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MARIAN ELLIOTT KOSHLAND
1921—1997

A Biographical Memoir by
RUTH LEVY GUYER

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Biographical Memoir

Photo Courtesy Marian Kosshland Science Museum

MARIAN ELLIOTT KOSHLAND

October 25, 1921–October 28, 1997

BY RUTH LEVY GUYER

MARIAN ELLIOTT KOSHLAND WAS AN eminent immunologist. She was spirited, practical, insightful, and inventive, and she had tremendous integrity, energy, and smarts. She was also a caring and generous person. I was fortunate to be one of her graduate students at the University of California at Berkeley in the early 1970s.

Marian had become a professor in the bacteriology and immunology department at Berkeley shortly before I joined her group. Her laboratory was in the old Life Sciences Building near the (in)famous eucalyptus grove, a campus landmark redolent of medicinal oils and site of commonplace conversations, licit and illicit trysts, and spurned lovers' fist fights.

Marian's laboratory was large and classic: Rows of tall, stately black benches spanned much of the width of the room, and at the back near the windows that looked out onto the building's courtyard was a hulking rectangular conference table. That table was where we—the four graduate students, the postdoc from Lausanne, the two technicians, and Marian—gathered every day at lunchtime to eat and to talk about J chain—the joining protein of immunoglobulin molecules that Marian & Co. had recently identified and were characterizing—the structural peculiarities of secretory antibodies

and their distinctive activities, the immune system's newly distinguished T and B cells, our families, and politics.

George McGovern was running for president, and one graduate student was taking large chunks of time off to run McGovern's California campaign. America was still involved in Vietnam. Harvard's George Wald had recently returned from a fact-finding trip to China, and he was traveling around the country giving talks at colleges and universities—including ours—called "Acupuncture for McGovern" and donating his honoraria to the McGovern campaign. (Two vivid images from that talk have remained in my mind: Wald said that [1] after he watched a surgeon resect a grapefruit-size tumor from a woman who was awake and smiling throughout the surgery [smiling, thanks to the acupuncture needles], the surgeon had sent the tumor on a platter from the operating theater up to Wald in the observation gallery where he, like a client in a gourmet restaurant, had then sent down to the surgeon his admiring "compliments to the chef," and [2] just believing in acupuncture was not what made it work, and he had been persuaded of its value by watching surgery on a horse for whom acupuncture had been an efficacious pain-killing anesthetic.)

Everyone in Marian's lab, except me, was working on J chain. In a small room at the front of the lab, glass chromatography columns were sorting the constituent parts of J chains and dropping the fractions into humming fraction collectors. The starting materials—colostrum and myeloma protein preparations—retained the names of their sources. So, people would say, "Anne Good is on column two" or "so-and-so is on column one." Our laboratory's immunochemistry had a very human feel.

Marian arrived at the lab each day late in the morning and stayed until early evening. We all liked each other, and we ate lunch together every day. (The Swiss postdoctoral fellow

and I alternated packing lunches for each other, so that we didn't each have to face the daily annoyance of preparing our own meals. She made more cosmopolitan sandwiches than I did, making me the key beneficiary of that collaboration.)

Marian cared about us. She was focused, of course, on our research but she also took a genuine interest in what else we were doing and what we were thinking about our futures. She would talk to us about what might best be labeled "juggling," helping us—the young women and the young men—look hard at how we each could combine meaningful careers with the sorts of overall lives we wanted to live. Two of the graduate students were married and had small children; two of the people in the lab were single, and three of us were married and hoped later to have children. We all were passionate about immunology, and Marian helped us understand that there was not just one path we might follow in order to have an interesting career in science.

Marian shared with us the lessons of her personal and professional experiences as well as her thought processes and her wisdom. She had interesting reflections on everything. She was a successful scientist at a time when that was not easy for women, she was the mother of five (with one son still at home, which was why she worked only part-time in those days), she was married to another successful scientist, and although she was wealthy by the time we were within her sphere, she had not grown up privileged.

