tions of the earth are shown to be inconclusive, and, in the Fourth Day, Galileo produced what he considered his decisive argument, the celebrated, and unfortunately mistaken, proof from the existence of the tides that the earth moves.

In the first part of his book Maurice A. Finocchiaro rightly insists on the importance of Galileo's rhetorical skill in the *Dialogue*. Never before had any critic of Aristotle been so gifted as a writer, so apt at convincing an opponent by the sheer brilliance of his presentation, and so masterful at laughing him off the stage when he refused to be persuaded. Galileo drew from the literary resources of his native Italian to convey insights and to stimulate reflection, but his style did not possess the bare factualness of the modern laboratory report or the unflinching rigor of a mathematical deduction. Words are more than vehicles of pure thought. They are sensible entities, they possess associations with images, memories, and feelings. Galileo knew how to use these associations to attract, hold, and absorb attention. He did not present his ideas in the nakedness of abstract thought but clothed them in the colors of feeling, intending not only to inform and to teach but to move and to entice to action. He wished to bring about nothing less than a reversal of the 1616 decision against Copernicanism, and the dialogue form seemed to him most conducive to this end. It is true that the written dialogue is deprived of the eloquence of facial expression and the emphasis of gestures, of the support of modulated tone and changing volume, but it retains the effectiveness of pauses, the suggestiveness of questions, and the significance of omissions. Galileo made the most of these techniques, and it is important to keep this in mind when assessing his arguments, for too often passages of the *Dialogue* have been paraded without sufficient regard for their highly rhetorical content.

Finocchiaro is a philosopher, however, and he is eager to disclose the logic inherent in Galileo's reasoning. For instance, Galileo's refutation of the Aristotelian assertion that the world is perfect because it has three dimensions is spelled out as follows (pp. 346–347):

(A1) The world is perfect because (A11) it has the three dimensions of length, width, and depth and (A13) these are all the dimensions that exist; and (A11) the world has three dimensions because (A111) three is a very special number (in that three is (A1111) the number of parts that everything has, namely beginning, middle, and end; (A1112) the number used in sacrifices to the Gods; and (A1113) the least number of things required before the word "all" can be applied to refer to them collectively).

The relevant proposition here is the three-dimensionality of the world, A11. Galileo is here accepting this proposition, but neither its alleged implication (A11, ∴ A1), nor its alleged justification (A1111, A1112, A1113, ∴ A111; ∴ A11). In short, Galileo is agreeing that the world is perfect and that it has all three dimensions, but denying that there is a connection between the two propositions such as to ground perfection on three-dimensionality.

This exercise may come as a pleasurable experience to some philosophers, but scientists and historians of science will be excused for finding that it actually robs Galileo's text of its rhetorical force without providing any demonstrative rigor. As Galileo himself says in a passage from the *Dialogue*, "The art of demonstration is learned by reading words which contain demonstrations. These are mathematical treatises, not books on logic." In the *Discourses on Two New Sciences*, Galileo's most important scientific contribution, this art is brilliantly illustrated. If Finocchiaro had wrestled with the proofs in this work, he would have found it more difficult to use Galileo as a scourge to castigate a wide range of philosophical positions and individual researchers in the second and third parts (over 300 pages) of his book. The great Galilean scholar Alexandre Koyré is faulted for "demonstrated inadequacies in erudition, logic (reasoning), methodology (historiography) and scholarship" (p. 205), Maurice Clavelin for "his practice of interpreting passages out of context" (p. 246), Stephen Toulmin for his tendency "to neglect the interdisciplinary nature of most creative reasoning" (p. 304), and Ernan McMullin for offering an argument "at best circular" (p. 22). The only person to escape unscathed seems to be Stillman Drake, on whom Finocchiaro leans heavily and uncritically for his interpretation of Galileo's notion of inertia and the proof from the tides. Readers with a taste for swashbuckling rhetoric rather than historical accuracy will take to this book.

