A SCIENCE AUTOBIOGRAPHY

Off to the east the sky shone golden with the first glow of dawn. An old woman wrapped in a blanket sat on a low hill overlooking vast plains. Dry grass covered the gently rolling land, broken only by a thin line of distant railroad tracks and shining telegraph wires that came from the east and stretched off to the western horizon. Once the old woman had gone south to the railroad; the wires had been making a strange singing sound.

The woman was worried about what was happening to her people. The white men had brought with them alcohol and many other diseases of the body and of the soul. Young men were dying in fights with the white men. The death she felt creeping into her old bones was also coming to her people as a whole.

All during the night now ending she had sat in the medicine lodge watching, listening and praying while the old men sat around the fire doing ceremony and urging a return to the old ways. The tribe was weakening, they had said, because the people were not following the old ways of the ancestors. The old woman felt within herself this old knowledge, the ways of the earth, the seasons, the plants and the animals. These ways were good, but now they were not enough. She was tired of hearing the old men say the same things over and over.

She had left the tipi and come to this hill to be alone and talk to spirit directly. Sitting there, she realized that something about the white men's ways fascinated her; there was power in their medicine, a power she felt could help her people.

As her body weakened, her spirit seemed to strengthen. The light in the eastern sky resonated with an inner light she felt more and more. As the sun's first rays came above the horizon, her soul rose out to greet it. She was going home at last. Just as awareness of her body began to drop away, she said joyfully to herself, "I want to learn the ways of the people of the singing wires."

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In April 1942 I was born in Boston, Massachusetts in a non-labor cesarean delivery. My father was an electrical engineer and my grandfather was a professor at Massachusetts Institute of Technology (MIT). So my

beginnings were surrounded by technology, both in the birth and in the family. There also was connection to the natural world. My mother was a gardener, growing both flowers and vegetables, and we lived in an old farmhouse on 40 acres of field and woodland 30 miles north of Boston.

I remember as a child having a flashlight that I took apart over and over to see how it worked. I also watched my father as he made minor electrical repairs such as replacing a defective light switch by the bathroom door in our house. My grandfather had retired from MIT and was a cabinetmaker. He encouraged me to watch him work and gave me wood pieces, a hammer and nails with which I fashioned small boats, trucks and other toys. I also attended an Audubon nature camp and drank in all I could of the natural world. I won the grand prize at the school science fair for my butterfly collection when I was in 7th grade.

Aside from required junior high school science classes and a beginning biology class in my sophomore year of high school, I did not take any science classes until college. I did, however, take four years of math, including beginning calculus. I graduated from high school in 1960.

During my freshman year at Mount Holyoke College I took the introductory physics course for liberal arts students rather than the one for science majors. I had no thoughts of majoring in science. I chose physics rather than chemistry because I thought the chemistry lab smelled bad!

Dorothea Bell, the physics lab instructor, lived in my dorm that year and had the room next to mine. Thus we had many opportunities to become friends. I thoroughly enjoyed the physics lab work; for me it was like having big toys to play with. Dottie noticed my interest and my ability and invited me to do the lab experiments with her on Saturday mornings and then help her teach the lab the following week. Eventually we divided the class with her teaching one experiment two weeks in a row and me teaching another experiment two weeks in a row. The class was divided into two smaller groups that spent time with each of us. During sophomore year I taught the same labs, this time for pay.

When it came time for me to choose a major, Dottie was very helpful, both with advice and as a role model. There were no women phys-

ics professors. Over the next two years I progressed easily through the required physics courses. I also assisted in the second year physics lab during my junior year.

During that year, one of the courses I took was an introduction to quantum mechanics. Several of us, including the teacher, found that subject quite confusing on a common sense level, though it hung together logically in its mathematics. We were being told things like, "Light is a wave, light is particles, both and neither all at the same time." When Nobel prize winner Isidor Rabi came to campus to give a lecture, we physics majors were invited to a reception and discussion afterwards. I asked him about this paradoxical state of things in quantum physics, and his answer was that one shouldn't concern oneself about things that cannot be measured or be described mathematically. In other words, I was to ignore my confusion and be satisfied with the mathematical descriptions.

