

Artificially generated lightning crackles around Nikola Tesla's Colorado laboratory.

## PHYSICS

# The mind electric

Patrick McCray assesses a biography of Nikola Tesla, the Serbian wizard of the alternating current.

When entrepreneur Elon Musk named his all-electric car company Tesla Motors, he was paying homage to a remarkable man. Serbian inventor and electrical engineer Nikola Tesla (1856–1943) created a veritable zoo of electrical inventions, from motors that used alternating current (AC) to radio-controlled boats, and a proposed system for the wireless transmission of electricity from one continent to another.

Bernard Carlson's superb biography follows Tesla from his years in what is now Croatia, Austria and Hungary, where he studied physics, engineering and mathematics, to his 1884 arrival in New York City and then on to spectacular successes and failures in electrical innovation. Carlson brings to life Tesla's extravagant self-promotion, as well as his eccentricity and innate talents, revealing him as a celebrity-inventor of the 'second industrial revolution' to rival Thomas Alva Edison.

Tesla worked briefly for Edison in the United States, but quit in disgust when Edison declined to use his arc-lighting system. Financially strapped, Tesla plunged into the technological ecosystem of New York, with its growing demand for electricity for the power and communications industries. As Carlson relates, these technological frontiers were largely unsettled at the time, with inventors,

entrepreneurs and financiers all fighting to secure a competitive advantage. A key question was whether Edison's direct-current approach or the AC option favoured by Tesla would come to dominate power transmission.

Tesla's signal accomplishment was the realization of his AC motor in the late 1880s. This was based on a series of inventions and patents for using two sources of alternating current out of phase with one another. Tesla saw that these created a rotating magnetic field that could make a motor. His polyphase power systems were backed by funds from US entrepreneur George Westinghouse and ultimately allowed utilities to transmit electrical power over longer distances than before.

The first biography on Tesla appeared in 1894, when he was riding high after building an "oscillating transmitter" (a resonant transformer also called the Tesla coil) and seeing his polyphase AC motors deployed for power generation at Niagara Falls. Public lectures in the United States and Europe followed. Tesla had a consummate ability to impress audiences and potential backers with stunning electrical displays. An 1891 lecture, for instance, featured two large zinc sheets suspended from the

auditorium ceiling and connected to a power source. Under dim lighting, Tesla stepped between the slabs holding a gas-filled tube in each hand. The electrostatic field made the tubes glow as Tesla told the enthralled crowd how electric lights might be moved around without being tethered to wires.

Tesla further studied the possibility of wireless power transmission in 1899, while on sabbatical in Colorado Springs. (A well-known double-exposure photograph, **pictured**, in which he seems to sit nonchalantly amid fierce electrical discharges, was taken here.) The region's summer storms led him to surmise that lightning bolts initiated electromagnetic waves in Earth's crust, creating stationary waves. He believed that this process would allow power transmission "in unlimited amounts, to any terrestrial distance and without loss".

Many writers have cast Tesla as a "Nietzschean superman", as Carlson puts it. But Carlson looks critically at Tesla's wilder claims — such as his proposed particle-beam weapon, which never came to fruition despite stirring up interest among Soviet, British and US officials on the eve of the Second World War. Carlson is also frank about Tesla's misunderstanding of scientific discoveries. In 1887, for example, German physicist Heinrich Hertz detected the electromagnetic waves predicted by Scottish physicist James Clerk Maxwell. Tesla decided that the glow in evacuated glass discharge tubes was due to "electrostatic thrusts". The error did not prevent him from trying to convert Hertz's basic discovery into devices in the lab. Technological innovation, not scientific discovery, remained this visionary engineer's primary goal.

Carlson contextualizes Tesla's approach with excursions into the nature and psychology of invention, exploring theories such as economist Joseph Schumpeter's model of "creative destruction" and business professor Clayton Christensen's more recent idea of "disruptive innovation". Both these theories are based on the idea that entrepreneurs and inventors who produce radical technologies can cause widespread social and economic disruption. Tesla's inventive style, says Carlson, existed in "tension between ideal and illusion": he first shaped inventions in his mind rather than taking Edison's empirical approach. Tesla believed that his polyphase system rested on a beautiful principle, which he expected businessmen and customers to adapt to. However, putting design ideals ahead of practical considerations — not unlike Apple's late chief executive Steve Jobs, Carlson notes — sometimes meant that Tesla missed out on commercial possibilities.

In about 1900, Tesla began to conceptualize a grand system that would enable the wireless transmission of power and communications "from Pike's Peak" in Colorado's Rocky Mountains "to Paris". Buoyed by support from

**Tesla: Inventor of the Electrical Age**  
W. BERNARD  
CARLSON  
Princeton University  
Press: 2013. 520 pp.  
£19.95, \$29.95

Wall Street wizard John Pierpont Morgan, he oversaw the building of Wardencllyffe, an imposing laboratory-cum-transmitting tower on Long Island, New York. However, faulty research results undermined the plan and, unnerved by Tesla's self-promotion and suspicious of the growing speculative bubble in wireless communications, Morgan withdrew. The giant transmission facility was never completed and Tesla found himself scrambling for cash. (Despite this, Tesla's activities probably spurred physicist and inventor Guglielmo Marconi to speed up his own work on wireless communications.)

