Review essay

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Faster-than-light reading

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David Kaiser, *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (New York: W.W. Norton & Company, 2011), 372 pp., £19.99/€20.99/$26.95. ISBN 978-0-393-07636-3.

The hippies, it seems, are ready for their close-up. A raft of books in the past few years has carved out a prominent role for the counterculture in the history of science and technology: Kelly Moore's (2008) *Disrupting Science: Social Movements, American Scientists, and the Politics of the Military*; Fred Turner's (2006) *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*; Andrew Kirk's (2007) *Counterculture Green: The Whole Earth Catalog and American Environmentalism*; Eric Vettel's (2006) *Biotech: The Countercultural Origins of an Industry*; and now David Kaiser's (2011) *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival*. Thanks to these works, we can dispense with the conventional view that the hippies were uniformly anti-science and anti-technology. Instead, we can see that many participants in the counterculture possessed an enthusiastic, if often unorthodox, vision for science and technology. That vision was inhomogeneous to the point of contradiction: sometimes opposed to, sometimes partnering with the military–industrial complex; sometimes anticapitalist, sometimes entrepreneurial in the extreme; sometimes other-directed, sometimes narcissistic. Yet, in some ways, that diversity was the counterculture's contribution to science and technology – the hippies and their fellow travelers pried open the homogeneity and narrowness of vision of the early Cold War, and replaced them with a spirit of wide-ranging inquiry and experience.

How the Hippies Saved Physics is, as the title implies, mostly concerned with the beneficial effects of that wide-eyed, countercultural mode of exploration in the discipline of physics, especially in the subfield of quantum theory. The main protagonists of

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Kaiser's story are the Berkeley-based 'Fundamental Fysiks' group and its extensive global network of interlocutors who eagerly plumbed the deep questions of quantum theory at a time when those questions were looked upon as deviant, even career-suicidal, topics for American physicists.

In particular, those affiliated with Fundamental Fysiks were fascinated by a then-obscure proposition that has come to be known as Bell's Theorem. Bell's Theorem describes some of the strange consequences of the phenomenon known as quantum 'entanglement'. If, for instance, two particles are emitted from a radioactive decay in such a way that their spins must sum to 0, but it is unknown which one is up and which one is down, then they are entangled. Until one member of an entangled pair is observed closely enough to measure its quantum state, both of them are in an indeterminate state – at least as far as anyone can tell. But if the state of one of them is determined, then the state of the other one suddenly becomes determinate as well – even if nothing has been done to the second member of the pair, and even if the two particles are separated by vast distances.

Attempts to think through the weirdness of quantum theory (such as the Einstein–Podolsky–Rosen paradox, Schrödinger's cat, and John von Neumann and David Bohm's competing 'proofs' regarding hidden variables) have a long and distinguished history, but by the time John Bell developed his theorem in the early 1960s almost no one was interested in such questions. But as the counterculture gained strength, a few free spirits, led by the Fundamental Fysiks group, began to see the 'spooky action at a distance' implications of Bell's Theorem as the thin end of a wedge that might leverage a whole host of strange phenomena: 'psychokinesis … time travel w/o paradox … ESP [extrasensory perception] and extraterrestrial communications … Jungian world' (p. 67).

Again, as Kaiser notes, connections between cutting-edge physics and paranormal research have a venerable pedigree but had been pushed to the margins of the discipline in the early Cold War. Yet the Fundamental Fysiks crew made the most of being at the fringe. The margin of their discipline turned out to be a thriving borderland where they could easily make connections to individuals and institutions through countercultural networks. If they couldn't get funding from mainstream sources like the Office of Naval Research, well, the charismatic self-empowerment mogul Werner Erhard would help them out. If they couldn't get tenure-track academic jobs, well, they could always teach extraordinarily popular seminars at Esalen. If they couldn't publish in prestigious journals, well, the underground publishing scene circulated their ideas just as effectively.

