Preface

In 1909, the German physical chemist Fritz Haber devised an apparatus for the synthesis of ammonia from its elements, hydrogen and nitrogen, under conditions of very high pressure and temperature, in the presence of a catalyst, osmium in particular. Four years later, in September 1913, mainly thanks to the industrial chemist Carl Bosch at BASF, Haber's method was turned into a process for the manufacture of nitrogen fertilizer. It was, arguably, one of the greatest inventions of the twentieth century, and for many certainly the most beneficial. However, the inauguration less than a year before the outbreak of World War I of what became known as the Haber-Bosch process would mean that its earliest large-scale application was to be in the manufacture of explosives for the Kaiser's armed forces. Nevertheless, and despite much belief to the contrary, then and now, it was not the only important process employed in Germany for the manufacture of nitrogen products during the war.

My own interest in nitrogen products began in the early 1980s, when working with Brent Schools and Industry Project, a programme of the London Borough of Brent aimed at introducing the application of science into the classroom. At that time, the few studies of the history of the ammonia process and of related early twentieth-century nitrogen fixation processes were written for specialist audiences. The outcome of my research was the publication in 1984 of *The High Pressure Chemists*. Usefully, the project was aided by the presence in Brent, at North Wembley, of the research laboratories of the (British) General Electric Company (GEC), with which Haber's skilful coinventor Robert Le Rossignol was associated. It was through former GEC head chemist the late Dr. Ralph C. Chirnside, a close friend of Le Rossignol, that I learnt about some of the connections with Haber. No less important was the manufacturing and research facility of Johnson Matthey Metals Limited located on the site of the former Wembley Exhibition grounds. There I was able to view the weaving of platinum wire gauzes required in the oxidation of ammonia to nitric acid, a vital step in the munition manufacture that was brought to perfection under conditions of war after 1914. Johnson Matthey also operated a nitric acid pilot plant adjacent to the facility.

Since the 1980s, there have appeared several published accounts of the life and work of Fritz Haber, who also happens to be associated with the introduction of large-scale gas warfare in 1915. None of these accounts, however, deal in a balanced way with the technical story of both ammonia, with which Haber and Carl Bosch were so intimately associated, and the rival nitrogen processes, in particular the electric arc and Frank–Caro (cyanamide) processes. It is in order to make up for this lacuna that I here present the result of an extensive reworking of my earlier research, incorporating the studies of several colleagues, including participants in the European Science Foundation's Evolution of Chemistry in Europe, 1789–1939 programme. I would especially like to acknowledge the members of the committee of the Historical Group of the Royal Society of Chemistry who kindly invited me to give the 2014 Wheeler Award Lecture on the topics dealt with here. The staff of the Wellcome Collection, London, and the Sidney M. Edelstein Library for the History and Philosophy of Science, Technology and Medicine at the National Library of Israel, Jerusalem, are thanked for great assistance. Luca Bianchi of Casale SA kindly answered a number of questions and provided useful background information. A special thanks to Peter J. T. Morris, of the Science Museum, London, with whom I have shared an interest in the history of chemical technology for over two decades, and at whose suggestion I undertook the writing of this monograph. I am grateful to Dr. Morris for extensive review of an earlier version of the manuscript and for kindly providing information based on his own research. Finally, it is important to emphasize that the events described in Chaps. 1 and 2 are as much a prelude to World War I as were the stories of the build-up of fleets of battleships among the "Great Powers" in the decade or so prior to 1914. In Chaps. 4 and 5, this is reflected, at the climax of the war in November 1918, through the vast nitrogen factories undergoing expansion, under construction or planned in Germany, Britain, France, and the United States, and, in the aftermath, the struggles until the mid-1920s to develop rivals to the Haber-Bosch process mainly based on research started during 1916–1918.

Thanks for permission to reproduce illustrations are due to The Albert Einstein Archives (The Hebrew University of Jerusalem), Evonik Industries, Yara International ASA, Nick Lera, Archive of the Max Planck Society, Berlin (Archiv der Max-Planck-Gesellschaft, Berlin-Dahlem), the Central State Archive of Saxony-Anhalt, Merseburg Division (Landeshauptarchiv Sachsen-Anhalt, Abteilung Merseburg), and Professor Hideko T. Oyama/Tamaru Family Collection. Uncredited figures and photographs are by the author. Figures 1.4, 2.5, 2.29, 4.1 and 5.15 were prepared by the author for teaching purposes and appear in A. S. Travis, *The High Pressure Chemists* (Wembley: Brent Schools and Industry Project, 1984). They are based on diagrams in R. Coles, *Chemistry Diagrams* (London: John Murray 1960).

Units of measurement are as given in the original sources.

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The Synthetic Nitrogen Industry in World War I
Its Emergence and Expansion
Travis, A.S.
2015, IX, 163 p. 66 illus., 16 illus. in color., Softcover
ISBN: 978-3-319-19356-4