



ISSEI KATO/REUTERS/CORBIS

Journalists visit the Fukushima Daiichi nuclear power plant in Japan ahead of the first anniversary of its meltdown.

NUCLEAR ENERGY

Meltdowns, redux

Two accounts take contrasting lessons from nuclear accidents, finds **Mark Peplow**.

How safe is safe enough? Dig into the nuclear-power debate, and you will soon reach that question. Two books offer answers — but arrive at utterly different conclusions.

In *Atomic Accidents*, James Mahaffey tries to persuade us that the mighty atom is our friend by showing how much nuclear engineers (he is one) have learned from the industry's mistakes. Whereas he puts accidents under the microscope to pinpoint where things turned nasty, in *Fukushima*, David Lochbaum, Edwin Lyman and Susan Q. Stranahan blame the entire nuclear establishment.

Mahaffey guides us through more than a century of atomic research, including misadventures with radioactive elixirs ("The radium water worked fine until his jaw came off", reads a 1932 headline) and long-forgotten accidents at enrichment plants. Along with show-stoppers such as Three Mile Island and Chernobyl, he covers milestones including the first weapons-test accident (in 1954, when the detonation of the compact US hydrogen bomb 'Shrimp' unintentionally contaminated 18,000 square kilometres of the Pacific Ocean) and the first meltdown (1952, at Canada's Chalk River reactor). The accidents are mostly reconstructed from

Atomic Accidents: A History of Nuclear Meltdowns and Disasters from the Ozark Mountains to Fukushima

JAMES MAHAFFEY
Pegasus Books: 2014.

Fukushima: The Story of a Nuclear Disaster

DAVID LOCHBAUM, EDWIN LYMAN AND
SUSAN Q. STRANAHAN
The New Press: 2014.

official reports, and Mahaffey includes a lot of technical detail that serves as a useful introduction to nuclear engineering.

Entertaining anecdotes about foolhardy pioneers abound. In the 1940s, after diving into a spent-fuel pool to adjust an experiment, bomb-core-assembly expert Louis Slotin was moved from Oak Ridge National Laboratory in Tennessee to Los Alamos National Laboratory in New Mexico, "where daring was better appreciated". He was killed 18 months later, in a stupid accident with a screwdriver and some plutonium. The compelling tales unravel like slow-motion horror stories, spiralling towards disasters we know are coming.

A theme emerges. Accidents happen when operators do not

follow the correct procedures, or because ambitious plant designers overlook glaring weaknesses — not because nuclear power is inherently unsafe. The disaster at Japan's Fukushima Daiichi power plant — triggered by the 2011 earthquake and tsunami — is afforded fewer than 30 pages. As with his other accounts, Mahaffey quickly identifies the accident's turning points. In the case of the plant's Unit 1 reactor, which suffered a complete meltdown, he singles out an operator who closed two crucial coolant valves, effectively overriding an automated safety system.

He takes the same approach to the whole industry, picking a little-known US accident in 1961 as the moment that led plant designers to take a wrong turn. When a control rod was inadvertently pulled from SL-1, a low-power military reactor in remote Idaho, it caused a steam explosion that took the lives of three people — the last to die in a power-reactor accident in the United States. The incident soured the industry on small, simple reactors, and pushed it towards bigger, more expensive ones that became ever more complicated as safety features were retrofitted.

Mahaffey argues for a return to smaller reactors, reasoning that accidents are inevitable, so they had best be small. He extols the

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virtues of safer designs such as the thorium molten-salt reactor. If these changes are made and lessons are learned, he concludes, accidents like Fukushima should be behind us.

On the contrary, say Lochbaum, Lyman and Stranahan. “Nuclear power is an energy choice that gambles with disaster,” they write. “The problems that led to the disaster at Fukushima Daiichi exist wherever reactors operate.” They unpick those problems in forensic detail, using multiple sources in a thriller-paced retelling. *Fukushima* takes a much broader view of the accident than *Atomic Accidents*, delving into political wrangling and the roles of international agencies. It shows how Japan’s complex nuclear bureaucracy — involving power companies, an independent regulator and government departments — stymied the response. A vivid picture emerges of utter confusion in the hours and days after the tsunami.

