For the scholar endeavoring to understand the evolution of our health-care system more fully, it provides a solid foundation upon which to build.

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A Military Technology

The Poisonous Cloud. Chemical Warfare in the First World War. L. F. HABER. Clarendon (Oxford University Press), New York, 1986. xiv, 415 pp., illus. $59.

L. F. Haber, an economic historian interested in the development of the chemical industry, has in *The Poisonous Cloud* provided an excellent scholarly history of gas warfare in the First World War. Haber undertook this study not just for scholarly reasons but for intensely personal ones. His father, Fritz Haber, who directed the Kaiser-Wilhelm Institute for Physical Chemistry in Berlin, was the key figure in German chemical warfare during the conflict. Harold Hartley, a physical chemistry professor at Oxford who played a crucial role in wartime and postwar British chemical warfare, often lamented the absence of both a definitive history of chemical warfare and a biography of the elder Haber and persistently encouraged the son to write this work. Yet despite these personal motives for the study, this book is not a biography or defense of the author's father or one in which personal bias determines or intrudes upon the interpretations. It is a dispassionate and critical history of chemical warfare in the Great War.

Haber used significant newly available information, particularly Hartley's papers and documents from the British Ministry of Munitions. He supplemented the fragmentary German material in the federal archives with files from the archives of the German states, particularly Bavaria. With an array of these "new" and old sources, he has written a penetrating, analytical study of gas warfare on the western front between the Germans and the British and French, with comparative references to the United States. He devotes little space to gas warfare between other countries on other fronts, primarily because of the absence of documentation and the insignificant nature of chemical warfare elsewhere.

The author does not concentrate narrowly on the military and the front. Instead, in sophisticated fashion he links the chemical war at the front to the development of science and industry in the rear and probes the complex industrial-scientific-military relationship behind chemical warfare that previous writers have neglected. Thus his study of the only genuinely new weapon that was used in combat in the first World War but not in the second emphasizes the relationships between chemists and soldiers in the development and use of the weapon and of defenses against it and the impact of gas on the combatants.

Haber explains clearly the background of chemical warfare, ranging from the development of the capacity to mass-produce such gases as chlorine and phosgene to the science fiction fantasies that exaggerated the effect of gas warfare. A crucial point that he reiterates throughout the book is that gas as a weapon remained underdeveloped in comparison to the defenses against it. During the war the military perceived gas defense as essential to morale and gas offense as merely an adjunct to more fundamental operations. Furthermore, the defense could concentrate on clearly defined objectives such as the development of respirators, while on the offensive side inadequate communication between scientists and soldiers impeded the development of a successful chemical weapon.

Haber emphasizes that the exaggerations of the threat of gas before, during, and after the war stemmed from ignorance of the actual circumstances of gas warfare, which gave rise to and was compounded by science fiction fantasies and journalistic license. In fact, as his accounts of gas operations during the war make amply clear, gas was not that effective or reliable a weapon. Concentrations of a gas in the field were usually below the levels necessary to kill the enemy in great numbers; the inability of meteorologists to forecast wind speed and direction accurately made gas clouds as likely to incapacitate one's own troops as the enemy; and the issuance of adequate respirators enabled trained and disciplined troops to withstand the onslaught of the new weapon.

The author describes and analyzes knowledgeably such disparate topics as the development, introduction, and efficacy of the various gases, weapons, and respirators used by the combatants. He compares the state of the chemical industry and the approaches to chemical warfare in the major powers, and he does not hesitate to praise or condemn their respective achievements and failures. In general he is quite critical of the powers' approach to chemical warfare. Though he acknowledges the complexity and newness of gas warfare, the reluctance of soldiers to accept technological innovation, and the difficulties of communication between scientists and soldiers, he finds that significant avoidable human errors exacerbated these already difficult conditions. Haber characterizes developmental programs as "adaptive improvisation rather than purposive research" (p. 108). The absence of logic behind the piecemeal approach to chemical warfare pursued by all powers resulted in a lack of systematic progress in research during the war.

Haber concludes that gas was ultimately a failure, because the military lacked commitment to it, the organization of chemical warfare was unduly amateurish, and defense sufficed to contain the threat. Even in 1918 chemical warfare was relatively unimportant, its casualties usually overstated. He further asserts that in practice poison gas posed no serious military threat to soldiers or civilians after 1918—a circumstance that explains why it was not used in combat in the Second World War. Yet artists and writers transformed gas into a far greater threat than it actually posed, and the fantasy outweighed the facts in the public mind during the interwar period.

This exemplary monograph approaches its subject the way scholarly histories of military topics should. Any study of 20th-century weapons that have been scientific, technological, and industrial in inception and development must investigate these aspects of their history in order to be complete. As this monograph amply demonstrates, it is simply impossible to comprehend front-line military developments without knowledge of those in the rear. This thought-provoking study also has broader implications for understanding the role of science in modern warfare and the impact of war on scientific and technological progress. And its value is not the less because it deals with a development that the author himself concludes was a failure and relatively unimportant. The explanation of that failure and unimportance is as enlightening and instructive as studies of success.

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Migrationism Exemplified

Migrations in Prehistory. Inferring Population Movement from Cultural Remains. IRVING ROUSE. Yale University Press, New Haven, CT, 1986. xiv, 202 pp., illus. $20.

Thor Heyerdahl and his Kon-Tiki voyages notwithstanding, the Polynesians peopled the vast triangle in the Pacific from the west, moving out of small islands off New