

retired from the physics department at the University of Bristol in 1982 to pursue a second career in science and technology studies, concedes that scientific facts are unavoidably “theory-laden” and that the social institutions that support science have a strong influence on its agenda. For Ziman, the heart of the science wars can be understood in terms of a breakdown in communication. Science and technology studies scholars have hidden behind the word “construction” while naively or antagonistically denying the impact of its many negative connotations. Ziman accepts a constructivist view of science, but he maintains that science still has characteristics that distinguish its assertions from, say, a religious belief or a political ideology. He cautions scientists against responding to the relativism of science and technology studies by retreating to the naive scientism of what Ziman calls “The Legend,” the mythological view of science as the product of the entirely rational and selfless efforts of dispassionate humans.

Everyone who has participated in research knows that it is an untidy process, guided as much by intuition as by logic, the work of reasonably intelligent beings with all the incumbent faults and frailties. Its “objectivity” is far from perfect, residing not in the individuals who practice it but in the scientific community, and especially in its systems of communication, which Ziman calls “collective skepticism.” Refereed journals, conferences, and less formal contacts help to root out bias and error. The end result falls far short of perfection, but it does represent a body of facts and theories that a reasonably prudent individual can use as a guide to practical action.

Ziman uses the controversy as a “bully pulpit” to expound on what really worries him: the gradual emergence of what he calls “postacademic science,” the convergence of academic and industrial modes of research. University research is increasingly supported by industrial sponsors and mission-oriented government agencies that exercise control of the research agenda and restrict the dissemination of findings that is so essential to the process of science. This potential bias is likely to further erode public confidence in science. He sees no way to buck this trend. Scientists must find new modalities to maintain their collective integrity. Scientists, sociologists, philosophers, and historians alike would be better served paying attention to the issues surrounding postacademic science than continuing the petty battles of

the science wars.

Much of the antagonism of the science wars can be traced to the well-established academic practice of stating one’s views in extreme form to stir up a controversy and thereby attract the kind of attention that can actually enhance a career. This is common practice in the humanities and not unknown in natural science. Understanding the source of the antagonism and misunderstanding between scientists and science and technology studies practitioners is key to getting beyond the science wars, and both of these volumes make significant steps in this direction. Any scientist interested in establishing a more constructive dialogue with the science and technology studies community would be well-advised to read these works.

Einstein in Love: A Scientific Romance

▶ Dennis Overbye
Viking/Penguin, New York, 2000.
\$27.95 (416 pp.).
ISBN 0-670-89430-3

Einstein: The Formative Years, 1879–1909

▶ Edited by Don Howard
and John Stachel
Birkhäuser, Boston, 2000. \$54.95
(258 pp.). ISBN 0-8176-4030-4

The “Einstein Industry” is flourishing as never before. Since the appearance of Abraham Pais’s best-selling and still unsurpassed scientific biography of Albert Einstein, *‘Subtle Is the Lord...’* (Oxford U. Press, 1982), at least four other, more “popular” biographies have been published, as well as several other Einstein-related books such as a collection of quotations and Einstein’s love letters to his fiancée. Now Dennis Overbye, a well-known science writer and deputy science editor of the *New York Times*, has added his *Einstein in Love* to the list of Einstein biographies for a general audience.

Is there a need for yet another biography? Obviously Overbye thinks there is. In his prologue, he claims that this book is not a biography in the strict sense of the word, but rather “an attempt to bring the youthful Einstein to life.” The somewhat strange title, that suggests a musical comedy rather than a serious biography, must be seen in this light: The Einstein portrayed here is a man full of vigor and love—for physics as well as his com-

panions, both female and male. Despite this somewhat different approach, Overbye’s book contains the usual biographical ingredients, such as a narrative of the well-known facts of Einstein’s life and an exposition of his science.

The latter is less successful than the former; although Overbye’s prose is clear and his style is polished, his discussion of the science, aimed at a general audience, is not always accurate. His description of Max Planck’s work on radiation theory, for example, and his summary of Hendrik Lorentz’s electron theory are not only inaccurate but sometimes downright misleading.

But where Einstein as a person comes to the foreground, *Einstein in Love* makes for good and entertaining reading. In a well-balanced account, Overbye succeeds in making Einstein come to life in all the complexities of his personality, which is no small achievement. He portrays Einstein as a human, not as a saint, and he makes no secret of the darker sides of Einstein’s personality—such as his less than exemplary behavior as a husband and father—without, however, giving them undue emphasis.

The book ends rather abruptly and unsatisfactorily around 1920, after the confirmation of general relativity’s prediction of the deflection of starlight by the Sun, which turned Einstein into a public figure almost instantly. It remains unclear why this cutoff point was chosen. Perhaps it is because Einstein’s correspondence up to 1918 is easily available, both in German and in English translation, and with detailed commentary, in the volumes of the *Collected Papers of Albert Einstein* that have been published so far. In any case, Overbye has made good use of the Einstein edition, enlivening his text with many well-chosen quotations. Despite the shortcomings noted earlier, his book is a useful addition to the Einstein literature.

Einstein: The Formative Years, 1879–1909, aims at a more specialized audience. This collection of essays is the eighth volume in the Einstein Studies series, edited by the well-known Einstein scholars Don Howard and John Stachel, and is partly based on papers presented at a meeting held in 1990.

As the title indicates, the volume focuses on the first 30 years of Einstein’s life, the years before he held an official academic position—the years during which he produced or laid the foundation of his most important work. In eight papers, the contributors to this collection explore the new material that came to light during preparation of the early volumes of

the *Collected Papers of Albert Einstein*, shedding light on such diverse topics as the influence on Einstein of his readings as an adolescent, the impact of Immanuel Kant's philosophy on Einstein, and the genesis of special relativity. It is a very valuable volume for all scholars who are seriously interested in the intellectual development of the young Einstein.

