conjecture. First, a considerable part of the reduction in mortality is due to a reduction in the incidence of specific infectious diseases rather than to lower case fatality rates. Second, the congruence of the age patterns of sickness and of death, especially the exponential increase of each through the adult years, also serves to link the phenomena of morbidity and mortality. Finally, the reduction in the incidence of disease has delayed effects. According to this "insult accumulation" hypothesis, episodes of disease at younger ages weaken the capacity of the organism to resist sickness and cope with life-threatening experiences at older ages. In sum, Americans today should live not only longer lives but healthier ones as well.

James Riley's examination of the historical record of morbidity in Britain fails to bear out this optimistic conjecture. Low-mortality populations are also characterized by low fertility, the demographic condition that has been responsible for the aging of populations. (Because the average age of those not dying as mortality declines differs little from the mean age of the living population, the reduction of the death rate has had only a minor impact on the age distribution.) Because of its age composition, an older population has more sickness than a younger one. Even if fewer insults are accumulated over time by a cohort in a low-mortality situation, at the same time a larger fraction of frail individuals fail to be eliminated early in life. The greater heterogeneity of frailness in a low-mortality population may mean that the level of sickness will be higher than in one whose cohorts have been more severely winnowed by death.

Finally, the quantitative behavioral evidence on morbidity does not support the belief that health improves as mortality declines. Riley measures morbidity by wages lost from work owing to injury and illness that were compensated for by insurance. Data from several insured groups between the mid-17th and early 20th centuries supply the principal empirical basis for this study. Riley correctly notes that measurement of sickness in this manner is considerably more problematic than the recording of mortality. Although deaths may be incompletely registered, they are unambiguous vital events. In contrast, both cultural and economic factors contribute to the measured incidence and duration of work time lost that was compensated for by insurance.

Necessarily relying on the best available empirical evidence, Riley wants it to have validity. His claims sustaining this hope are not persuasive. Actuarially, the expenditures on funded sickness must balance the revenues provided by the premiums of the workers; the insured thus could only afford a certain amount of sickness among their fellow policyholders. Riley shows that the average duration of sickness episodes increased before the final decade of the 19th century in England, but he is not convincing that the reason for this change was longer periods of ill health in a biological sense. He also attempts to distinguish morbidity patterns in the era of high and highly variable mortality before 1800 from those in the long period of moderate and more stable death rates in the 19th century. The apparent reduction in annual variability in sickness between the two eras may be an artifact of much larger base populations of insured individuals in the 19th century compared to those in the pre-1800 era.

Quantitative evidence on morbidity in the 20th century is even less consistent over time than it is for earlier centuries. Compensation for work-related accidents has been spun off into separately funded workman's compensation schemes. Various welfare-state programs, especially pensions for the old, have altered the relationship between income for work and stipends for non-work. More precise medical categorization and an increasing awareness in the population of novel types of sickness, such as mental depression, have altered the boundaries between good and ill health. Prolonged episodes of sickness, like a short work week and paid vacations, are luxuries of economically advanced societies. It is quite possible that historians will never be able to provide reasonably certain estimates about the long-run trend in morbidity. Nevertheless, this wide-ranging volume usefully lays out the issues and provides a first survey of the relevant historical record.

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The Civics of Science

Teaching the History of Science. MICHAEL SHORTLAND and ANDREW WARWICK, Eds. British Society for the History of Science and Basil Blackwell, New York, 1989. viii, 281 pp. $29.95. Based on a conference, Oxford, U.K., 1987.

Concerned about the quality and the effectiveness of science education, historians, scientists, and other educators on both sides of the Atlantic in the past few years have tried to define scientific literacy and to determine how it can best be achieved. The issue has not been an easy one to resolve, in part because the scientifically literate individual is often depicted as both an insider and an outsider: as someone who not only possesses a certain mastery of scientific knowledge and an ability to think and work scientifically but who can also formulate critical judgments and informed opinions about applications of science and technology in society. Especially in recent discussions on the revision of pre-college science and history curricula, educators have turned to the history of science as one source of alternative approaches to science teaching and, perhaps more appropriately, as a rich repository of material concerning how science operates in its own community as well as in the larger political, economic, and social contexts.

The papers in this volume represent the first effort of the Education Section of the British Society for the History of Science to relate the history of science to school science and history courses. They are divided into three sections: on perspectives, practice, and sources. The last section, listing multimedia resources in the history of science available in Great Britain, is least useful for an American audience, although it should inspire the Committee on Education of the American-based History of Science Society to produce a similar compilation.

