

## Machi F. Dilworth

### How did you spend your career?

I was born and raised in Japan and did not expect to build my career in the United States. But here I am, contributing the story of my career as a Founding Member of the ASPB Legacy Society. How did this happen?

I attended a small liberal arts college in Tokyo called International Christian University (ICU). In my senior year at ICU, Bernard Phinney from the University of California, Los Angeles (UCLA), was in the lab of my adviser, Masayuki Katsumi, who did his doctoral studies with Phinney. Phinney was looking for a graduate student and invited me to come to UCLA. I accepted the offer after a strong recommendation by Katsumi. The biology program at ICU was a small group, and every year about a half of its students went abroad for graduate studies, so I was not an exception. That was in 1967.

Katsumi emphasized the importance of chemistry for biology students, and I took all the chemistry courses offered at ICU along with biology courses. I still remember studying hard for the physical chemistry course my junior year. It turned out that this training prepared me well for graduate studies at UCLA, as it was the pre-molecular biology era and biochemistry was at the forefront of biology then. One of the most interesting courses I took at UCLA was Physical Chemistry of Biological Macromolecules, and it gave me the basis to understand molecular biology later.

In 1971, I completed my PhD in plant physiology and biochemistry



at UCLA. My thesis topic was on the biosynthesis of gibberellins.

In addition to research, Phinney tried to help me come out of the traditional Japanese woman's mold. He kept telling me, "Speak up, Machi!" By my fourth year at UCLA, I was able to argue with him. Phinney also gave me an opportunity to meet many of his colleagues, one of whom was Jake MacMillan at the University of Bristol. Phinney and his family usually spent the summer in Bristol, and I joined them one summer and worked in MacMillan's lab. I became good friends with the Macmillans and some of the lab members, and we have stayed in touch to this day.

When I finished my degree, I was supposed to return to Japan, with the expectation that Katsumi would find appropriate employment for me. However, while at UCLA I met Greg Dilworth, and I married him the day after I submitted my thesis. I then moved to Michigan State University (MSU), where Greg was doing his graduate work in Bob Bandurski's lab.

Soon after arriving in East Lansing, I was offered a postdoctoral position in the MSU-DOE Plant

Research Laboratory (PRL). Hans Kende was my sponsor. My research focused on the hormonal control of nitrate and nitrite metabolism in germinating *Agrostemma* seeds. Hans was a great postdoctoral adviser. He did not micromanage us but was always there when we needed advice and when we did not even know we needed advice. At that time, PRL was a mecca for plant biology research, with Anton Lang as director and generous financial support from Bob Rabson's program at DOE. There were about a dozen labs at PRL, including those of Joe Varner and Jan Zeevaart, with a small number of graduate students and many postdocs and visiting scientists from around the globe. It was a magical place where people of diverse backgrounds could exchange ideas, and "Saturday afternoon experiments" were encouraged. I spent three years in Hans's lab, where my lab mates included Mike Sussman, Dick Firn, Gary Gardener, and Andrew Hanson. Tony Trewavas was there for a year as a visiting scientist. Toward the end of my tenure at PRL, I was put on a faculty search committee as a representative of the postdocs. Although the plan was to hire one assistant professor, PRL ended up hiring two, including Debbie Delmer. While Greg and I were at MSU, our first child was born, and I took maternity leave for a year.

When my husband completed his PhD, we agreed that one of us should follow the other, depending on who got a desired position first. This arrangement brought me to the University of Georgia

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(UGA), where there was a microbiologist with whom Greg wanted to work. Very soon after we arrived in Athens in the fall of 1975, I was able to find a research associate position with Leon Dure. Leon hired me literally off the street, despite the fact that I was visibly pregnant with our second child. My research in Leon's lab was to understand the regulation of amino acid metabolism in relation to storage proteins in germinating cotton seeds. It was around this time that Leon and Joe Key began promoting plant molecular biology. They invited Jeff Schell to UGA, and that is how I learned about the naturally occurring genetic engineering of plants by *Agrobacterium tumefaciens*. I was in Leon's lab for three years, minus six weeks of maternity leave.