She was born in New Haven, Connecticut, in 1921. Her mother—Margrethe Schmidt Elliott—was a teacher who had come to the United States from Denmark; her father—Walter Elliott—was a hardware salesman with a Southern Baptist background and the prejudices that came with it.

Marian had a little brother who developed typhoid fever when his big sister was just four years old. She pointed to her brother's illness as the first of several factors that contrib-

uted to the "sheer luck" that led her to eventually become an immunologist. While her baby brother was languishing in the hospital and her parents were holding a vigil at his bedside, Marian became the special project of two young girls who lived next door. They taught her to read and to do math, and then they took her to their school and let her "perform." This, she said, was a heady intellectual experience for a four-year-old (1996).

When Marian's brother got back home, the Elliotts quarantined both of their children for a year to protect their immunologically compromised son from the many childhood infections that were afoot in the town, the neighborhood, and the school. Marian's father, like the girls next door, tutored and drilled his daughter at home—she described his style as that of a martinet—and by the time she finally got to a regular classroom, she was well ahead of the other children and had great confidence in her innate ability to learn.

In high school Marian encountered her second piece of luck: Her closest friends—three boys—were intellectuals and sophisticates, and it was simply routine for her to do everything that the boys did academically and culturally. Academically that meant enrolling in the hardest courses in the school. Culturally her activities fell into the "high" version—attending productions of the Metropolitan Opera—and the "low"—holding a long black snake in the biology classroom and eating canned rattlesnake meat. She braved any challenge.

She attended Vassar College, where she supported herself with scholarships and jobs and lived in a co-op dormitory. She made all of her own clothing. She graduated from Vassar in 1942 with a B.A. degree in bacteriology. Her immuno-luck at Vassar centered on Catherine Dean, whose lectures about the fledgling field of immunology were intriguing. In addition, Dean expected her students to be creative, to pose questions,

to design experiments, and to develop strategies for solving problems. Marian wrote that it was Dean who "hooked" her on immunology, and she marveled fifty-plus years later: "I look back now and wonder how, at age 19, I could have had the sense to select a field that has grown more exciting and intellectually challenging every year."

Money remained tight, but Marian wanted to leave the east coast. So, for post-baccalaureate work, she went to Chicago ($16 for the overnight train), where she spent one year in medical school before switching to research and a graduate program. She earned both her M.S. (in bacteriology in 1943) and her Ph.D. (in immunology in 1949) from the University of Chicago. She had no idea when she headed out to the University of Chicago that it was "a hub of wartime research, not only for the development of the atom bomb . . . but also for the control of infectious diseases among the troops."

Marian worked on two projects at Chicago. One involved the development of a vaccine for cholera, which was needed for protecting American soldiers who were stationed in the Far East. The vibrio that cause cholera reside in the gut, and thus getting rid of them was going to require an oral vaccine. (She pointed out that the successful cholera vaccine set a precedent that was important later in the development of the oral polio vaccine.) Proof of protection was associated with the production of fecal antibodies. Marian identified this research as the springboard for her lifelong interest in secretory antibodies, those antibodies that are made by cells in mucous membranes and are responsible for immune reactions at all of the body's orifices, and which in milk and colostrum protect newborns "passively" until their own immune systems kick in.

Her other project focused on finding ways to reduce the spread of respiratory diseases in soldiers during basic train-

ing. Strep infections were rampant, and the most susceptible soldiers were those who came from rural areas and had little exposure to strep on the farm. The sequelae to these infections were often serious—rheumatic fever, glomerulonephritis, and other autoimmune complications. The solution turned out to be more mechanical than medical—spraying oil droplets on bedding and clothing, so that fewer bacteria became airborne in the soldiers' barracks.

Marian met another graduate student in Chicago, Daniel E. Koshland, Jr. Work on the bomb took Dan to Oak Ridge in 1942, but they corresponded and often saw each other, and in 1945 they got married.

