From: D. Kaiser, How the Hippies Saved Physics
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Chapter 4

From Ψ to Psi

> In my opinion, the quantum principle involves *mind* in an essential way [. . . such that] *the structure of matter may not be independent of consciousness!* . . . Some component of the quantum probability involves the turbulent creative sublayer of ideas in the mind of the "participator."
>
> **—Jack Sarfatti, 1974**

Members of the Fundamental Fysiks Group were certainly fascinated, even mesmerized, by Bell's theorem and nonlocality. Yet when it came to what Einstein had called "spooky actions at a distance," most members concluded that Einstein hadn't known the half of it. For the Fundamental Fysiks Group had been founded not, in the first instance, to explore the meaning of Bell's theorem, but to plumb the foundations of quantum mechanics in search of explanations for parapsychological, or "psi," phenomena: extrasensory perception, psychokinesis, the works. For most members of the group, Bell-style nonlocality seemed tailor-made to explain curious, occultlike actions at a distance. Their interests in Bell's theorem and in psi phenomena blossomed side by side.

The young physicists of the Fundamental Fysiks Group launched their quest at a propitious moment. The Central Intelligence Agency, the Pentagon, and several defense laboratories across the United States were each hard at work on psi, spurred by fears of Soviet-bloc advances in mind reading and mind control. Leading representatives of the military-industrial complex had been on the parapsychology trail even before long-haired hippies embraced the New Age occult scene.[1] Like psychedelic drugs in the 1960s, which had likewise spread from quintessential Cold War settings to the wide and inchoate youth movement, the Bay

Area witnessed a strange conjunction in the early 1970s: cloak-and-dagger spycraft entwined with the latest enthusiasms of the flower children. In the middle of it all sat the Fundamental Fysiks Group.

Early on, members of the Fundamental Fysiks Group drew up a roadmap for their discussions. "Quantum reality" led inexorably to all manner of New Age speculations.[2] (Fig. 4.1.) At first glance such a mishmash of interests must surely look bizarre: PhD physicists from elite programs dabbling in the occult? Yet on a longer view the combination appears neither shocking nor unprecedented. Both mesmerism in the 1770s and spiritualism in the 1870s had become international sensations. In both cases, leading scholars from Madras and St. Petersburg to Paris, London, Boston, and New York had formed committees and staged public demonstrations. Learned periodicals and the popular press published tens of thousands of articles debating the reality of the purported effects and evaluating possible explanations drawn from the scientific canons of the day. Indeed, spiritualism—the claim that certain special individuals, particularly sensitive "mediums," could establish contact with the dead and, by translating the spirits' mysterious knockings on tables or rappings on walls into specific alphabetic codes, deliver messages from beyond the grave—proved to be just the opening gambit of a broad fin-de-siècle revival of all things occult. Telepathy, psychokinesis, and alchemy all moved to center stage. In Britain, major scientific authorities, including Lord Rayleigh, J. J. Thomson, William Ramsay, and William Crookes—several of whom went on to become Nobel laureates and presidents of the Royal Society—devoted decades of effort to investigating the latest claims. They urged skepticism, not outright dismissal: Rayleigh, Thomson, and many more sat through hundreds of séances, each time wondering whether *this time* they might hit upon unimpeachable evidence of genuine effects. Others, such as Crookes and decorated physicist Oliver Lodge, issued bold and repeated pronouncements about the reality of such "psychical" phenomena.[3]

The occult revival lasted well into the early decades of the twentieth

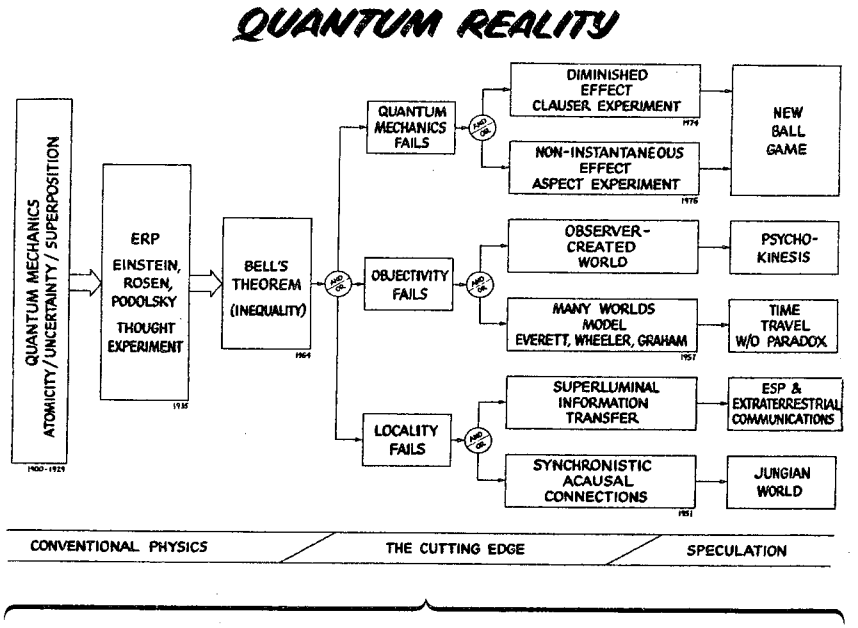

FIGURE 4.1. Saul-Paul Sirag's roadmap for the group's discussions, 1976. (Courtesy Saul-Paul Sirag.)

century. New societies were formed, laboratories established, and journals launched. In fact, several founders of quantum mechanics wondered whether the strange behavior of the atomic realm might lead to still stranger phenomena. Erwin Schrödinger, for one, devoted extensive effort to understanding Eastern mysticism. In unpublished notes written just before his breakthrough with quantum mechanics, Schrödinger delved into Sanskrit etymology to clarify various Hindu beliefs. Several years later he lectured a Berlin journalist about "the Brahman doctrine that the all equals the unity of consciousness," admonishing that "it would be a vast error to believe that science knows any better or clearer answer [than the Brahman teachings] concerning these things."[4] Pascual Jordan, who helped develop quantum mechanics with Werner Heisenberg and Max Born during the 1920s, wrote a whole book about

quantum physics, the Freudian unconscious, and parapsychology. The first edition appeared just as the ink was drying on the new quantum formalism; a second edition appeared two decades later. He published an English-language précis in 1955 in the *Newsletter of the Parapsychology Foundation*, describing how quantum theory could account for telepathy or clairvoyant visions of the future.[5]

Beginning in the early 1930s, Heisenberg's longtime friend and fellow quantum physicist Wolfgang Pauli worked closely with the psychoanalyst Carl Jung on a similar quest. For decades they sought to plumb hidden connections between quantum physics and what Jung famously called the "collective unconscious." Not only did Pauli join Jung in scholarly studies of the history of alchemy and mysticism but the fabled physicist and Nobel laureate also kept a diary of his dreams—eventually bulging with 400 entries—over which Pauli and Jung together pored in search of clues for how "even the most modern physics lends itself to the symbolic representation of psychic processes," as Pauli put it. Perhaps his log of symbol-laden dreams could point the way toward "deeper spiritual layers that cannot be adequately defined by the conventional concept of time."[6] Pauli wrote essays extolling the need to synthesize "rational understanding" with "the mystic experience of one-ness," achieving the same kind of complementarity that his generation had first formulated for particle and wave.[7]

