Media Reviews

I Wish I'd Made You Angry Earlier: Essays on Science, Scientists, and Humanity. By Max F. Perutz. Cold Spring Harbor Laboratory Press: 10 Skyline Drive, Plainview, NY 11803-2500, 1998. Figures. xv + 354 pp. 16.0 × 23.3 cm. $39.00. ISBN 0-87969-524-2.

As frequent book reviewers, we particularly enjoyed this fascinating collection of essays (22 of which are book reviews) by Max Ferdinand Perutz, the Austrian-born British biochemist who shared the 1962 Nobel Prize for Chemistry with John C. Kendrew for X-ray diffraction analysis of the structure of hemoglobin. In his preface to this well-chosen selection he describes hemoglobin as his "mistress." The reviews transcend the genre and can be read with pleasure as independent essays. The book is suitable for both browsing and for careful reading.

Perutz was Director of the Medical Research Council Laboratory for Molecular Biology, Cambridge, England from its establishment in 1962 until 1979, and he remains a scientific staff member. To date nine MRC-LMB staff members have received ten Nobel prizes, and Perutz muses on the factors underlying such creativity. He concludes that

> "Creativity in science as in the arts, cannot be organised. It arises spontaneously from individual talent. Well-run laboratories can foster it, but hierarchical organisation, inflexible, bureaucratic rules, and mountains of futile paperwork can kill it. Discoveries cannot be planned; they pop up, like Puck, in unexpected corners."

Allusions to literary and classical characters abound in Perutz's essays and bear witness to his status as a true Renaissance man. In this collection creativity is only one of numerous scientific themes that are discussed with the same lucidity and precision that characterize Perutz's pioneering work in crystallography.

Perutz's book contains 28 essays, all but one of which were originally published during the period 1968–1997 in slightly different forms and mostly under different titles. Eleven appeared in *The New York Review of Books*, three each in *London Review of Books* and *Nature*, and one each in *Nature Structural Biology*, *The Scientist*, *Gene*, *The Times Higher Education Supplement*, *New Scientist*, *The Independent*, *Proceedings of the American Philosophical Society*, *Scientific American*, and *International Union of Crystallography*.

The book is divided into four sections; the selections in the first three were written for nonscientists and consequently presuppose no scientific knowledge. Those in the last section were addressed to scientists and may be more difficult for laypersons to follow. The essays explore a remarkable range of scientific topics, and, replete with amusing and insightful anecdotes, they profile many of Perutz's favorite scientists, some of whom he knew personally. The contents give some idea of the scope of the volume.

I. "Plowshares into Swords"

"Friend or Foe of Mankind?" (Fritz Haber, "a man's fascination with poison gas")

"Splitting the Atom" (Lise Meitner)

"The Man Who Patented the Bomb" (Leo Szilard, who, before his flight from Europe, "always lived with two packed suitcases, in case he had to flee from wherever he happened to be")

"Why Did the Germans Not Make the Bomb?" (Werner Heisenberg)

"Bomb Designer Turned Dissident" (Andrei Sakharov)

"Liberating France" (François Jacob)

"Enemy Alien" (the book's longest essay and the only one that had not been previously published. It recounts Perutz's multifarious experiences as one of numerous German and Austrian refugees who were paradoxically classified as "enemy aliens" (the camp commander said, "I had no idea there were so many Jews among the Nazis.") and consequently imprisoned on the Isle of Man and then deported to Canada. Perutz eventually made his way back to Britain, where he remained.)

II. "How to Make Discoveries"

"High on Science" (Peter Medawar)

"Deconstructing Pasteur" (a convincing critique of Gerald L. Geison's revisionist biography)

"The Battle Over Vitamin C" (Albert Szent-Györgyi)

"A Mystery of the Tropics" (malaria and tropical diseases)

"The Forgotten Plague" (tuberculosis)

"What Holds Molecules Together?" (obituary of Linus Pauling)

"I Wish I'd Made You Angry Earlier" (The book's title essay. Perutz had shown his mentor W. L. Bragg his X-ray diffraction results confirming Linus Pauling and Robert B. Corey's α-helix model for α-keratin and stated that the idea for the experiment was sparked by his fury at missing the structure himself. Bragg replied, "'I wish I'd made you angry earlier!' because discovery of the 1.5-Å reflection would have led us straight to the α-helix.")

