PHYSICS

Let's Be Fysiksists Again

Matthew Wisnioski

In 1968, a cartoon hippie strumming on a slide rule admonished potential employees of the United Nuclear Company to "drop in":

> If you despise routine and regimentation, we're more than halfway interested in you. If you're skilled in any one of many scientific or engineering disciplines, we want you. We need freethinking creative types to help us design and develop new processes and equipment for the future of the nuclear industry.
>
> If you're our man, you'll find $E=MC^2$ more mind-expanding than LSD. You'll find suburban Westchester more comfortable than Hashbury or Tompkins Square. And you'll find our generous benefits program more nourishing than hippy stew. (*1*)

In this potted recruitment joke were warnings of what historian and quantum physicist David Kaiser calls a "perfect storm."

After four decades of scholarship documenting how the Cold War changed American science, the scale of the transformation continues to shock. No discipline was more entangled than physics. Driven by federal manpower demands, the production of Ph.D.'s increased more than 20-fold between 1945 and its peak in 1971. Enrollment in individual graduate courses at Berkeley and MIT regularly exceeded 100 students. The practical and ideological constraints of expansion played a role in evaluating what topics were worthy of inquiry. Armed with Feynman diagrams, postdocs were told to "shut up and calculate," while *Physical Review* instructed referees to reject any paper on quantum mechanical interpretation that failed to make quantitative predictions. In this culture of "hyperpragmatism," John S. Bell's 1964 proof of nonlocality (*2*)—retrospectively named "the most successful scientific theory of all time" (*3*)—languished for years without citation.

By the time United Nuclear gave its pitch, however, physics looked less like the endless frontier than a real-estate bubble about to pop. In *How the Hippies Saved Physics*, Kaiser shows that to a growing number of students, faculty, and industrial scientists, suburban comfort no longer was a fair trade for routine and regimentation. Congress revoked the exemption that made graduate school a refuge from the military draft. The Department of Defense reconsidered its return on investment in basic science. Then there were the hippies, who many in the scientific community believed were a threat to the very foundation of Western rationality. Physics was besieged on multiple fronts, and the demand for physicists plummeted. For nearly two decades, until the late 1960s, the placement office of the American Institute of Physics had listed more jobs than graduates, but in 1971, there were 1053 applicants for 53 positions.

How the Hippies Saved Physics
Science, Counterculture, and the Quantum Revival
by David Kaiser
Norton, New York, 2011. 400 pp. $26.95, C$31. ISBN 9780393076363.

Kaiser chronicles life after the collapse. In 1975, Elizabeth Rauscher and George Weissmann, two Berkeley graduate students with nothing left to lose, created the Fundamental Fysiks Group to study the "spooky actions at a distance" of quantum reality. Their informal seminar linked a network of underemployed physicists, Eastern mystics, and spoon-bending psychics funded by a fried chicken magnate, *est*-guru Werner Erhard, and the Central Intelligence Agency. Given that chemical substances could alter human consciousness and that quantum information appeared to travel faster than light, the group asked, why could not cognitive manipulation of matter be possible? Participants conducted experiments on extrasensory perception and built a "metaphase typewriter" out of a mainframe computer, radioactive thallium, a Geiger counter, and a teletype machine—which they used in an attempt to channel the spirit of Harry Houdini.

The Fundamental Fysiks Group appears as the ultimate test case of the boundary between science and pseudoscience. Indeed, scholars of science studies in the 1970s and early 1980s constructed their theories of demarcation with reference to practitioners in its network. Drawing on extensive interviews, citation index statistics, and lucid technical explanations, Kaiser shows the inherent plasticity of mainstream and fringe. Scientists who blended physics with parapsychology (psi) received support from leaders of the profession, including Geoffrey Chew, Victor Weisskopf, and John Wheeler, with the latter's notion of a "participatory universe" serving as a foundational inspiration. While they might have rejected psi phenomena (e.g., extrasensory perception, psychokinesis, telepathy) out of hand, even hardheaded Nobel Prize winners were not above a nude steam bath at the famed Esalen workshops on quantum physics and the nature of reality. The margins also yielded results: Fritjof Capra's *Tao of Physics* (*4*)—which treated quantum physics and Eastern mysticism symmetrically—became a staple text of physics pedagogy. Group member Saul-Paul Sirag, a college dropout, published two articles in *Nature* (*5*, *6*) while working as a night watchman.

For Kaiser, the Fundamental Fysiks Group offers a morality tale about modes "of doing physics and of being a physicist." The scientists

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"The 'new physicists' as countercultural darlings." With their interests in consciousness, mysticism, and the paranormal, members of the Fundamental Fysiks Group—here (standing, left to right) Jack Sarfatti, Saul-Paul Sirag, Nick Herbert, and (in front) Fred Alan Wolf—garnered considerable attention from the media. (Photograph circa 1975)

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behind the first quantum revolution—Niels Bohr, Albert Einstein, Werner Heisenberg, Erwin Schrödinger—worked in an "earnest" and "informal" "tight-knit community," quoted Hindu scripture, dabbled in Jungian depth psychology, and chose the yin-yang symbol for their coat of arms. World War II and its resultant organizational culture ended the "golden age." To a person, members of the Fundamental Fysiks Group, who were trained in the new regime, described a childhood love of science dashed by "turn-the-crank stuff." Down and out in Northern California, they resurrected the "big-picture search for meaning."