Over time, however, the occult movement quietly faded from the mainstream, lumbering under the weight of so many decades of disappointments, spiked by occasional evidence of outright fraud. Whereas the Society for Psychical Research, founded in London in 1882, had quickly attracted renowned scientists and statesmen—several members of Parliament served as vice presidents of the Society alongside elite scientists, and even four-time British prime minister William Gladstone joined its ranks—by the 1950s the Society and its kin limped along on the sidelines. When the *Newsletter of the Parapsychology Foundation* announced in September 1955, for example, that "World-wide research moves ahead," few outside its dwindling membership seemed to notice or care. Just a few weeks earlier the journal *Science* had carried a devastating critique

of "science and the supernatural," and commentators from the *New York Times* and *Time* magazine had gladly declared the field dead.[8]

When members of the Fundamental Fysiks Group rediscovered the occult twenty years later, and began to investigate psi phenomena from the vantage of cutting-edge physics, they were resurrecting a once-proud tradition. Like their routes to Bell's theorem, they bumped along crooked paths to psi. Or, as several of them would have it, perhaps it was all meant to be—just one more example of Jungian "synchronicity."[9]

Consider, for example, Jack Sarfatti's entrance into the psi world. In the summer of 1973, soon after receiving his invitation to the International Centre for Theoretical Physics in Italy, Sarfatti happened to read a story in the *San Francisco Examiner* about research under way at the Stanford Research Institute, or SRI.[10] SRI, much like defense-oriented laboratories at MIT and elsewhere, had been a flashpoint of student and faculty protest just a few years earlier. Much of the heat and light of the April 1969 marches and sit-ins at Stanford University focused on the vast array of classified military projects at SRI—everything from chemical weapons to Vietnam-era counterinsurgency techniques. Early in 1970, Stanford's trustees, eager to quell the protests, spun off SRI as a private research enterprise and divested the university's ties to it. SRI's researchers took their defense contracts with them, only to see contract revenues plummet as the Cold War bubble burst.[11]

The lean years brought new opportunities for some, including laser physicist and former Stanford lecturer Harold Puthoff. Puthoff had previously worked as a naval intelligence officer and a civilian researcher at the National Security Agency. He completed his PhD at Stanford in 1967 on a new type of tunable laser, and stayed on for several years to teach in Stanford's electrical engineering department, where he coauthored a textbook on quantum electronics. He joined SRI in 1969 and left the university the following year, when SRI was spun off; in short order his laser-research government contracts began to deflate. With time on his hands, he asked his SRI supervisor for permission to begin conducting a different set of experiments: tests of parapsychological effects. Puthoff was a devotee of Scientology at the time, a controversial set of beliefs

that centers on mystical connections between mind and body. He had also dabbled in early rumblings of the California New Age scene during the 1960s, including workshops on gestalt therapy and consciousness expansion. Puthoff secured a grant from a private philanthropist who had made his money in the fried chicken business; with a check for $10,000 (more than $50,000 in 2010 dollars), he was up and running. He courted another laser physicist from Sylvania's research laboratory, Russell Targ, who had done some graduate-level work at Columbia but left before completing his PhD. Targ, too, had begun to sample some of the New Age offerings around the Bay Area. Together, Puthoff and Targ jumped into the psi business.[12]

Their big break came in September 1972, when the Israeli performer Uri Geller visited SRI to conduct laboratory tests of his psychic abilities. Geller claimed not only clairvoyance—the ability to read minds or receive signals from the future—but psychokinetic powers as well. His most famous feat: bending metal objects, such as spoons and keys, by focusing psychic energy in his fingers. Puthoff and Targ's psi lab at SRI, already up and running by the time promoters had brought Geller to the United States, seemed the perfect place to put Geller's powers to the test. Weeks of close observation ensued; hours of film were shot. Puthoff and Targ concluded that Geller had indeed demonstrated parapsychological abilities, such as reproducing drawings that had been sealed in an envelope, or guessing correctly—eight times in a row—the number on a die contained within a steel box.[13]

Even before the physicists at the Stanford Research Institute began to publish their results, their research started to make headlines around the Bay Area and beyond.[14] Thus it was that Sarfatti happened upon the newspaper article about their work in the summer of 1973, just a few weeks before he was to leave for Italy. Intrigued, he called SRI, was connected to the Electronics and Bioengineering Laboratory (as Puthoff and Targ's psi lab was called), and invited to come and see for himself. He spent a marathon day at the lab, seventeen hours in all, during which he met Puthoff and Targ as well as paranormal enthusiasts Brendan O'Regan and Edgar Mitchell, the latter a former astronaut who conducted

telepathy experiments with friends on Earth while he orbited the moon during the Apollo 14 mission of February 1971. (Upon his return to Earth, Mitchell founded the Institute for Noetic Sciences in Palo Alto, California, to support parapsychological investigations; his institute had helped to bankroll Geller's visit to SRI in 1972.)[15]

Not long after Sarfatti's day-long visit at SRI, one of Uri Geller's close associates, the medical doctor and parapsychologist Andrija Puharich, published an admiring biography of Geller, entitled simply *Uri*. Puharich gave a copy to Sarfatti, who in turn loaned it to his mother. The book, combined with Sarfatti's recent introduction to Geller's feats at SRI, triggered a momentous shift in the young physicist. Puharich asserted in the book that Geller had received repeated telephone calls from a robotic-sounding voice that called itself "Spectra." The voice claimed to be an extraterrestrial computer orbiting the earth, contacting a small group of select individuals to help prepare for future contact. Upon encountering that passage, Sarfatti's mother told Jack that he, too, had received such telephone calls twenty years earlier, at the age of thirteen. The young Sarfatti had ignored, forgotten, or repressed all memory of the strange calls until his meeting with Puthoff and Targ, and his mother's reading of Puharich's book, brought it all screaming back to consciousness. From that point on, there was no going back: Sarfatti threw himself into the strange world of psi.[16]

During Sarfatti's first visit to the Stanford Research Institute psi lab, Brendan O'Regan had asked Sarfatti if he could introduce Geller to some of the European physicists whom Sarfatti was about to visit, so that the scientific tests could continue. Once Sarfatti joined his friend and San Diego State physics colleague Fred Alan Wolf in London a few months later, the two did just that. Their case was helped by Geller's own promoters, who had managed to book Geller on a live British Broadcasting Company television show in November 1973. A London-based mathematical physicist participated in the broadcast and declared Geller's feats to be genuine psychokinetic effects, in need of explanation from the world's physicists. By February 1974, with Wolf's and Sarfatti's help, renowned physicist and hidden-variables expert David Bohm and a colleague at

London's Birkbeck College had made contact with Geller and begun their own series of investigations, which would stretch over the course of the next year. (Bohm's colleague, an experimental physicist, had arranged Wolf's invitation to Birkbeck.) Sarfatti was in London during one of their sessions with Geller that June, and he dashed off a detailed press release. Not only had Geller again managed to bend metal objects (including, this time, one of Bohm's own keys), but he also produced a burst of radioactivity, from no known source, that sent a Geiger counter held in his hand clicking up to 150 times per second. The next day, Geller repeated the Geiger counter burst and bent the house key of skeptical observer and famous science-fiction author Arthur C. Clarke, while Clarke, Sarfatti, Bohm, and others looked on.[17] (Fig. 4.2.)

