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Tod aus Luft

Steven Shapin

- *Between Genius and Genocide: The Tragedy of Fritz Haber, Father of Chemical Warfare* by Daniel Charles Buy this book

Hydrogen and nitrogen combine only with difficulty. Since the reaction $N_2 + 3H_2 <-> 2NH_3$ is reversible, you need just the right conditions to drive it forward to produce significant quantities of ammonia (NH_3). If the temperature is too low, the formation of ammonia is favoured but the reaction goes slowly. If the temperature is too high, the reaction goes faster, but any ammonia produced tends to dissociate into its elements. Pressure is another relevant variable: higher than atmospheric pressures favour ammonia formation. So, if ammonia is what you want, you need very cleverly to manipulate temperature, pressure, a catalyst and the design of the reaction vessel. In 1909, the academic physical chemist Fritz Haber and the industrial metallurgical engineer Carl Bosch succeeded in doing this, and they patented the process the following year. Within four years, the process had become commercial, the foundation of a huge German-dominated industry centred on ammonia works in Oppau and, from 1917, in Leuna. Haber became famous and wealthy. The giant chemical firm Badische Anilin und Soda-Fabrik (BASF) – later folded into I.G. Farben – had been funding Haber's research, doubling or tripling his already generous professorial salary at Karlsruhe, on the condition that he obtain company permission before publishing any details, and the terms of the BASF patent gave him 1.5 pfennigs for every kilo of ammonia produced using his process. In the last year of the war, the factories in Oppau and Leuna produced 115,000 tons, and Haber's royalty payments were worth the present-day equivalent of about $4 million. Haber won the Nobel Prize for Chemistry in 1918; Bosch became chairman of BASF, which made huge amounts of money from the process, and he too

eventually won the Nobel Prize (in 1931). All this represented an early milestone in the formation of what came to be called the military-academic-industrial complex.

Along with DNA, ammonia is a candidate for 'molecule of the 20th century'. DNA is a very large molecule, and ammonia a very small one, but ammonia has greater bearing on the way in which the century's history unfolded. Synthetic ammonia is both a foundation stock for the manufacture of such nitrogenous fertilisers as ammonium nitrate or sulphate, and a substance which, in its liquid state, can be directly injected into the soil. Plants need nitrogen to grow but they cannot get it directly from the atmosphere, which is 78 per cent nitrogen by volume. Legumes – plants like peas, beans and clover – harbour nodules of nitrogen-fixing bacteria in their roots, converting free atmospheric nitrogen into compounds usable in plant metabolism, and you can plant legumes to give the soil a dose of fixed nitrogen. But prior to the Haber-Bosch process, sources of nitrogen-containing fertilisers were limited. You could use animal manure, but that was bulky, hard to distribute and low in nitrogenous oomph. You could use the bird fecal deposits called guano, usually obtained through a vast global trade from islands off the coast of Peru, or the naturally occurring nitrates from saltpetre deposits in the deserts of Chile. But by the end of the 19th century, it was looking as if both of these sources would soon be exhausted.

In 1898, the English chemist William Crookes sounded a Malthusian alarm: the world's population, he said, would very soon outstrip its food supply. This was a global crisis in the making, but, Crookes warned, it was especially acute for white people: 'The fixation of nitrogen,' he announced, 'is a question of the not-far-distant future. Unless we can class it as among certainties to come, the great Caucasian race will cease to be foremost in the world, and will be squeezed out of existence by races to whom wheaten bread is not the staff of life.' Crookes's apocalyptic vision was widely credited and may indirectly have inspired Haber's work. The production of cheap synthetic fertilisers permitted by the Haber-Bosch process was a vital ingredient in the sevenfold increase in the world's food supply during the course of the 20th century and the almost fourfold increase in its

human population. *Brot aus Luft* was the slogan: bread out of the air. A hundred million tons of nitrogen a year are now removed from the atmosphere and turned into fertiliser. That's the bit of Haber's career which gets him called a genius and a saviour of humankind.

The same synthetic ammonia that could be transformed into fertiliser could also, by way of nitric acid, become a feedstock for military explosives. After the outbreak of the Great War, the British blockade cut Germany off from its Chilean nitrate supplies, and the rate at which the Haber-Bosch process could make ammonia became crucial to Germany's ability to wage war, and, especially, to its strategic planning. If enough of the stuff could not be made, a protracted war was bound to be a disaster. In the autumn of 1914 it became clear that Germany would run out of munitions in six months if further nitrate supplies could not be secured. Haber was already on the job, becoming head of the chemistry department of Walter Rathenau's *Kriegsrohstoffabteilung* (War Raw Materials Section). For this, and other reasons, he became a hero of the war effort.