At the end of 1978, we moved to a Washington, DC, suburb, as Greg had received a staff fellow's appointment at NIH to continue his research interest in the lab of Thressa Stadtman. I was optimistic about finding a position, as the area had a number of universities as well as several large public and private research institutions. However, it took me almost 11 months to find a position. Eventually, I was offered a research associate position from Beth Gantt at the Smithsonian Radiation Biology Laboratory (this lab closed in mid-1980s). In Beth's lab, I was part of her ongoing project to study the structure and function of phycobilisomes in *Porphyridium cruentum*. I did not stay long enough to produce a complete publication, but with a generous acknowledgment, Beth incorporated my results into a paper she later published. I

learned from Beth that by keeping one's priorities straight, a woman can have it all—a successful career as a scientist, a marriage, and a family.

In 1979, I made a career change from a researcher to a science administrator by accepting an assistant program director position for the Developmental Biology program at NSF. The person who hired me was Mary Clutter, who was program director for Developmental Biology at that time. Mary taught me everything I know about the job of a science administrator, including its impacts and pitfalls. She essentially made me shadow her for the first year, so I learned most of the lessons by observing her in action. Perhaps the most important lesson I learned is that if we keep science front and center and treat everyone equally in making our decisions, this job has the power to make a difference.

After working for two years at NSF, in 1981 I joined the USDA Competitive Research Grants Office (CRGO, a predecessor of the Agriculture and Food Research Initiative) as an associate program manager for the Genetic Mechanisms Program. As the CRGO grew, my responsibilities expanded to encompass a broad range of basic research in USDA's portfolio. CRGO's program director job is different from that at NSF in that the responsibility to manage each proposal review panel fell on panel managers, who were university professors and recognized experts in the subject matter of a specific panel. Having the opportunity to work with the very best scientists from all over the United States was the most exciting aspect of the CRGO job. Brian

Larkins, Bob Goldberg, Sam Levings, Ian Sussex, and Ralph Quatrano are examples of people I worked with.

In early 1990, Mary Clutter invited me back to NSF as a program director for the Biological Infrastructure Division; by then, Mary was assistant director for Behavioral and Biological Sciences (later the Directorate for Biological Sciences [BIO] after a reorganization). Mary brought me back to NSF specifically to work on the Arabidopsis plant genome program. I worked with fellow program officer DeLill Nasser to develop the Multinational Coordinated *Arabidopsis thaliana* Genome Research Project, followed by the international Arabidopsis genome sequencing program and finally the Arabidopsis 2020 Project.

Under Mary, BIO had a sabbatical system for program directors. I took advantage of it and spent nine months (1996–1997) at Riken, a large scientific research institute in Japan, as a visiting fellow with a fellowship from the Science and Technology Agency (a predecessor of the Japan Science and Technology Agency). My sabbatical project was to assess the status of biotechnology research in Japan, and I visited many universities, government laboratories, and industry laboratories across Japan, getting connected to Japanese scientists and science administrators in the process. Toward the end of this sabbatical period, there was a proposal back in Washington to create the National Plant Genome Initiative (NPGI). I remember spending many hours exchanging emails with Mary and others. Upon my

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return from Tokyo, Mary put me in charge of establishing the Plant Genome Research Program (PGRP) at NSF. The PGRP was part of the NPGI, and it was made possible through collaborations with USDA and DOE. USDA-ARS was especially helpful in providing an infrastructure for long-term maintenance of data and plant materials resulting from PGRP-supported research.

Mary retired from NSF in 2005. Soon after, I left BIO and became an accidental diplomat as a science and technology attaché at the U.S. embassy in Tokyo while I served as head of the NSF Tokyo Office (2007–2010). The Tokyo assignment gave me the opportunity to get connected to Japanese scientists and government administrators working toward increasing participation of women in STEM. After that, I came back to NSF and served as executive officer (acting) for Mathematical and Physical Sciences (2010–2011) and head of the Office of International Science and Engineering (2011–2012). This last position gave me an opportunity to visit Antarctica as a member of the NSF leadership visiting team.

I retired from NSF in June 2012 and joined my husband, who had been living in Hawaii since 2010. Then, I was asked to serve as the senior adviser for the Office of the Chancellor at the University of Hawaii at Hilo, which I did on a part-time basis.

