Magnetic personalities

Fatal Attraction: Magnetic Mysteries and the Enlightenment
by Patricia Fara
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David W. Hughes

It is a great shame that the history of physics is not an integral part of a standard university physics education. Teaching it would provide an ideal means of dragging the laboratory- and computer-based academic physicist out into the wider world. Not only would it underline the contemporary relevance of physics, it would also civilize the subject by reconnecting it with its roots.

One requirement would be a collection of excellent introductory books on the history of physics — and Patricia Fara's *Fatal Attraction* is a trail-blazer for magnetism. Fara, a lecturer in the history and philosophy of science at the University of Cambridge, accurately targets the enquiring student reader. The writing is pacy, informative, riveting and unencumbered by footnotes. But the book also contains a copious reference section and draws extensively from Fara's scholarly tome *Sympathetic Attractions* (Princeton University Press, 1996).

Magnetism has a past rooted in the mists of antiquity. Certain types of magnetite iron oxide ore, when struck by lightning, become strongly magnetized. This natural loadstone was once greatly treasured and was first used by the Chinese in the fourth century BC to produce the magnetic compass, which found application both in the art of feng-shui and as a navigational device.

Fara takes us back to the times before magnetism was allied with electricity. Her main period is the Enlightenment in the seventeenth and eighteenth century, when natural philosophers and thinkers optimistically believed that the problems of society could be solved by reason and common sense. In those days, cosmic magnetic forces were the precursors of universal gravity. England's wealth and protection depended on sailors successfully navigating rough oceans, so the magnetic compass was of paramount importance. And the dawn of today's alternative medicine was heralded by the supposed hidden powers of magnets. People were happy to strap magnets to the afflicted parts of their bodies, expecting them to draw out the pain and heal toothache, rheumatism, gout, scurvy and a host of other ailments.

The story is built around three main characters: Edmond Halley, Gowin Knight and Franz Anton Mesmer.

Halley, who in 1720 became England's second Astronomer Royal, was not only a scientific polymath but also a naval adventurer who sailed the Atlantic measuring magnetic variation (the difference between true and magnetic north) in the hope of finding a way to calculate longitude at sea. He was the first scientist to insist that the government pay for his instrumentation and finance a scientific mission. Halley was a great believer in speedy publication and in sharing his results (especially as they were obtained by a paid public servant).

The charts of magnetic variation drawn up by Halley were revolutionary, as he used lines to link places of equal variation. These 'halleyan lines' (now known as isogonics) have become a ubiquitous feature of modern meteorological charts. Spurred on by William Gilbert's textbook on geomagnetism from 1600 and Henry Gellibrand's discovery in 1635 that the magnetic variation changed with time, Halley proposed that the Earth had four magnetic poles: two on the surface and two on an inner sphere, 500 miles below, that rotated at a slightly different speed.

Gowin Knight was a scientific entrepreneur from the same period whose main aim was to become rich and famous. He pioneered the production of strong artificial steel magnets and an efficient gimballed maritime air compass. He also convinced the state that science mattered — a legacy that still benefits us all.

Franz Mesmer, a Viennese physician who treated Mozart, suggested that the source of the magnetic force was a stream of invisible, weightless cartesian effluvia coursing through the minute pores of the affected substance. This cosmic magnetic fluid was not only the key to our physical well-being, he claimed, but also the *modus operandi* of astrological influence. Moving to Paris in 1778, Mesmer then creamed off the wealthiest patients, causing such annoyance to competing doctors that he was eventually forced to flee the country.

Fara ends her excellent historical review by briefly relating how the magic of magnetism was somewhat spoiled by Michael Faraday. Britain's first professional scientist founded electromagnetism, one of the cornerstones of the modern consumer society, and now nearly every aspect of it is well understood. ■

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A poisoned reputation

Between Genius and Genocide: The Tragedy of Fritz Haber, Father of Chemical Warfare
by Daniel Charles
Jonathan Cape: 2005. 313 pp. £20
Published as *Master Mind* by Ecco Press in the US ($24.95).

John Cornwell

Fritz Haber will be forever linked with the Haber–Bosch recipe, which produces plentiful and cheap supplies of ammonia. Yet he was one of the greatest chemists of the twentieth century and was the founding father of the industrial–military complex. The story of his life, which has all the ingredients of a Thomas Mann novel, is a tale of scientific genius in the service of the German fatherland. Haber was a Jew who adopted Christianity to advance his career prospects but instead became a victim of the Nazis. He was an outstanding hero of science but stood accused of war crimes.

The process for which Haber is best known is the synthesis of ammonia from two plentiful gases in nature: hydrogen and nitrogen. He collaborated with Carl Bosch to discover, after some 4,000 trials, an ideal catalyst composed of iron and oxides of aluminium, calcium and potassium. The process is virtually unchanged to this day. The discovery culminated in the production of prodigious quantities of artificial nitrogen fertilizer, which allowed the global population to rise to 6 billion from below its estimated upper limit of 3.6 billion. As a result, Haber richly merits consideration as one of the greatest figures of the past millennium.