"Big Fleas Have Little Fleas..." (Max Delbrück)

"How the Secret of Life Was Discovered" ("From the Double Helix to the Human Genome: 40 Years of Molecular Genetics," cochairman's remarks at a UNESCO symposium)

"Dangerous Misprints" (screening for genetic diseases)

"A Deadly Inheritance" (Harvard pediatrician David G. Nathan and thalassemia, a genetic disease resulting in defective synthesis of hemoglobin)

"Darwin Was Right" (a new view of evolution)

"A Passion for Crystals" (obituary of Dorothy Crowfoot Hodgkin, who "radiated motherly warmth even while doing scientific work;" LMK's favorite essay)

III. "Rights and Wrongs"

"By What Right Do We Invoke Human Rights?" (the collection's only nonscientific essay)

"The Right to Choose" (Carl Djerassi and the contraceptive pill)

"Swords into Plowshares: Does Nuclear Energy Endanger Us?" (Britain, the welfare state, and nuclear proliferation)

IV. "More About Discoveries"

"The Second Secret of Life" (the structure of hemoglobin and respiratory transport)

"How W. L. Bragg Invented X-ray Analysis"

"Life's Energy Cycle" (Hans Krebs and the ornithine and citric acid cycles)

"The Hormone that Makes Nerves Grow" (Rita Levi-Montalcini and the nerve growth factor, 3 pp, the collection's shortest essay)

"How Nerves Conduct Electricity" (Alan Hodgkin and Andrew Huxley)

A "Photo Gallery" includes 23 formal and informal portraits of some of the scientists featured in the book. As an inveterate collector of quotations and a frequent user of such pithy sayings in writings and lectures, one of us (GBK) was particularly entranced by Perutz's 19-page classified appendix of wise sayings, "My Commonplace Book," a name that goes back to antiquity when Greek and Roman orators collected metaphors to be used for speeches in public places. Thirteen pages of notes and references (ranging in time from Thucydides and Marcus Aurelius to 1996) and a 12-page (double-column) subject index conclude the volume.

Unfortunately, this otherwise error-free book is marred by a number of typographical misspellings, especially in proper names. Many of these were probably introduced by editors in compiling the index and do not appear in the original essays, e.g., *Berthollet* not *Berthelot* (C. L.) (pp 5, 344), *Walther* not *Walter* (Nernst) (pp 11, 349), *Frédéric* not *Frederic* Joliot (pp 26, 348), *Mill* not *Mills* (John Stuart) (pp 225, 226), *Dirk* not *Dick* (Coster) (p 345), *Irène* not *Irene* (Curie) (p 345), and *Stoltzenberg* not *Stolzenberg* (p 352). Also, nouns are not capitalized in the German title of Hahn and Strassmann's classic article on nuclear fission (p 330).

According to Nobel Laureate Peter Medawar (physiology or medicine, 1960), one of the many scientists profiled in this book, "science at all levels of endeavour is a passionate enterprise and the pursuit of natural knowledge a sortie into the unknown." Perutz's book, which we heartily recommend to scientist and nonscientist alike, will convince its readers of the truth of this statement.

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Organic Chemistry: Structure and Function 3rd ed.; by K. P. C. Volhardt and N. E . Schore. W. H. Freeman: New York, 1999. xxxiv + 1210 pp plus answers to problems, credits, index, and CD-ROM. ISBN 0-7167-2721-8.

