Mastermind: The rise and fall of Fritz Haber, the Nobel laureate who launched the age of chemical warfare. By *Daniel Charles.* HarperCollins, New York, 2005. 313 pp., hardcover $24.95. –ISBN 0-06-056272-2

"Unwilling to admire him, unable to condemn him, most people found it easier to look away. Yet while Haber's name disappeared from view, the shadow of his work continued to grow. Haber was the patron saint of guns and butter. He was a founder of the military-industrial complex and the inventor of the chemistry through which the world now feeds itself." These apt words from the pen of Daniel Charles, a National Public Radio correspondent and a free-lance science writer, illustrate well the views perpetuated in his new biography of Fritz Haber (1868-1934). Unlike its scholarly predecessors by Dietrich Stoltzenberg and Margit Szöllösi-Janze, Charles's narrative is interpretative, laced with psychological explanations and speculations, and told with the poignancy of the spoken word. Indeed, the style of the book may be a tribute, inadvertently or not, to the manner in which Haber himself had been able to rivet his audiences. Be it as it may, the result is an exquisitely readable account of the life, work, and impact of one of the most controversial scientists of all time. Charles explores the bright and dark sides of Haber's life and work, ties the loose ends together, and conjures up an image which is plausible, consistent with the scholarly literature, and comprehensible to the non-specialist, also in some of the details of Haber's science. Both the novice and the initiated reader will be thrilled to meet the familiar characters from Haber's circle in cartoon-like portraits drawn by Charles's incisive pen. These include Carl Bosch, Albert Einstein, Clara Immerwahr, Walther Nernst, Rudolf and Fritz Stern, Chaim Weizmann, and Richard Willstätter, among others.

Since the scholarly sources on Haber have been recently reviewed in these pages [B. Friedrich: Angewandte Chemie **44**, 3957 (2005)], we'll limit ourselves here to pointing to some of the most striking observations made by Charles about the various stations on Haber's path and the connections among them.

The first five chapters deal chiefly with Haber's personal and professional onthogenesis, up to the point when he discovered how to make ammonia from air.

In 'Young Fritz' Charles connects the devastation that befell Haber's father following the loss of his wife to death in childbirth, and the antagonism vis a vis the father who "never found it within himself to fully love or accept the son whose birth had brought so much sadness." This antagonism was among the reasons why, later in life, Haber sought an independent career, rather than tending to the family business in an "impossible alliance" with his father.

Fritz opted to study chemistry, a science most closely linked to the rise of industrial Germany in the second half of the 19th century, and glorified by the cult of *Wissenschaft und Technik*, prevalent then and still alive today. According to David Landes, "[in] technical virtuosity and aggressive enterprise, [the German] leap to hegemony [in chemical industry], almost to monopoly, has no parallel." And neither does Haber's often visionary sense for what was useful to his country and, by extension, to himself.

In 'Diversions and Conversion' Charles points out that Haber's conversion to Christianity, at age twenty-four, may have been inspired in part by Theodor Mommsen's famous essay written to foster the newly-fledged German unity: Germans were to abandon "those loyalties and affiliations that divided them." Similarly to his Jewishness, however mild, Christendom entailed for Haber a cultural rather than a religious identity. He felt German – and wanted everybody to know it.

'Ambition' tells the story of one of Haber's first public performances, when he was a Privatdozent at Karlsruhe. Charles speaks of "the emerging phenomenon of Fritz Haber, an impetuous scientific outsider fighting for respect and acceptance from sometimes resentful colleagues" and of a display of "his extraordinary energy, quick wit, and ability to command a stage." Richard Abegg, Haber's onetime classmate at the University of Berlin, who had climbed up the academic ladder in the meantime, often "smoothed the path of Haber's [papers] into [scientific

journals].” Abegg also provided a fateful link for Haber to his doctoral student, Clara Immerwahr.

Haber knew Clara from his teen-age days and tried to forget her “diligently and unsuccessfully,” according to a later confession. With Abegg acting as a chaperon, Clara and Fritz met again at a conference, hooked up before the conference had ended, and journeyed together to their native Breslau “like a fairy-tale prince and princess, caught up in a dream,” as Fritz put it, to announce their engagement.

Clara was the first woman to receive a doctorate from the University of Breslau; the year was 1900. The doctissima virgo was celebrated by the dean with caution, however, as he didn’t “wish to see the dawn of a new era” with women enlisted outside of home and family. Abegg remained Clara’s confidant for the rest of her short life – and their correspondence attests to the pain and frustration of her marriage with Fritz, who later noted about his relation to women in general “[they] are like butterflies to me. I admire their colors and glitter, but I get no further.”

In 1902, Haber was delegated by the German Electrochemical Society to visit the United States on its behalf and, according to Charles, to play “two roles, of ambassador and spy,” on his journey. This was a mission to a place which “[is] geographically … for us among civilized countries the most distant; intellectually and spiritually, however, the closest and the most like us.” This view of America, consistent with Haber’s, was formulated somewhat later by Adolf von Harnack, Kaiser Wilhelm’s far-sighted counselor, whose influence and vision were instrumental to the creation of the Kaiser Wilhelm Society for the Advancement of Science (in part co-opted, after the second world war, by today’s Max Planck Society). On his return to Germany, Haber’s message rang an optimistic note: the use of machines to save labor cost and the bent toward the practical were key to the success of the New World – and not impossible to implement in the Old. Curiously, Haber correctly recognized that America was powered by coal rather than hydroelectric plants, as the wide-spread myth had it at the time. Germany possessed

plenty of coal as well, or so it seemed. Charles: "… Haber was already the most American of imperial German scientists. He, too, was an impatient man of action, drawn to projects with immediate practical consequences."