The most notorious of his contributions to the war – and probably the one which most engaged his enthusiasm – was poison gas. That's the bit of Haber's work which attracts Daniel Charles's description of him in the subtitle of his new biography as the 'father of chemical warfare'. As early as December 1914, Haber attended a test-firing of munitions containing a tear gas called xylyl bromide, and was immediately gripped by the opportunities gas offered to the patriotic chemist. He had a better idea than using gas to burn soldiers' eyes and put them temporarily out of commission: he wanted, as a co-worker related, 'something that puts people permanently out of action'. Some colleagues drew back from the idea, but Haber suggested to the High Command using the asphyxiating gas chlorine in the stalled trench warfare of the Western Front. The generals had misgivings – if the Germans could use gas, so could the British and French and, anyway, it seemed unsporting – but they agreed, and on 22 and 23 April 1915 several hundred tons of chlorine gas were released into trenches around Ypres occupied by Canadian, French and Algerian soldiers: *Tod aus Luft* this time. The Germans gained about a mile of territory, and fewer of the enemy than Haber would

have liked were 'put permanently out of action' – perhaps 350 were killed and 7000 disabled. Haber was miffed that the advantage of being the first to use poison gas was not pressed home: if the German generals had been more serious about gas, he reckoned, the Allies could have been driven into the sea in quick order.

Haber had no qualms about the use of gas, despite its prohibition by the Brussels Declaration of 1874 and subsequent bans by the Hague Conventions of 1899 and 1907. War was hell and death was death: it really didn't matter by what means a soldier died. Opposition to the use of gas was just standing in the way of inevitable progress. Chlorine was soon replaced with phosgene and then with mustard gas, which Haber applauded as a 'fabulous success'. He told a group of officers that 'the disapproval that the knight felt for the man with a gun is repeated by the soldier who shoots steel bullets when confronted by a man who appears with chemical weapons.' Get used to it. Charles writes that Haber viewed gas warfare 'as an intellectual challenge'. He thought conventional warfare was like draughts, but 'gas weapons and gas defence turn warfare into chess,' he told the industrialist Carl Duisberg. The psychological effects of gas were as much the point as the deaths they caused: they were, and were designed to be, terror weapons, not weapons of mass destruction. The Nobel Prize committee didn't seem to have had serious problems with Haber's position. It awarded him his prize for the Haber-Bosch process within months of the war's end and diplomatically didn't mention his work with poison gas in its official biography. His first wife, Clara Immerwahr, may have had a different view: just after his triumphant return from Ypres at the end of April 1915, she took Haber's service revolver and shot herself in the heart.

That aside – and it had been a miserable marriage – war was very good to Haber. At the University of Karlsruhe, he had been Herr Professor; called in 1911 to head the richly endowed Kaiser Wilhelm Institute for Physical Chemistry in Berlin-Dahlem, he became Herr Geheimrat, walking the corridors of power, mixing with politicians and captains of industry, and turning his institute into a well-stocked science shop for the military. The war completed Haber's transformation, as a colleague put it, 'from great researcher to great

German'. He had been a non-commissioned vice-sergeant but the Kaiser now promoted him to captain, and, as the physicist James Franck said, he learned 'to think like a general'. A scientific collaborator, the British chemist J.E. Coates, wrote that 'the war years were for Haber the greatest period of his life . . . To be a great soldier, to obey and be obeyed – that, as his closest friends knew, was a deep-seated ideal.' The war 'transformed him into a Prussian officer, autocratic and ruthless in his will to victory'. (A photograph on the occasion of his second wedding in 1917 shows Haber doubly happy, his new wife on his arm, resplendent in officer's uniform, sword and *Spitzhelm*.) In 1986, Haber's son Lutz, a distinguished economic historian, produced a powerful study of chemical warfare in World War One, and wrote that, in his father, the German High Command 'found a brilliant mind and an extremely energetic organiser, determined, and possibly unscrupulous'. At the end of hostilities, the Allies put him on the list of German war criminals, and he escaped to Switzerland until the extradition order was withdrawn.