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Views of a Watershed

Reminiscences of Los Alamos, 1943–1945. LAWRENCE BADASH, JOSEPH O. HIRSCHFELDER, and HERBERT P. BROIDA, Eds. Reidel, Boston, 1980 (distributor, Kluwer Boston, Hingham, Mass.). xxii, 190 pp. Cloth, \$26.50; paper, \$9.95. Studies in the History of Modern Science, vol. 5.

The birthplace of the atomic bomb looms larger in the legend of wartime science than the magnitude of its contribution would seem to warrant. As one contributor to this volume puts it, "Radar won the war, atomic energy shortened it." Yet the accomplishments at MIT's Radiation Laboratory, Chicago's Metallurgical Laboratory, Oak Ridge's separation plants, and the Hanford Engineering Works do not exert the hold that Los Alamos does upon the generation of American scientists who contributed to these efforts. The story of Los Alamos, after all, features a tragic hero, Robert Oppenheimer, a picturesque and isolated setting that is easily romanticized, and a spectacular climax that casts a long shadow over the future of humanity, even if Los Alamos did not "win" the war.

This collection of lectures, delivered at the University of California at Santa Barbara in 1975 by veterans of the wartime experience at Los Alamos, illuminates the reality behind the drama. They capture domestic nuances of Los Alamos life as well as more compelling tales of implosion research and development, effects studies, and preparations for the Trinity test. Although the entire range of wartime Los Alamos society is not represented, we hear from scientists, engineers, soldiers, and housewives. Their reflections upon problems ranging from bomb design to truancy, from the contradiction between security and scientific communication to the conflicts between army censors and wives who illustrated their letters with unauthorized doodles, capture the spirit of life in this army camp cum academic think tank.

Scientists who spent long days inside the technical area recall tensions arising there between academic and military rationality and between the scientific and technological demands of wartime research. In a humorous talk, Richard Feynmann recounts his struggle against the censorship and compartmentalization imposed by military regulations upon the project. George Kistiakowsky recalls the conflict between little science and big technology in developing the implosion technique, a conflict he was called in to resolve against his better judgment that Los Alamos would make no contribution to victory. The initial intimacy of Los Alamos was eroded by unforeseen growth, which some attribute to the residue of experts who had completed their assigned tasks but could not leave because of security regulations. Still others praise the flexibility of these same experts, which contributed to the solution of new problems that arose in the course of the project and were the real reasons for growth in their view. For many, the contradictions between their ideals of research and the realities of Los Alamos were personified by General Leslie Groves, who even his supporters admit had "an almost *uncommon* facility for saying the wrong thing to a scientist." Yet these same problems have arisen repeatedly in the evolution of Big Science, and Norris Bradbury's account of post-war Los Alamos indicates how he managed them, although not without cost.

Los Alamos was a watershed not only in the evolution of the relationship between science and government and in the development of modern Big Science but also in the individual lives of many of its inhabitants, who remember this period as an unparalleled adventure. No doubt the confluences of the primitive and beautiful environment with the makeshift town, of ancient Indian pueblo life with modern scientific research, and of wartime necessity with the opportunity to mingle with the greatest scientific minds lent excitement, intensity, and romance to the experience. The events at Trinity, Hiroshima, and Nagasaki, however, gave it meaning. Laura Fermi recalls that her younger son felt that his father, Nobel laureate Enrico Fermi, was less important than a playmate's father, who held the exalted rank of captain in the army, until after Hiroshima. For him, as for many veterans of Los Alamos, the experience there is forever illuminated in the light of Trinity. Most of the lecturers represented here defend that experience in the light of the conflict resulting from the use of the bomb.

The editors have attempted to place these lectures in a different perspective by focusing on the prehistory of Los Alamos in their introduction. They have deliberately avoided reconciling conflicts between differing accounts to preserve the spontaneity and authenticity of this historical "source material," but they have gone too far, in my opinion, in preserving some of the stylistic inadequacies of a number of the lecturers, so that one is actually repelled by the prose in some essays. Although a number of the lecturers have told their stories before, there are enough new faces in the book to afford novel insight into the Los Alamos experience and some corrective to the heroic legend.