Over the last three decades there has been an increasing number of undergraduate-level textbooks published in the field of organic chemistry. Many aspects of the "how, what, why, and to whom" organic chemistry is taught have changed over this period and this is reflected in the way that modern textbooks are set out. Undergraduate textbooks now target much wider audiences than before, because fewer students taking organic chemistry intend to become chemists. Examples are students taking degrees in biochemistry, pharmacy, medicine, dentistry, physiotherapy, zoology, and botany; the list is actually quite long!

The presentation of material has also changed because publishers can economically produce textbooks of much higher quality than in the past. Technology has moved ahead and the black-and-white undergraduate textbooks that were produced in the first three-quarters of the twentieth century should be entirely a thing of the past. Quality, layout, illustration, and supplementary materials have improved to the point that current texts are visual works of art! This textbook lives up to these expectations and is very well illustrated. The authors use color in many ways, especially within structures to direct attention to that part of a molecule being modified during a reaction or to a functional group being discussed.

Another of the improvements in textbooks is based upon the realization that students need to feel supported when using the text. Undergraduate texts in organic chemistry are no longer repositories of fine-detailed and often-confusing information, but now have a clear and defined structure containing obvious themes. While the authors have not followed a standard compartmentalized format, they have integrated relationships and themes throughout the text, and I think that this will produce some good teaching.

It is also important that students have a good idea of the structure of a textbook and the most productive way for them to use it. To these ends the authors include a very useful and clear preface that should make it easy for students to navigate through the textbook. In each chapter, theory is supplemented by several grades of exercises: "Integration Problems" that are solved problems to integrate theory within and between chapters, "Problems," and "Team Problems." The latter problems are more complex, and students are challenged to solve these working as a team. In my experience this is an excellent way of teaching and learning. I am impressed that the text gives answers to all exercises and not just to selected questions. There are also useful summaries of important concepts for each chapter, as well as summaries of synthetic pathways where relevant.

I like the authors' coverage of stereochemistry and their use of 3D ball-and-cylinder structures to complement the usual stick structures that emphasise the three-dimensionality of organic chemistry. This style of presentation shows more clearly the stereochemical relationships within a molecule. Enantiotopicity, diastereotopicity, and prochirality are not discussed, as is unfortunately the case with most modern textbooks. I think that these are important stereochemical concepts and belong in such undergraduate textbooks.

Acid–base chemistry is covered briefly as a review of acid–base concepts in the chapter on alkanes. These concepts are continued throughout the text, but I think acid–base chemistry is so important to so many disciplines that it warrants a stand-alone chapter.

Nuclear magnetic resonance spectroscopy (NMR) is well covered as a stand-alone topic, although 2D techniques are not discussed. Infrared (IR), UV–visible spectroscopy (UV–vis), and mass spectrometry (MS) are covered as part of other chapters. IR is introduced in the chapter on alkenes and MS in the chapter on carboxylic acid derivatives. UV–vis is covered in the chapter on extended conjugated systems and, to a degree, this is more logical. The coverage of IR and UV–vis is fairly brief, and I prefer spectroscopy and spectrometry as stand alone topics, though this might take away some of the integration of theory in the text, which is one of its attractive features.

Throughout the text there is a wonderful linkage of theory to the applied aspects of the biological and health sciences and to industrial and environmental chemistry within chapter asides called "Chemical Highlights." These highlights should be stimulating reading for any student and I think that much can be done with them, in terms of teaching. In one of them, however, it is stated that the bioactivity of penicillin is due to

the fact that it is a beta lactam, sterically stressed, resulting in increased reactivity (electrophilicity) of the lactam carbonyl carbon atom as compared to aliphatic amides. This is only part of the story, because it is the stereochemistry at the lactam nitrogen atom that is of critical importance for the bioactivity of penicillins and cephalosporins. The geometry of the fused two-ring system forces the nitrogen atom into a tetrahedral geometry and it no longer behaves as a normal amide because p–p orbital overlap between the nitrogen atom and carbonyl carbon atom is not possible. Penicillins are not flat, but more like half-opened books. This could be expanded to illustrate how stereochemistry can change acid–base and reactivity (and stability) properties of compounds. Salicylic acid could be another example to illustrate unexpected spectra, and acid–base, solubility, and hydrophobicity properties.

