person who shall have produced in the field of literature the most outstanding work of an idealistic tendency; and one part to the person who shall have done the most or the best work for fraternity among nations, for the abolition or reduction of standing armies and for the holding and promotion of peace conferences. The prizes for physics and chemistry shall be awarded by the Swedish Academy of Sciences (*Svenska Vetenskapsakademien*); that for physiological or medical works by the Caroline Institute in Stockholm (*Carolinska Institutet i Stockholm*); that for literature by the Academy in Stockholm (*Academien i Stockholm*); and that for champions of peace by a committee of five persons to be elected by the Norwegian Parliament (*Norska Stortinget*). It is my express wish that in awarding the prizes no consideration whatever shall be given to the nationality of the candidates, so that the most worthy shall receive the prize, whether he be a Scandinavian or not" (Schück, H. Alfred Nobel: A Biographical Sketch. In *Nobel: The Man and His Prizes,* 3rd ed.; Nobel Foundation and Odelberg, W., Eds.; American Elsevier Publishing Co.: New York, London, Amsterdam, 1972; pp x–xi).
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Chemistry: The Molecular Science, First Edition. John W. Moore, Conrad L. Stanitski, and Peter C. Jurs. Brooks/Cole Pub Co.: Monterrey, CA, May 2001. 1184 pp, hardcover. $125.50 (includes CD-ROM). ISBN 0-0303-2011-9.

Drs. Moore, Stanitski, and Jurs have done an enormous amount of work to bring the volume, "Chemistry: The Molecular Science" to those who would teach and learn general-level college chemistry. The book is well written, visually appealing, and logically organized. It is also a new entry into a very saturated field.

The organization of this book follows for the most part what has become a standard pattern, but with a few modernizing twists. Nomenclature, stoichiometry, reaction chemistry, reaction energetics, molecular structure, and gas laws are all treated in the first half of the book. The second half deals with kinetics, thermodynamics, electrochemistry, and the specialty subjects that are usually covered and examined in detail in a general chemistry text. But this book inserts a chapter titled "Fuels, Organic Chemicals, and Polymers" right into the middle. This added emphasis on organic chemistry is an arrangement that has been catching on in general chemistry texts of late, in one form or another, and its placement here will help those faculty members who must squeeze a bit of organic chemistry into a one-semester chemistry class.

To be fair, there is a certain amount of organic chemistry scattered into other chapters as well, such as chapter 8, "Covalent Bonding." This chapter treats organic chemistry in more detail than the usual first contact with Lewis structures, examining subjects such as cis–trans isomerism and isomerism in aromatic compounds. Overall though, the organization of the chapter is not radically different from the many other texts in the area.

The graphics of the book are certainly advanced, which may be as much a desire of Brooks/Cole, the publisher, as it is of the authors. Hard-core teachers of first-year, general chemistry might claim that such art, and especially the use of what could be called cartoon bubbles, is actually too much eye candy for such a book. The authors and publisher though are apparently of the belief that an eye-catching set of pages is one that students will at least want to open. Whether or not it is a plus, pragmatically one can say colorful artwork goes a long way to make a book attractive, but at the same time raises the price tag for the ultimate users—the students.

Questions and problems throughout and at the end of the chapters are numerous for most topics, and at the end of the chapters they are divided into sections. Additional, end-of-chapter questions are added under the headings "General Questions" and "Applying Concepts," which give more breadth to what is asked in all cases. The number and scope of questions and practice problems is a plus for the book, because many students consider general chemistry more of a class in which to solve problems than one in which to just read a text. On the other hand, this is often a more important feature for faculty than for students, because it allows faculty teaching to various levels of students all to utilize the same book.

Additionally, Moore, Stanitski, and Jurs have bought into the icon craze in textbooks with a passion. In the past ten years it has become fashionable to use an icon to reinforce or point out some specific item or feature in the body of the text. This book has icons for: organic chemistry, biochemistry, concepts, and the CD-ROM tie-in. It's perhaps a bit of overload, but at least students can't claim ignorance of an important point because it wasn't made obvious to them.

The authors of "Chemistry: The Molecular Science" are three highly accomplished chemical educators; there is no doubt about it. They have put together a book that should appeal to a wide-ranging audience of faculty at colleges and universities throughout the country. So, what's the final take on this book? On the up side, it is a very well written textbook that can be used in a wide variety of general chemistry settings. On the down side, for all the accomplishments and hard work of the authors, the book does not stand out from a crowded field.

