Media Reviews

Chemistry Comes Alive!, Volume 1. Compiled by Jerrold J. Jacobsen and John W. Moore. Special Issue 18, 1998; CD-ROM for Macintosh and Windows; JCE Software, University of Wisconsin-Madison, 1101 University Ave., Madison, WI 53706-1396; Phone: (608) 262-5153 or (800) 991-5534; FAX: (608) 265-8094; email: jcesoft@chem.wisc.edu; Prices/Licensing (prices for non-U.S. are in parentheses): single user on a single machine, $60 ($80); additional single user copies, $45 ($65); libraries: single machine, $120 ($140); networks: up to 12 simultaneous users, $240 ($260); up to 50 simultaneous users, $800 ($820); more than 50 simultaneous users, contact JCE Software for a quote.

This disk is the first in a multivolume series of CD-ROMs featuring collections of pictures, computer-generated graphics and animations, explanations, and Apple QuickTime videos depicting chemical reactions that should stimulate the curiosity of students and motivate them to learn, thus bringing chemistry to life as the series title implies. The collections are divided into volumes on related topics, generally included in a first-semester college or high school introductory chemistry course, as recommended for maximum usefulness by a group of chemical educators. For Volume 1 the topics and demonstrations (a few of which can be considered under more than one topic) are:

• Stoichiometry

Reactions of Magnesium with Carbon Dioxide; Exploding Soap Bubbles: Hydrogen + Oxygen; Acid–Base Titrations and Animation; Redox Titration and Animation; Loss of Mass of Marble Due to Reaction with Nitric Acid.

• Combination Reactions

Reactions of Potassium and Bromine; Reaction of Sodium and Chlorine; Reactions of Metals + Iodine; Hydrogen + Chlorine Cannon; Burning of Sulfur to Produce Sulfur Dioxide; Oxidation and Reduction of Copper.

• Decomposition Reactions

Ammonium Dichromate Volcano; Nitrogen Triiodide Detonation; Electrolysis of Water; Electrolysis of Aqueous Solutions.

• Single Exchange Reactions

Reaction of Magnesium with Carbon Dioxide; Water Gas Reaction; Thermite Reaction; Electrochemical Series—Metal Trees; Oxidation and Reduction of Copper.

• Double Exchange Reactions

Precipitation Reactions; Acid–Base Titrations and Animation; Thermodynamic vs. Kinetic Control: Forming Mercury(II) Iodide; Loss of Mass of Marble Due to Reaction with Nitric Acid.

• Gases

Fluidity of Gases; Atmospheric Pressure; Gas Volume; Effusion of Gases; Gas Density; Light and Heavy Balloons.

• Electrical Properties of Matter

Electrical Conductivity; Electrostatic Attraction.

The emphasis in the collection is on chemistry—with reactions shown in close-up (in only a few cases, where scale is important, are more than the demonstrators' hands shown). Each demonstration or reaction illustrates an important aspect of chemistry.

The disk is organized like a World Wide Web site to maximize its usefulness in the classroom, and accessing its contents via web browsers should be a very easy and familiar process for most users. Correlation to a number of popular high school and college chemistry textbooks is provided, allowing the user to select the text used in class from a list and then move to each chapter to locate images that complement the content of the chapter.

Links are provided to *JCE Online*, where the user will find resources that complement the disk, including a consolidated index for all volumes of *CCA!* as they are developed, instructional materials that utilize *CCA!,* and previews of all *CCA!* volumes. The viewer must install QuickTime for the videos (played directly using MoviePlayer on the Macintosh or Media Player in Windows) and Chemscape Chime for the molecular animations, both of which can be used as lecture aids. Images can be easily incorporated into multimedia presentations or lessons. The web browser's Bookmark function is an especially convenient way to organize material for lectures or student lessons. Sufficient written information about each video segment is provided to allow students to use the disk independently.