Another visiting lecturer who was an important influence on me was Houston Smith. He was a philosophy professor at MIT and gave a talk on philosophy of science. He had dinner with a group of us at the home of one of our professors and spoke informally of his participation in consciousness research going on at that time at Harvard, including work with psychedelics in the well-known Good Friday experiment on mystical experience, in which graduate students had attended church services, some having ingested LSD (it was still legal at that time) and some taking a placebo. I remember being fascinated but also thinking that I would never do anything like that.

I enjoyed the small group of physics majors. We really became a family, going on hikes together and many of us attending the Unitarian church in Northampton with one of the physics professors. We were introduced to the world of physics research, both on trips to the accelerator laboratory at Princeton where that professor was part of a research group, and on the June "Physics Trips" he and Dottie organized. We visited Bell labs, Goddard Space Flight Center, Oak Ridge, and National Radio Astronomy Observatory, and went to a physics

conference at the University of Wisconsin. Along the way we camped out and visited various points of interest.

Without too much consideration of other paths, I chose to go on to graduate school in physics, accepting a Teaching Assistantship at the University of Wisconsin in the fall of 1964. The course work there was interesting and challenging, though not overly difficult. I ranked 3rd out of 40 on both the Masters level qualifying exam and the PhD preliminary exam. But socially and personally I felt I had run into a stone wall. I had moved from a supportive all-woman environment to one where I was the only woman. All the way through graduate school I was the only woman in any of my classes and research groups.

I received a lot of attention, positive and negative, just for being female. It was hard to tell how I was doing as a physicist, even though my grades were good. Somehow doubt was cast on the appropriateness of my being in physics, and nothing I could do would dispel that shadow. My self-esteem had never been particularly high, and during graduate school it fell considerably. I was the only teaching assistant, among the five or six who worked in the introductory physics course who had to attend all the lectures. The instructor said this was because he needed me to take attendance. I never thought to question this or to suggest that all the teaching assistants take turns doing this chore. Later on, after I had left physics, I was told by another professor who was a friend that the instructor was known to be strongly anti-woman, and that was why he had worked me harder.

During the second year of graduate school I explored a variety of specialties, areas for doctoral research. I spent time with a spectroscopy group and concluded that they were not doing much that was new. Then I spent a summer working with a medical physics group, and again there was not much that was new. It seemed like it was engineering rather than physics that was being done. I intentionally stayed away from high energy particle physics because I had experienced it on trips to Princeton during my undergraduate days. But finally I accepted that that was the field most interesting to me; it really was on the frontier of physics.

My third year in graduate school I was a research assistant in a high energy particle physics group that had professors whose styles seemed friendly to me. One of them, Robert March, was writing an undergraduate text called *Physics for Poets*, all the while doing particle physics research. I participated in a number of bubble chamber experiments at Argonne and Brookhaven National Laboratories. We graduate students designed and built some counters and particle detectors, ran the experiments day-to-day and did data analysis afterwards, lots of supervising film scanners and running computer programs. We also attended seminars and colloquia and occasionally attended national physics conferences. It was strange being the only woman physicist in any of these activities. At parties I felt neither here nor there as I socialized with all-male groups of physicists or all-female groups of wives and girlfriends.

Two events stand out in my memory. Once while I was working at a lathe in the student machine shop, turning lucite light-pipes for a scintillation counter, one of the regular machinists passed the door and glanced in. He skidded to a stop, came back, stared at me, shook his head and went on his way. Another time, at a cocktail hour at a medical physics conference during my second year, one of the professors I was working for came up to me and cautioned me not to get too educated or I wouldn't be able to find a husband.

During my first year, I had met a meteorology graduate student while on a ski trip to Colorado. He was also a good black-and-white photographer and introduced me to darkroom techniques. I took to photography and did a lot of it during my spare time all through graduate school. We both showed and sold lots of prints at student art sales. For me, photographing nature was a way of staying in touch with life in the midst of my technological and theoretical activities in physics.

Another factor in my graduate school years was the political climate. It was during the late 60's and I was surrounded by both Vietnam War protests, complete with tear gas, and the growing hippie counter-culture, with its psychedelics. Being naturally shy, I did not participate in the political activities, though I sometimes had to take a circuitous route

to the physics building to avoid tear gas. I felt more akin to the inner explorations of the counter-culture. So there I was, high achieving physics graduate student by day, and photographer and budding hippie evenings and weekends.