The text comes with an easily installed CD-ROM to give practice in problem solving. Its use, although intuitive to those experienced with computers (in these days, most of us), is clearly and simply described and it is a useful adjunct to the textbook. Further support is provided in the form of a well-designed *Study Guide and Solutions Manual* written by Neil Schore (ISBN 0-7167-3165-7).

Any undergraduate organic chemistry textbook will be open to criticism by those who teach organic chemistry from different points of view or with different aims. There will always be things that please and displease, and such textbooks cannot be all things to all teachers. In summary, this textbook explains the basic concepts of organic chemistry clearly, is visually attractive, and is interestingly written. The underlying theory is well-integrated throughout and should increase students' interest in, and enjoyment of, the subject. I have few criticisms and I think that this text is eminently suitable as an undergraduate organic chemistry textbook.

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Pesticides in Fruits and Vegetables, by Susan E. Kegley and Laura J. Wise. University Science Books: Sausalito, CA, 1998. 8-1/2 × 11 inches, illustrated, 114 pp, softcover, ISBN 0-935702-46-6.

One of the most controversial public issues today is public confusion about where pesticides fit into human society. For a teacher to allow the emotional thread to cloud the scientific lessons that can be learned from this issue is a disservice. Doing so robs students and the teacher of an opportunity to convey some basic scientific building blocks and practical experiences associated with chemistry, biology, and environmental sciences.

Susan Kegley and Laura Wise set an excellent example of how to introduce these issues to students in a balanced fashion, without losing the science to the emotional side of this volatile topic. The authors help students decide for themselves how to deal with the pesticide issue through a series of exercises, research data, testing and analysis, and debate. This textbook was written as a module for any general or advanced chemistry course.

Students using this laboratory manual are directed to design their own sampling plan to answer questions about organochlorine pesticides in foods. The authors cover such concepts as structure and solubility relationships of organic compounds, extraction techniques, gas chromatography, and risk assessment. In addition to collecting data, students are asked to prepare themselves for debate of the pesticide issue by reading selected articles referenced in the text. The module, if implemented in the classroom, will take three to four weeks of laboratory time. According to the authors, the module was extensively tested with students enrolled in general chemistry and instrumental analysis at the University of California at Berkeley. The module is also recommended for use in an organic chemistry course. The authors offer a detailed instructor's manual, complete with instrument parameters, prelaboratory-lecture notes, and evaluation data on the pesticide debate, as a separate resource to this module.

As a pesticide specialist, I particularly appreciated the authors' coverage of the latest pesticide issues, including the Food Quality Protection Act passed by the U.S. Congress in 1996. This tied the module to the state of the art of modern food-safety regulation in the United States. This, along with an extensive treatment of the debate and background references, can in itself be useful to teachers and students in other disciplines, including the social sciences and pest-management education. Although it is obvious that parts of the laboratory manual are designed specifically for chemistry students, especially the chapters on analysis and instrumentation, it provides an excellent review of this complex and technical science of pesticide residue analysis and regulation. I would recommend this book as a reference to anyone interested in the issue of pesticides in food or in teaching the subject in high school, college, and adult education courses.

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Powers of Ten Interactive: A Production of the Eames Office Presented by Pyramid Media. *Powers of Ten Interactive:* written, produced, and designed by Eames Demetrios; English version; a production of the Eames Office and Datt Japan based on the film by Charles and Ray Eames: Published by Pyramid Media: Eames Office: P.O. Box 268, Venice, CA 90294, 1999. Telephone: 310-396-5991; Fax: 310-454-4413; Websites: http://www.eamesoffice.com, http://www.pyramidmedia.com, or http://www.powersof10.com. CD-ROM. $79.95, plus $3.20 shipping. ISBN 1-5598-1629-5.

