



Bees, including *Apis mellifera* (pictured), perform a waggle dance to tell others about new resources.

ETHOLOGY

Intrepid translator of the hive

Mark L. Winston reviews a study of Karl von Frisch, the ethologist who unravelled bee communication.

One of the most remarkable scientific discoveries of any century was honeybee dance language. Foragers and scouts run and turn to communicate the distance, direction and quality of flowers or nest sites to other worker bees. Many scientists were involved in elucidating the dance's sophisticated communicative functions, but Austrian ethologist Karl von Frisch (1886–1982) delivered the main results during the 1940s, for which he won the 1973 Nobel Prize in Physiology or Medicine. Excellent observations, painstaking experimental designs, laborious research and some controversy made von Frisch's work novelistic in its drama. Brilliance was required to discover

and translate the language of an invertebrate as behaviourally complex as the bee.

The story has been well told in a number of books, most notably von Frisch's own 1967 classic, *The Dance Language and Orientation of Bees* (Harvard University Press). Now, in *The Dancing Bees*, Tania Munz gives us von Frisch the man, whose stellar accomplishments are well known but whose personal history has not been so well described — especially his years under the Third Reich.

Many German scientists fled the country when Hitler came to power; those who remained were expected to contribute their expertise to the war effort. Although von Frisch was never a member of the Nazi

Party, his research flourished against the odds during the Second World War, while he was based at the Zoological Institute at the University of Munich.

As Munz rivetingly shows, von Frisch was triply vulnerable. His maternal grandmother was deemed Jewish under Nazi doctrine. His laboratory reputedly employed numerous Jewish researchers, although Munz does not address the accuracy of those claims. And von Frisch had enemies in academia, driven by either professional jealousy or rabid anti-Semitism. They included astronomer Wilhelm Führer, head of the University of Munich's Instructor's League, and botanist Ernst Bergdolt, president of the National Socialist Lecturer's League — both members of the Nazi Party. Yet von Frisch also had supporters. Among them were two powerful names in German science: Alfred Kühn and Fritz von Wettstein, both from Berlin's Kaiser Wilhelm Institute for Biology. They lobbied hard on his behalf. But in the end, it was the bees that earned him an academic reprieve. In 1941, *Nosema*, a dysentery-causing fungal parasite, destroyed 800,000 of Germany's bee colonies, threatening the regime's already strained agricultural productivity.

Von Frisch was tasked to address this problem. He interpreted this to include devising ways to attract bees to crops, a topic that led him towards the discovery of dance language. He had described the dances as early as 1927 (in a book also entitled *The Dancing Bees*; Springer) without understanding their remarkable functions. But his wartime research revealed their importance. Most significantly, he found that forager bees communicated the distance and direction to flower sources through a 'waggle' dance. The bees make a straight run while wagging and buzzing; the duration indicates distance, and the angle of the dance on the comb relative to the vertical indicates direction relative to the Sun.

Von Frisch's ability to block out the chaos around him was astounding. His research output was prodigious, even as his institute and lab were reduced to rubble, food supplies dwindled and friends, colleagues and relatives were wounded or killed.

Munz also covers von Frisch's postwar research, when he further demonstrated his extraordinary capacity to observe, design experiments and recognize the paradigm-breaking significance of data. His work on the colour vision of bees set experimental protocols that are still used by behavioural scientists, and towards



The Dancing Bees: Karl von Frisch and the Discovery of the Honeybee Language
TANIA MUNZ
University of Chicago Press: 2016.

the end of his career, he uncovered the mystery of how bees in flight orient themselves to the Sun's position using polarized light.

Not all of *The Dancing Bees* is spellbinding. Munz devotes a chapter to dance-language denial, a controversy based on meagre evidence that, with the benefit of historical hindsight, deserves a couple of paragraphs at most. A few inserted vignettes about honeybee observations in the eighteenth century by Swiss naturalist François Huber, and von Frisch's films about fish behaviour, interrupt the book's flow. Moreover, key aspects of von Frisch's personal life are under-represented. His relationships with his wife, children and friends are mentioned, but further elaboration would have enriched our understanding of how he persevered through scientific controversy and historical tragedy.

