Italy, obviously as important and painful to the author as irrelevant to the world at large. This tendency to avoid the deeper aspects of a controversial issue, skirting them by taking a pragmatic attitude while keeping a disenchanted eye on the matter, is characteristic of Segrè's writing and reveals itself in his own behavior on several occasions, as in the case of the loyalty oath required of the faculty in 1949 by the regents of the University of California; regarding the whole affair as "a grotesque episode," Segrè nonetheless swore the oath, considering the requirement a "transient lunacy." Transient it was indeed, but it was a lunacy that cost Berkeley such scientists as Geoffrey Chew, Gian Carlo Wick, Robert Serber, Wolfgang Panofsky, and Marvin Goldberger. It must be noted that Segrè's actions were at times strongly conditioned by his relatively weak position as an immigrant and former "enemy alien."

"Emilio at home, doing his daily chinning exercise, 1981." [From *A Mind Always in Motion*; courtesy of the *San Francisco Examiner*]

A scientist's autobiography is not usually meant just as a selection of anecdotes and recollections from the author's life: it is offered as a document for history, in which the author intends that "the facts as they actually happened" be revealed and committed to posterity. This is certainly the case with Segrè's; his declared purpose, prompted by the observation that many of his colleagues "remember the facts . . . the way they would like them to have happened," is to "tell the unvarnished truth." Historians have long been aware of the care required in the use of such historical reconstructions, learning to treat them as at once valuable documents and unreliable sources. How does Segrè's contribution rate checked against independent historical evidence? Certainly better than average, thanks to the author's habit, developed in his own writings on the history of physics, of reliance on documentation. Still, tricks of memory and the unconscious wish to tell facts the way one "would like them to have happened" take over on occasion, and one is given an overall picture that, while composed of single elements that are factually accurate, can nonetheless be altogether misleading. This is the case with the account of the events that led in 1955 to the antiproton experiment that finally won Segrè and Owen Chamberlain the Nobel Prize four years later. Segrè says that he "decided to attack the problem in two ways," but no mention is made of the fact that the second way (observation of annihilation tracks in photographic emulsions) had been proposed to him by Edoardo Amaldi, who already had obtained some slight evidence of antiproton annihilation in emulsions exposed to cosmic radiation, and was developed as a joint enterprise between the Rome group led by Amaldi and the Berkeley physicists, so that the emulsion work that confirmed the results of the first experiment was actually performed in Rome. The collaboration between the two groups is mentioned, later in the narrative, in such a way that it is not at all clear that it had to do with the antiproton, and the only way the reader can get a hint of Amaldi's actual role in the story is by looking, in the notes at the end of the book, at the names of the authors of the papers that appeared in the *Physical Review*. Altogether, the author carves for himself and his group a larger share of the credit than available evidence suggests is warranted. This is by no means meant to detract from the book's worth as valuable reading and significant testimony; it only offers a further small warning about the objectivity of involved witnesses. Even if at times what Segrè tells of others has to be taken with care, it tells us much about Segrè, and this is, after all, what an autobiography should strive for.

Giovanni Battimelli
Department of Physics,
University of Rome La Sapienza,
00185 Rome, Italy

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Home Life of a Hero

The Private Lives of Albert Einstein. ROGER HIGHFIELD and PAUL CARTER. Faber and Faber, London, 1993. xii, 355 pp. + plates. £14.99.

Albert Einstein is as fascinating as he is puzzling. A man of enormous achievement in science and often singular dedication in social affairs, he evokes public adulation like few others of this century. Despite the efforts of numerous biographers, Einstein's private life and personality have remained largely unknown, provoking both the fascination of the curious and the puzzlement of any scholar attempting to comprehend the public Einstein in human terms. Only recently, and especially with the advent of the project to research and edit Einstein's collected papers, has Einstein's personal life been successfully subjected to as much scrutiny as has his early and most influential scientific work. Closely supported and guided by the Einstein editors, British journalists Roger Highfield, science editor of the *Daily Telegraph*, and Paul Carter, deputy chief subeditor of the *Daily Express*, provide a readable, thoughtful, and insightful report on the private Einstein uncovered so far by the Einstein project. Their account displays both the strengths and the weaknesses of their craft and of the Einstein editorial project on which they rely.

Like most investigative reports, one aim of this book is to debunk the heroic Einstein: to reveal the self-described "Jewish saint" in the public arena as a secular sinner in private affairs. There seem to be plenty of personal faults for which to condemn the man, but the authors do not always avoid the Fleet Street mania for muck. In a chapter entitled "The holy one" they resolutely wring every unseemly bit of gossip they can from the memory of Einstein's former live-in maid; elsewhere, pages are filled with the macabre story of how Einstein's brain was removed and analyzed after his death; and gossipy statements and biographies by anyone claiming inside information on Einstein are presented as fact. In a manner more to the journalist's than to the scholar's taste, all sources are treated as equal, and historical wisdom devolves mainly from the members of the Einstein editorial project. The book concludes with a brief history of the editorial project, criticism of attempts by the executors of Einstein's estate to shield the great man's private life, and an epilogue updating an earlier chronicle of the editors' seemingly obsessive efforts to track down Einstein's illegitimate offspring. Apparently at a loss for news, the authors make almost as much a story of the Einstein editorial project as they do of Einstein himself.