In 2015, I came out of retirement to serve as vice president for gender equality at a new and unique university in Japan, the Okinawa Institute of Science and Technology Graduate University (OIST). OIST

represents a bold experiment by the Japanese government to show that there can exist a truly international and world-class science university in Japan. This opportunity came about as a direct result of the connections I had made while serving as head of the NSF Tokyo Office. My motivation for taking this job was twofold. One, I wanted to see this new endeavor succeed, and two, I wanted to contribute to the advancement of women in STEM in Japan. During the four years I was at OIST, I met many amazingly talented scientists and administrators. It was a once-in-a-lifetime experience to work with executives, faculty, researchers, students, and staff coming from 60+ countries, all sharing the same goal of making OIST a leading university in science and technology. Although I thoroughly enjoyed the experience, I felt that I was missing too much in my personal life. I was also beginning to feel my age for the first time. I retired from OIST in April 2019.

All in all, I have had a very satisfying career. Science administration is not the career I aspired to, but rather I accidentally happened upon it in my search for a permanent position within the metropolitan Washington, DC, area. I ended up making it my lifelong career, as I found that the position allowed me to fully use my research training, to expand my scientific horizons, and to contribute to the advancement of science, even though I could not work at the bench conducting original research or in academia teaching and training the next generation of scientists. I have no regrets for having pursued this career.

### What do you consider to be your most important contributions to plant science?

I was fortunate that my tenure as a science administrator coincided with explosive advances in biological sciences in general and plant biology in particular, including plant biotechnology in the 1980s, genomics in the 1990s, *-omics* and synthetic biology in the 2000s, and integrative biology in the 2010s. These topics provided funding agencies such as NSF with opportunities to create new initiatives and funding programs to support the plant science community. Two of the most rewarding initiatives I was involved in are the interagency and international Arabidopsis genome project that I coordinated and the Plant Genome Research Program that I was given the responsibility to establish. Although I cannot claim that I personally contributed to the spectacular outcomes of these initiatives, I am proud to have played a part in those efforts.

### When did you become a member of ASPP/ASPB?

I do not remember exactly when, but it was while I was a graduate student. I remember having to get Phinney's signature to qualify for a student membership. My guess is 1968 or 1969.

### How did the Society impact your career, and what motivated you to become a Founding Member of the Legacy Society?

ASPB had a major impact on my career. Not being a bench scientist, a science administrator may have difficulty staying connected to his

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or her scientific community. ASPB provided me with a home where I could feel a sense of belonging. For example, I was a member of the Publications Committee when *The Plant Cell* was being established, and I was its inaugural News and Views editor for a short time. Annual meetings provided me with the opportunity to catch up with people I had known and worked with before I left the laboratory, as well as to meet in person many applicants and awardees of the programs for which I was responsible. Both NSF's and USDA's competitive research grants programs are as good as the scientists who apply and receive grants and who serve on the review panels and advisory committees. Throughout my 33-year career as a science administrator, a countless number of ASPB members contributed their time and effort to keep these programs robust and relevant. So of course

I didn't hesitate to become a member of the Legacy Society.

### **What important advice would you give to individuals at the start of their career in plant science?**

I would tell them that plants hold the key to solving many of the challenges we face today. Joe Varner's favorite quote was, "Plants are primary." This is so true. Plants can exist without humans, but humans cannot exist without plants. Plant science is not a single field of science, so a career in plant science does not necessarily mean one must become a plant scientist. One could be a biomedical scientist, microbiologist, computer scientist, mathematician, physicist, chemist, materials scientist, marine scientist, soil scientist, etc., etc., and still study plants or plant processes that lead to new discoveries or unexpected applications to solve societal prob-

lems. History is full of examples in which a discovery was made first in plants—Mendel's law, Brownian motion, cell theory, the first virus isolated, the first enzyme isolated, etc., etc. In fact, there will likely be more opportunities for "plant scientists" to make such breakthroughs, as plants are generally ignored even within the field of biology.

I would further advise that if you choose to become a plant scientist in its traditional sense, keep an open mind to and keen interest in the broad area of the sciences. Likewise, if you become a non-plant scientist but are interested in plants, stay connected to the plant science community, including ASPB.

### **Academic Family Tree**

<https://academictree.org/plantbio/tree.php?pid=806286>