The writers have impressive pedigrees. Stranahan was on the *Philadelphia Inquirer* team that won a Pulitzer Prize in 1980 for its coverage of the Three Mile Island accident. Industry insider Lochbaum and global-security specialist Lyman have both been heavily involved in the Union of Concerned Scientists’ lobbying on nuclear power.

That may explain why the second half of the book becomes an attack on the US Nuclear Regulatory Commission (NRC), which the authors argue is complicit in the industry’s disregard for safety. According to *Fukushima*, the NRC refused to learn from Three Mile Island, and failed to mandate that the industry prepare for similar events. The commission, the book claims, had run simulations showing that Mark 1 boiling-water reactors, designed by General Electric and installed at Fukushima, were vulnerable to meltdown in a power blackout. If the NRC had been bolder about improving safety at home, in the authors’ opinion, other countries would have followed — and Japan might not be facing a US\$100-billion nuclear clean-up.

Lochbaum, Lyman and Stranahan disagree strongly with Mahaffey’s stance on the benefits of smaller reactors, which would almost certainly be built in clusters: at Fukushima, simultaneous problems with multiple reactors complicated emergency-response efforts. “Nuclear power’s safety problems cannot be solved through good design alone,” they write. Instead, they say, the NRC must accept the possibility that dam breaches, fires or terrorist attacks could trigger a nuclear accident worse than Fukushima on US soil.

Both polemics offer thought-provoking analyses. However much they differ, they are both right: if nuclear power is to have a future, it needs better science and better regulation. ■

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Books in brief



The Future of the Mind: The Scientific Quest to Understand, Enhance, and Empower the Mind

Michio Kaku DOUBLEDAY (2014)

Taking a break from contemplating the cosmos, Michio Kaku plunges into the universe inside the skull, training his theoretical physicist’s eye on the field. His intriguing ‘space-time’ theory of consciousness frames the extraordinary findings emerging from ever-more-finely targeted brain scanning and other technologies. A fascinating sprint through everything from telepathy research to the 147,456 processors of the Blue Gene computer, which has been used to simulate 4.5% of the brain’s synapses and neurons.



Girls Coming to Tech! A History of American Engineering Education for Women

Amy Sue Bix MIT PRESS (2014)

The Second World War flung open windows of opportunity on aircraft engineering for thousands of women in the United States. In the 1950s, many eager to pursue an engineering degree hit a wall; less than 1% of the era’s engineering students were female. Focusing on three iconic technology institutes (California, Georgia and Massachusetts), science historian Amy Sue Bix relates how these “oddities at best and outcasts at worst” made headway in closing the gender gap: women now earn one-fifth of degrees in the field.



The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies

Erik Brynjolfsson and Andrew McAfee W. W. NORTON (2014)

In this comparative study of economic and digital progress, Erik Brynjolfsson and Andrew McAfee argue that we stand at an “inflection point” — poised to reap big rewards if we harness the forward leap of innovation. With measured optimism, they survey a digital landscape of exponential progress in computing power and application; technological benefits and their uneven spread; and policy. Crammed with analyses of everything from human–machine competition to the state of US education.



Joy, Guilt, Anger, Love: What Neuroscience Can — and Can't — Tell Us About How We Feel

Giovanni Frazzetto PENGUIN BOOKS (2014)

Neuroscientist Giovanni Frazzetto enters the restless realm of human emotion through the portals of physiology, genetics, history, art and philosophy. Anger, guilt, anxiety, grief, empathy, joy and love are anatomized in turn, enlivened with research on everything from the role of monoamine oxidase A in anger to the engagement of opioid receptors as we thrill to music. And who knew that surrealist Salvador Dali created an art installation in the shape of a giant caterpillar to explore the process of sedation?



GDP: A Brief but Affectionate History

Diane Coyle PRINCETON UNIVERSITY PRESS (2014)

A raft of economists, including Robert Costanza (see *Nature* 505, 283–285; 2014), argue that gross domestic product (GDP) is a flawed measure of national prosperity, hiding social inequality and pushing growth at the planet’s expense. Economist Diane Coyle is less severe in this brief, lucid history. She traces GDP from its roots in the eighteenth century to its twentieth-century heyday, offering a smart analysis of its status and uses now, as a one-note statistic in an increasingly complex world. [Barbara Kiser](#)