Eventually, the rest of the discipline began to notice what was going on in Berkeley. In particular, physicists elsewhere took up the Fundamental Fysiks group's speculations about superluminal transmission of information. If Bell's Theorem was correct, then establishing the quantum state of one entangled particle instantaneously determined the state of the other entangled particle, no matter how far apart they were. Perhaps, then, a message could piggy-back on their entanglement and travel faster than the speed of light. Members of Fundamental Fysiks, with their eyes on unidentified flying objects (UFOs), time travel, and communication with the dead, were eager to show that superluminal communication was possible; some of them even patented such schemes. Those schemes didn't pan out, but their ideas were sophisticated enough, and their network of contacts

prestigious enough, that they gave rise to a global research effort that is today one of the hottest, and most technologically promising, areas of mainstream physics.

It's an inspiring story of underdogs overcoming the odds, and a colorful story of oddballs and eccentrics teaching the world the value of astonishment and speculation. In telling it, Kaiser skillfully avoids the pitfalls of a lurid exposé or credulous apologia, partly because of his marvelous collection of interviews and other source material from members of Fundamental Fysiks and their affiliates, and also because of his easy familiarity with the longer history of science. That allows him to put Fundamental Fysiks into the context of both the counterculture and the discipline of physics in a way that will be entertaining to the lay reader and indispensable for the specialist.

My only complaints stem from the book's title, the contortions needed to justify that title, and the limitations of the narrative that follows from it. As Kaiser admits, the title is 'ironic and defiant' and tinged with 'bravado' and 'brashness' (p. xxv). Great! It's a common refrain among more seasoned Science and Technology Studies (STS) scholars that Kaiser's (and this reviewer's) generation is not adventuresome and provocative enough. This book, from its title page forward, debunks that conventional wisdom.

But what does the book's title mean, and what does it imply for the historiography of science in the 1970s? In his introduction, Kaiser offers three ways that the Fundamental Fysiks group and their fellow travelers 'saved' physics. The first is that 'they self-consciously opened up space again for freewheeling speculation, the kind of spirited philosophical engagement with fundamental physics that the Cold War decades had dampened' (p. xxiii). The second and third are that they rescued Bell's theorem and 'instigated' 'major breakthroughs' as a result (p. xxv).

Senses #2 and #3 were certainly worthwhile, but hardly qualify for 'saving physics'. Of course, *How the Hippies Saved Bell's Theorem* wouldn't have been a very inviting title, so Kaiser goes to some lengths to persuade readers of the importance of retrieving quantum entanglement from obscurity. The book opens, for instance, with a description of a 2004 demonstration of a cryptographic system based on quantum entanglement, which Kaiser says could revolutionize the transmission of financial data and other private information. Well, quite possibly, although such systems are still far from widespread implementation. And even if they were widely used today, providing banks with a new way to move numbers around seems like a narrow basis for talk about 'saving physics'. Moreover, Kaiser shows that most of the steps toward quantum encryption were made by physicists seeking to correct the off-base (but inspirational and stimulating) speculations of the Fundamental Fysiks group.

Sense #1, on the other hand, is a more plausible candidate for 'saving physics'. Kaiser's (2005) earlier work has shown the extent to which the early Cold War influx of cash and graduate students transformed American physics into a machine for mass-producing personnel. The need to move people through the education pipeline as quickly as possible, in order to ready many of them for defense-related work in government and industry, led to a narrowing of the discipline's focus. Extraordinarily sophisticated and rapid calculation methods were promoted, but prolonged discussion of the paradoxes and philosophical implications of physical theory were almost annihilated. *How the Hippies Saved Physics* races through that backstory, but the title of Chapter 1 best conveys the flavor of early Cold War physics pedagogy: 'Shut up and calculate'!

The precipitous decline in research funding and job prospects for physicists around 1970 therefore alleviated much of the pressure to calculate quickly. Those who were so inclined, and who could find or create tolerant institutions, could return to deep discussion, grappling with paradox, provocative speculation, and open-eyed exploration. Berkeley, Esalen, and the Fundamental Fysiks group became magnets for physicists disaffected with the Cold War curtailment of the sometimes playful, sometimes intense pre-war discussions of the meaning of quantum theory begun by Bohr, Einstein, and others. Their efforts eventually transformed what counted as good physics, so that once-maligned topic areas such as Bell's Theorem are today the mainstays of the discipline. To me, that broadening of focus is certainly one of the things that needed to happen to 'save physics' – though, as Kaiser shows, it wasn't just 'the hippies' who made that broadening possible. Highly regarded older colleagues such as John Wheeler and David Bohm offered professional shelter, resources, advice, and legitimating interest in the paradoxes of quantum theory, without which the Fundamental Fysiks network might have gone nowhere.

