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The Chemists' War: 1914–1918 by Michael Freemantle.

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If the American Civil War was the first "modern" war, with both sides using railroads, the telegraph, and ironclad warships, then World War I was the first to be dominated by chemistry, with the introduction of poison gas, high explosives, dyes, fuels, and fertilizers on an unprecedented scale. Science writer Michael Freemantle wrote *The Chemists' War* to explain the roles of chemicals in the war and of the individual scientists recruited by all the belligerents to support their armies and navies. Rather than a narrative history of chemistry's impact on the war, he has assembled twenty freestanding chapters: "It was not my aim to write a book that could be read from cover to cover but rather one for the reader to dip into" (vi).

Freemantle blends descriptions of how various chemicals were produced and employed in combat with biographical essays on specific chemists. Four chapters concern gas warfare, from the first German "cloud" attacks using chlorine released from cylinders at Second Ypres (22 Apr.–25 May 1915) to the routine firing by German, French, and British armies of thousands of shells full of toxic compounds before each battle. Some scientists, we learn, were busy making more effective poisons even as their other colleagues worked to improve gasmasks to block them.

One biographical essay (chap. 12) stands out. It describes Fritz Haber, a German-Jewish chemist who developed poison gas and enthusiastically promoted its use. His life was, Freemantle shows, an extended tragedy. Haber's first wife committed suicide—using *his own* service pistol—during the war, apparently in revulsion over his part in introducing gas warfare. Poison gas, as *The Chemists' War* explains, was neither an especially effective killer, nor a war-winner. And many people found it appalling. When Germany lost the war, Haber was not a hero to the Germans and was despised by his former enemies. Once Adolf Hitler came to power, Haber lost his position and was forced into exile. He died, a broken man, in Switzerland.

No other topic in the book receives the attention devoted to poison gas. But the author does include some fascinating, rarely discussed subject matter. "Whaling for War" (chap. 8) is a case in point:

> I began to look further into the sources of chemicals used in the war. It was only then that I became aware that whale oil was the prime source of the glycerine used to make nitroglycerine, a component of the propellant cordite and the blasting explosive dynamite. The industrial-scale killing and wounding of soldiers and civilians in the war required the industrial-scale production of such explosives. So it soon became obvious to me that this production depended, to a large extent, on the industrial-scale slaughter of whales. (122)

Chapter 6, "The Chemistry of a Single Firearm Cartridge," pinpoints the metals used in cartridge cases and bullets themselves, as well as the types of explosives used in primers and propellants. Many readers will be surprised to learn that so many metals—copper, nickel, lead, antimony, aluminum, and zinc—were used in every British .303 rifle cartridge. The aluminum, incidentally, was used in the pointed tip of the lead bullet, causing the unbalanced projectile to tumble when it struck flesh, creating devastating wounds. The chapter also briefly describes the types of pistols, rifles, and machine guns each belligerent used.

Unfortunately, these same chapters, however interesting and enlightening, suffer from Fremantle's tendency to inundate the reader with too much background material irrelevant to chemistry or the First World War. Information about the use of whale oil in combating trench foot and making nitroglycerine is useful and instructive, but sketching the history of whaling, starting in the first century, and cataloguing species of whales are not. So, too, the chapter on the firearm cartridge includes a long section on the way machine guns changed combat; though certainly an important aspect of World War I, it has nothing to do with chemists and chemistry. Similarly, the chapters on chemical warfare contain four pages on an incident in the *Second* World War, when thousands of American soldiers were accidentally exposed to mustard gas.

Taken together, the discrete, wide-ranging essays in *The Chemists' War* are full of valuable information not found in military histories, such as the role of acetone, a solvent vital to the production of explosives, and potash, used in fertilizers. But the book has huge limitations. Freemantle admits, for instance, that he only used English-language materials, and he concentrates almost entirely on the Western Front. Aside from a brief passage on the chemical industry in America, his eyes are on Great Britain and Germany. Even France, the other major power on the Western Front, gets only brief coverage; Russia, Austria-Hungary, Italy, and other belligerent nations are barely mentioned.

Not all the chemicals that played a role in the war get their due here. To be sure, coal, as both fuel and source of feedstocks, is well covered, as are the metal content of bullets and shells, the chemistry of poison gas, and the importance of fertilizers. But Freemantle could have done much more with food and medicine. Germany, in particular, experimented with hundreds of ersatz foods, drinks, and spices to compensate for deprivations caused by the British blockade of its seaborne trade. In terms of health, the author does discuss the development of disinfectants, but only briefly. Though the discovery of antibiotics occurred during World War II, more work was done on drugs such as painkillers in the First World War than this book mentions.

The Chemists' War was written for, and published by, the Royal Society of Chemistry, the British professional association. It should appeal to chemists interested in either military history or the history of their scientific specialty. It will also be a useful resource for scholars studying the role of scientists in waging war.