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Events of Physics

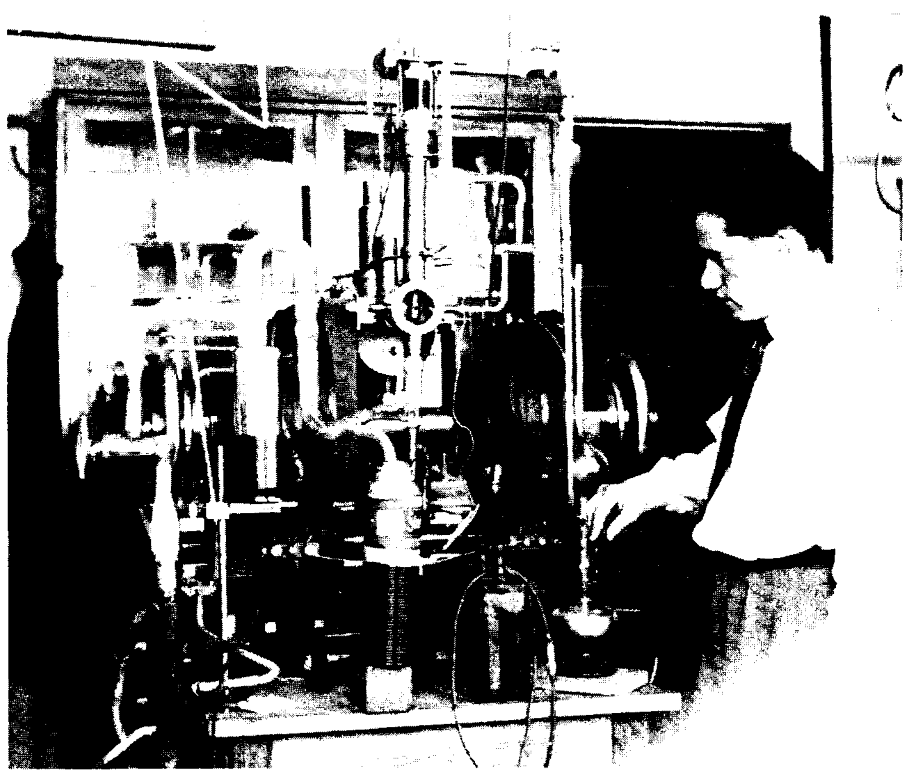
From X-Rays to Quarks. Modern Physicists and Their Discoveries. EMILIO SEGRÈ. Translated from the Italian edition (Milan, 1976). Freeman, San Francisco, 1980. xii, 338 pp., illus. Cloth, $20; paper, $9.95.

Emilio Segrè, codiscoverer of the element technetium and of the antiproton, for which he shared the 1959 Nobel Prize in Physics with Owen Chamberlain, has written a modest and engaging personal account of 20th-century physics, emphasizing the parts he considers most fundamental. By no accident, these include the fields of his major contributions: nuclear and elementary particle physics. His opinion about future trends is that "the possibility of intellectual discovery points to particle physics," as opposed to the study of multibody systems, such as liquids or nuclear matter. Other scientists might well disagree, as he is quick to stress.

Based on lectures given at Berkeley, Chicago, and Rome and "addressed to people who are curious about the physicist's world," the book is a chronologically ordered collection of essays describing the important discoveries and relating anecdotes about the great personalities. A number of these have been told before, and if they are not entirely accurate Segrè is a charming raconteur who tells his stories simply and well.

In the preface is a disclaimer: "The book does not pretend in any way to be a history of modern physics and even less to be a small physics text. It is rather, an impressionistic view of the events as they appeared to me during my scientific career, which started about 1927." (However, the first half of the book is background). Accepting this at face value, I found a lot to enjoy in Segrè's essays.

When he deals with events that occurred on his home ground, whether Rome or Berkeley, where he was a participant or witness, or when speaking of colleagues and personal friends, Segrè



"Otto Stern's laboratory, Hamburg, 1931. O. R. Frisch is shown with the apparatus for measuring the magnetic moment of the proton." [Photograph of Emilio Segrè, from *From X-Rays to Quarks*]