One seemingly small event that had a large influence on my life later on was my picking up a copy of Alan Watts' book, *THE BOOK on the Taboo Against Knowing Who You Are.* In this book I found discussions of various Eastern mystical traditions and was struck by the same paradoxical logic I had found in my quantum physics texts while an undergraduate. I avidly read every book by Alan Watts that I could find, and I participated in a "Free University" informal course on mysticism. Then one day as I was reading one of Watts' books something fell apart. I realized that I couldn't find the answer to my confusion in any book. I tossed the book across the room in disgust! I didn't know what to do. In retrospect, I see that my way of proceeding was to increase my photographic work and my inner explorations. I also attended one encounter group weekend. Something in me knew that the answer to my confusion was in nature and in my own being.

Though I could see a big change was coming in my life, I decided to stick it out and finish my PhD. I figured it would open doors for me later on — which it did. My research topic was "Resonance ('particle') Formation in Backward Elastic Anti-Proton/Proton Scattering from 500 to 900 Mev." The data came from bubble chamber film taken at Brookhaven. The results were not earth-shaking, though they did confirm some theoretical predictions of resonance formation at certain specific energies.

During my dissertation research I also helped with the experimental runs for the dissertation research of other graduate students in the group. One of these was an experiment at the Princeton accelerator. I felt as if I were returning home. We graduate students were given a lot of freedom there and used some innovative experimental techniques, feeling somewhat amazed that we lowly graduate students seemed to be in charge a lot of the time.

During graduate school I had live-in relationships with two different physics graduate students, one a nuclear physicist and one in medical physics. I also had a variety of short-term relationships with other physicists. I was an anomaly, being both colleague and part of the group of girlfriends and wives.

Stress was building in my life. It was becoming clear to me that I did not want to live the life of a high energy physicist. It was too competitive and was a great strain for me always being expected to behave in a masculine mode, while being subtly criticized for not being feminine enough. I decided to try to find other things to do as soon as I finished my PhD, with the idea that photography might be a big part of my path.

In retrospect I see that some of the strain was generated simply by attempting to live in the world of high energy physics, a world that Sharon Traweek describes in *Beamtimes and Lifetimes: The World of High Energy Physics* as, "...an extreme culture of objectivity: a culture of no culture, which longs passionately for a world without loose ends, without temperament, gender, nationalism, or other sources of disorder — for a world outside human space and time." (p. 162)

One of the professors in my research group, Ugo Camerini, seemed to me to be a warm human being as well as a good physicist. I spoke with him of some of what I was experiencing and of my decision to explore other paths. His response was very supportive. He suggested that I be assigned as a post-doc to the spark chamber experiment at Lawrence Berkeley Laboratory (LBL) that Wisconsin was doing with University of Hawaii and UC Berkeley. His reasoning was that Berkeley would be a good place for me to explore other possibilities. A lot was going on there at that time.

So in 1970 I went to Berkeley. I remember one day at the Bevatron, the particle accelerator at LBL, I was looking into an oscilloscope as part of tuning up some of the particle detectors. I saw the reflection of my eyes superimposed on the green screen with its bright green traces. I realized that I was more fascinated with the question of just who I was than with the physics I was supposed to be doing. I wondered if I was

going crazy. I worked there for 6 months making a lot of new connections in the Bay Area, including one with Stillpoint, a Taoist meditation center in the Santa Cruz mountains run by Gia-fu Feng. He and I immediately felt a special connection between us.

My real point of decision came one morning at dawn after I had been up all night tending the experiment at the Bevatron. I got a phone call from a high energy physics research group at Rutgers offering me a post-doctoral appointment there. As I stood at the outdoor pay-phone and looked at the Golden Gate Bridge lit by the rising sun, I realized that it would be a kind of death for me to take a position in bleak New Brunswick, NJ. I said no to the offer. I trusted that somehow I could make a living with my photography and that I would be able to live, at least for a while, at Stillpoint.