One such project, *the* project, concerned forcing nitrogen and hydrogen gases to react to form ammonia. Some of the nitty gritty of ammonia's catalytic synthesis from its elements and its significance for both agriculture and the military are described in chapters 'Fixation,' and 'Myths and Miracles.' The need to find new ways of replenishing agricultural soil with nitrogen in a form that can be metabolized by plants was articulated, in 1898, by William Crookes (who also coined the term fixation, as in fixing a date between nitrogen and hydrogen) and was widely perceived as a challenge. Haber took up this challenge with his Karlsruhe team and, in 1909, was able to live through his *eureka* moment: his words were "There's ammonia!" Charles estimates that nowadays "nearly a hundred million tons of nitrogen are taken from the air each year, converted into ammonia and spread across the surface of the earth as fertilizer. … about two billion souls could not survive in the absence of the Haber-Bosch process." China is the largest producer today; its opening to the West in the 1970s may have been driven by an impending food crisis, alleviated by importing the ammonia technology from the West. Charles also discusses the negative environmental impact of the vast worldwide fertilizer production, particularly the contamination of groundwater it causes along with the unwanted feeding of the wrong plants, such as algae.

'Empire Calls' describes the creation of the Kaiser Wilhelm Society and its Institute of Physical Chemistry and Electrochemistry, whose director Haber had become, in 1911. This appointment provided both a tribune and a platform for Haber's ambition, and enabled him to spread his influence to include the uppermost echelons of the Prussian establishment. Not everybody was impressed with either Haber or the establishment. Einstein, Haber's new personal friend in Berlin, commented in a letter to his future wife Elsa: "Haber's picture unfortunately is to be seen everywhere. It pains me every time I think of it. Unfortunately, I have to accept that this otherwise so splendid a man has succumbed to personal

vanity and not even of the most tasteful kind. This defect is in fact generally and unfortunately a Berlin kind. When these people are together with French or English people, what a difference! How raw and primitive they are. Vanity without authentic self-esteem. Civilization … but no personal culture (raw in speech, movement, voice, feeling)."

Haber's status peaked at the outbreak of World War I with the realization that Germany had to rely on synthetic ammonia to feed its explosives industry. Haber, as quoted by Weizmann: "I was one of the mightiest men in Germany. I was more than a great army commander, more than a captain of industry. I was the founder of industries; my work was essential for the economic and military expansion of Germany. All doors were open to me." Indeed, Haber set in motion a revolving door for "the general, the scholar and the technologist" to come together and to talk. This synthesis of their separate interests and the creation of a common goal for the various sectors is the basis for Charles's claim that Haber was a founder of the military industrial complex (although the notion itself dates from the post World War II era). For his part, Haber attempted to outperform even himself, and within a few months into the war he had dedicated his science institute to the development of a new war idea, that of chemical warfare. In 'The Greatest period of his Life,' the longest chapter of the book, Charles describes how the "higher form of killing" came about, Haber's pragmatic but erroneous view of its impact on the war, and the suicide of Clara. According to James Franck "the fact that her husband was involved in gas warfare certainly played a role in her suicide. … [Haber] agonized over his guilt."

During the post-war era, Haber, with his status enhanced by a Nobel Prize, channeled his energy into science management and organization of the academic community and, at occasions, acted as an ombudsman striving to appease the antagonistic political strata in the boiling Germany of the 1920s: "Don't forget that only ignorance and old age give in to hate; they feel their weakness and their inability to persuade." At the institute, he wanted to be "both your best friend and God at the same time," according to Haber's neighbor, Lise Meitner.

Charles rounds off the picture: "Researchers who had plans for the evening were known to escape through ground-floor windows when they saw 'the old one' wandering meditatively through the garden in the direction of their laboratory."

'Dispossession' tells the story of the rise to power of the Nazis, the fall of Haber they had forced, and Haber's homeless exile which followed. To William Pope in Cambridge, his host for a period of time, Haber wrote: "My most important goals in life are that I not die as a German citizen and that I do not bequeath to my children and grandchildren the civil rights of second-class citizenship, as German law now demands … The second thing that's important to me is to spend my last years in a scientific community of people, with honor, but without heavy duties." What a change of agenda. It wasn't years, however, but only months that were left for the ailing Haber to live. He died, in January 1934, on a trip without a clear destination, while passing through the city of Basel.

In 'Requiem,' Charles recounts the story of the memorial service held semi-legally in January 1935 at the faculty club of the Kaiser Wilhelm Society in Berlin, with speeches by Max Planck and Otto Hahn delivered against the background of swastikas. Carl Bosch loyally appeared, with his suite, at the service; ironically, he just had signed a contract with the Nazi government to convert coal into gasoline, which would eventually fuel Hitler's blitzkrieg. Haber's academic colleagues were represented by their wives, having been forbidden to come themselves. 'The Heirs' provides an account of the fate of Haber's children, including his godson, the great historian Fritz Stern. Stern's essay contrasting the lives of Einstein and Haber belongs to the best written on the subject of Germany's squandered greatness.

Einstein's words read like an epitaph to Haber: "At the end, he was forced to experience all the bitterness of being abandoned by the people of his circle, a circle that mattered very much to him, even though he recognized its dubious acts of violence. … It was the tragedy of the German Jew: the tragedy of unrequited love." We may amend it by saying that despite the ambiguity grounded in Fritz Haber's work, his love is no

longer unrequited in Germany. On Max von Laue's suggestion, Haber's institute in Berlin-Dahlem was named for its founder, in 1953. Also, the Hebrew University in Jerusalem cherishes its Fritz Haber Center.

Charles's book is a document in belletristic style, readable and to be read. I highly recommend it to both colleagues and the public at large.

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