Haber's embrace of war proceeded from his intense patriotism. In September 1914 he signed – along with the scientists Max Planck, Walther Nernst and Paul Ehrlich – the infamous 'Manifesto of the 93 German Intellectuals to the Civilised World', which protested

> against the lies and slander with which our enemies are endeavouring to stain the honour of Germany in her hard struggle for existence – in a struggle that has been forced on her . . . It is not true that the combat against our so-called militarism is not a combat against our civilisation, as our enemies hypocritically pretend it is. Without German militarism, German culture would long since have been extirpated from the face of the earth . . . The German army and the German people are one.

The manifesto provoked outrage among British and French intellectuals and deep disappointment in Albert Einstein, Haber's good friend. Einstein respected Haber as a scientist and was grateful for Haber's support as his first marriage was disintegrating, but he was astounded at Haber's unquestioning embrace of German nationalism and militarism. The American historian Fritz Stern – Haber's godson – wrote that 'Haber and Einstein had a sense of

science as a call to a special priesthood in a faith only recently established.' The same sense of vocation, however, took different ethical expressions. Einstein thought that the war was insane, that Germany had provoked it, and that scientists who worked as diligently as Haber in assisting the war effort were, in effect, putting 'an axe in the hand of a pathological criminal'.

Charles's book has the advantage over *Fritz Haber: Chemist, Nobel Laureate, German, Jew*, the only other serious treatment of Haber in English – an abridged translation of a worthy but rather stodgy 1994 biography by the chemist Dietrich Stoltzenberg, whose father, Hugo, worked with Haber on poison gas. Charles is a journalist, and was drawn to Haber by way of an earlier book, *Lords of the Harvest: Biotechnology, Big Money, and the Future of Food* (2001). *Between Genius and Genocide* goes into far less detail about Haber's scientific work and institutional circumstances than Stoltzenberg, and, while Charles has made good use of the manuscript and oral history material on Haber deposited in the Max Planck Society in Berlin, he relies heavily on the work of Fritz Stern and Lutz Haber, and on Margit Szöllössi-Janze's still untranslated 1998 Haber biography. Charles occasionally lets his arguments run away with him – as when he suggests that without the Haber-Bosch process neither the Bolshevik Revolution nor the rise of Hitler would have happened – but his accessible, engaged and often elegantly written book finds the question of Haber's moral and social identity compelling in a way that Stoltzenberg does not. And if Charles passes severe judgment on Haber's public and private life, he does so largely by mobilising the assessments of many of those who knew him well. According to their testimony, Haber was capable of generosity, real friendship and great science, but he could also be cold, overbearing, pompous, ruthless and amoral.

Max Weber's 1918 address on 'Science as a Vocation' endorsed the amorality of science, but only by claiming that the possession of scientific knowledge didn't give the scientist – acting in the person of a scientist – an intellectual basis or an institutional right to pronounce on moral matters. Weber did not consider the morality of technical consequences because he reckoned that the motives of 'the

practical man' could be clearly distinguished from those pursuing knowledge 'for its own sake'. But the realities of contemporary scientific life had overtaken Weber's sensibilities and Haber was spectacular evidence of that fact. Yet in another sense Weber understood Haber's predicament very well. The scientific life was so insecure and so poorly rewarded that a calling for it had to be unmistakable and intense. 'The academic life is an utter gamble,' Weber wrote, but if the aspirant was a Jew, then 'you can only say: *lasciate ogni speranza* (abandon all hope).'

It was about the time that the young Haber decided on an academic career that he had himself baptised. He had already had his application for a Prussian reserve officer's commission rejected – no Prussian Jew had yet become an officer, apart from in the medical corps – and he was not keen to have the experience repeated in the academic profession. From then on, he would identify himself on official forms as *evangelisch* ('Protestant'). There is no evidence that his decision was doctrinal: his transformation was from secular Jew to secular Christian. Apart from removing the professional obstacles that stood in the way of Jews, baptism was a way of identifying with the idea of Germany. For many Jews originating in eastern lands, German seemed the language of Enlightenment and German Protestantism a *Vernunftreligion* – a 'religion of reason'. Many years later, Haber had a tense conversation on the subject of his conversion with his friend and physician, Rudolf Stern. He described to Stern the enthusiasm he and his friends had felt for the cause of German unification: 'We felt 100 per cent German, and no longer felt any ties to the Jewish religion.' The equation between Christianity and German identity was reinforced in Haber's mind when, as an adolescent, he read Theodor Mommsen's passionate defence of German pluralism against an anti-semitic outburst by Heinrich von Treitschke: the Jew, Mommsen asserted, was as much German as the Schwabian or the Prussian. The idea of Germany required both the toleration and the submergence of diversity. Just as the Schwabian should submit tribal loyalties to the idea of Germanness, so too should the German Jew, and this, in Mommsen's view, meant conversion to an encompassing form of Christianity that was far more cultural than doctrinal. And so, in Haber's mind, as in that of other