For years we have been absolutely captivated, entranced, and enamored by *Powers of Ten: A Book about the Relative Size of Things in the Universe and the Effect of Adding Another Zero* (by Philip and Phyllis Morrison and the Office of Charles and Ray Eames; W. H. Freeman: New York, 1982; $34.95, cloth; $19.95, paperback), which initiated the popular Scientific American Library series that now comprises more than 70 volumes. In an era of hoopla, hype, and unwarranted use of superlatives, we hesitate to proclaim a product "unique," yet in this case we feel that the book, the films on which it was based, and now the CD-ROM, deserve this overused adjective as well as the highest accolades.

Charles (1907–1978) and Ray (née Kaiser) (1912–1988) Eames are, of course, the well-known American husband-and-wife team designers renowned for the beauty, comfort, elegance, and delicacy of their mass-producible furniture. However, they also wrote books and designed exhibitions, fabrics, and industrial and consumer products. After 1955 they became increasingly active in the making of motion pictures, chiefly of an educational nature, the prime example of which is *Powers of Ten*.

In 1968 the couple produced an eight-minute, largely black-and-white film titled *A Rough Sketch for a Proposed Film Dealing with the Powers of Ten and the Relative Size of Things in the Universe*, not only a trial run for a future movie but also "a marvelous film in its own right." In 1977 for IBM they produced a longer (nine-and-a-half-minute), more detailed full-color film, titled *Powers of Ten*, narrated by physicist and science popularizer Philip Morrison. The scores of both films were written by Hollywood film composer Elmer Bernstein. In 1989 a 21-minute videocassette, *Powers of Ten: the Films of Charles and Ray Eames, Volume 1* (Pyramid Film & Video, Santa Monica, CA; distributed by W. H. Freeman, New York, NY; Eames Office, $39.95, U.S. and Japan; $59.95, Europe) of the two films that included a five-minute introduction to the Eames' career and films, narrated by Hollywood screen star Gregory Peck, was released. The video received the Miami International Film Festival's Gold Medal, the Trieste Science Fiction Film Festival's Special Jury Award, and the Wescon Science Film Theater's Best Film Award.

Five years in the making, the new Macintosh/Windows hybrid CD-ROM is the creation of writer/producer/director Eames Demetrios, Charles and Ray's maternal grandson, who has expanded upon his grandparents' ideas and woven a rich intellectual tapestry that utilizes modern technology to its fullest potential. Accompanied at no extra charge by an extremely detailed tutorial VHS videotape and a 1.4 MB floppy disk (IBM and Macintosh files) to facilitate installation and use, it contains one of the most famous educational films of all time, *Powers of Ten* (1977 version), updated for the digital age along with its newer companion, *Powers of Time*—and much, much more. The videotape, conducted by Demetrios, consists of a Basic Tutorial (15 min); an Advanced Tutorial (7 min), which describes bookmarking and how to create "Journeys" (image-by-image experiences of the disk using bookmarked images) and "Tours" (station-by-station experiences of the disk for use in different classroom presentations); Macintosh Install (4 min); and Windows Install (5 min). ("Image" and "station" are described below.)

The classic *Powers of Ten* film takes the viewer on a breathtaking spatial journey through 44 orders of magnitude (10^{25} to 10^{-18} meters). At "the scale of human companionship, conversation, and touch" we observe a couple of sleeping picnickers on a lazy October afternoon in the park near Lake Shore Drive and Soldier Field in Chicago (10^{0} or 1 meter wide). We are first transported at the dizzying rate of one power of ten every ten seconds on a plane perpendicular to the Milky Way galaxy to observe the entire earth (10^{7} m), the orbit of the moon (10^{9} m), the solar system (10^{13} m), the Milky Way spiral (10^{21} m), galactic clusters (10^{24} m), and the outer edges of the universe. We are then returned to the park at the even faster rate of one power of ten every two seconds. Finally we move inward into the sleeping man's hand with an increase of ten in magnification every ten seconds until we enter a subatomic particle (the proton of a carbon atom within a DNA molecule in a white blood cell).