The papers in the first two sections of the volume, which either discuss examples of how the history of science can be used in the classroom or examine past and present historiographical trends in the history of science, are of mixed quality. They do more to dismantle stereotypical images of science and scientists than to make convincing arguments about how lessons and materials drawn from the history of science offer compelling advantages over more traditional pedagogical approaches to learning science. Thus valuable political and ideological purposes are served by Piyo Rattansi's sensitive exploration of the ways in which school science could unwittingly underestimate non-Western approaches to the study of nature when the value-laden conceptual frameworks within which Western science functions are ignored; by Roger Hennesey's challenge to the Marxist view that technology is unnatural and enslaving; and by Stephen Brush's unforgettable discussion of how history reveals the racial biases built into the Stanford-Binet IQ test. Richard Jones's thorough review of the historiography of science—covering not only the well-known Anglo-American traditions but also the lesser-known French, Marxist, and critical theorist strands—is intellectually stimulating but of marginal value for the schoolteacher, even for those who deal with precocious teenagers.

In recent years British historians of science, primarily those associated with the so-called "Edinburgh School," have strongly

promoted the historical study of experimental practices by focusing on the conduct and reporting of experiment, on the process of social negotiation leading to consensus regarding experimental results and, to a lesser but increasing extent, on the technical skills deployed in experimentation. In the present volume Harry Collins and Steven Shapin argue that the precepts of this historical methodology can be applied with profit in science education, especially the laboratory component of secondary school science. A paper by David Gooding on Michael Faraday's electromagnetic experiments of 1821 demonstrates the obvious point made by Collins and Shapin that students may acquire a more sensitive understanding of experimentation by studying actual practices than by relying on the reconstructed images appearing in textbooks.

There is much to be said for the benefits to science pedagogy that could result both from studying historical exemplars of scientific experimentation closely and from enhancing skill acquisition. But in two respects the claims made by Collins and Shapin are overstated. They call the historical literature whose utility they advocate the "new history and sociology of science" (even conferring on it an acronym, "NHS"). Yet in some respects neither their history nor their sociology is all that new. To be sure, this British group has produced some of the most historiographically mature studies of experimentation, but their efforts have not been entirely without precedent. American audiences need only think of the work of Henry Guerlac on Lavoisier, of L. Pearce Williams on Faraday, and of Frederic L. Holmes on Bernard and Lavoisier. These American authors did not take up the social dimensions in the construction of scientific knowledge that this British group considers so important, but here too the British are not entirely "new." Despite the centrality of the social negotiating process to the analyses of experiment advocated by these British historians, they make no mention of Ludwik Fleck's *Genesis and Development of a Scientific Fact*, a seminal work from a half-century ago that viewed the construction of scientific knowledge in terms of community consensus.

Citing the example set by the *Harvard Case Histories in Experimental Science* series, whose editor, James B. Conant, argued for the *civic* importance of understanding the methods and limits of experimental practice for making responsible judgments on the role of science in a democratic society, Collins and Shapin feel that the NHS approach aids a "radical rethinking" of how to educate nonscientists and even "scientists for their roles outside the laboratory—that is, for educating citizenry in matters scientific" (p. 70). Insofar as critical judgments about science rely upon familiarity with the knowledge-producing acts that occur largely within the scientific community (for example, those involved in challenges to scientific results, the achievement of consensus, or the assessment of certitude), NHS literature does help to create informed citizenry. But it does not work as effectively in teaching the concepts and tools that could be used for judging how science is to be applied in the larger world. As John L. Heilbron and Daniel J. Kevles have pointed out, properly teaching "the 'civics' of science and technology" requires a consideration of matters that lie outside the scientific community, especially the larger historical forces at work in society ("Point of View," *Chronicle of Higher Education*, 15 February 1989, p. A48). Some authors in this volume, most notably Bill Brock, do emphasize relating science to its larger context in order to help students think about debates involving science, but a more sustained effort at creating pedagogical material suited for dealing with broader social, political, and economic questions concerning science is needed.

The issue of scientific literacy has raised questions about the adequacy of extant narratives of the scientific past. The historical narratives found in science textbooks often depict science as a technico-rational activity serving the Enlightenment goals of progress and truth and fulfilling the liberal ideal of highly developed individual expression. The authors in this volume justifiably find that image unsatisfactory. The pedagogical demands now being placed on the history of science require an image of science more consonant with actual scientific practice since World War II, in particular one taking into account large-scale projects that are carried out by teams of individuals and are often tied to military or security interests. Historians of science now have the opportunity to offer that revised narrative to a broader audience and to shape a citizenry that is scientifically literate in the political sense. Projects on this side of the Atlantic—including the NSF-supported summer institute for high school teachers of science and history at the University of Florida, Gainesville, conducted by Frederick Gregory and Robert Hatch—complement the efforts made in *Teaching the History of Science*. But much more needs to be done. It is not merely a matter, as some authors in this volume seem to think, of using exemplars from the history of science as alternative tools in teaching science. Much more is at stake. To neglect the writing of a narrative of science and technology that is accessible and that accurately depicts their roles in society would be a tragedy. One lesson learned from recent West German debates over the role of historical knowledge in society is that those who create the memories also shape the future.

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Books Received

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