Perhaps the most important means through which the Fundamental Fysiks group expanded the boundaries of physics, and in doing so displaced the 'center' of their discipline so far that they were no longer located at the fringe, was the publication of bestselling, accessible expressions of the wonders of the quantum world. Those books, by themselves, may have been the Fundamental Fysiks group's greatest contribution to 'saving physics'. Kaiser doesn't put it that way, but he retells, at length and with obvious admiration, the publication histories of *The Tao of Physics* and *The Dancing Wu-Li Masters* and the genre they inspired. In an era when student enrollment in physics had plummeted and many young people viewed the discipline as a cold, heartless appendage of the military–industrial complex, these books were a powerful antidote. Kaiser nicely shows that they were used in physics courses for almost two decades as a way to entice students back into physics classrooms, but that they also provided a means for pushing the boundaries of what counted as a legitimate question for physicists to ask.

That sense of saving physics is one that I can mostly endorse. Only 'mostly', though, because there were many other ways of saving physics in the 1970s that Kaiser neglects or even seems to slight. Kaiser's argument is that the Cold War steered physics toward a narrowly instrumental and unreflective view of the world, and that the Fundamental Fysiks crowd revived the discipline by expanding its focus to include deep philosophical discussion of the implications of quantum theory. But another way of looking at it – represented, for instance, by Bill Leslie's (1993) *The Cold War and American Science* – is that postwar American physicists had focused too narrowly on those questions that seemed likely to have relevance for national security. Thus, an alternative way of reviving the discipline was to expand its scope to include questions likely to have relevance for peace and quality of life.

That path was, indeed, followed by many physicists in the years around 1970. At the same time that the Fundamental Fysiks group was relaxing in the co-ed naked hot tub scene at Esalen, holding séances to communicate with Houdini, and debating the finer points of ESP, psychokinesis, and teleportation, many American physicists were taking up a different set of methods and topics that had been neglected in the early Cold War:

more sophisticated detection of air pollution; more efficient solar power generation; better medical diagnostic and therapeutic techniques; cheaper mass transit and public housing; imaginative aids for the deaf and blind, and so on.

In many ways, the mix of folks who tried to save physics by turning toward civilian projects wasn't so different from the Fundamental Fysiks network: there were theorists and experimentalists, Young Turks and venerable elders, hippies and squares, pragmatists and idealists. The narrative arc of their fortunes also lines up with that of Kaiser's actors: a period of freewheeling experimentation in the early 1970s; a gradual attrition of the more radical figures in tandem with a mainstreaming of their preferred research topics in the 1980s; and a significant broadening of the boundaries of physics after the end of the Cold War, but at the cost of collective disciplinary amnesia regarding the reform and radicalism of the early 1970s.

My point isn't that this more civilian-application-oriented way of 'saving physics' was more significant than the contributions of Fundamental Fysiks. Rather, I'm simply suggesting that the revival of physics took place along a very broad front, of which the restoration of deep discussion of the paradoxes of quantum theory was a rather small part. Some of characters in Kaiser's book might agree with me on this point: in the closing pages, he notes in passing that some of them eventually worked on environmental and medical topics, but makes little mention of whether they were interested in such issues in the Fundamental Fysiks group's heyday. The only figure whom Kaiser shows to have been simultaneously influential in both the environmental movement and the quantum revival is the charismatic murderer Ira Einhorn, the emcee of the first Earth Day. In every other case, characters are glimpsed almost completely in terms of their interest in Eastern religions, parapsychology, psychedelics, self-empowerment, and quantum paradoxes. Ironically, the one weakness of an otherwise wonderful book about the expansion of awareness and the broadening of disciplinary scope is that it filters out many of its actors' wider interests, and excludes many of the ways that physics was 'saved'.

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Biographical note

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