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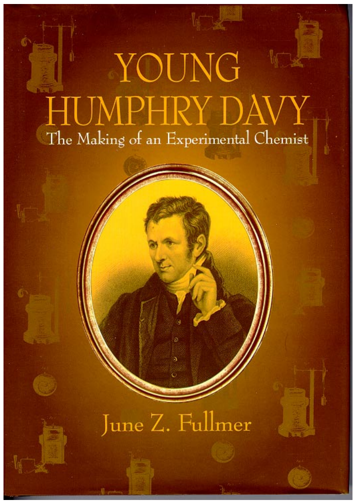
Young Humphry Davy: The Making of an Experimental Chemist. June Z. Fullmer. American Philosophical Society: Philadelphia, PA, 2000. 15 illustrations. xvi + 385 pp, hardcover. 18.1 × 25.8 cm. $30.00. ISBN 0-87169-237-6.



Sir Humphry Davy (1778–1829) was my first scientific hero, a true romantic and one of the most fascinating and exemplary chemists of all time. The saga of this Cornish youth and his rapid rise to the professorship of the Royal Institution, popular science lecturer *par excellence*, darling of London society, recipient at the age of 33 of a knighthood from the Prince Regent, and president of the Royal Society, the highest position in British science, at the age of 41, made an indelible impression on my adolescent mind.

In every possible way I emulated my idol and role model. In my boyish enthusiasm, I followed his dangerous propensity for testing the physiological effects of various substances on myself. In Davy's case, this practice may have contributed to his early death at age fifty. I duplicated his preparation of nitrous oxide by heating ammonium nitrate before the Texas City explosion of April 16, 1947, the United States' worst industrial accident, made me aware of the danger inherent in heating this endothermic substance. I unsuccessfully tried to duplicate Davy's electrolytic preparation of metallic potassium (As one of the founders of electrochemistry, he was the first to isolate potassium and sodium [1807] and barium, strontium, calcium, magnesium, and boron [1808]).

Davy achieved fame as a poet as well as a chemist and natural philosopher, and he continued to write poetry almost until he died. Among his friends were the Romantic bards William Wordsworth, Lord Byron, and Samuel Taylor Coleridge, who attended Davy's lectures "to increase his stock of metaphors." I began to write poetry on chemical themes, and later, as a professor, I devoted considerable time to preparing lectures and demonstrations—activities in which Davy and his "greatest discovery," his protégé Michael Faraday, excelled. Thus I have long had a personal and professional concern with the man who successfully aspired to become the Newton of his day (He was the first scientist to be knighted since Newton, and when he received a baronetcy, the highest honor conferred on a British scientist, he surpassed Sir Isaac himself).

Davy made the Royal Institution, supported by money paid to attend his public lectures, Britain's premiere research institution. His zeal and showmanship in popularizing his experimental discoveries in chemistry, electrochemistry, agriculture, geology, and catalysis brought him the patronage of influential people and made him the first advocate of applied science. His inventions included the carbon arc light, miner's safety lamp, and cathodic protection to prevent corrosion of the copper hulls of warships, a principle still in use today. At a time when science as a career was most unusual, he became a professional scientist when only the Astronomer Royal could be so described.

In 1813, at the pinnacle of his meteoric career, Davy resigned his professorship and began to travel on the Continent, accompanied by his wife, Faraday, and two chests of apparatus to continue his experiments. After 1820 his health deteriorated, and he died on May 28, 1829 in Geneva. He left no school of disciples to continue his work.

Thus it was with more than usual interest that I awaited the appearance of *Young Humphry Davy*. Its author, June Z. Fullmer, devoted four decades to the study of Davy, which began with the publication of an article on his poetry [1]. The monograph under review here was intended as the first volume of a multivolume life-and-letters biography; however, it proved to be her swan song, for she died on January 31, 2000 at the age of 79 after putting the finishing touches on the manuscript.