The results seemed clear. "My personal professional judgment as a PhD physicist," Sarfatti closed his press release, "is that Geller demonstrated genuine psycho-energetic ability at Birkbeck, which is beyond the doubt of any reasonable man, under relatively well controlled and repeatable experimental conditions." Bohm and his Birkbeck colleague agreed, publishing an account of their investigations in the top-flight scientific journal *Nature*. They urged caution against runaway theoretical

FIGURE 4.2. Physicists tested the psychic abilities of Israeli performer Uri Geller, first at the Stanford Research Institute in California (*left*) and later at Birkbeck College in London (*right*, with physicist David Bohm). (Photographs by Shipi Shtrang, courtesy Shipi Shtrang and Uri Geller.)

speculations, arguing that (as in the early stages of any scientific field) it was most important to establish a baseline of reliable empirical observations first. Sarfatti had a different idea. To him, the Geller tests forced physicists to return to the foundations of quantum mechanics. "The ambiguity in the interpretation of quantum mechanics," Sarfatti argued, "leaves ample room for the possibility of psychokinetic and telepathic effects." Most important, he elaborated, was the "intrinsically nonlocal" character of quantum theory. Drawing on a preprint of Bohm's own latest grapplings with Bell's theorem and nonlocality, as well as intriguing ideas from such giants of the discipline as Eugene Wigner and John Wheeler, Sarfatti argued that consciousness need not be separate from brute matter. Sarfatti maintained that quantum mechanics, properly understood, could provide a mechanism to account for psi effects like those exhibited by Uri Geller.[18]

A decade earlier, in an admittedly speculative move, Princeton's Nobel laureate Eugene Wigner had proposed that consciousness plays a central role in quantum mechanics. Left on its own, the quantum formalism seemed to imply an infinite regress of probabilities: an electron had a certain probability to be spin up or spin down; a detector had a certain probability to measure the particle's spin as being up or down; the detector's needle had a certain probability to point toward "up" or "down" on its display screen; and so on. This had become known as the "measurement problem" of quantum mechanics. What if, Wigner wondered, the consciousness of a human observer were the only thing that could break the regress and register a definite response: spin measured as up or down?[19]

Wigner introduced a simple thought experiment, often referred to as "Wigner's friend," to motivate his conclusion. Imagine that instead of conducting the spin measurement on the electron yourself, you ask a friend to do so. Until you interact with your friend by asking her what the measured outcome was, the best you can do is represent the total system—electron plus measuring device plus friend—by one quantum wavefunction. As far as you are concerned, when you ask your friend for

the outcome, she will have a certain probability of responding "spin up" and a certain probability of responding "spin down." After the dust has settled, Wigner pressed on, you might go back and ask your friend, "What did you feel about the spin-measurement outcome before I asked you?" No doubt your friend would respond, "As I already told you, it was spin up (or spin down)." That is, as far as your friend is concerned, the outcome had already been settled before you bothered asking the question. Or, in quantum-mechanical parlance, the wavefunction for the system had already settled into one of its two possible states: electron spin up and friend in the state "I have measured the electron to be spin up"; or electron spin down and friend in the state "I have measured the electron to be spin down." That was *her* version of the wavefunction prior to your asking your question; yet your own version of the wavefunction was still stuck in a superposition of both possibilities. To Wigner, there could only be one proper wavefunction for the system—meaning that your friend's consciousness had already changed (or "collapsed") the wavefunction from a sum of possibilities to one definite outcome, even before you asked her about it. If you didn't believe that—if you clung to your own version of the wavefunction after her measurement was complete but before you asked her the outcome—then, feared Wigner, you would be forced to the "absurd" conclusion that your friend was "in a state of suspended animation" before she answered your question: caught, like Schrödinger's famous cat, between two irreconcilable states. Such suspensions were bad enough when attributed to cats; they simply would not do when applied to tenured professors at Ivy League institutions. "It follows," Wigner concluded, "that the being with a consciousness must have a different role in quantum mechanics than the inanimate measuring device." Or, more strongly: "Consciousness enters the [quantum] theory unavoidably and unalterably."[20]

Such talk stood out starkly from the pragmatic concerns with which most of Wigner's colleagues occupied themselves at the time. He came by it honestly. The Hungarian-born physicist had been trained on the Continent between the world wars; as a student, he had heard Einstein, Heisenberg, and others lecture on the still-new quantum mechanics.

Years later, his philosophical interests were rekindled when he took on Abner Shimony as a graduate student at Princeton. (Shimony, recall, later worked with John Clauser to rederive Bell's theorem in a form suitable for laboratory test.) Shimony came to Wigner directly from his own PhD in philosophy at Yale. From that time forward, Wigner devoted more and more of his attention to the foundations of quantum mechanics, corresponding frequently with pockets of physicists in Europe who chased these questions throughout the 1960s.[21]

Wigner soon acquired an interlocutor closer to home. His friend and Princeton colleague John Wheeler picked up on the theme of consciousness and quantum mechanics during the early 1970s. Wheeler, too, stood out from the pack. An American, he had come of age in the 1920s and 1930s, a time when Americans who wanted to become theoretical physicists still had to travel to Europe to "learn the music, and not just the libretto" of work in that field, as one of Wheeler's contemporaries famously put it.[22] Wheeler studied with Niels Bohr in Copenhagen in the 1930s and often hosted his mentor during Bohr's many extended visits to Princeton after the war. These contacts helped to stoke Wheeler's continuing philosophical engagement with quantum theory. Spurred further by Wigner's efforts, Wheeler emerged, by the mid-1970s, as one of the few leading physicists working in the United States who took the interpretation of quantum mechanics seriously.[23]

Wheeler argued for a view that he came to call the "participatory universe": observers participate in creating the reality they measure. As Wheeler argued, a physicist's decision to measure a particle's position rather than its momentum changes the objective properties of the real world. Wheeler emphasized the point at a conference at Oxford early in 1974. Quantum theory, he stipulated,

> demolishes the view we once had that the universe sits safely "out there," that we can observe what goes on in it from behind a foot-thick slab of plate glass without ourselves being involved in what goes on. We have learned that to observe even so minuscule an object as an electron we have to shatter that slab of glass. We

> have to reach out and insert a measuring device. We can put in a device to measure position or we can insert a device to measure momentum. But the installation of the one prevents the insertion of the other. We ourselves have to decide which it is that we will do. Whichever it is, it has an unpredictable effect on the future of that electron. To that degree the future of the universe is changed. We changed it. We have to cross out that old word "observer" and replace it by the new word "participator." In some strange sense the quantum principle tells us that we are dealing with a participatory universe.[24]

To drive the point home to his physicist colleagues, Wheeler included a cartoon contrasting the old notion of an "observer" with his new idea of a "participator"—a cartoon he inserted into other conference talks over the next few months.[25] (Fig. 4.3.)

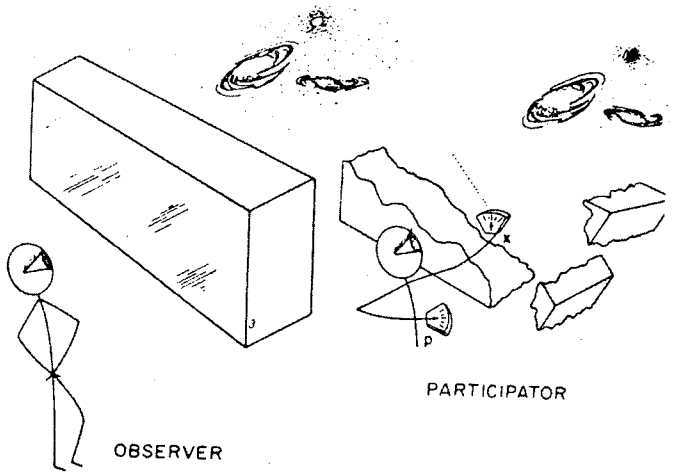

FIGURE 4.3. Princeton physicist John Wheeler's cartoon version of the difference between the "old concept of the 'observer,'" and the "new concept of 'participator'" as required by quantum mechanics. (Patton and Wheeler [1975], 563. Reproduced with permission of Oxford University Press.)