The *Powers of Time* film presents a similar journey in terms of time rather than space. Beginning at one second (10^{0} s), it zooms down to 10^{-18} s. Various phenomena are documented at each decreasing time interval—with computer animations showing the behavior of molecules and atoms at the shortest times. The images and descriptions are scientifically accurate and cease at 10^{-18} s because quantum effects do not allow resolution of briefer phenomena. Reversing the zoom, we see everyday activities at 10 s and 100 s, then daily changes, then seasonal changes, then changes in an individual life span. The images of a young girl growing into a mature woman through 31 years (10^{9} seconds) are particularly compelling. Time then continues to accelerate past all human history, through the ice ages, and into the eras of plate tectonics where the continents are shown in rapid motion. The formation of the earth and moon are shown, and finally the first stages of the universe itself at 10^{18} seconds—a most impressive journey.

Anyone with the slightest interest in the universe surrounding us or within us should see both of these wonderful short films, which are available separately from the Eames Office in the larger formats better suited for classroom use. But there is much more. With these films providing anchor points in space and time, the CD-ROM adds more than a thousand images and brief movies (in Apple's QuickTime format) plus 2400 pages of text and anthology explaining what we see and hear.

The information on the disc is organized into four important divisions:

1) the 44 **Powers of Ten** (10^{-18} to 10^{25});
2) Six color-coded **Strands**—each visited for each Power of Ten by clicking the mouse on the number on the left side of the screen; the border of the screen changes for each strand;

- **Space** (red), which, at each power of ten, accesses the portion of the *Powers of Ten* film that relates to that power, e.g., for 10^{21} meters (100,000 light-years) the view reveals the shape of the Milky Way galaxy.
- **Time** (yellow), which, at each power of ten, accesses the portion of the *Powers of Time* film that relates to that power, e.g., for 10^{15} seconds (ca. 31 million years), the view is of the (apparently) rapid continental drift.
- **Tools** (orange) that mankind has used to understand each Power of Ten, e.g., Galileo's telescope, Stonehenge, and representations of the Sun from different cultures. Not all the Tools are instruments. At 10^{9} s we find the Saguaro cactus study; at 10^{20} m, Myth and Faith; and at 10^{-1} m (perhaps "the scale of the human heart"), a series on Jane Austen.
- **People** (purple) who thought deeply about each Power of Ten—chemists, physicists, biologists, paleontologists, fishermen, gardeners; e.g., Marie Curie, Frank Lloyd Wright, Edwin P. Hubble, and James D. Watson and Francis H. C. Crick with their DNA model.
- **Eames** (green)—a close look at the Eames' work including clips from numerous films, rarely-seen photographs, behind-the-scenes stories from the Eames Office, and extensive excerpts from Charles' celebrated Norton Lectures in Poetry.

- **Patterns** (blue)—different ways to slice time and space; another way of looking at a given order of magnitude.

3) 264 **Stations**, each the intersection of a Power of Ten and a Strand image; give access to about 1500 still images, more than 3000 pages of descriptive text, 200 videos and audio clips, the Digital Anthology, and other features;
4) between 1 and 19 **Images** (audio or video clips) expressing the idea of the particular Station, e.g., Golden Gate Bridge (10^3 meters long); more than 800 images and all the interviews were prepared especially for this disc.

