How the Hippies Saved Physics

By David Kaiser. Norton, 2011, 372 pages.

About 20 years ago when David Kaiser was a college undergraduate he encountered Dr. Ludwig Plutonium. Each day this "curious individual" rode into town on a bicycle, worked as a dishwasher at the local inn, and lectured from the school quadrangle. This man, who had legally changed his name to Ludwig Plutonium, believed that the universe was a gigantic plutonium atom and that the earth was just an electron orbiting around the nucleus. Dr. P. took out advertisements in the school newspaper and filled them with mathematical proofs of his work. Did this "doctor" know any physics? Yes. Did he advance mankind's knowledge of physics? No. Was he a crackpot? Yes. But, as Kaiser, an M.I.T. professor, so handsomely demonstrates in this book, one must be careful about using the *c* word.

He reminds us that in the early years of the 20th century a small group of underemployed physicists gathered in Berne, Switzerland. These friends, who immodestly called themselves The Olympia Academy, argued ideas at the intersection of physics and philosophy, and were unafraid to ask themselves open-ended and seemingly naive questions, e.g., what is time, and what is meant by simultaneous events? Crackpots? The President of the Olympians was Albert Einstein who, a few years after this period of ferment, published his revolutionary ideas on relativity and quantum mechanics.

The historical background to Kaiser's story is a boom period for government funding in physics that grew out of the scientific successes of World War II. In postwar America, job offers were plentiful if you had a Ph.D. in physics; classroom enrollments ballooned, professors were in demand, and the Soviet launching of Sputnik added to the abundance.

Trouble struck about 1968 when the Pentagon diverted money from basic research to waging war. Meanwhile, campuses became hostile to defense department funding, adding to the hard times. Kaiser explains that in 1971 the Placement Dept. of the American Institute of Physics registered 1053 applicants competing for 53 jobs.

Why "hippies" in the title? The book is about how circa mid 1970s a bunch of young physicists, all of them male with one important exception, and without job prospects, banded together to ask themselves some questions about the fundamental concepts in quantum mechanics. Here we're reminded of The Olympians. The major player here was The Fundamental Fysik's Group [FFG] at U.C. Berkeley, founded in the spring of 1975. If you were a graduate student in California then, or a recent Ph.D., you might well have been part of the hippie culture. The Group was not immune to the blandishments of LSD, marijuana, casual sex, Zen, and the rest of the counterculture package. With time, some became deeply immersed.

Kaiser introduces us to around 20 characters who were either FFG members or fellow travelers in the contemporary West Coast Consciousness Theory Group or the Physics/Consciousness Research Group. Unless you have a keen memory, you'll want to make a list of them as you read, although you'll probably have no trouble recalling the one woman: the FFG cofounder, Elizabeth Rauscher. Another name that will stick in your mind is Jack Sarfatti — one of the most colorful, difficult, and arrogant of the bunch. Strange to say, I knew him at Junior High 240 in Brooklyn circa 1951-1953, where he went by the name of Jack Sarfatt; by the time he turned up in my class at Cornell in 1956 he was Jacque Sarfatti. A man with three names displays

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a penchant for reinventing himself, and in Kaiser's story he does not disappoint us.

Why should people have started the basics of quantum mechanics in 1975? Max Planck was thinking these thoughts in 1900, and in later decades so were the greats of physics like Einstein, Bohr, Heisenberg, and Schrödinger. They could sweat over apparent paradoxes like the wave-particle duality, e.g., when is electromagnetic radiation to be regarded as a wave and when is it a stream of photons?

The clue about the return to deep questions is in Kaiser's chapter "Shut up and Calculate." In the big money period, 1945-1968, physics classes were full and crowded, and overworked professors assigned easily graded computational homework and exam problems requiring the manipulation of numbers; no thought was expected on the underlying deeper philosophical implications of what was being calculated. And of course the jobs available to these students, many in the defense industry, were to require number crunching, which meant slide rules and computers.

In the early 1970s, with dismal job prospects, people like Rauscher and the FFG's other founder George Weismann had the leisure and curiosity to shake off the number crunching mindset and to start pondering the implications of what are the seminal papers for this book: two articles published in the middle 1960s by the Irish physicist John Bell, a scientist working "on the fringes" who was then living in the United States. These articles firmly establish the principle of what is called "quantum nonlocality." A way to think of nonlocality is this: one can create a physics experiment resulting in the generation of two quantum particles moving off in opposite directions. If you make a measurement on one of these particles, say its position or momentum, the act of measurement affects the physical parameters of the particle — a well established principle of quantum mechanics. But, according to Bell, the particles are "entangled" and measurements you make on one particle are "nonlocal." They immediately affect the other particle. This is very strange for two reasons – the immediate transfer of information from one particle to its twin would seem to violate a precept of Einstein's special relativity: you can't send a signal to someone faster than light moves. The other queer thing is the mechanism whereby one particle communicates with the other – no matter how long they have been separated, or how far. This is in marked contrast to phenomena physicists and engineers feel they understand quite well, e.g., how the motions of electrons on a radio transmitting antenna affect the motions on the receiver of your home radio.

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Einstein, in a famous paper published with his colleagues Podolsky and Rosen in 1935 saw similar bizarre results as arising from a limitation of quantum mechanics—quantum mechanics must therefore be incomplete. Bell not only showed that nonlocality was inherent in quantum mechanics but that there are experiments you can perform to test for it. But because Bell's work was regarded as so far from what was then considered respectable main line physics, it was 4 years before anyone published the first experimental verification. This was the work of a young physicist, John Clauser, which appeared in 1972. An experiment disproving entanglement would have thrown into upheaval the very foundations of quantum mechanics. A few years later he was to find a congenial environment in the FFG while a post-doctoral student at Berkeley.