"Marrying her was by far the most important thing I did in my life," Dan told an interviewer at the University of California who conducted a series of interviews with colleagues and family members after Marian died and collected them into a thesis-style publication.[1] "Both of us being so mutually sufficient affected our life in many ways. As long as I could have an evening with her, that was it. I always enjoyed talking to her more than I enjoyed talking to anybody else."

Marian joined Dan at Oak Ridge in 1945 and spent a year there working on the Manhattan District Atomic Bomb Project. She was one of just a few women scientists who worked on the Manhattan Project—conducting research on the biological effects of radiation.

One of the wonderful stories that Marian told me about Oak Ridge illustrated how hush-hush everyone's work was at that time. Researchers had no idea what the person in the next room was doing. They also were forbidden to talk to their spouses about their research.

There wasn't much to do at night in Oak Ridge, and often couples would get together to play charades after dinner. One evening the women were pitted against the men, and someone had rigged the game such that Marian had

to act out the word "plutonium." She was the only scientist on the women's team that night, and when her teammates finally guessed the word they still didn't know that they had solved the puzzle, because none of them had ever heard of plutonium. This was proof that the male scientists were not talking to their wives (or talking in their sleep).

Marian and Dan finished up in Chicago in 1949 and moved to Boston, where she had a postdoctoral fellowship in the Department of Bacteriology at Harvard Medical School (and Dan had a postdoctoral position at Harvard as well). Two years later they moved to Long Island, where both did research at the Brookhaven National Laboratory until they left for Berkeley in 1965.

When the Koshlands arrived at Brookhaven, the head of the department reneged on his promise of a job for Marian ("We are not going to have the wife of anybody."[2]) They had four children under five at the time and Marian seriously considered giving up science altogether. (The third "child" turned out to be twins, a situation Marian characterized as an "unexpected complication.") She wrote that her "luck" at that time was that Dan convinced her that she could remain competitive as a scientist by working part-time, by "being creative and undertaking high-risk projects that a tenure-track scientist could less afford to do" (1996).

Marian learned that the person in charge of the publications that followed the various Brookhaven symposia was a physicist who knew nothing about biology. She suggested that, in exchange for a small lab and a technician, she would edit the collections in biology for Brookhaven, and that was how she got back into the laboratory during that period.

James Allison, who was a colleague of Marian at Berkeley from 1984 until her death, characterized her 50-plus-year scientific career as "spectacular." He summarized her work

decade by decade in a memorial eulogy, showing how Marian had made major contributions to understanding of the immune system for half a century:

As a graduate student at the University of Chicago in the 1940s, Bunny, as she was known, worked on a vaccine for Asiatic cholera. This work not only demonstrated the importance of mucosal antibodies in immunity but also led to her lifelong interest in the structure and origin of antibodies.

By the early 1950s and before the formal definition of antibody classes, Bunny had shown that secreted and serum-borne forms of antibodies were discrete molecules.

By the 1960s, she began to address one of the central problems in immunology—the origin of antibody specificity. There was a raging debate between instructive models, which held that antibody proteins were all the same and just fold around their target antigens, and selective models, which argued that they were the products of different cells. Bunny analyzed polyclonal antibodies directed against two different haptens, and on the basis of exquisitely careful amino acid composition analyses, convincingly showed that these antibodies had different amino acid compositions and therefore must differ in their amino acid sequences. These data had a profound effect on theories of antibody formation and how antibody specificity was generated. Legend has it that at the annual meeting of the American Association of Immunology where she first presented her data, her talk was received by a standing ovation—quite high praise indeed.

By the end of the 1960s, Bunny's work had become part of the mainstream of an emerging idea that is now one of the cornerstones of immunology, that is, that antigen receptors, both of T cells and B cells, are encoded by multiple rearranging gene segments. Her work in this area was seminal…

By the 1970s, Bunny had returned to her studies of secreted versus serum-borne antibodies. She identified a novel antibody subunit called the J chain, characterized it, and showed that it played a central role in antibody assembly and secretion and that the beginning of its expression marked a clear, discrete step in the maturation of B cells. This work led to the central theme of the remainder of her scientific career: understanding the way in which a B cell becomes an active player in the immune response.