Von Frisch clearly did not collaborate in any substantial way with the Nazis. Munz is largely silent on whether he could or should have been more proactive or outspoken against the regime. She writes: "It is difficult

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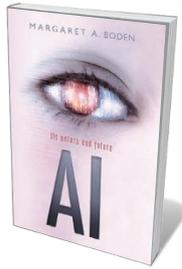
Karl von Frisch translated the bees' dance.

to shake the image of a scientist who escaped the horrors that surrounded him by burying himself in his work." After the war, von Frisch wrote that "many professors welcomed the changes, some out of caution, others from conviction. And soon it was clear that any serious opposition would lead to one's personal destruction."

We are left with this: immersed in the unimaginable horrors perpetrated by a brutal regime, von Frisch managed to craft a hugely significant scientific discovery. Perhaps that is enough. ■

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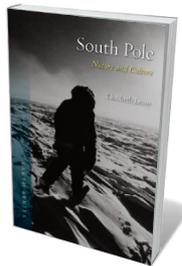
Books in brief



AI: Its Nature and Future

Margaret A. Boden OXFORD UNIVERSITY PRESS (2016)

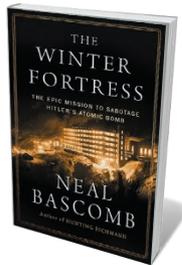
From search engines to satnavs, artificial intelligence (AI) permeates society. In this masterclass of a book, cognitive scientist Margaret Boden traces the evolution of AI from conceptual framing by Ada Lovelace through key research by the likes of Alan Turing and Paul Churchland, to the schism between cybernetics and symbolic computing. Traversing today's landscape, she examines the 'holy grail' of artificial general intelligence and the potential of neural networks and robots, and winnows the apocalyptic predictions from the real ethical dangers of AI misuse.



South Pole: Nature and Culture

Elizabeth Leane REAKTION (2016)

As the quintessence of Earthly remoteness, Antarctica has drawn hordes of scientists, iconic explorers such as Robert Falcon Scott and Roald Amundsen, and novelists who have peopled it with vast humanoid lobsters or radioactive elephant seals. Historian Elizabeth Leane tours the research, literature, exploration and geopolitical manoeuvrings that swirl around the pole. Hers is a detailed, compelling portrait of a place at once central and marginal, fantastically inhospitable and beautiful, and a mecca for physicists, government claimants and extreme tourists.



The Winter Fortress: The Epic Mission to Sabotage Hitler's Atomic Bomb

Neal Bascomb HOUGHTON MIFFLIN HARCOURT (2016)

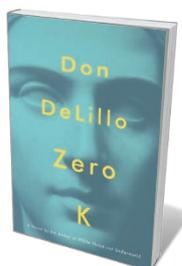
Journalist Neal Bascomb delivers a deeply researched account of a half-forgotten episode in the Second World War: the Allied raids that sabotaged the Nazi effort to build a nuclear bomb. In 1940, the Third Reich co-opted Norway's Vemork hydroelectric plant, sole source of the heavy water ($^2\text{H}_2\text{O}$) needed for the bomb technology. Bascomb interweaves the stories of Hitler's 'Uranium Club' and of atomic chemist Leif Tronstad, who directed the Allied operation, with the thriller-esque tale of the commandos who put the plant out of action in 1943.



Where Are the Women Architects?

Despina Stratigakos PRINCETON UNIVERSITY PRESS (2016)

'Male-dominated' is an understatement in architecture: in Britain alone, just 24% of architects are women, and the late Zaha Hadid was a rare star. In this slim chronicle, architectural historian Despina Stratigakos incisively catalogues the setbacks. In 1908, for instance, German architectural critic Karl Scheffler claimed that female practitioners were "irritable hermaphroditic creatures"; Ayn Rand's 1943 paean to architectural misogyny *The Fountainhead* became a university cult. Despite the equality debate, Stratigakos notes, the work of architects such as Thekla Schild remains low profile.



Zero K

Don DeLillo SCRIBNER (2016)

Cryogenics and climate change permeate this existential science-fiction tale by novelist Don DeLillo. Set in a shadowy compound near Bishkek, Kyrgyzstan, it centres on Zero K, a "faith-based technology" that promises future immortality in cyberhuman form. Sceptical protagonist Jeff meets the cultists, views videos of catastrophes and contemplates ageing in a satirical narrative shot through with poetic lyricism. Ultimately, a celebration of life's "mingled astonishments", as a counterweight to fantasy futurism and pessimism alike. [Barbara Kiser](#)