Wheeler had grand ambitions for these "participators." Not only did they fix the reality of the here and now; they could even do so retroactively. Wheeler returned to that old standby of quantum theory, the double-slit experiment, and gave it a new twist. Suppose, he argued, that the photographic plate behind the slits were mounted on a pivot. In one position, the plate would sit smack in the path of any particles that traversed the slits, thereby registering the familiar interference pattern. In another position, the plate could be swung clear of the particles' paths, so that they bypassed the plate altogether. In this second setting, the particles would continue on their way and encounter one of two sensitive detectors: one placed to detect only those particles that had traveled through the top slit, and the other placed to detect only those that had traveled through the bottom slit. Next the participator could tune down the intensity of the particle source so that only a single quantum was released at a time. The participator now had a choice. Insert the photographic plate into the particle's path and observe the famous quantum interference pattern—which could only arise if each particle effectively went through both slits at once. Or remove the photographic plate and let the detectors determine whether a given particle had traveled through the top or the bottom slit. But here's the rub: the participator could decide to insert or remove the photographic plate *after* the particle had already passed through the slits! (Fig. 4.4.) Wheeler dubbed such scenarios "delayed-choice" experiments: a "last-instant free choice on our part," he explained, "gives at will a double-slit-interference record or a one-slit-beam count." The lesson? "The past has no existence except as it is recorded in the present. . . . The universe does not 'exist, out there,' independent of all acts of observation. Instead, it is in some strange sense a participatory universe." Not everyone was pleased with Wheeler's conclusion. Some anonymous reader highlighted this passage in the MIT library's copy of the conference proceedings, adding in the margin simply, "ugh."[26]

Wheeler still wasn't done. One could replace the benchtop apparatus of particle source, double-slit, and swiveling photographic plate with a cosmic substitute. Consider, he pressed on, streams of light imping-

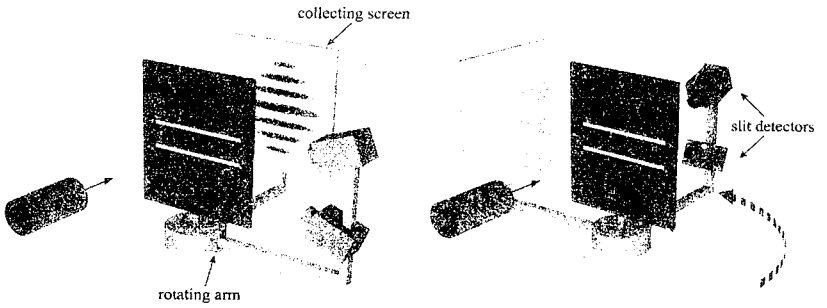

FIGURE 4.4. Physicist John Wheeler's "delayed-choice" thought experiment. After a particle has passed through the wall with double slits, an experimentalist may choose whether to leave the collecting screen behind the double slit, on which the particles will fill out the familiar interference pattern; or to swivel the slit detectors into place, which will determine through which slit each individual particle traveled. (Illustrations by Alex Wellerstein.)

ing on an earthbound participator from a faraway quasar, an intense astronomical light source billions of light-years away. In between the quasar and the Earth lies a galaxy, massive enough to bend the light's path and thus act as a "gravitational lens." (At the time Wheeler was writing, astronomers had recently identified just such a quasar-galaxy pair.) Some quanta of light, or photons, would travel directly from the quasar to Earth; others would travel a more circuitous route, starting off in a direction away from the Earth but getting bent back toward the Earth by the intervening galaxy. Now repeat the delayed-choice setup: by suitable arrangement of photographic plates and sensitive detectors, the participator could decide to measure by which route an individual photon traversed the cosmos (direct or via the path-bending galaxy); or she could decide to measure the quantum interference that comes from traversing both paths. "But the photon has already *passed* that galaxy billions of years before we made our decision." It was as if "we decide what the photon *shall have done* after it has *already* done it"—in this case, not microseconds before we make our choice, but billions of years before. Indeed, Wheeler emphasized, our decisions today can

determine the past of a particle that was emitted long before there was even life on Earth.[27]

To Wheeler, the central feature of quantum theory—its participatory nature—thus explained not only the outcome of this or that experiment, but the emergence of the universe itself. He cited the pre-Socratic philosopher Parmenides and the Enlightenment philosopher George Berkeley, names that did not often appear, as they did in Wheeler's essay, nestled between citations to Einstein, Bohr, Richard Feynman, and Stephen Hawking. Building on all those authorities, Wheeler advanced his view: the participator "gives the world the power to come into being, through the very act of giving meaning to that world; in brief, 'No consciousness; no communicating community to establish meaning? Then no world!'" He continued, "On this view, the universe is to be compared to a circuit self-excited in this sense, that the universe gives birth to consciousness, and consciousness gives meaning to the universe." Or, as he returned to the theme a few years later, "Acts of observer-participancy—via the mechanism of the delayed-choice experiment—in turn give tangible 'reality' to the universe not only now but back to the beginning." In case his colleagues missed the point, Wheeler again turned to a whimsical cartoon. Like his "observer" and "participator" stick figures, Wheeler's self-actualizing universe continued to grace several of his talks and essays over the next few years.[28] (Fig. 4.5.)

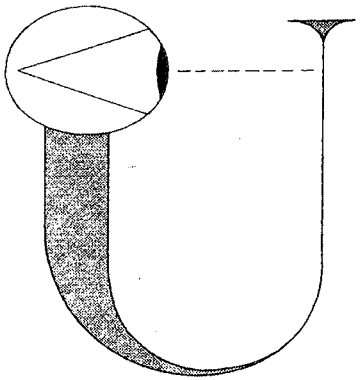

FIGURE 4.5. John Wheeler's vision of the entire universe as a "self-excited system brought into being by 'self-reference.'" (Patton and Wheeler [1975], 565. Reproduced with permission of Oxford University Press.)