I acted on this decision and by fall of 1970 was living at Stillpoint. After I had been there only a week, feeling joyful and liberated in my new life, I heard from a visitor that some anti-war radicals had set off a bomb in the physics building at Wisconsin where I had just finished graduate work. Such a feeling of bridges burning behind me that evoked! A year or so later, when I was visiting back at Wisconsin, Ugo Camerini told me there were two reasons he was annoyed that I had dropped out of physics. One was that I was being used as an example of why UW should not admit women physics graduate students, and the other reason was that he, Ugo, envied me!

On Christmas day 1970 friends of Gia-fu's arranged for Alan Watts, who had been an Anglican priest, to do a Buddhist wedding ceremony for us. That was the only time I met Alan before his death a few years later.

For the next couple of years I was not active in science. Then around 1973 Gia-fu and I co-taught courses on Chinese Philosophy and Modern Physics at Colorado College, and at Thomas Jefferson College in Michigan. While teaching I felt somehow unqualified to be teaching. I wondered if I hadn't read enough on the subject, but also suspected that no amount of reading and study would be enough. I again felt how a purely intellectual approach was inadequate; there was a gap between words and experience.

While I was with Gia-fu I continued photographing even more intensively. I was delighting in creativity, my own and nature's; I was also reaching for some truth that seemed to be out in nature. This led to our doing translations of the Chinese classics *Tao Te Ching* and *Chuang Tsu: Inner Chapters*, illustrated with Gia-fu's calligraphy and my black-and-white photos. Both books were published by Random House, one in 1972 and the other in 1974. Soon after this, we made a trip to Europe to lead some Tai Chi workshops. There I met the British publisher of *Tao Te Ching* who, noting that I was a physicist, asked me to look over a manuscript that had been submitted to him for publication. It was Fritjof Capra's *Tao of Physics*, which had already been rejected by 11 publishers. I took one look at it, saw that it covered the same ground I had been exploring in the courses I had been teaching, and exclaimed to the publisher, "Of course you are going to publish this!" He invited both Fritjof and me to dinner that night. We met somewhat uneasily, both feeling defensive of our "turf," bringing the competitiveness of high energy physics to this new field where, with eastern philosophy's emphasis on the interconnectedness of things, such competitiveness is quite out of place.

Shortly after this trip, Gia-fu and I went our separate ways. I stayed on at Esalen Institute in Big Sur, CA where we had been visiting friends of his and leading workshops; he returned to Stillpoint in Colorado. While at Esalen I began intensive inner explorations using Gestalt, Rolfing, Tai Chi, chanting, dreamwork, guided imagery and a variety of other body/mind/spirit practices. I had gone from *experimental* physics to *experiential* study of consciousness. One theme that began to emerge for me was the relevance of my non-labor cesarean birth. It seemed to be a factor in my psychological makeup and in my way of relating to people and to the world in general. I kept a journal of my thoughts and experiences.

In the midst of this inner soup, I received an invitation to speak at a conference at UC Santa Cruz on "Energy." It was a real stretch to reassemble something approximating my physicist persona and give the talk, though I did enjoy the process of looking at the roots of the concept of energy and realized that it was just that, a concept, albeit a useful concept.

After almost a year at Esalen I left to participate in a nine month Sensory Awareness study group led by Charlotte Selver, a teacher of Fritz Perls, the founder of Gestalt. In her work we really went back to basics. It was a form of meditation based in awareness of body and had some similarities to Zen meditation. In fact our sessions took place at Green Gulch Farm, a part of San Francisco Zen Center. After a few months of this practice most of us were in very sensitive, open states of being.

In the midst of this I received from the British publisher an almost final version of *Tao of Physics*. I sat down one Sunday afternoon to read it. As I read the phrase, "awareness of atomic reality" something shifted in my being. I actually experienced that awareness. The paradoxical nature of the wave-particle paradox that had been bothering me for 15 years fell away in a transcendent experience where light was not an object that was either wave or particle, and there was no subject (me) seeing light. Neither subject nor object was real. There was just consciousness and the understanding that the ways this seamless unity is divided are conventions, temporary divisions. This experience is more fully described in the chapter, "Science and Transformation," on page 99.

I had earlier had brief moments of this state of consciousness while photographing. I sometimes seemed to become what I was photographing. Such moments were both exhilarating and scary. I had times of wondering if I was going crazy. A few weeks later, during one of the sensory awareness sessions, I came to the understanding that all my photographs are, in a way, self-portraits. They are reflections of my states of consciousness.