German Jews, many things partook of one common sensibility: rational science (for which he felt a personal vocation), the idea of Germany (which stood for reason, civilisation and tolerance), Protestant Christianity (a religion of reason), the German state and its army (the bulwark of reason and civilisation), and the use of the fruits of rational science to protect everything in Germany that made the practice of science possible.

But the ease of assimilation was a great illusion: Jews and Germans turned out to combine with rather greater difficulty than hydrogen and nitrogen. With the Nazi seizure of power, Haber discovered that he wasn't German after all and that his service to the German nation counted for nothing. In April 1933, Hitler's new regime promulgated a law removing all Jews from civil service positions – including the universities and the Kaiser Wilhelm institutes – except those who had served in the Great War. That left Haber on a narrowing ledge, but, unlike some other Jewish scientists, he continued to hope. Moving more swiftly than he had expected, the Nazis demanded some immediate dismissals, and Haber's associates urged him to sack junior staff at once in order to protect the institute's top scientists. Haber chose instead to dismiss two of his most senior scientists, including the Hungarian Jew Michael Polanyi, who had been offered a position in Manchester. 'The old man is completely kaputt,' a junior colleague wrote at the time. A few days later, Haber had had enough and decided to retire. He was a broken man even before he left Germany in August, shuttling between Switzerland and England. 'I am bitter as never before,' he wrote to a German colleague: 'I was German to an extent that I feel fully only now.' And to an English colleague he wrote a begging letter inquiring about the possibility of an academic appointment: 'Perhaps you will have some understanding for the feelings of an old man who was tied to his country for his whole life, but who now has the feeling that he has lost his homeland – a homeland that his ancestors and he himself served to the best of their ability.'

Desperate, he made contact in London with the Zionist leader, and chemist, Chaim Weizmann, and began a series of conversations with him about the possibility of moving to Palestine. Weizmann found

dealing with Haber almost unbearable: 'The truth is that I could scarcely look him in the eye. I was ashamed for myself, ashamed for this cruel world, which allowed such things to happen, and ashamed for the error in which he had lived and worked throughout his life.' By the time he and Weizmann met again in Basle in August, Haber was talking himself into Jewishness and even into Zionism: 'I was one of the mightiest men in Germany' but 'at the end of my life I find myself a bankrupt. When I am gone and forgotten,' he told Weizmann, 'your work will stand, a shining monument, in the long history of our people.' 'In my whole life,' he told Einstein, 'I have never felt so Jewish as now.' Einstein – who had renounced his German citizenship as an adolescent – responded in terms as cruel as they were sympathetic. Borrowing a phrase from Nietzsche, he expressed his pleasure that Haber's 'earlier love for the blond beast has cooled off a bit'. Haber still hoped to secure a decent resignation settlement from his institute, and, in December 1933, wrote a letter asking for help from his old associate Carl Bosch, now the chief executive of I.G. Farben: 'I have never done anything, or said a single word, that would stamp me as an enemy of the men who rule Germany.' Bosch did not reply. In January 1934 Haber died of heart disease.

Late in World War One, Haber had done some research on insecticide gases which could be used to control flour moths and other pests. The hydrogen cyanide-based gas developed by his institute worked quite well, but, because it was odourless, endangered the people who used it, so a process was devised to warn workers by giving the gas a foul smell. Development continued through the 1920s, making the gas still safer and easier to use. During the starving years of the late 1920s and early 1930s, Zyklon B protected the food supply and ensured that more people were adequately fed than otherwise would have been. But soon a use was found for the gas that made the addition of a foul smell unnecessary, and among those who perished in the gas chambers were many of Haber's own relatives.

From the *LRB* letters page: [9 February 2006] Hugh Aldersey-Williams [9 March 2006] Raymond Clayton.

Steven Shapin teaches at Harvard and has written several books on the history of early modern science. His next will be *The Life of Science: A Moral History of a Late Modern Vocation*.

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