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Light Science: Physics and the Visual Arts

▶ Thomas D. Rossing and Christopher J. Chiaverina
Springer-Verlag, New York, 1999.
\$79.95 (442 pp.).
ISBN 0-387-98827-0

Efforts to make physics courses more meaningful to nonscience majors are continuing by bringing the course work closer to the students' experiences with nature and art. I have taught elective courses in light and color and in sound and music, as well as a required "core" course called, "Exploration of Color." For the light courses, I used *Seeing the Light* by David Falk, Dieter Brill, and David Stork (Harper & Row, 1986). It was somewhat less suitable for the core course. So I was pleased to see that *Light Science* by Thomas D. Rossing and Christopher J. Chiaverina was described in its preface as "intended for students in the visual arts and for readers interested in art." This new book on light, as did Rossing's *The Science of Sound* (2nd ed.; Addison Wesley, 1990), updates existing texts. The book on sound does this with discussions of electronic music and digital techniques, while the light book does it with chapters on advances in holography, computer images, optical recording, communication, and photonics.

The first 8 of the book's 14 chapters deal with the basic physics of light and color which, to a large extent, can be found either slightly more or slightly less mathematically treated in other texts. The structure is similar to that of *The Science of Sound*: text, summary, references, glossary, review questions, and experiments for home, laboratory, and classroom demonstrations. In addition there is an appendix containing about 60 pages of laboratory experiments, which would be useful if a laboratory were to accompany the course.

The frontispiece of the book is denoted as an "ambigram," a word that I could not find in any of my dic-

tionaries. It is in fact a picture with twofold rotational symmetry. This made me think of "topsy turvy" pictures, which look the same upside down as right side up, and of the *Turvy Topsy Contest*, which was run by Arthur Schawlow in the periodical of the Optical Society of America (*Optics News*, February 1975): Produce a slide that can never be right way up! (For winning entries, see *Optics News*, January 1976.) In chapter 13 of their new book, Rossing and Chiaverina return to ambigrams, citing a musical counterpart by Mozart. (There are other well-known examples of musical symmetry, for example, in Igor Stravinsky's *Canticum Sacrum* and Paul Hindemith's *Hin und zurück*.)

Artists use color theory, often in more than an intuitive way. In the 1979 exhibit of the Armand Hammer Collection at the Museum of Fine Arts in Houston, I recall seeing sketches by Paul Gauguin showing his understanding of ray tracing, prisms, and color combinations, with accompanying notes on art theory. Rossing and Chiaverina give a number of well-known applications, as in pointillist, anamorphic, and op art. Sometimes, in turn, artists make a contribution to the science or technology of art: Two musicians, Leopold Godowsky Jr and Leopold Damrosch Mannes invented the Kodachrome process. (But this is a half-truth: They both also had physics degrees!) There are interesting sections in the appendices of *Light Science* on analysis of art materials and conservation and restoration of paintings. These subjects are not treated in the other texts that I consulted.

Holography, the creation of Dennis Gabor, is discussed, from the early use of the laser in this application by Emmett Leith and Juris Upatnieks, and white-light reflection holography by George W. Stroke and Antoine Labeyrie, to present-day TV holography and computer-generated holograms. The basic physics, however, is not explained adequately.

There are a few incorrect statements in the book. The measurement of the speed of light by Olaus Rømer (1644–1710) was not made with use of the Doppler effect; Christian Doppler lived from 1803–1853. Madam Chen-Shiung Wu and Eric Ambler never received the Nobel Prize.

While I can appreciate that authors don't want to scare students with too much mathematics, burying formulas in the text is cosmetic and counterproductive, particularly when these are required in the "exercises" (not called "problems"). Only halfway through the

book do display formulas appear. There are numerous other errors, more or less significant, which I would hope a second edition would correct. Careful editing should eliminate unnecessary repetitions and the introduction of terms without definitions. I can understand the unhappiness of students who encounter such shortcomings. Notwithstanding these criticisms, *Light Science* should serve well its stated readership.

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Bose-Einstein Condensation of Excitons and Biexcitons and Coherent Nonlinear Optics with Excitons

▶ Sviatoslav A. Moskalenko and David W. Snoke
Cambridge U. Press, New York, 2000. \$85.00 (415 pp.).
ISBN 0-521-58099-4

Bose-Einstein Condensation of Excitons and Biexcitons and Coherent Nonlinear Optics with Excitons, by Sviatoslav A. Moskalenko and David W. Snoke, is a most useful text by two physicists each of whom has made substantial contributions to the field of Bose-Einstein condensation (BEC) with excitons, a subject attracting increasing interest at present. My own awareness of this subject goes back to 1993, when I read a paper reporting evidence of BEC in an excitonic gas; the paper caused quite a stir. I was on sabbatical at that time working at NIST, in Gaithersburg, Maryland, and so had time to read it properly. Snoke was a coauthor on the paper, which described a significant development clearly, and a heated debate arose about what had been observed and the potential for future experiments.

Excitons are weakly interacting composite bosons, and one should, therefore, be able to observe BEC in its pure form (BEC is seen in its pure form only in weakly interacting systems) using a gas of excitons. For this and other reasons, there had been an effort to produce a sufficiently dense and cold excitonic gas with which to observe BEC.

That was an exciting time for research in BEC in general, with breakthroughs in the production of atomic condensates soon to occur. (This closely related field has grown