The starting point for accessing the program is the index page. Directions are given on how to access the index page from within a web browser. From this point the user can view the videos and animations in any order, either following the table of contents or going directly to the topics section, where a particular topic and all the associated videos can be seen. A very useful aspect of the program is the crosslinking between topics and videos, much in the same way that a webpage provides links.

The movies include voice-over narration, and the sound from the reaction is included whenever it is important, e.g., in Exploding Soap Bubbles: Hydrogen + Oxygen, in which the loudness of the explosion depends on the mole ratio of the gases in the mixture that is ignited. Several demonstrations are accompanied by computer-generated animations, which provide microscopic explanations of the observed macroscopic phenomena, e.g., Electrolysis, Acid–Base Titrations, and Redox Titration. Some demos consist of a comprehensive series of reactions that permit both the instructor and students to compare and contrast the behavior of similar reactions and to provide material that can be used in constructing tests, e.g., Precipitation Reactions, Reactions of Metals + Iodine, Electrolysis of Aqueous Solutions, and Electrochemical Series—Metal Trees. Frames diagramming the reaction can be found on the same page as the video.

System Requirements

• Netscape Navigator version 3 or later, or Microsoft Internet Explorer version 3 or later

• QuickTime plug-in version 1.1 or later

• For Mac OS

Mac OS compatible computer
68040 or Power PC microprocessor
16 MB RAM available
256-color graphics
2× CD-ROM drive
System Software version 7.1 or later

- For Windows
  - Windows compatible computer
  - 80486 or higher microprocessor
  - 16 MB RAM
  - 256-color Super VGA graphics
  - 2× CD-ROM drive
  - Windows 95, Windows 3.1

The greatest strength of *Chemistry Comes Alive!* lies in the many reactions demonstrated that would be impractical or too dangerous for students to perform. The reaction videos can be worked into lectures or class demonstrations and quickly shown to illustrate or reinforce information given during a lecture or lab. With increasing costs for reagents and equipment as well as concern over liability to students and faculty, this CD-ROM is an excellent alternative to actually performing potentially dangerous experiments and cleaning up or disposing of reaction products. Admittedly, for students nothing can replace the thrill of observing or performing a highly exothermic reaction, such as the thermite reaction or the detonation of hydrogen and oxygen gas in soap bubbles. However, in many situations the gains in being able to witness an energetic reaction hands-on do not outweigh the risks involved.

The contents of all *CCA!* CD-ROMs can be simultaneously browsed and searched by visiting the Website: http://jchemed.chem.wisc.edu/JCESoft.

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S1430-4171(01)04492-7, 10.1007/s00897000492a

Physical Chemistry. By Peter Atkins, Oxford University Press: Oxford, U.K. xvi + 997 pp. £28.99. Includes CD. ISBN 0-19-850101-3. *Student's Solutions Manual* and *Instructor's Solutions Manual* are also available.

It is perhaps appropriate that this, the one hundredth media review in *The Chemical Educator*, should have as its subject one of the modern classics in chemistry textbooks: *Physical Chemistry*, by Peter Atkins.

In contrast with the Arts, in science one gets used to the regular appearance of new editions of established, successful textbooks. Many of us, when undergraduates, will have been encouraged to buy a new edition of a textbook when it appeared, rather than choosing the cheaper option of buying an older edition at a knock-down price from a colleague. We might at the time have wondered if the primary motivation of publishers who introduce new editions of established textbooks is to make money. The topics covered in most general undergraduate textbooks do not change much from year to year, so why should new editions be required, if it is not that publishers (and their authors) would like the extra money? If not to make money, could the need for a new edition perhaps be that earlier editions were so full of errors that a new edition must be printed to correct them?

Once one gets beyond being a poor (and skeptical) undergraduate, most scientists become less jaundiced about the appearance of new editions. Peter Atkins' textbook has now reached its sixth edition—a rare, but certainly not unheard-of degree of maturity in chemistry publishing—so there has been plenty of opportunity to weed out errors since the book first made an appearance in 1978. There are substantial changes in this edition, and these maintain its steady evolution over a period of more than two decades. Few errors must remain; I have come across none so far. There have been changes to the contents of chapters, to the very large number of figures, to the problems and to the Further Reading sections. These changes are not mere tinkering with the text, but introduce significant improvements.