Wheeler pushed this line vigorously throughout the 1980s, encouraging a number of physicists to conduct actual delayed-choice experiments. Yet his basic ideas on the matter had already jelled by the mid-1970s. They dribbled out in a series of little-noticed conference talks and preprints, attracting virtually no citations in the scientific literature for the remainder of the 1970s. They were little noticed, that is, except by a small number of people like Jack Sarfatti, who struck up an active correspondence with Wheeler and received Wheeler's latest musings by preprint and letter. In fact, Sarfatti and Wolf had tried to arrange unpaid visiting appointments with Wheeler at Princeton for their 1973 sabbaticals. "We understand that no financial support would be forthcoming during these hard times," they explained; desks and library cards would suffice. Only after Wheeler politely declined each of their repeated requests did they take off for Europe instead. Wheeler was relieved to learn of their European invitations. "I hated so much to seem unwelcome," he replied, which cut against his "natural eagerness to be hospitable." He wished them well and pledged to stay in touch, which indeed he did. Wheeler sent Sarfatti a preprint of his 1974 Oxford talk, for example, complete with its "participator" stick figure and self-actualizing universe cartoons, and it made a deep impression on Sarfatti. He began to cite it and build on its ideas even before Wheeler's essay had appeared in print.[29]

Sarfatti aimed to stitch these diverse ideas together. If every quantum object were interconnected with every other via quantum entanglement (as per Bell's theorem), and if consciousness played a central role in quantum mechanics (as Wigner and Wheeler had reasoned), then modern physics might provide a natural explanation for psi phenomena. From Wigner and Wheeler, Sarfatti took the point that everyone's consciousness participates in shaping quantum processes, both by deciding which observations to make and by collapsing the multiplying possibilities into definite outcomes. Sarfatti recast Wigner's main argument in terms of action and reaction. Surely matter can affect consciousness—LSD and other psychedelic drugs had made that lesson clear enough—so why not posit an equal and opposite reaction of consciousness on matter? To Sarfatti, such a move paid double dividends: it opened up a

possible avenue for understanding psychokinesis, and it offered hope that Age of Aquarius students might come back to physics classrooms, finding new relevance in the subject.[30]

Most mental contributions to the behavior of quantum particles, Sarfatti continued, would be "uncoordinated and incoherent"—that is, they would each push in different directions and, on average, wash out. But, as Uri Geller seemed to demonstrate, certain talented individuals might possess "volitional control" such that they could impose some order on the usually random quantum motions. Some "participators" seemed to be more effective than others. Moreover, thanks to Bell's theorem, these individuals could exercise their control at some distance from the particles in question. In short: perhaps Geller could detect signals from far away or affect metal from across a room because the quanta in his head and the quanta far away were deeply, ineluctably entangled via quantum nonlocality. Bizarre? No doubt. But was it really any more outlandish than Wheeler's giddy flights?[31]

Sarfatti's first effort to bring Geller and psi into the rubric of quantum physics appeared as the lead article in the inaugural issue of a brand-new journal entitled *Psychoenergetic Systems*. Brendan O'Regan, whom Sarfatti first met at the Stanford Research Institute psi lab before departing for Europe, helped launch the journal to feature just this kind of reasoned—and, granted, speculative—investigation into effects beyond the usual boundaries of science. O'Regan cited historians and philosophers of science such as Thomas Kuhn and Gerald Holton, who had written about the spur to new scientific breakthroughs from previous accumulations of "anomalies," to bolster his claim that psi studies would usher in a whole new "paradigm" across the sciences. Pleased with Sarfatti's contribution, O'Regan appended a brief comment to the opening article, arguing that the exciting recent developments in quantum mechanics meant that "physics might have to invent psychic research, if it did not already exist." Over the next several years, the journal published many follow-up articles pursuing further relations between quantum mechanics and psi.[32]

Sarfatti's and O'Regan's enthusiasm was hardly dampened when, a few months after his first Birkbeck dispatch, Sarfatti began to distance

himself from the Geller tests. His pro-Geller press release had been published in the weekly magazine *Science News*, and soon the magazine was inundated with letters. Most of the letter writers called for professional magicians to test Geller alongside of, or in place of, physicists. (Magicians had served as the most effective debunkers of spiritualist mediums back in the 1890s; and none other than the great magician Harry Houdini had devoted years of effort during the 1920s to debunking the claims of psychics, mediums, and other purveyors of the paranormal.)[33] Rising to the latest challenge, accomplished magicians such as James "The Amazing" Randi mobilized, proudly demonstrating that many of Geller's famous feats could be replicated by well-known sleight-of-hand tricks. After lunching with Randi and watching him bend spoons and affect the rate at which wristwatches' hands spun—all by the admitted power of conjuring, not psychokinesis—Sarfatti was moved to retract his earlier declaration in favor of Geller's powers. (Randi also explained how he could make Geiger counters burst with activity: by hiding a small source of beta-radioactivity up his proverbial sleeve.) "I do not think that Geller can be of any serious interest to scientists who are currently investigating paraphysical phenomena," Sarfatti explained in a new press release.[34]

In short order, the unease that Sarfatti articulated escalated into widespread controversy over Geller's psychic claims. "Super mystic or super fake?" asked *San Diego Magazine* a few years later, emphasizing in its feature article on Geller that the young Israeli performer seemed to be "eternally on trial." A kind of cold war of Geller publications had erupted: for every debunking effort by magicians like James Randi, there also appeared a new glowing endorsement. One of the latest had come from the Naval Surface Weapons Center in Silver Spring, Maryland, whose experts had proclaimed that "Geller has altered the lattice structure of a metal alloy that can *not* be duplicated. There is no present scientific explanation as to how he did this."[35] "The enormous spate of publications did little to quell the rising controversy," the San Diego journalist noted. "If anything, they simply added to the fire." Critics such as magician James Randi harrumphed that they had revealed Geller's psychic powers to be little more than skillful conjuring. Randi claimed (rather prematurely) that Geller's continued performances, even after magicians like Randi were on his trail, amounted to "digging his own grave." Yet all the while Geller's admirers, fanning out across the entire world, continued to keep faith in the authenticity of his proclaimed powers.[36]

As far as Sarfatti was concerned, his retraction applied to Geller, not to psi. Here again Sarfatti was following a well-trod path. Exactly a century earlier, William Crookes, J. J. Thomson, and the rest had followed the same procedure: whenever questions about a particular medium emerged, they dismissed that medium but not the notion of spiritualism in general. To Sarfatti, a whole universe of psi effects still beckoned, and their relationship with quantum mechanics remained to be explored. (More recently, Sarfatti has in effect retracted his retraction, maintaining that Geller did display at least some genuine psychic abilities.)[37]

Sarfatti worked out his many ideas in conversation with Fred Alan Wolf while they were in Europe. Like Sarfatti, Wolf enjoyed a front-row seat for an explosion of New Age activities. A high school friend and freelance writer got him interested in Uri Geller. When the friend learned that Wolf was heading off for Europe, he urged Wolf to seek out other notables of the New Age scene. Wolf obliged. Immediately upon arriving in Paris in January 1974, for example, Wolf looked up Carlo Suarès—painter, philosopher, and master of the ancient tradition of Kabbalah, or Jewish mystical numerology. Sarfatti joined Wolf for some of these chats with Suarès, and in no time Sarfatti began urging John Wheeler to contact Suarès himself because of the similarity of Wheeler's and Suarès's ideas about the structure of the universe.[38] A few months later, back in London, Wolf attended the "May Lectures," featuring presentations by New Age gurus like Andrija Puharich (of Uri Geller–studies fame) and Werner Erhard (the human-potential magnate). During his presentation at the May Lectures, Erhard announced that he wanted to meet physicists—he had been fascinated with the subject since boyhood, and he believed that physicists' rigorous training could offer insights beyond quantum theory. Wolf introduced himself to Erhard at intermission and was invited to a speakers-only workshop the next day.[39] Overnight, Wolf's circle of interlocutors widened considerably. When the time came to return to

the States at the end of his sabbatical, Wolf reached California by way of Puharich's personal-residence-turned-psychic-laboratory in upstate New York. He spent several weeks there, attempting, on Puharich's request, to relate Puharich's psychic discoveries to Wolf's research in quantum physics. Wolf eventually admitted defeat—"I can't say that I discovered anything that would lend credence to their abilities," he later wrote—but only after undergoing his own out-of-body experience and enjoying stimulating discussion with Puharich and his followers. Along with Sarfatti, Wolf, too, was hooked.[40]