In the late 1970s, Bunny did a sabbatical stay in David Baltimore's laboratory at MIT to learn molecular biology, as she felt that the future of the field lay in this area. While at MIT she collaborated in cloning the gene encoding the J chain, and brought the gene and her knowledge of the emerging technology of molecular biology back to the immunology group at Berkeley.

In the 1980s, Bunny turned her attention to regulation of transcription of the J chain gene by B cell growth factors.

By the 1990s, her work had extended to the more general area of events that accompany and direct B cell activation and maturation. In an invited talk at the national meeting of the American Association of Immunologists in February 1997, she presented a wonderful description of recent work from her lab demonstrating that the action of a transcription factor, BSAP, was very complex and dynamic, and that it could have both positive and negative effects, extinguishing some genes whose products were no longer needed, while turning on new genes with roles important to the emerging antibody-producing arm of the immune system. This talk was a marvel, and put together complex biochemical phenomena in an understandable context of biological function.

If there is any single feature that marked Bunny's work, it was her ability to reduce complex phenomena to experimentally addressable components. She did this by putting a very high emphasis on experimental rigor and absolute integrity. She was not affected by fads in science, but only by the bottom line—how well hypotheses hold up to hard experimental scrutiny.[3]

I felt fortunate that Marian—I never was comfortable calling my thesis adviser Bunny, although a number of her other students were—was not dazzled solely by faddish research. My project was something quite out of the mainstream of immunology in general and also different from what everyone else in the lab was doing. I was interested in how newborns absorb maternal antibodies during the period when they are nursing and before they have active immune protection of their own. Mouse myeloma proteins had recently become available, and I was feeding baby mice radioactively tagged populations of pure IgM and IgA and various subclasses of

IgG (as well as the Fc and Fab fragments of these immunoglobulins) and following their trajectories in the body in order to discover the locations and natures of the binding sites for these molecules. This biological system looked not at the production of secretory antibodies but at their uptake and absorption. Marian was totally supportive of my work and encouraged and guided my research as enthusiastically as she did the others' work on J chain.

She had high expectations of her students, and she guided us at every step of our training. She helped us become thoughtful and careful experimenters (the expression "if you don't have time to do it right this time, when will you have time to do it again?" was something of a mantra in our lab), she insisted that we write precisely and with integrity (She was an excellent and careful writer, although she said she found the task difficult. Her colleague Anne Good said of her publications—"She was very rigorous and meticulous. She would really think things through… Papers did not come out of her lab without her having thoroughly reviewed them."[1]) and she worked with us so that we would become confident speakers. I went with Marian to Atlantic City one year to present my Ph.D. research at the meeting of the Federation of American Societies for Experimental Biology. She had me rehearse my presentation for her several times and then she told me to practice it a few more times in my hotel room. I still recall saying my speech aloud in my empty, bargain-price hotel room and then being totally humiliated when the person next door clapped as I wrapped up my presentation. (For the rest of that week I slipped stealthily out of my room in order not to face the person who had been listening. When I later moved to the National Institutes of Health, I told that story to a colleague and he said, "Where were you staying. . . The Carolina Inn?" and I said, "How did you know that?" and he said, "It's the cheap-

est hotel in Atlantic City, that's where I always stay, and the walls are paper thin.")

I was not alone in thinking that Marian was a truly dream-come-true mentor. Chip Wilde, who was a graduate student at the same time I was and now teaches microbiology in Indianapolis at the University of Indiana, recently told me that he had gone to Berkeley to work with another professor, but after taking Marian's immunology course, he realized that immunology was what he wanted to do. Chip said, "There were so many unanswered questions, so many neat possibilities. And I loved to go to the lab every day. I liked the interplay of the people—I can still remember everyone. Marian was so meticulous and she was demanding but not tyrannical. I was in awe of her—her intellect, her work ethic, the way she felt it important to dot every i and cross every t. She felt that before you presented your work it was necessary to have everything wrapped up so there were no questions."