As in previous editions, this text covers physical chemistry in considerable depth (there are almost one thousand pages in this edition) and with rigor. The book is divided into three broad sections, covering "Equilibrium," "Structure," and "Change". A glance at the chapter titles provides an indication of the coverage. The section on "Equilibrium" includes chapters entitled: The properties of gases, The First Law: the concepts, The First Law: the machinery, The Second Law: the concepts, The Second Law: the machinery, Physical transformations of pure substances, Simple mixtures, Phase diagrams, Chemical equilibrium, and Equilibrium electrochemistry.

"Structure" opens with chapters titled Quantum theory: introduction and principles, and Quantum theory: techniques and applications. These are followed by Atomic structure and atomic spectra, Molecular structure, Molecular symmetry, Spectroscopy 1: rotational and vibrational spectra, Spectroscopy 2: electronic transitions, Spectroscopy 3: magnetic resonance, Statistical thermodynamics: the concepts, Statistical thermodynamics: the machinery, Diffraction techniques, The electric and magnetic properties of molecules, and Macromolecules and colloids.

The final section of the book, "Change," includes the chapters: Molecules in motion, The rates of chemical reactions, The kinetics of complex reactions, Molecular reaction dynamics, Processes at solid surfaces, and Dynamic electrochemistry.

The author has managed to retain the flexibility characteristic of earlier editions, which allows lecturers in different institutions, who may teach chemistry in an order quite different to that adopted in the book, to still use this as their primary text. This is no mean feat, bearing in mind the way in which the different parts of the subject are interconnected.

To a degree, the style reflects the approach to physical chemistry in the undergraduate program at Oxford University, where Atkins has taught for many years, with the emphasis which that course has on fundamental principles. More applied areas, such as colloids and fuel cells make an appearance, but one senses that these form a kind of side show, brought in primarily to illustrate the principles of the subject; throughout, the emphasis is on the core material of physical chemistry.

The fine-tuning which one would expect to result from the production of six editions over twenty years is apparent in various ways. The writing, as in all of Atkins' books, is a model of clarity. No attempt is made to avoid mathematics—indeed the mathematical soundness of *Physical Chemistry* has always been one of its strengths—but it is introduced and used without overwhelming the qualitative treatment of topics. Figures are simple, clear, and relevant; very many of them have been redrawn or redesigned for this edition. Tables of data in the textbook are generally brief—often consisting of four or five lines—and provide just the right amount of information to illustrate the arguments in the body of the text.

Helpfully, numerous tables are then expanded in the Appendices, which provide fuller numerical data on such diverse topics as diffusion coefficients, screening constants, isothermal compressibilities, third-law entropies, Henry's law constants, electronic affinities, and numerous other parameters. End-of-chapter problems have been revised and expanded (there are around one thousand in all) and microprojects, which bring together topics from several chapters within a section to form more challenging tasks, have been added.

Broad-based and thorough the book certainly is, but no instructor would ever admit to liking every morsel in a textbook (unless he or she is the author). I was occasionally disappointed to find that a "mechanical" or mathematical explanation of a physical phenomenon was chosen over a descriptive one, when a combination of the two might have been more effective.

For example, Atkins takes the conventional approach to explain why a change in pressure may affect the position of equilibrium in a gas phase reaction, using Le Chatelier's principle. The explanation, in terms of an equilibrium constant, is one with which many students will be familiar—the position of equilibrium moves so as to try to nullify the change imposed upon the system—but *why* do chemical systems behave in this way? This approach, in which Le Chatelier's principle is given as a simple statement of fact, mirrors that which is adopted in most textbooks, but it does not address the question of how the position of equilibrium responds through changes at the *molecular level* to alterations in the values of parameters such as the pressure. How do individual molecules know that they must obey Le Chatelier? Le Chatelier's principle is often taught to students in this fashion, and when asked for an explanation in physical terms they not surprisingly fail to come up with anything meaningful, even though explanations in terms of what the molecules themselves are doing are straightforward.