Bell's paper is one of the most cited in modern physics, and one wishes that Kaiser would explain why he didn't win the Nobel Prize. If you can send information faster than the speed of light, (superluminal communication) then why not apply for a patent on a device that will do it? This occurred to Jack Sarfatti, who filed for one in May of 1978. Do a Google Patent search for him and his device and you'll come up with nothing. I wish Kaiser had told us whether the patent office rejected it – putting it into the same wastebasket that holds patent applications for perpetual motion machines — or whether Sarfatti withdrew the application. The latter seems likely. Two papers in the late 1970s, one from Philippe Eberhard and the other from GianCarlo Ghiradi showed that Bell's nonlocality does not undermine Einstein's relativity.

Philippe Eberhard had been a physicist working at Berkeley who had joined the FFG while GianCarlo Ghirardi had been at the International Center for Theoretical Physics in Trieste. Like a number of physicists drawn into the implications of Bell's work, he had kept his investigations on the side — such work was considered outside of mainstream respectable physics and might jeopardize a career.

The mysterious question of how information moves from one quantum particle to the brother with which it's entangled emerged at a time of popularity for a public performer named Uri Geller, who apparently performed uncanny acts of mental telepathy, extra sensory perception, and psychokinesis.[1] The FFG and their friends at the nearby Stanford Research Institute [SRI] saw this quantum communication as a way of

[1]Psychokinesis refers to the ability to move objects without touching them but by mental exertion alone.

perhaps explaining what Geller was demonstrating. Sarfatti in particular became a Geller apologist/publicist. Strangely, the CIA and Defense Department were sucked into these ideas, seeing the possibility of a cold war weapon which they were convinced the Soviet Union already possessed, and pumped millions of dollars into funding research, much of it going to SRI.

If you can remember the hippie era you'll recall two gurus: Werner Erhard, founder of the so-called EST movement, promising a Zen-based method of self knowledge and improvement, and Michael Murphy, creator of Esalen, an organization and retreat, still in existence in Big Sur, California, that is nearly synonymous with what came to be called the human potential movement, rooted in eastern mysticism, meditation, nude, coed hot bath immersions and a good deal of drug experimenting. Both Erhard and Murphy were science buffs and were drawn into a world that seemed to blend physics, the occult, and eastern mysticism. Erhard was soon providing financial support to FFG people, while Murphy's Esalen hosted conferences devoted to their concerns. Famous physicists, (like CalTech's Richard Feynman) some of them quite skeptical, but liking the natural setting, the luxury, and the chance to interact with other lively minds sometimes chaired these meetings.

Why might someone even joke that hippies saved physics? What did they accomplish? Think for a moment of perpetual motion machines, the bane of the patent office until it started a tough policy on such applications. Throughout the latter half of the 19th century, physicists took proposals for these devices seriously, and their efforts to discredit the gadgets led to important results in conservation of energy and thermodynamics. Similarly, the trouble-making hippies stimulated groundbreaking work by theoreticians, both inside and more often outside of the FFG. Among their findings was a proof of what has become known as the "no signaling theorem" which has found its place in standard quantum mechanics textbooks. It asserts that quantum entanglement cannot be used to send signals faster than light. The theorem arose in response to a proposal for superluminal communication by FFG member Nick Herbert.

The FFG crowd can also take credit for stimulating others to derive a law of direct practical importance in technology: the no cloning theorem, again written to undercut the quest for superluminal communication. It asserts that you cannot make perfect copies of a photon's unknown quantum state. The result has been exploited in quantum encryption, which allows the sending of information, like election results, with perfect security. The arrangement allows for immediate detection of any effort to eavesdrop on the information, and has resulted in a billion dollar industry.

One of Kaiser's best chapters tells what happened to his hippies after the FFG disbanded in 1979. None turned into tenured college professors. Some became best selling authors, seeking to explain the new physics to the general public and connecting its mysteries to Hindu and Buddhist practices. Sarfatti's history is particularly interesting as an instance of reinvention. Falling out with Geller and with the heads of both Esalen and EST, he jumped to the political right. Kaiser tells us of his cozying up to members of the Reagan administration in an effort to obtain Defense Department funding for his proposal to use quantum entanglement as a "star wars" antimissile weapon. He recently described himself as a "countercultural radical conservative who hobnobs with Reaganites and billionaires."

Some humorless newspaper reviewers have chided Kaiser over his book's title, since he never proves that the "hippies saved physics," but he is too good a scientist and historian to make this claim seriously, a fact he states early where he compares his title to the slightly facetious notion that the Irish saved civilization [1]. His "saving physics" is a nostalgic reminder of the jokiness and "put on" of the hippie era. These reviewers miss Kaiser's important historical points: that the reputed hostility of the counterculture to technology and science, as promoted by some 1960s era social historians, is wrong, and that this same culture benefited not only physics but the advancement of technology.[2]

References

[1] T. Cahill, *How the Irish Saved Civilization*. New York, NY: Anchor 1995.

[2] T. Roszak, *The Making of a Counterculture*. New York, NY: Doubleday, 1969.

[3] E.S. Brand, *The Whole Earth Catalog*. Menlo Park, CA: Portola Inst., 1968.

[2]For a presentation of this hostility see [2]. For a view of how the counterculture did embrace technology, see *The Whole Earth Catalog* [3], first published in 1968. The Wikipedia entry for this catalog is also useful.