His fame and reputation, however, have been dogged by controversy and paradox. The same Haber–Bosch process could be used to make high explosives, enabling Germany to prolong the trench warfare of the First World War despite a Royal Naval blockade of mineral nitrogen.

Haber's reputation has been further besmirched by his involvement in poison-gas warfare. On the afternoon of 22 April 1915, Haber and a troop of gas scientists opened the valves of nearly 6,000 cylinders containing chlorine gas in liquid form. A blanket of thick green-yellow gas swept into the Allied trenches, killing some 5,000 Allied troops (a figure that would be revised downwards by Germany after the war) and injuring 10,000 more. The Germans gained only one mile on the Ypres front as a result. Haber was disappointed: he had hoped to unleash a weapon of mass destruction so powerful that it would bring the war to an abrupt end, and he blamed his generals for restricting its use.

These actions earned Haber the reputation of a war criminal, forcing him into hiding for a period after the war. But there was worse. It was Haber who oversaw the research that created the insecticide Zyklon B, which, a decade after this death, would be used in the Nazi gas chambers on his own relatives.

There has long been a need for a book in English on the life of Fritz Haber, and Daniel Charles is the ideal biographer. His previous book, *Lords of the Harvest*, explored biotechnology and the global food supply, an essential dimension of the Haber story.

In *Between Genius and Genocide*, Charles takes in the huge range of Haber's scientific, technological and patriotic interests, including his quest for cheap gold to beat the postwar reparations burden. A typical Haber scheme, hare-brained from one perspective and yet eminently practicable from another, was his attempt in the 1920s to harvest gold from the sea. The Swedish chemist Svante Arrhenius had found tiny amounts of gold in sea water and calculated that every ton of the ocean contained 6 milligrams of the precious metal. After extensive experiments and many trips on the oceans of the world, Haber discovered that Arrhenius was wildly out: sea water contains only 0.01 milligrams of gold per ton.

Nor does Charles neglect the turmoil of Haber's private life, including his marriages. The tale of the suicide of Haber's first wife, Clara — an event that has prompted various contradictory accounts — is a model of scrupulous biography. Clara, one of the first women to get a PhD in Germany, had married Haber in the hope of sharing in his life in science. But it seems she was increasingly isolated by his preoccupation with work, and during the First World War deplored his use of poison gas. After returning from Ypres, Haber threw a party and Clara found him in an "embarrassing situation" with the woman who was to become his second wife. After he had fallen asleep, she took his service revolver and killed herself.

But Charles's principal focus is Haber as a faustian embodiment of science and technology in the twentieth century. For Charles, Haber's fatal flaw is his willingness "to serve any master who could further his passion for knowledge and progress. He was not an evil man." Charles draws the chilling conclusion that the moral choices that Haber confronted during his life "were not so different from those that we face today".

Charles might have gone further to reflect that underlying Haber's flaws is the proposition, widely accepted and promoted by those involved in the public understanding of science today, that science is morally neutral. The Janus-faced nature of the Haber–Bosch recipe seems to support the contention. In Germany, moreover, scientists traditionally worked under the auspices of a civil service that was both apolitical and value free. Yet it was precisely this neutrality that provided an alibi for the German scientific community when Jewish researchers were expelled after the Nazis came to power. Haber was forced out of the Kaiser Wilhelm Institute, which he helped to found in Berlin, despite Max Planck's attempt to argue his case with Hitler. "A Jew is a Jew," Hitler shouted.

The Institute for Physical Chemistry in Berlin now bears Haber's name, but this is still controversial. As the historian Fritz Stern comments in his elegant essay on Haber and Einstein: "The memory lives on — dimly in distorted controversy." Charles's admirable biography will elucidate the controversy and shed fresh light on Haber's memory. ■

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Short cut to space-time

A Briefer History of Time
by Stephen Hawking with Leonard Mlodinow
Bantam Books: 2005. 176 pp. $25

Jim Al-Khalili

The phenomenal success of Stephen Hawking's *A Brief History of Time* demands that the arrival of this new edition be treated as a major publishing event. So let me begin with a few facts. First, *A Briefer History of Time* is not a new book, but rather an updated and reworked edition of the original. Second, it is certainly briefer, at three-quarters the length of the original. Third, the simple black-and-white diagrams of the first book have been replaced by stylish colour images, ranging from the amusing (Hawking and co-author Leonard Mlodinow strapped into their time machine) to the misleading (space-times, of expanding universes and wormholes, embedded within space-time).

So what is the motivation for *A Briefer History of Time*? I will leave aside any cynical accusation of opportunistic marketing because I believe the authors have made an honest attempt here to rectify what they perceive as a problem with the original: that millions of readers with no scientific background did not get beyond the first chapter before their brains blew up. To remedy this, that first chapter has been chopped into three bite-sized