Despite such excesses, the center of this book remains the scrutiny of Einstein's "private lives," by which is meant mainly his relationships with women. Gossip aside, the authors rest their case on the more solid evidence of Einstein's recently uncovered "love letters" with his two wives—although, for him, love seems to have played only a minor role in either marriage. When not merely summarizing these letters, the authors achieve a number of unique and important insights, some of which touch upon the most significant question of any scientific biography: how did this person achieve his or her scientific contributions?

"Mileva [Marić Einstein] and her sons Eduard and Hans Albert in 1914, when she left Albert Einstein and returned to Zurich" from Berlin, in effect ending their life together. [From *The Private Lives of Albert Einstein*]

"Albert Einstein and his second wife, Elsa, on board the *SS Rotterdam* in 1921, the year they paid their first visit to the United States." [From *The Private Lives of Albert Einstein*; AIP Emilio Segrè Visual Archives]

One of the more heated controversies in this regard surrounds the role, if any, of Einstein's first wife, Mileva, in his early work, especially in the formulation of the theory of special relativity. The authors claim the middle ground by concluding that Mileva did not contribute directly to Einstein's breakthroughs but did provide the encouragement and the intellectual and emotional support that Einstein needed to complete his work. His success eventually led to the collapse of their marriage, however, for in finding intellectual support elsewhere he no longer needed her, especially as general relativity began to consume his entire being. For emotional support, Einstein turned from the now increasingly jealous Mileva to his motherly first cousin Elsa, whose presence in Berlin beckoned him to that city and who eventually became his second wife. With his wrenching separation and divorce from Mileva, something seemed to have died within Einstein, for, if the authors are right, his emotional reactions to those closest to him became increasingly cruel and unfeeling. Yet Albert and Mileva remained somehow "knotted together" until the end of her sad and lonely life in 1948. Indeed, for everyone close to Einstein, including Einstein himself, life took a tragic turn, perhaps even more so because of Einstein's emotional limitations. These are themes and insights that bear closer study and, if maintained, will prove essential for any comprehensive appreciation of Einstein as both scientist and human being.

David Cassidy
Natural Science Program,
Hofstra University,
Hempstead, NY 11550, USA

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Respiratory Physiology

Oxygen Transport in Biological Systems. Modelling of Pathways from Environment to Cell. S. EGGINTON and H. F. ROSS, Eds. Cambridge University Press, New York, 1993. xii, 298 pp., illus. $110 or £55. Society for Experimental Biology Seminar Series, 51. From a symposium, Birmingham, U.K., April 1991.

Multicellular organisms are possible only because of transport systems that have developed to carry oxygen from the environment to individual cells and subcellular particles. A complete system transfers oxygen between the environment and a transport fluid, which is convected to an internal exchanger by which the oxygen is delivered to the cell. Models have contributed greatly to our understanding of oxygen delivery. *Oxygen Transport in Biological Systems* reviews the most recent advances in modeling oxygen transport in the animal kingdom as well as in plants.

The first chapter (Shelton) discusses total respiratory exchange as an engineering system in a broad variety of animals, with emphasis on the different types of exchangers—counter, parallel, and cross-flow—for steady-state and non–steady-state conditions. The second chapter (Alexander and Young) explores the dynamic interaction between lung ventilation and major bodily movement by way of a simple, ingenious model of mass, spring, and dashpot. The authors are able to prove that the piston-like action of the viscera probably contributes little to ventilation in the galloping horse, although it contributes significantly in the wallaby.

In the 1980s Weibel and Taylor stimulated interest in comparing structure and function in the respiratory system by using stereoscopic morphologic techniques to determine structure and proposing that nature provided no more structure than necessary for functional demands. An excellent review (Perry) of comparisons of the effective transfer function in lungs and gills for oxygen calculated by morphometry methods and measured by physiological methods is more discouraging than I consider justified, given the general agreement of the two methods' results and the many limitations of the experimental measurements from both approaches. The limitations on exchange provided by the red cells themselves are not addressed here.

In fetal mammals the placenta (rather than the lung) becomes the external exchange organ, but with additional layers on the maternal side. A morphometric study of human placentas from births at high and low altitudes is reported by Mayhew. The diffusion distances were found to decrease remarkably with gestational age and with altitude, indicating adaptations of the exchanger to oxygen need. Hemoglobin, the most studied protein, is the star of oxygen transport. Our knowledge of its structure, models of its function, and recent contributions from molecular biology are reviewed succinctly by Bellelli and di Prisco.

Fractals and L sets are irregular geometric structures or sets produced by recursive (repeated) rules. An example is a bifurcating vascular network in which the length of each daughter branch is a constant (trivial if not different) fraction of the length of the mother branch. Fractals resemble natural objects—in the present context, trees and vascular beds—rather than regular geometric shapes. This tool provides a mathematical statement of vascular heterogeneity that can be manipulated in computer descriptions of oxygen transport in tissues. Van Beck provides a clear introduction to the subject and discusses as an example the flow distribution in fractal self-similar networks of increasing complexity. Fractals could prove to vitalize the field much as did the advent of the computer. The recursive rules that govern them may even be analogous to the unknown laws that govern the growth of tissue vascular beds.

Models are most fruitful when their predictions can be verified by measurements, but they remain useful even when experimental tools are limited. This is true of the simplified model developed by Krogh and the mathematician Erlang in 1918 of the final step in oxygen transport in muscle, the progression from the capillary through the cell. This model consisted of a single capillary surrounded by homogeneously metabolizing muscle fibers whose axes were parallel to that of the capillary. The basic form of this model is still used today. One of its major defects is that it does not capture the fact that in real tissue there are many capillaries, not all of which are parallel to