Students of other eras admired Marian too. I spoke to Marcy Blackman, an immunologist at the Trudeau Institute, who graduated from Berkeley more than a decade after Chip and I did. At the time Marcy was in Berkeley (she got her Ph.D. in 1985), Marian had just come back from her sabbatical at MIT. Marcy was eager to work with her because "she seemed to be the one who was moving the department into the future. I was totally impressed that at her age she would go on sabbatical and learn a new technology. I had a wonderful time in the lab. She always brought her lunch and half a candy bar (she said there were too many calories in a whole bar). We all sat around that table. I was strongly influenced by her—she was a woman, she had a family, and she managed to juggle it all and have status in the university. She taught me to be very critical. I was very inspired by her."

Other immunologists talked about Marian's high standards and acumen. James Allison said in his eulogy that "Bunny was well known for her impatience for and willingness to challenge half-baked ideas. I am sure that there are many immunologists who, like me, can recall times when we were forced to defend our hypotheses to this formidable devil's advocate. Bunny was not at all shy in attacking and probing every assumption, every finding, every control. Merely surviving an encounter with Bunny always gave me confidence that I could defend my ideas to anyone." Henry Metzger described her as "a very forceful, tough and clear-headed interlocutor but in a non-self-serving way."

Marian became the chairperson of the Department of Microbiology and Immunology in 1982 and remained the chairperson until 1989. She recruited prominent scientists for the department during that period (James Allison was one of them) and also made substantive changes that improved conditions for students in the department. In 1994 she became the head of the Graduate Affairs Office of the Department of Molecular and Cell Biology (the university had undergone a major rearrangement and that was where the immunologists were located) and that allowed her to continue working intensively on behalf of students.

Marian also developed a close relationship with Haverford College during the 1980s and 1990s. Both of her sons had done their undergraduate studies at Haverford, and in 1982 she became a member of Haverford's Board of Trustees and its Educational Affairs Committee. She stayed on the board until 1994. Elaine Hansen, who was provost of Haverford and one of the faculty members on the board during Marian's tenure and who is now president of Bates College, told me that Marian "connected us to the broader academic world and helped us see the college in that landscape. She was confident and forthright. She held the college to high standards. For

her to take time to serve on the Board of a small college was a bit unusual for someone from a large university."

Judy Owen, an immunologist and biology professor at Haverford, knew Marian well both from her immunology research and from her work on the board. "She really cared passionately about the college," Judy said. "She was very impressive. The Board had people with different roles—academic, financial, etc. When I was the faculty representative to the Board, she would absolutely grill me . . . in all the right ways. She never overstepped the line of a Board member. She said what she thought and then she was very supportive. She gave a Philips lecture at Haverford and right before it she was pacing up and down, smoking, really nervous; but then she gave a lecture that was clear as a bell, blistering, and people were absolutely blown away by her."

"She was also stunning," Judy said, "and there was something absolutely appealing about that: you didn't have to give it all up to be a successful scientist—you didn't have to carry a pocket protector! She did elegant work and she was a dynamo. She had a firm reputation among the oldsters. I was inspired by her fearlessness—to learn whatever it took at whatever age. She was tough, had high expectations, and she had a real warmth for students. Her example affirmed for me that you can be tough and not hard—this was something I saw in her and wanted to emulate."

While Marian was on the board, the college developed a plan to bring all of the sciences under one roof in order to promote more interaction and collaboration among faculty members and students and more interdisciplinary research. Today the 140,000-square-foot science complex—the Marian E. Koshland Integrated Natural Sciences Center (KINSC)—houses Haverford's biologists, chemists, physicists, mathematicians, psychologists, astronomers, and computer scientists.

In 2001 I was invited by a chemistry professor at Haverford

to give a talk about the work I was doing in bioethics, and by chance I was the first person to give a talk in the auditorium in KINSC. My host did not know that I had a connection with Marian, and I had not been aware of Marian's involvement with the college. It was touching, though, and seemed appropriate, for me to give my talk in her building. The next year I became a visiting professor at Haverford, and now in my sixth year there it gives me great pleasure to think about Marian as I walk by or into KINSC.