The information is seen on three interactive interface screens:

- (1) provides a preview ("teaser") of each Station (part of a video clip or a series of dissolves through the Images at that Station in the window in the center of the screen);
- (2) allows maximum access to the information resources at each Station; contains a selection of icons, most of which are not self-explanatory, e.g., clicking on a circle gets you a text overview of the image shown, while clicking on a sunburst image gets more extensive text from the Digital Anthology.
- (3) the "Giant Fishtrap," a map or table of contents where the viewer can use an index function and edit the collection of Images, and where the *Powers of Ten* and *Powers of Time* films can be played in their entirety; a useful browsing tool. Once you've learned to use it, the Giant Fishtrap is an effective navigational aid to the entire CD-ROM. By running the mouse over the six colored strands you can choose Space, Time, Tools, People, Eames, and Patterns. By moving along a colored Strand you can choose any Power of Ten desired. Text information pops up as you move the mouse, telling you what you can select by clicking at any given spot. The two movies are at the two extreme ends of the Fishtrap.

Because of the complexity and richness of the material, we recommend that you keep the four-panel Interactive Guide, which outlines all the icons and controls in a user-friendly manner, on the desktop as you access the CD-ROM. Sound levels can be controlled by hitting the 1 through 9 keys on your keyboard (except for the two films). Because sound levels vary with different small clips, knowing how to control sound is essential. The images were slightly small for effective presentation in an electronic classroom with a computer projector, but were perfectly satisfactory for individual use.

Each Strand (Space, Time, Tools, People, Eames and Patterns) has a series of still images or short movies to go with each power of ten. You can change power either in the Fishtrap or using the area to the right of the Big 10. Don't be surprised if the images you get are not what you might expect; this is part of the intellectual adventure of this disk. Choosing Tools and 10^{11}m , for example, got us a picture of a computer chip taken with an atomic force microscope. The images which followed this, by using the arrow icons, were of a planetary computer flyby. This particular tool–power combination showed how computers can make the very large visible to us.

Although we have devoted decades to teaching and learning about orders of magnitude and we regularly manipulate exponents on an almost daily basis, we are still amazed at the tremendous effect of adding another zero as depicted in this CD-ROM, which converts mere cerebral knowledge into a vivid actual experience of the senses. Perhaps if enough students are exposed to this disk, we chemical educators will no longer be forced to groan over impossible answers by unthinking students , e.g., 4.27×10^{21} g for the weight of a chlorine molecule, produced by multiplying, rather than dividing, the gram-molecular weight by Avogadro's number.

This is a wonderful disk to explore for hours on end and literally to get lost in—in the best sense of the word. You can explore all the various absorbing connections and associations between orders of magnitude and acquire an appreciation for the otherwise very elusive concept called scale, a most powerful way to organize knowledge and experience. In Eames Demetrios' well-chosen words, "Everything in this CD-ROM is ultimately about how man has gotten his hands on the richness of the universe.... [and] how we know what we know from the edge of space to the interior of the atom."

We enthusiastically recommend this fascinating, delightful, and exciting interdisciplinary adventure, a perfect example of a true marriage between art and science, not only to science teachers and professors, Eames aficionados, science buffs, and everyone concerned with the creative process, but to kids and scientists from eight to eighty. It makes an ideal gift for anyone interested in the world around us and within us

Powers of Ten: A Flipbook (ISBN 0-7167-3441-9), a coproduction of the Eames Office and Optical Toys (P.O. Box 23, Putney, VT 05346), is available from the Eames Office for $11.00 and from W. H. Freeman, 41 Madison Ave., New York, NY 10010 (http://www.whfreeman.com) for $9.95. However, why would anyone with access to a computer choose this 6 in. × 4 in. one-dimensional, "horse-and-buggy" version instead of the spectacular journey through space, time, and other dimensions that readily lends itself to the cyber-age CD-ROM? One answer might be that many teachers (especially at the elementary level) will probably find the flipbook a good adjunct to the CD-ROM because students may be a little less intimidated by it and can literally hold the journey in their hands. Also, the students will see the zoom portion of the concept immediately, thus setting the stage for the disk. Similarly, educators may find a 27 in. × 27 in. *Powers of Ten Poster* (Eames Office, $24.00 plus shipping) displaying the steps in the spatial journey useful because students can view it all in one glance.

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