While Sarfatti and Wolf broadened their horizons in Europe, other physicists who would soon form the Fundamental Fysiks Group followed a complementary line of inquiry in Berkeley. Like Sarfatti, Nick Herbert and Saul-Paul Sirag were captivated by Wigner's suggestion about the central role of consciousness in quantum measurement. They turned Wigner's proposal on its head, asking what quantum theory implied about the nature of consciousness. Herbert had noticed a string of recent papers by a fellow physicist, Evan Harris Walker, in which Walker had begun to construct a theoretical model of consciousness. Walker, who had written a dissertation at the University of Maryland in 1964 on plasma physics and the behavior of charged bodies in motion, had made his career at the Ballistic Research Laboratories of the Army's Aberdeen Proving Ground in Maryland. Like Harold Puthoff (founder of the Stanford Research Institute psi lab), however, Walker began to find more time on his hands as defense spending on research waned. He began toying with Bohm's hidden variables during his off hours.[41]

Walker postulated that consciousness might be an infinite set of hidden variables, real but beyond direct physical observation. Like the hidden variables in Bohm's original model, these "c-variables," as Walker dubbed them, would determine the measured outcomes of quantum processes. And then he began to calculate. Quantum processes in the brain, such as electron tunneling across synaptic gaps between nerve endings, seemed to establish three distinct rates of data processing: subconscious

(at a trillion bits per second); conscious (100 million bits per second); and "will" or volition (10,000 bits per second). This last, Walker suggested, could serve as a "data channel" for psi effects. According to quantum mechanics, all kinds of events could transpire, some with high probability and others with vanishingly low probability. Walker hypothesized that an individual might be able to consciously select an otherwise low-probability outcome, and use his or her will to arrange the c-variables so as to produce that outcome. After all, Bohm had introduced hidden variables into quantum theory precisely to replace probabilistic descriptions with definite, causal mechanisms. Walker's hypothetical process would involve no transfer of energy, he clarified, only information. Thus a psychic could in principle violate the second law of thermodynamics—creating a more-organized state out of a less-organized one—but not the conservation of energy. Moreover, thanks to Bell's theorem and long-distance entanglement, the low-probability event could take place miles away from the volitional brain that had willed it into being.[42]

Several of Walker's papers appeared in the *Journal for the Study of Consciousness*, which served as the house organ of Arthur Young's Institute for the Study of Consciousness in Berkeley, the meeting place and watering hole where several members of the Fundamental Fysiks Group frequently crossed paths. Herbert and Sirag were thus among Walker's earliest readers and devoted fans. Herbert was so impressed that he made dozens of photocopies of Walker's early articles to hand out to friends. (He was still working his day job at the copy machine company Smith-Corona Marchant, so he could make photocopies rather easily.) Sirag featured Walker's work in some of his freelance articles, and defended it from skeptical critics, including hidden-variables maven David Bohm. Undeterred, Sirag shot back: one of the most attractive features of Walker's model was that "just those things that are peculiar about quantum mechanics remind us of those things that are peculiar about consciousness, especially as exemplified in psi phenomena." Psi and ψ were made for each other, and, as far as Sirag was concerned, Walker's unified theory illuminated both aspects equally.[43]

Herbert and Sirag had the opportunity to tell Walker in person how

much they admired his work when he came to give a talk to the Fundamental Fysiks Group in the mid-1970s. By that time they had explored Walker's work from a number of angles, well beyond mere pencil and paper. Most playful, no doubt, was the bizarre contraption that Herbert dreamed up with a colleague who worked at the Xerox PARC research laboratory, which he dubbed the "metaphase typewriter." Sirag, in a thinly veiled fictional account of what happened next—Nick Herbert became "Manny Hilbert"—explained that the metaphase typewriter had begun "as a joke, a tongue-in-cheek way of challenging the farfetched but intriguing theory of Harris Walker that consciousness functions as a set of Hidden Variables in a quantum mechanical system." Herbert reasoned that if Walker were correct, then the mind might be at root a quantum effect, separate from the physical body. Mind could control the body by consciously adjusting the c-variables to shift the underlying probabilities for various events. Moreover, if mind were separate from body, this subtle biasing of quantum probabilities might be accomplished either by flesh-and-blood people sitting next to you in a room, or by any free-floating mindlike essences: "spirits of the dead, beings from other dimensions, or dissociated fragments of living personalities." With the metaphase typewriter, even these ethereal quantum-mind-spirits could have their say.[44]

Herbert's device, forged from the latest that quantum theory and digital computing had to offer, was a 1970s gadget for an 1870s dream. Like the Victorian-era spirit mediums, Herbert sought to make contact with the other side—"the realm of mind, or spirit, or subquantum level, take your pick," as Sirag put it—and convey messages by convoluted alphabetic code: the table knockings and wall rappings of old replaced by radioactive sources and fancy electronics. Herbert assembled his apparatus in a cramped, out-of-the-way computer room nestled deep within the Medical Center at the University of California, San Francisco. A friend from Herbert's graduate-school days at Stanford had since joined the Medical Center staff, and he snuck Herbert and company into the facilities. In the computer room, Herbert had stashed a sample of the radioactive element thallium, first identified a century earlier by renowned chemist and outspoken spiritualist Sir William Crookes.[45]

Although not as stringent as today's safeguards, by the mid-1970s several barriers stood between would-be experimenters and radioactive materials like thallium. Herbert had to file a formal petition with the Department of Public Health of the State of California; just a few years earlier, authorities in the United States had banned the use of thallium in rat poison and pesticides precisely because of public health concerns. Rather than raise eyebrows among bureaucrats by describing his contraption in detail, Herbert wrote on his application merely that the radioactive thallium would serve as a "source of random pulses for statistical analysis."[46] He grew more expansive in an unpublished technical report on his contraption that same year. "It is probably no coincidence that thallium, our licensed source, is sandwiched in the periodic table of the elements between two of the traditional alchemical metals, mercury and lead." No wonder Crookes's element was so effective at producing "quantum anagrams" from the spirit world.[47]

Along with the radioactive thallium, Herbert had rigged up a Geiger counter and a fast-printing teletype machine. (It seems that Herbert could never fully escape his day job.) He loaded his own program onto the room-sized computer to convert time delays between radioactive decays into printed letters on the teletype. Radioactive decays are a prototypical quantum-mechanical phenomenon. Individual decay events—such as when this or that nucleus will decay—can never be predicted with certainty. Nuclei of a given type have an average rate at which they decay, related to the element's half-life; but individual nuclei from a large sample of a radioactive substance will decay at random times, scattered around the average value. Herbert zeroed in on that randomness. His device measured time delays between successive radioactive decays, and converted those time intervals to letters of the alphabet. If the gap between two radioactive decays was close to the average rate for thallium, then his metaphase typewriter would spit out a letter that appeared frequently in ordinary written English, such as *e* or *t*. If the time delay between successive radioactive decays departed further from the average rate, then Herbert's machine would produce less likely letters, such as *j* or *x*. Ever a stickler for accuracy, Herbert had obtained the statistics

for English-language letter frequencies from an unclassified report by the National Security Agency.[48]