In a discussion of spectroscopy, Atkins points out that infrared transitions between molecular vibrational levels for which $|\Delta v| > 1$ are weak, and therefore difficult to observe. This is followed almost immediately by a discussion of Birge–Sponer extrapolation, which, for its success, requires knowledge of the position of many vibrational levels. Some readers may be left wondering how, if few transitions to vibrational energy levels can be observed, it is possible to determine the position of a sufficiently large number to carry out the extrapolation. The explanation is simple, but appears in a quite different portion of the text.

The CD that accompanies *Physical Chemistry* was something of a disappointment. Repeated revision of the text has refined it into an impressive and satisfying work, but the CD by comparison seems rather unimaginative. Instead of detailed and flexible simulations that might enhance the text, most of the animations fail to illustrate chemistry in a particularly dynamic or interesting way; in truth, they are rather dull. Much of the CD is taken up with textual or mathematical material that mirrors what is presented in the text, and while the CD may offer a marginally faster way of finding information on some topics, I suspect that most lecturers (and students) may find it of limited value. It is unfortunate that the quality of the CDs which accompany textbooks these days seems all too often to fall below the quality of the texts themselves; I have yet to find one that I would regularly use with my students.

These are minor criticisms, though. Overall, *Physical Chemistry* continues to be the book by which other texts are judged. There is considerable competition in this area—several impressive textbooks are available—but it is hard to match the authority and readability of this book. It is one of perhaps a dozen textbooks in chemistry that instructors all over the world would recognize. Indeed the name of the author occupies an area on the cover of the book three times as great as the title—a telling indication of the respect that the name Peter Atkins commands in scientific publishing.

Not every lecturer will find the level of the textbook appropriate for their course; those working in liberal arts colleges, for example, may find the depth and rigor are greater than they require. However, Atkins' writing remains as clear and persuasive as ever. This book provides solid value, whether one is building a library in chemistry from scratch, or simply ensuring one's understanding is up-to-date. It should be an essential item on the shelf of every practicing chemist; indeed, if there is room on the shelf for only one physical chemistry textbook, this should be it.

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S1430-4171(01)04493-6, 10.1007/s00897000493a

Instruments and Experimentation in the History of Chemistry. Frederic L. Homes and Trevor H. Levere, Editors. The MIT Press: Cambridge, Mass., 2000. £34.50. xvii + 415 pp. ISBN 0-262-08282-9.

Instruments and Experimentation in the History of Chemistry is a collection of fourteen essays that focus on the development of the tools and methods of science. The authors, who have a broad range of academic backgrounds in chemistry and the history of science, are divided roughly evenly between North American and European universities.

It is by no means obvious that a book about chemistry equipment is going to be a riveting read (except perhaps for science historians). However, each author covers a different period or aspect of the evolution of instrumentation, and they bring to the book various perspectives and writing styles. This variety of styles does much to make the topic palatable. Indeed, the way in which modern instruments have developed from the crude apparatus available to the alchemists turns out to be far more fascinating than one might at first expect.

The book takes the reader on a scientific adventure from the alchemists to the start of the twentieth century. While it is ostensibly concerned just with instruments and how they were developed and used, it is inevitably also about the instrument makers and the arguments in which they became embroiled. The evolution of instruments is thus interwoven with the history of contemporary scientists.

An illustration of this intermixing of science and personalities is the controversy and confusion surrounding the development of the thermometer and its differing scales, which involved numerous scientists. It is not hard to appreciate that even the meaning of a thermometer reading was uncertain for a long period. Boerhaave, for example, was not alone in believing that a thermometer would measure the amount of heat in a body rather than its temperature. He argued that: "…common sense … manifestly shews that iron in winter is colder than feathers and quicksilver than alcohol." Quite a persuasive argument at the time, one imagines. John Robison pointed out that: "The experience of more than a century had made us consider the thermometer as a sure and accurate indicator of heat." Such fundamental misconceptions were common in the eighteenth and nineteenth centuries.