June Zimmerman was born on December 12, 1920 and received her B.S. and M.S. degrees from the Illinois Institute of Technology in 1943 and 1945, respectively [2]. In 1948 she was awarded her Ph.D. in physical chemistry from Bryn Mawr College. After a year (1949–1950) of postdoctoral research with Sir Cyril Hinshelwood (1956 Nobel chemistry laureate) at Oxford University as a Sarah Berliner Fellow of the American Association of University Women, she served as Assistant Professor of Chemistry at Chatham College in Pittsburgh, PA (1950–1955) and Associate Professor and Head of the Chemistry Department (1955–1964) at Newcomb College, the women's college of Tulane University, New Orleans, LA, where she taught her first course in the history of science. In 1953 she married Paul Fullmer, who died on January 6, 2000, predeceasing her by only several weeks.

After a short stint at Ohio Wesleyan University, in 1966 June became Associate Professor of History at Ohio State University, where she earned a reputation as an excellent teacher, scholar, and encourager of and role model for women historians of science. In 1966 she became the second woman Full Professor of History at OSU. Her critically acclaimed biobibliography of Davy [3], whom she used to explicate the more general history of chemistry, appeared in 1969. She was active in various history of science organizations and succeeded me as Chairman of the American Chemical Society's Division of History of Chemistry in 1971. After her retirement in 1989, she continued her research and writing. In 2000 the American Philosophical Society, which published her latest and last book as Volume 237 of its *Memoirs,* bestowed on her its Frederick Lewis Award for her outstanding scholarly achievement. Although ill health slowed her publication program, she leaves us a considerable *oeuvre* and lasting legacy in the field.

Books and essays on Davy abound, beginning with John Ayrton Paris' biography [4], published only two years after Davy's death, and Fullmer discusses and critiques the most important of them. In this volume she limits herself to his first 22 years, from his birth on December 17, 1778 in Penzance, of Gilbert and Sullivan fame, to his arrival in London on March

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11, 1801 to become Assistant Lecturer in Chemistry and Laboratory Director of the Royal Institution. Because of this restricted time frame she is able to recount his personal and professional life in meticulous, occasionally extreme, detail with extensive and lengthy quotations from Davy's notebooks, letters, diaries, memoirs, poetry, moral essays, and informal and published writings. For example, she reports the Davy family income in 1794 as £128 9s. 10d (p 12), she notes the name of Davy's water spaniel (Chloe, pp 25, 264, who "displayed 'joy unbounded'" on his return to Cornwall), and she lists the coach companions on his journey from Penzance to Bristol (p 98), the books that he borrowed from the Bristol Library (p 111-112), the animals (cats, kittens, rabbits, guinea pigs, mice, and goldfinches) on which he tested the effects of nitrous oxide (p 255), and various minutiae from his notebooks.

Davy was the first of five children of an often unemployed woodcarver, Robert Davy (1746–1794), whose death when Humphry was 16 left the mother, Grace Davy, née Millett (1750–1826), with debts that forced her to support the family by opening a millinery shop. In contrast to the common description of his life as a rags-to-riches saga Fullmer emphasizes the fact that, although not rich, his family was prominent in Penzance and far from indigent. Little in Davy's plebian roots presaged his becoming both the most brilliant chemist of his age. Fullmer's goal in writing this book is to account for this transformation by scrupulously examining his family background and formative years. She attempts to answer the question: "How could Davy achieve so much so quickly?" (p 5). In her own words,

> The Humphry Davy of this biography is not yet the fully matured chemical and technological experimenter, not yet the discoverer of new elements, and not yet the seasoned administrator of the scientific enterprise…. This study aims to trace some of the forces which left their imprint upon him. It aims, too, to follow the erratic, sometimes contradictory, often certain trail of a beginning experimenter. It is, ultimately, an attempt to portray the making of a notable experimental natural philosopher at the turn of the nineteenth century (p 7).

In my opinion she succeeds in achieving her goal.

Apprenticed at sixteen to John Bingham Borlase, a Penzance apothecary-surgeon, Davy seemed destined to become a physician. He was largely self-taught, learning chemistry by reading Lavoisier's *Traité élémentaire de chimie* in English translation [5] and William Nicholson's *Dictionary of Chemistry* [6]. The two treatises differed in their approaches—Lavoisier was expository, while Nicholson was didactic. Fullmer discusses them and their influence on Davy's theoretical and experimental activity in detail, quotes from them repeatedly throughout her book, and notes where he came to differ from these mentors.