If ordinary quantum theory ruled the subatomic world, then the output from Herbert's machine should have been pure nonsense: a random jumble of letters spewed out in a row. But if Evan Harris Walker's musings were on track, and someone's (or something's) consciousness could skew the probabilities for radioactive decay—nudging individual events toward or away from an otherwise likely value—then that mind could control the sequence of letters tapped out by Herbert's teletype. Following along Walker's train of thought, Herbert reasoned that some conscious entity might be able to speak to the group by way of Herbert's machine. "A rather suspect communication channel you might think," teased Sirag in his article. "But then you haven't encountered the strange mind of Manny Hilbert."[49]

Herbert and company tried out the device several times. First they invited a series of self-proclaimed psychics to join them, asking the guests to use their conscious willpower to spell out a list of target words on the teletype. If consciousness consisted of Walker's hidden variables, Herbert contended, then the psychics might be able to use their minds to prod less-likely events into fruition (say, a longer-than-expected delay between radioactive decays), or pause likely events in their tracks. Proof would come from the string of letters rat-tat-tatted out on the teletype machine. Other times the group conducted séances around the machine, trying to make contact with recently departed colleagues who had known about the research before they died.[50]

The climax came in March 1974, when Herbert, Sirag, and about a dozen friends held a day-long séance to mark the one-hundredth anniversary of Harry Houdini's birth. They relished the irony: the famed magician had been an outspoken skeptic and debunker of spiritualism in his day. Yet Houdini, being the ultimate escape artist, had promised friends and family before he died that if there were any way to come back and communicate, he would. Now was his chance. In Sirag's fictional account, the metaphase typewriter whirred into action, spitting out the string of letters "anininfinitime," close enough to a recognizable

phrase—"and in infinite time"—to convince the onlookers that in their brush with Houdini, his spirit had complained that their equipment was too slow to allow effective communication. During the actual demonstration, as Sirag recalls, they did not hear from Houdini, although the string "byjung" did crop up unexpectedly—just as a laboratory technician passed the room with a copy of *The Portable Jung* tucked into her pocket. Jungian synchronicity at its best. After the inevitable paper jams, celebratory drinking, and psychedelic drug use, the party disbanded. No hard conclusions to the mysteries of quantum mechanics, perhaps, but a good time was had by all.[51]

When Fundamental Fysiks Group cofounder George Weissmann arrived in Berkeley to study physics in 1971, he was, by his own lights, "a complete materialist." He had no truck with those who chased woolly spirits or pored over works by Eastern mystics. All that changed abruptly in 1974 when his father died, and George had what he can only describe as a "mystical experience" lasting several days. Looking back, he cites that event as the "awakening" he had needed. He wandered in and out of various Berkeley discussion groups, and worked his way through books like *Time, Space, and Knowledge*, a study of Tibetan thought by an American religous scholar. He delved more deeply into Buddhism, and he returned to books he had read as a teenager, including the writings of controversial French Jesuit priest and paleontologist Pierre Teilhard de Chardin. Writing during the early decades of the twentieth century, Teilhard pursued a notion of teleological evolution: all matter evolved in a goal-directed way toward greater and greater complexity. Consciousness emerged at critical stages of this complexification: it inhered in one form or another in seemingly inanimate objects like rocks and plants, and in higher, self-aware forms in humans. Teilhard posited a realm of shared consciousness, or "noosphere," extending beyond the minds of isolated thinkers. Immersing himself in Buddhist texts on the one hand and Teilhard's on the other, Weissmann recalls, made it "possible for me to think about quantum nonlocality." All the while, Weissmann had

been interested in anomalies—tiny, seemingly inexplicable phenomena that might point to some hidden layers in the laws of physics. His twin interests in mysticism and anomalies pushed him ever more quickly into the realm of parapsychology.[52]

Elizabeth Rauscher, who founded the Fundamental Fysiks Group with Weissmann, had likewise caught the parapsychology bug. Like Sarfatti, her entrée into the world of psi came via the Stanford Research Institute. What had grabbed her was not the Geller studies, but a different set of experiments. One month after Uri Geller had arrived in Puthoff and Targ's psi lab, another unusual guest had appeared: a "spook" from the Central Intelligence Agency. The CIA, like other branches of the defense establishment, had begun to harbor fears of a "psi gap" vis-à-vis the Soviets, the consequences of which could prove as devastating (according to some) as the missile gap and the manpower gap. (Never mind that neither of those previous "gaps" had been real.) In July 1972, the Pentagon's Defense Intelligence Agency completed a lengthy classified report, entitled *Controlled Offensive Behavior: USSR*, detailing what was known about parapsychological research behind the Iron Curtain. "The Soviet Union is well aware of the benefits and applications of parapsychology research," declared the report's opening summary. "Many scientists, US and Soviet, feel that parapsychology can be harnessed to create conditions where one can alter or manipulate the minds of others. The major impetus behind the Soviet drive to harness the possible capabilities of telepathic communication, telekinetics, and bionics are said to come from the Soviet military and the KGB." And they were already off to a strong start: "Today, it is reported that the USSR has twenty or more centers for the study of parapsychological phenomena, with an annual budget estimated at 21 million dollars." With such a robust institutional base, the conclusion seemed inescapable: "Soviet knowledge in this field is superior to that of the US." Might the Soviet military and KGB be leaping ahead with new breakthroughs in telepathy, mind control, and psychokinesis?[53]

The CIA operative approached Puthoff to try to close the psi gap. Puthoff's prior experience in Naval Intelligence and the National Security Agency, combined with his new psi lab at the Stanford Research

Institute, made him an obvious target for CIA largesse. The agent hammered out an initial contract with Puthoff and Targ, and by October 1972 the first installment of $50,000 was in hand ($260,000 in 2010 dollars). Additional seed money came from the National Aeronautics and Space Administration (NASA), thanks in no small part to the urging of astronaut-telepathist Edgar Mitchell.[54]

With the infusion of cash, Puthoff and Targ rapidly expanded a side project that had been running alongside their Geller studies. The laser physicists had been working with several seers, some of whom had claimed prior psychic abilities and others who had not. The SRI scientists' goal was to investigate whether one person could receive telepathic messages or visual stimuli from another person, even if the "sending" person were far away from the "receiver." They dubbed the phenomenon "remote viewing."

A colleague at the Stanford Research Institute drew up a list of 100 locations in the San Francisco area, including swimming pools, children's playgrounds, a bicycle shed, specific benches on the Stanford University campus, a toll plaza, and so on. Each target location was within thirty minutes' driving distance from the SRI laboratory. The protocol that Puthoff and Targ reported included its share of spycraft spice: a member of the SRI upper management, "not otherwise associated with the experiment," drew up the secret list of target locations. He printed the name and address of each location on a separate card. Each card was then sealed in an envelope, each envelope assigned a number, and the whole stash locked in the division director's office safe. When the time came to conduct a remote-viewing test, the division director used a random-number generator to select a particular envelope from the pile in his safe. An outbound "target demarcation team" received the card from the division director, hopped in a car, and drove off to the specified location. Once they arrived at the site, their job was to stare intently at the specific object or location for fifteen minutes. Meanwhile, back in the laboratory, a test subject and an experimenter—neither of whom had any knowledge of the set of target locations, let alone the particular location toward which the outbound team was speeding—would wait for

thirty minutes (to allow for the outbound team's travel time). Then the remote-viewing subject would begin to describe into a tape recorder any images or impressions that came to mind; the subject could also draw pictures. The experimenter who remained at the lab with the remote-viewing subject would ask questions to prompt further description or ask for clarifications. The subject's verbal descriptions were then transcribed, and the transcripts and drawings given to a panel of judges, along with a stack of photographs of the target locations that had been visited. The question became whether the judges would discern any statistically significant matches between the target locations and the stream-of-consciousness descriptions produced by the remote-viewing subjects.[55]