Using an analogy to Ireland's medieval monks, Kaiser shows how the interpretive work of hippie physicists "saved" Bell's theorem. John Clauser, a postdoc at the Lawrence Berkeley Laboratory, published the first experimental verification that the spin of subatomic particles correlated across distances that could not be explained by local forces (*7*). That did little to improve his job prospects, but it introduced him to Rauscher and the group. A decade later, Nick Herbert, the mastermind behind the metaphase typewriter, seemed to achieve a viable model of superluminal communication (*8*). He conceived of a means to send messages instantly across any distance by measuring the polarization of individual photons, cloned by laser amplification to overcome the uncertainty principle. Though flawed, his thought experiment was the catalyst for Bill Wootters and Wojciech Zurek's proof that an arbitrary unknown quantum state cannot be copied, a discovery that made possible the billion-dollar quantum cryptography industry (*9*).

An argument premised on the Middle Ages suggests a new era of light. As historians turn to projects like quantum cryptography with the same energy once reserved for the Cold War, competing interpretations hold court. In the "commercialized science" camp, Philip Mirowski describes a dangerous creep of market forces into knowledge production, characterized by managerial innovations such as the contract research organization (*10*). Steven Shapin, in contrast, argues for continuity in the modes of doing science and being a scientist, offering a full-throated defense of research managers and venture capitalists (*11*). In his thick description of the Fundamental Fysiks Group, Kaiser mostly avoids a position on the contours of late-20th-century technoscience. The career of Jack Sarfatti, the group's mercurial network builder, gives credence to the rise of a privatized, entrepreneurial mode in which the mantra "we are all one" spawns unbreakable bank transfers. Once a bohemian critic of the military-industrial complex, Sarfatti now describes himself as a "counter cultural radical conservative who hob nobs with Reaganites [and] billionaires." At the same time, Kaiser argues, freewheeling online communities like the FQXi (the Foundational Questions Institute) maintain a necessary dialectic between the wild borders and the tweedy core of the scientific enterprise.

Though intended for the scientifically literate general reader, it is hard not to interpret Kaiser's praise for the quantum revival as a warning in humanism's present storm. Confronted with an anemic job market in a system that has embraced the commercialization ethic, one professor has issued a national warning to prospective graduate students to "Just don't go" (*12*). Meanwhile, the president of the American Historical Association defends the profession against charges of esotericism, jargon, and politicization (*13*). Kaiser forgoes eulogy or righteous battle and instead emulates Capra in an homage to the fundamental strangeness of the past. Meticulously researched and unapologetically romantic, *How the Hippies Saved Physics* makes the history of science fun again.

BROWSINGS

The Quantum Story: A History in 40 Moments. Jim Baggott. Oxford University Press, Oxford, 2011. 505 pp., illus. $29.95, £16.99. ISBN 9780199566846.
Richard Feynman famously claimed that nobody understands quantum theory. Nonetheless, it may be "the most successful theory of physics ever devised." Through descriptions of key moments, science writer Baggott charts the development and consequences of quantum ideas. These 40 episodes range from Max Planck's December 1900 discovery of his "quantum of action" in black-body radiation to the "crisis" of superstring theory. In an optimistic epilogue, Baggott sees hope for the future in current particle-physics research—whether results from CERN's Large Hadron Collider simply confirm the existence of the Higgs boson or overthrow current quantum field theory. Regardless, he has provided an accessible and informative history of physics "so profoundly at odds with a common-sense conception of the world."

Guidebook for the Scientific Traveler: Visiting Physics and Chemistry Sites Across America. Duane S. Nickell. Rutgers University Press, New Brunswick, NJ, 2010. 275 pp. Paper, $21.95, £14.95. ISBN 9780813547305.
Both armchair travelers and those who wish to make science-focused stops during their journeys will find much of interest in Nickell's short accounts. In addition to covering several science museums, he introduces a wide-ranging selection of locations associated with famous physicists and chemists; government, academic, and industrial research labs; and sites that highlight particle physics, nuclear weapons, or energy.

Long for This World: The Strange Science of Immortality. Jonathan Weiner. Ecco, New York, 2010. 320 pp. $27.99, £17.29. ISBN 9780060765361. Paper, 2011. $15.99, £9.88. ISBN 978-0060765392.
Gerontologist Aubrey de Grey, the book's central figure, believes that science will soon be able to radically extend the expected human life span and that doing so will bring innumerable benefits. Many of the other researchers whose stories and research Weiner weaves into this account of the science and pseudoscience of immortality doubt both the likelihood and desirability of our forestalling death. The author writes engagingly on such topics as the evolution of aging, free-radical damage of mitochondria, Methuselah mutants that live much longer than other members of their species, and the Sir2 gene that may underlie some effects of extreme calorie-restricted diets. His thoughtful philosophical reflections demonstrate that he did not succumb to de Grey's proselytizing, as he concludes, "The trouble with immortality is endless."

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