A neat contrast to the uncertainty of these times is provided by the final chapter in the book, "The physical chemistry of Michael Polanyi," covering fundamental work in early X-ray crystallography that had a profound influence on modern chemistry.

For the professional chemist much of the interest of this book will be in learning how instrumentation crucial to contemporary scientific theory was developed. Advances in instrumentation encouraged the refinement of theory, but, in a cyclic process, this in turn lead to increasingly sophisticated and powerful instrumentation.

Readers with less of an interest in the equipment may find that the story centers more on the scientists themselves. We have the sometimes prickly, yet scientifically productive, relationship between Berzelius and Liebig, Berzelius asking his (temporarily) former friend to "… stop being a chemical executioner." Bérard criticizes Thomson as having "… certainly been deceived in his calculation of the composition of an oxalate of 'strontian' …," while Thomson counters—politely but firmly—that Bérard's results "… are in general more erroneous than mine …" One detects more than professional differences of opinion below the surface.

There are appearances from Polanyi and Liebig, Bragg and Bunsen, Hales, Boyle, Norton, Lavoisier, Fahrenheit, Davy, Wollaston, Dalton, Noble, and many others; even Philip VI of France appears in a cameo role. These scientists flesh out what might otherwise have been a less interesting tale of inspired developments, surrounded by engineering flops and dead ends.

The personalities have a very direct role to play, since although this is a book about equipment, it is also inevitably about how individual scientists played their part in the creation of modern scientific theory. Thus, Melvyn Usselman's chapter brings William Hyde Wollaston out of the shadows—a former doctor whose name few chemistry undergraduates will recognize, but whose influence on the development of chemical theory early in the nineteenth century was considerable.

Most of the relatively small number of illustrations are line drawings of scientific equipment. While this helps to establish a historical feel for the book, I was disappointed that there are few photographs of original equipment. The quantity of historical scientific equipment that survives in good condition is not great, but some fascinating pieces still remain in museums in Paris, Milan, Oxford, and elsewhere. Photographs of real equipment, in addition to drawings, help to give one an idea of how the equipment actually looked, and a further reason to appreciate the skill of those who made it. It is a pity that few of the authors have chosen to take advantage of the opportunities the existence of this equipment provides.

However, this is a minor quibble. *Instruments and Experiments in the History of Chemistry* is authoritative, engrossing, and above all, readable. History it undoubtedly is, but history brought to life in a way that shows how some of the most brilliant minds, and the most skilled workers of their time, carved scientific theory out of almost nothing. A fascinating read for those interested in the development of science.

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S1430-4171(01)04494-5, 10.1007/s00897000494a

Teaching Excellence: A Collection of Essays on College Education, written by Recipients of the California State University Trustees' Outstanding Professor Award. Edited by Michael Flachmann. California State University Institute, Long Beach, CA. Illustrations. iv + 167 pp. 14.7 × 22.4 cm.; paperbound; ISBN 0-9661857-0-6. $30; including tax, postage, and handling; order from and make check payable to Dr. Michael Flachmann, Department of English, CSU Bakersfield, 9001 Stockdale Highway, Bakersfield, CA, 93311-1099, USA.

On September 9, 1963 the California State University statewide Academic Senate instituted annual Outstanding Professor Awards to be awarded for "achievement in teaching, scholarship, and service to institution, community, and nation" to two professors from each of the different campuses. The awards "have traditionally honored superb teachers who are also heavily involved in scholarship and/or service."

During the period 1964–1995, of the 64 awards in 21 academic subject areas, more than a third (24 or 37.5 percent) went to science professors, with chemistry living up to its name of "the central science" by leading the disciplines in the number of awards (11 or 17.2 percent). In the volume under review here, sixteen Outstanding Professors have contributed essays on crucial aspects of the teaching process. For the six essays by scientists (almost a third of the volume), the title, author, department, and length are given, followed by a brief description. Chemical educators will also find valuable pedagogical insights in those essays by the nonscientists (sociology, psychology, geography, English, philosophy, history, and music).