Puthoff and Targ reported some astounding results. After nine remote-viewing subjects had completed a total of fifty-one experiments, judges matched viewers' descriptions to photographs of the target locations at well above chance levels. In some cases, the odds appeared to be one in a million that the associations could have occurred merely by random chance.[56] The laser physicists managed to publish their findings in top-ranked scientific journals. They used appropriately scientific language to describe their results: "Information transmission under conditions of sensory shielding," for example, as they titled their 1974 article in the journal *Nature*; or "A perceptual channel for information transfer over kilometer distances" in their long 1976 article in the *Proceedings of the Institute of Electrical and Electronics Engineers*.[57] Journalists who caught a whiff of the research peppered their reports with juicier language, such as "mystic powers" and "supernatural phenomena." "If a man walked up to you on the street and told you that you had amazing mental powers that would enable you without using any equipment whatever to see through walls and watch things happening miles away," began one long article in the *San Francisco Chronicle*, "you would probably give him the fishy eye and walk away as quickly as possible"—and yet (the report continued) that was precisely what Puthoff and Targ seemed to be able to replicate in their laboratory at the prestigious Stanford Research Institute.[58]

Only decades later, after many of the early contracts and technical reports from the SRI remote-viewing work were declassified in the 1990s,

did a fuller picture begin to emerge. The documents revealed an expensive and long-lived program, clandestinely funded by the Central Intelligence Agency, the Pentagon's Defense Intelligence Agency, and related national-security bureaus, to develop what some advocates jokingly called "ESPionage": the use of extrasensory perception (ESP) to peer into secret military establishments within the Soviet Union and elsewhere.[59]

Long before the national-security impetus behind remote viewing came out into the open, Elizabeth Rauscher had been fascinated by the local press reports on Puthoff and Targ's work. The SRI work seemed to herald new breakthroughs in the nonlocal nature of human perception. Rauscher decided she had to learn more about it. The headstrong self-starter, who used to gate-crash her way into the Lawrence Berkeley Laboratory as a high school student, decided there was no need to wait for an invitation to visit the SRI psi lab. She just showed up on Puthoff and Targ's doorstep one day. They tried to give her the brush-off until she showed them a long manuscript she had been working on, concerning theoretical efforts to explain nonlocality.[60]

Rauscher had been dabbling in relativity and cosmology since her return to graduate school. An autodidact in those fields, she got in touch with Princeton physicist and relativity specialist John Wheeler—the self-same Wheeler of "participatory universe" fame with whom Jack Sarfatti was also enjoying an active correspondence at the time. Wheeler made frequent trips to NASA's Ames Research Center near San Francisco, and Rauscher often met with him while he was in town. They continued their discussions via letter, and he encouraged her forays into relativity and cosmology.[61] She had published a few short papers on obscure relativistic models and had begun to write a long monograph on the subject when she first heard about the Puthoff-Targ work on remote viewing.[62]

In the course of her work, Rauscher realized that one way to account for nonlocal effects—perhaps even to explain Bell's theorem, at a deeper level—would be to increase the number of dimensions of space and time. She began toying with a model in which the familiar coordinates of space and time were made complex: instead of a single dimension of time, for example, there would be two, a real component and an imagi-

nary component. A similar doubling of the three dimensions of space (height, breadth, and depth) led to an eight-dimensional space-time rather than Einstein's four-dimensional version. The expanded space-time would contain new sets of shortest paths between here and there. What might look like a far spatial distance within a four-dimensional world might in fact have *no* space-time distance within the enlarged eight-dimensional universe. A long duration of time, as viewed within the four-dimensional slice, might take no time at all when viewed within the larger multidimensional system.[63]

When Rauscher got to those last features of her model, Puthoff and Targ stopped trying to shoo her out the door. For some time, they had been grasping for deep physical explanations that might account for their puzzling experimental results. They had routinely ended their early reports on remote viewing with a gesture toward Bell's theorem and quantum nonlocality, but they had not pursued the connection any further.[64] What they really needed was a house theorist—a consultant, expert in theoretical physics, who could work alongside them and focus on establishing some first-principles explanation, based on the laws of physics, that might explain the mysterious remote viewing phenomenon. Rauscher fit the bill. Her model explained, or at least could take into account, why their remote viewers seemed able to receive signals, instantaneously, across great distances; why the strength of those signals did not seem to fall off with distance; and even why some viewers seemed to receive signals from the future ("precognition"). Almost immediately, Puthoff and Targ arranged for Rauscher to serve as a paid consultant to their psi lab at the Stanford Research Institute. The extra consulting fees no doubt came in handy for the young mother trying to make ends meet on a graduate-student stipend.[65] (Fig. 4.6.)

Rauscher began her consulting work at the psi lab one year before she and Weissmann started the Fundamental Fysiks Group. By the time the Berkeley discussion group began she had participated in, or closely observed, dozens of remote-viewing experiments. In her mind, the experimental data on remote viewing seemed at least as statistically solid and repeatable as the one-in-a-million "golden events" that particle

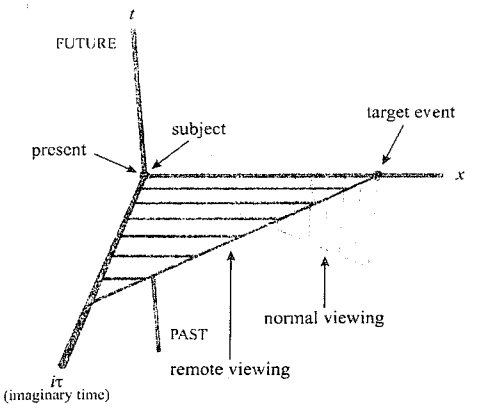

FIGURE 4.6. Elizabeth Rauscher's multidimensional approach to nonlocality and remote viewing. In this example, a subject sitting at the origin ($x = 0$ and $t = 0$) can receive signals instantaneously from the "target event," separated in space from where she is sitting, if those signals travel through the imaginary-time dimension, τ. (Illustration by Alex Wellerstein, based on Rauscher [1979], 60.)

physicists chased with their huge accelerators. Even with her healthy dose of skepticism about the paranormal, she reasoned that "any subject (even if it doesn't exist) is a science, if the methodology of science is used to study it."[66] And so, as the first order of business for the Fundamental Fysiks Group, Rauscher, Sarfatti, Sirag, and Weissmann set out to replicate the Stanford Research Institute remote-viewing experiments. They dedicated all of June and July 1975 to the new experiments. In the end, they failed to find any statistically significant results, as they reported at that summer's annual meeting of the Parapsychology Association: independent judges only managed to match viewers' descriptions and sketches with photos of the target locations at chance levels. But they did find intriguing correlations all the same. One viewer produced surprisingly detailed descriptions of *different* targets, shifted from the intended target by a day or so. Perhaps, Rauscher and company suggested, this viewer had received precognitive visions of where the outbound observer would be going for the next session. All ample material that the Fundamental Fysiks Group pursued in follow-up sessions throughout the next year, including presentations by Puthoff and Targ themselves.[67]