Shortly after this I attended a lecture on physics and consciousness and made connection with a group of physicists who met regularly at Lawrence Berkeley Laboratory to discuss research on the relation of physics and consciousness. Fritjof Capra was part of that group. We both commented on the positive changes in each other. Being back at LBL after the major inner changes I was experiencing felt both strange and good.

Meanwhile, my explorations of the personal, social and metaphysical implications of being born non-labor cesarean continued. The pro-

cess shifted from being just my own personal journey. Several times I noticed people behaving in ways that seemed both unusual and familiar. I subsequently found out that these people were also non-labor cesarean born. Then there were times when I talked with other non-labor cesarean born people about my own experiences and the ways I was conceptualizing them, and these people began to finish sentences for me and make heartfelt exclamations like, "I'm like that too! You mean I'm not crazy?"

One of the things that again emerged, as it had in my physics work and in my photography, was the question of defining inner and outer, subject and object, the question of identity. It seemed that non-labor cesarean born people have a different sense of psychological boundaries, probably from not experiencing the intensely limiting journey down the birth canal. (See the chapter on cesarean birth, page 65, for more.)

All this while I was aware of an inner voice telling me that this cesarean work I was doing wasn't very scientific. It was too subjective and not scientifically verified. But the inner motivation to heal myself and the excitement of feeling I was onto something new kept me going. Meeting Stanislav Grof, a Czech psychiatrist whose research in psychedelics had led him to a detailed topography of the perinatal experience for vaginal birth, inspired me to begin to map the cesarean experience in a similar way.

Stan also was my introduction to transpersonal psychology, areas of study that go beyond the individual psyche and explore the border between the personal and the spiritual. I also became acquainted with Charles Tart's idea of "state-specific science" wherein the state of consciousness of the scientist-observer is an important factor in what is observed. My own work began to look a bit more scientific, and therefore valid. I still subscribed to a scientific worldview with science being the criterion for validity. Houston Smith reappeared in my circle of acquaintances, and I found his writings on science, spirit and perennial philosophy quite helpful.

In the late 1970's and early 1980's I was recording my dreams, doing daily meditation and using the Tarot as an oracular mirror of inner states of consciousness. I began to notice amazing correlations between the dream images I was writing down and the images on the Tarot cards I would choose *after* doing the writing. This challenged the scientific voice that said that the choice of cards was random. Being still a scientist at heart, I proceeded to do a statistical analysis to find the probability that the frequency distribution of the cards I had chosen over a three year period was random. It was far from random, as were those of two other Tarot practioners' cards. I did control runs with numbered index cards, using the same shuffle procedure. The only other difference was that I was not meditating just before the choice. I also did controls with a computer random number generator. Both controls were consistent with randomness. See the chapter "Tarot and Physics" on page 49 for more on this. This was a major step in integrating my inner work with my scientific training.

In the 1980's, my continued exploration of cesarean birth, including giving talks at several psychology conferences, led me to learning shamanic techniques with Michael Harner. I learned that traditional shamans had explored the inner realms of consciousness and their interface with the manifest physical world with the same intensity and precision that high energy physicists use in the world of sub-atomic particles. It was interesting to hear a visiting Hungarian anthropologist say that in his language the word for "scientist" and that for "shaman" are the same word!

Over the past few years, my association with spiritual cosmologist and visionary artist Rowena Pattee Kryder has helped me to see science in a larger perspective. Rather than seeing science as the ultimate arbiter of reality, a container for everything true, I now find it more accurate to know science as a part of a much larger reality, a reality with spiritual, human, natural and cultural dimensions, a reality that cannot always be put into words or mathematics or even images.

This understanding was foreshadowed by a dream I had in 1978 while I was auditing a course with Angeles Arrien on creativity and perception. In the dream I was sitting in a beautiful garden with a young

girl. Several men who were physicists were having a serious discussion. They wore grey suits and were going into a grey stone building that had columns across the front, a temple-like hall of science perhaps. The girl was upset that we were not allowed in there. I explained to her that this was because we were female. Then we danced among the flowers and realized that we were happy not having to go into that grey building.

Liberated from the authority of orthodox science, I find myself working toward integrating "the old ways" and "the ways of the people of the singing wires." This book is a part of that process.