(1) "Successes and Failures in Teaching," Richard G. Botzler, Wildlife (12 pp). Disappointments in the classroom often teach the instructor more about the teaching process than successes, especially in the development of cooperative learning and student-centered pedagogical techniques.

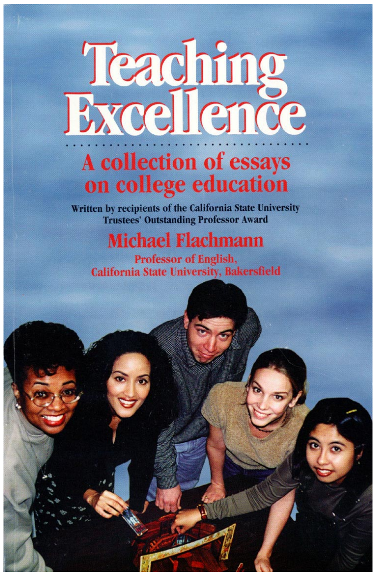
(2) "Undergraduate Research in Chemistry," Phoebe K. Dea, Chemistry (5 pp). In the sciences teaching and research are inextricably intertwined, and, with the proper encouragement, undergraduate students can frequently make important discoveries.

(3) "An Introduction to the Art of Scientific Research: A Personal View," George B. Kauffman, Chemistry (15 pp, the longest essay). Because the goal of a college education is to instill in students the ability and flexibility to apply creatively the principles of their chosen professions rather than to have them memorize a rigidly circumscribed body of knowledge, participating in original research is a prerequisite for a successful career in any field requiring independent thought.

(4) "The One-On-One Chemistry Classroom," Thomas Onak, Chemistry (4 pp). How to obtain financial grants to help provide one-on-one interaction with students at both

undergraduate and master's degree levels, which catches them up in the "discovery" aspect of their instruction and can lead to satisfying careers.

(5) "How to Set Up a Laboratory Teaching Program That Results in Student Publications," Steven B. Oppenheimer, Biology (4 pp). An explanation of how to teach large numbers



of students to perform hands-on group biomedical experiments, such as those with the sea urchin embryo, with minimal training, supervision, and financial support

(6) "What Is the Responsibility of University Faculty to Pre-College Students and Teachers?" David L. Pagni, Mathematics (4 pp). Methods in which greater attention to the education of primary and secondary teachers can help minority and disadvantaged youths achieve their full potential and eventually attend college, hopefully in the CSU system.

(7) "Reflections on Teaching Chemistry," Lloyd N. Ferguson, Chemistry (4 pp). Why the CSU, Los Angeles Chemistry Department has been so successful in teaching, attracting external funding, encouraging minority applicants, and publishing student/faculty coauthored articles and how it has won six statewide Outstanding Professor Awards.

In his 4-page preface Professor Flachmann presents a history of the Outstanding Professor Awards. He also provides a 2-page conclusion, "Teaching in the Twenty-First Century," which advances six "truths" about the process of good teaching that should remain as valid in the future as they are at present. A 9-page compendium of photographs, brief biographies of the contributors, and a 4-page list of all winners of the CSU Trustees' Outstanding Professor Award, from its inception through 1994–1995, conclude the book.

In his foreword to the collection, which he characterizes as representing "the best of college teaching in the California State University [System] and perhaps the entire nation as well," CSU Chancellor Charles B. Reed recommends it "to anyone interested in the current practice and future direction of post-secondary education in the United States." This outstanding and pedagogically important, but modestly priced volume by the CSU's *crème de la crème* deserves the widest possible exposure in educational circles. I heartily recommend it to new instructors and experienced teachers alike.

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S1430-4171(01)04496-0, 10.1007/s00897010496a