Haverford awarded Marian an honorary doctor of science degree in 1995. In 1998 the college established the Marian E. Koshland Prize in biology for a student showing excellence in research in biology.

Marian was the ideal professor for me. She was three dimensional in ways that others were not. Everything she did was well reasoned. She encouraged me to be resourceful, and she showed me ways to carve out an interesting life. (I, too, was married to another scientist, and we would be needing two positions in the same location. She proactively shared all of the lessons she had learned with me, and they have been invaluable to me over the years.)

Marian was the most rational person I'd ever met. For example, she explained how, having been surprised to have four children, she decided to go on and have a fifth. Her two oldest children were girls; the next two were a girl and boy—the twins. She worried about her son and decided that his life would be greatly improved if he had a brother and that the difference between having three sisters or four would not be significant. As it turned out, the gamble paid off, and her fifth child was a boy.

Another time she explained how she had solved a problem of painful cramps in her calf. She thought this might be a simple vitamin deficiency, so she began taking a daily multivitamin, and the cramps went away. Anyone else would

have been satisfied with the pain relief, but Marian had to prove to herself that the vitamins were really causal in stopping the cramps. She stopped taking the vitamins and was pleased when her cramps came back.

Marian was funny. One night she came to my home for a small dinner party. One of my husband's relatives, a researcher from the National Institutes of Health, was in town, and we also invited our closest friends—a graduate student in my husband's lab and her physicist husband, Keith. We had a gala evening, and Marian looked especially glamorous. When she got ready to leave, she put on her glasses. The physicist said, "Marian, you look so much better without your glasses." And, without a moment's hesitation, Marian said, "Keith, you look a lot better without my glasses, too."

Marian invited us to parties at her home. These included festive holiday gatherings for our small lab group and Dan's large gang and also intimate dinner parties, where my husband and I had an opportunity to meet some of Berkeley's luminaries. It was at one of these parties, sitting next to Bruce Ames, that I observed that black cloth napkins were orders of magnitude classier than white ones. Marian was a stylish and gracious hostess and also a gourmet cook.

She invited us out to her home to pick apples from her orchard and to swim in her pool. And when I graduated, she had a brunch in my honor and told me to invite any friends I wanted to invite. That was a wonderful party, elegant and comfortable at the same time.

I never met any of Marian's children. Four of them had gone off to college or beyond by the time I entered her lab, and the ones who went to Haverford were there before I became affiliated with the college. I had no idea what sort of mother she was. Her oldest daughter, Ellen, who lives in Australia, recently wrote me, "My mother had a great influence on my life by her indomitable moral force. It was this

force more than her capacity to juggle home and work that stays with me to this day. She conveyed that there were things to be tackled to improve the world and no time to waste in getting on with it. She demanded high quality but she was at heart a true egalitarian, believing everyone deserved a fair go and was capable of real achievement."

Interviews with several of her children are included in Berkeley's retrospective volume, and it is clear that they all admired and appreciated their mother.[1] Gail described Marian as being "definitely Protestant ethic, New England, brought up with the idea that you work hard, and that's part of the purpose of life." Gail's twin brother, James, said that his mother was "very interested in development and always said that her kids were a lifetime experiment. . . I think she clearly had a lot of interest in parenting. . . My parents were scientists. We always say science was their religion. . . They had a very scientific approach to everything, and really believed in that. . . I think what they really wanted to impose on us was a rigor and an intellectual approach in the scientific way. . . You couldn't be superficial about issues. You really had to think it through. . . My mother was a trailblazer who didn't care about recognition. She just wanted excellence in everything."