In 1798 Thomas Beddoes (1760–1808) appointed Davy his assistant at his Pneumatic Institute for treating illnesses by inhaling gases at Clifton near Bristol, where the 20-year-old youth analyzed the oxides of nitrogen to provide John Dalton with the data to support his law of multiple proportions. Beddoes taught Davy the importance of obtaining subsidization for his research, a *sine qua non* for anyone embarking on a scientific research at the time. In 1800 Davy's study of the physiological effects of nitrous oxide still used today as anesthesia, which Fullmer analyzes at considerable length in four chapters, aroused considerable popular as well as scientific attention and made inhaling laughing gas a fashionable fad [7, 8]. Davy used it to assuage the pain in his jaw from his emerging wisdom teeth (He was still not 21!), and he became addicted to it. Davy's publication of his results in Nicholson's *Journal*, which Beddoes magnanimously allowed him to announce without insisting on joint authorship, established him as a full-fledged scientist. Fullmer documents how Davy outpaced his mentor; he renunciated the tenets of pneumatic medicine but remained on friendly terms with Beddoes.

Fullmer devotes two chapters to Davy's embarkation on a fresh line of inquiry. Intrigued by a single observation made during his work on nitrous oxide and learning of Alessandro Volta's "curious" experiments, he began to construct voltaic piles and undertook a series of electrochemical experiments that he was to pursue off and on for the next quarter-century and on which his fame securely rests. Although Fullmer is usually sympathetic to Davy's work, she does not hesitate to criticize it when she feels it necessary as in his earliest publication on galvanism in Nicholson's *Journal*.

Fullmer recounts how Professor Thomas Charles Hope of Edinburgh had visited Beddoes laboratory and met Davy and how Benjamin Thompson (Count Rumford, 1753–1814) worked in Hope's laboratory and learned of Davy's "exceptional chemical abilities." This chance collaboration led to Rumford's offer to Davy of an appointment to the newly founded Royal Institution. Fullmer surveys Davy's first season at the RI, his three series of lectures given during his first season at the RI, and the fulfillment of his great aspiration—Fellowship in the Royal Society:

> Amiable, eager to please, ambitious, hungry for praise, yet awed by the glamour of his audience and his surroundings, he was young Humphry Davy, F.R.S., an established and internationally recognized professional chemist (p 344).

In an 11-page "Afterword" she briefly sketches the events and discoveries of Davy's later years.

Davy maintained judicious balance between theory and practice and was quite agile in adjusting his next experiment to previous unexpected experimental results. He favored facts above theories and was skeptical of Dalton's atomic theory. His relatively short life was motivated by his urge to understand nature and to apply this knowledge to useful purposes. A proud man, he constantly sought to claim for himself "key" reactions and "crucial" experiments, and he carefully dated his experiments to claim priority for his discoveries.

Fullmer has divided her book into three unequal parts, "I. Penzance" (8 chapters, 97 pp); "II. Bristol" (19 chapters, 232 pp, about two-thirds of the volume); and "III. London" (2 chapters, 21 pp). In the first two parts she devotes considerable space to describing the "power structure," culture, and society of Penzance and Bristol and how Davy fitted into them and into the intellectual and literary circles that he frequented. Whenever a person significant in Davy's life is introduced, she discusses the individual in varying amounts of detail based on his or her influence on Davy, in some cases—Dr. Beddoes; his wife, "whom Davy declared was "the most amiable woman in the world;" the philosopher Abraham Tucker, who published under the pseudonym "Edward Search" (1705–1774), and Benjamin Thompson (Count Rumford)—including a full-page portrait and a separate chapter. Fullmer meticulously relates events in Davy's life to the social, political, and cultural context of the time.

Considering the fact that Fullmer was able to see only a few pages of the proofs before her death, the number of errors is remarkably small: for example, "Borale's" for "Borlase's" (p 41), "phosphorous" for "phosphorus" (p 50), and "Watts" for "Watt" (p 88). In the table of contents "2 Afterword [p] 347" is repeated twice. She has utilized archival material and manuscript sources from England, the United States, and Germany, and she provides notes and references at the end of each of the book's 21 chapters, a 12-page select bibliography of books and articles as recent as 1993 and 1992, respectively, and a 15 double-column page index.

I recommend this inexpensive, painstakingly researched and documented, engaging biography to everyone interested in the early years of one of chemistry's brightest luminaries.

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