The failures that dogged Tesla's transmission scheme bit deeply into his perceptions of how the electrical world worked. Earth didn't behave as if it were filled with an incompressible fluid, as Tesla believed. When the Wardencllyffe experiment failed, Carlson recounts, Tesla faced a "serious dilemma ... Either he was wrong or nature was wrong." Ideas clashed with reality and Tesla, angry and depressed, had a nervous breakdown in 1905.

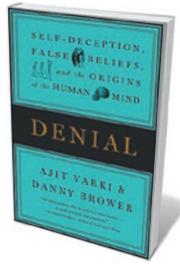
Tesla's last three decades in New York City were spent in relative obscurity. He never gave up the dream of wireless power transmission and continued to invent while living precariously off a modest stream of royalties. He gave annual press conferences in which he speculated about the future of technology. His life, one observer noted, took on a more "speculative, philosophical, and somewhat promotional character".

In the early 1970s, many years after his death, Tesla's enigmatic behaviour (such as his passion for feeding pigeons) and lingering reputation for grandstanding electrifying illusions helped to cement his appeal among free-energy claimants — who believe there is electricity in our environment waiting to be picked up with the right technology — and counterculturalists seeking mystery in the rational and material world. Public interest has spiked again in the past few years. In 2012, an online campaign raised close to a million dollars in a week for a Tesla museum. A recent YouTube video has Tesla duelling with Edison in a rap battle, and Christopher Nolan's 2006 film *The Prestige* features David Bowie as Tesla. Tesla's bold predictions and outsider glamour are still working their magic.

Tesla shows that a deep creative drive, guided by a formidable intuition, can serve inventors well up to a point. Innovation may be a subjective process, but Tesla's career demonstrates that it can also be undermined by believing that illusion has substance. ■

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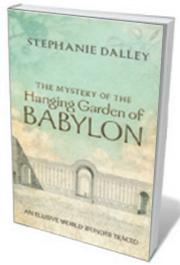
## Books in brief



### Denial: Self-Deception, False Beliefs, and the Origins of the Human Mind

Ajit Varki and Danny Brower TWELVE 384 pp. \$27 (2013)

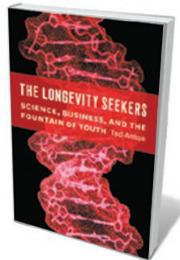
Do you skydive? Deep-fry? Chain-smoke? Denial of mortality is a strange trait that is also key to human nature, argues medic Ajit Varki. His argument stems from the ideas of late geneticist Danny Brower, who asked why species such as chimpanzees have not evolved to be aware of both self and the minds of others. Varki speculates that such intersubjectivity could only arise in tandem with 'death blindness', as fear would otherwise hamstring a species' fitness. A thoughtful foray into "mind over reality".



### The Mystery of the Hanging Garden of Babylon: An Elusive World Wonder Traced

Stephanie Dalley OXFORD UNIVERSITY PRESS 304 pp. £25 (2013)

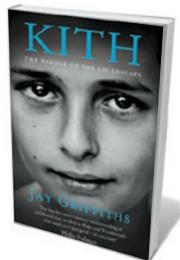
The puzzling dearth of research on Babylon's Hanging Garden, one of the seven wonders of the ancient world, prompted Assyriologist Stephanie Dalley to methodically sift the evidence. Her perusal of cuneiform tablets, rock reliefs and Latin texts yielded research gold, overturning long-held ideas about the creator and location of this vertiginous marvel. From its fantastical landscaping to its advanced irrigation system, the garden emerges as a wonder indeed — of engineering, aesthetics and metaphoric richness.



### The Longevity Seekers: Science, Business, and the Fountain of Youth

Ted Anton UNIVERSITY OF CHICAGO PRESS 240 pp. \$26 (2013)

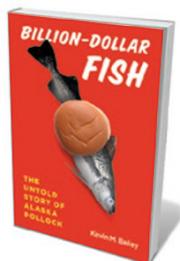
A "silver tsunami" is upon us, writes Ted Anton: by 2050, one-third of people in the developed world will be over 60. The time has come to tease out the "molecular tipping points" involved in maintaining geriatric health, Anton avers. Kicking off with molecular biologist Cynthia Kenyon — who in 1993 pinpointed a single-gene mutation that doubles the lifespan of the nematode *Caenorhabditis elegans* — Anton reveals a young field already rife with larger-than-life personalities and lab drama aplenty.



### Kith: The Riddle of the Childscape

Jay Griffiths HAMISH HAMILTON 432 pp. £20 (2013)

Sojourning on several continents to research her bestselling *Wild*, Jay Griffiths noted big differences between children from indigenous and Western cultures. She now grapples with that riddle, arguing that "human nature is nested in nature which co-creates the child". Her probings of the meeting point of developing psyche and environment interweave history, anthropology and memoir. But does an urban existence enfeeble the young? What is abundantly clear, yet sidelined in this often brilliant, poetically nuanced work, is the ferocious adaptability of our species and our children.



### Billion-Dollar Fish: The Untold Story of Alaska Pollock

Kevin M. Bailey UNIVERSITY OF CHICAGO PRESS 288 pp. \$25 (2013)

The last time you ate something labelled just 'fish', it might well have been pollock. The flesh of this Alaskan species turns up in fish fingers, sushi and seafood salad. Kevin Bailey, a former senior scientist at the Alaska Fisheries Science Center in Seattle, presents the first natural history of this ubiquitous fish and an analysis of its population. Although the market for pollock — worth more than a billion dollars a year in the United States alone — seems buoyant compared with some others, Bailey unveils a familiar tale of steep decline. **Barbara Kiser**