Douglas, the youngest of the Koshland children, was asked whether his mother had influenced his decision to become a scientist: "My oldest sister is a writer, my next sister is a sculptor, my brother is a lawyer, and my next sister started out in physical therapy. When I showed an interest in science, my mom joked that . . . by the time she got to me she no longer had the energy to direct me elsewhere." He also said, "People were attracted to her because of her tremendous sense of fairness. . . She had extremely high standards . . . in all aspects—her social behavior, science, and everything. If you were going to do something, you were going to do it

right. . . She demanded [the same] of herself, so she wasn't being hypocritical. . . I think my mom was born with determination. . . she was a woman with tremendous energy, and a leader and a go-getter. Let's go. Let's do it."

The volume includes an interview with James's wife, Catherine, who graduated from Haverford and, like her mother-in-law, is a professor at the University of California and a member of the Board of Trustees of Haverford College. Catherine told the interviewer: "One of the things that Bunny had encouraged me to think about was not being afraid to do something somewhat unorthodox. . . She probably was the most important mentor in my life in terms of how to do this. Number one was not being afraid to take risks and go on a somewhat unorthodox path. . . There's an interesting combination there of risk taking and judicious selection of 'back water' problems. . . When Bunny went full time on the faculty at age fifty, she had enormous energy and enormous interest. She wasn't burned out. She was not ready to retire. She was ready to take the world by storm."

She also commented on Marian's understanding and appreciation of art and beauty. "[Bunny] could as easily have been in sculpture or landscape architecture as she could have been a scientist. . . She could have pursued some of those things with equal success. She cared a lot about her physical surroundings. She enjoyed having beautiful things. She didn't need a lot. She was the opposite of a pack rat. She never accumulated that much stuff. But what she did acquire or did choose to have around was beautiful. . . I think probably the most dramatic and extravagant expression in some way was her garden, which was really spectacular and to which she devoted a lot of time and energy and which was just an absolute pleasure to look at and a work of art. . . She loved arranging flowers. Like Bunny, her arrangements were highly controlled and very formal."

Marian was elected to the National Academy of Sciences in 1981. The citation described her as "an imaginative and original investigator who was among the first to employ biochemical methods to examine the immune response." She served on the Committee on Science, Engineering, and Public Policy; the Commission on Life Sciences; the Council; and the Committee on Election Procedures. She was the president of the American Association of Immunologists (1982-1983) and served on the association's Council and various other committees for many years. She was on the Executive Council of the American Academy of Arts and Sciences, the Fellowship Screening Committee of the American Cancer Society in California, and the Postdoctorate Fellowships Screening Committee for the Jane Coffin Childs Memorial Fund for Medical Research. She was on the National Science Board of the National Science Foundation, the National Council of the National Institute of Allergy and Infectious Diseases, the Interdisciplinary Cluster on Immunology and Microbiology of the President's Biomedical Research Panel, the Director's Advisory Committee of the National Institutes of Health, and the Allergy and Immunology Study Section of the National Institutes of Health. She was on the editorial boards of the Annual Review of Cell Biology and the Journal of Immunology, and she was an associate editor of Biochemistry and a regional editor of Immunochemistry. She published some 200 articles. She was the recipient of many honors and awards.

Marian died of lung cancer on October 28, 1997. The headline of the Daily Cal, the campus newspaper, was "Staff Recalls Biology Prof: Colleagues Knew Marian Koshland as 'Superwoman.'"

In 2004 the National Academy of Sciences opened its new Marian E. Koshland Science Museum around the corner from the Keck Center in Washington, D.C. The Koshland family endowed the museum in acknowledgment of Marian's inter-

est in and fire-in-the-belly commitment to public education about science. The exhibits are connected with reports that are produced by the National Academy of Sciences.

I visited the museum not long ago. It is a lovely, small museum, currently featuring exhibits on global warming and DNA technology. The installations are engaging, visually striking, intelligent, and elegant, much like Marian Elliott Koshland herself. It is a perfect tribute to her.

NOTES

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Many of the quotations in this biographical memoir are, as the text indicates, from conversations that I had with James Allison, Marcy Blackman, Elaine Hansen, Daniel E. Koshland Jr., Douglas Koshland, Ellen Koshland, Henry Metzger, Judy Owen, and Charles E. Wilde III.

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