Jane Shen-Miller

How did you spend your career?

After hearing a story at the age of eight about my plant-breeder aunt, Shen Li Ying 沈骊英, China's "Sage of Wheat," who helped solve the nation's food supply problem during World War II, I wanted to become a farmer. I was accepted to the Horticulture Department at Colorado A&M (now Colorado State University) in spite of the lack of accommodation for female agriculture students in the 1950s. I obtained a BS from Washington State College (now Washington State University), notwithstanding the warning of a professor that "no farmers would listen to a girl county agent." In 1959, when I received my PhD from Michigan State University (MSU), the announcer at the podium loudly beckoned "Jane Yippee [Yupei] Shen"; the enthusiastic mispronunciation of my name broke the solemnity of the graduation ceremony.

In 1960, with a U.S. Atomic Energy Commission (now DOE) postdoctoral fellowship from the Argonne National Laboratory (ANL), I collaborated with radiobiologist Solon A. Gordon on transport of the plant hormone auxin in phototropism. The ANL Biomedical Division had a unique walk-in spectrograph that split a tungsten light source into a rainbow with a linear dispersion of 0.1 mμ/mm, enabling study of the action spectra of plant growth and tropistic response. At the ANL, Gordon, together with other scientists, designed and built innovative clinostats for the study of plant growth under simulated

weightlessness. In 1963 we selected the little-known weed Arabidopsis as our first test subject.

As an ANL plant biologist in 1977, a time when plant science was being nationally promoted, I was drafted by NSF to join the Metabolic Biology Program as associate program director. Through efforts of various ASPP members from universities and federal agencies, the Farm Bill passed by Congress in 1977 stipulated establishment in 1978 of a USDA competitive grants program for funding research specifically in photosynthesis and N_2 fixation. In 1978, before normalization of U.S.–China diplomacy, I went with a delegation from the Botanical Society of America to visit the People's Republic of China.

In 1980, I joined the University of California, Los Angeles (UCLA), Department of Chemistry and Biochemistry, where I served until 1985 as a research chemist, collaborating with Charles A. West in 1982 on investigation of ent-kaurene biosynthesis in the gibberellin pathway. I was then appointed to the UCLA administration as assistant vice chancellor for research, serving from 1984 to 1987.

I had multiple research sabbaticals (on leave from UCLA): in 1980 at Wageningen Agricultural University in The Netherlands, working on the role of xanthoxin in phototropism; in 1988 at the Royal Postgraduate Medical School and Rothamsted Experimental Station in the United Kingdom, working on in situ hybridization of ß-amylase; in 1998 at the University of Regensburg in Germany, working on thermostable proteins of long-living lotus fruits; and at UCLA in 1995 and 2003, working on lotus protein repair and sequencing of its heat-stable proteins.

I taught students at the University of Illinois at Chicago as a visiting professor. At ANL and UCLA, I mentored the research of dozens of undergraduates, graduates, postdoctoral students, and a Rhodes Scholar, as well as grade-school students, who adopted the lotus plant of my study into their official textbook. Many of my students achieved in academia, nationally and internationally. The Rhodes Scholar, who prepared an elaborate feast before leaving for a PhD program at Oxford, became the founding dean in nutrition at a university in Quito, Ecuador. A UCLA undergraduate who worked with me on lotus research (2017–2019) plans to pursue a career in medicine.

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What do you consider to be your most important contribution to science?

Using the ANL two-dimensional-rotation clinostat (2π), we derived the threshold force for the gravitational plant response under simulated weightlessness: ~10^{-2} × *g* for shoots and 10^{-3} × *g* for roots (1967). These force limits governing weightlessness used in NASA's spacecraft design of pitch, roll, and yaw are still being consulted by space researchers. The finding of plant growth inhibition and alteration of nucleolar morphology under simulated weightlessness was tested in space flight on the International Microgravity Laboratory-1 mission STS-42. The data similarly showed nucleolar variation (1995).

Our finding of blue-light inhibition of basipetal auxin transport in shoots (1964–1974) remains today a molecular exploration in phototropism. We initiated the study of organellar response to gravity, namely the Golgi apparatus, mitochondria, microbodies, and plastids. Our observation that auxin might increase activation of the Golgi apparatus (via vesicle production; 1974, 1977) suggests also that this activation might have differentially enhanced cell wall accretion in tropism.

Wild-type Asian lotus *(Nelumbo nucifera* Gaertn.) has become my research focus in retirement as a senior scientist at the UCLA Center for the Study of Evolution and the Origin of Life, Department of Earth, Planetary, and Space Sciences. Lotus fruits have exceptional longevity, with the record holder having germinated after 1,300 years and still the oldest living directly ^{14}C-dated fruit known (1995, 2013). I have made numerous visits to the ancient peat bed where the parent lotus fruits were grown in Liaoning Province, Northeast China (formerly Manchuria), where I collected more lotus fruits. ASPP's inaugural president, Charles A. Shull, was familiar with this fruit, calling it the "Manchurian lotus," and in 1955 he compared it to ASPP, having been dormant, as in the ancient Manchurian peat bed, and waiting for germination. ASPP became ASPB and will celebrate its centennial in 2024, well on its way to match the thousand-year germination of the lotus fruits.

Nelumbo is a wonderful example of Darwinian natural selection. If a stand of lotus is destroyed by a natural disaster (such as the earthquakes that destroyed the ancient Manchurian lotus lake), its rhizome population is replaced by germination of its long-living fruits. The genome of *Nelumbo* has been sequenced in a study led by Ray R. Ming at the University of Illinois (2013), whom I met at the 2008 ASPB meeting in Mexico. Its ~1 Gbp genome could contain universal survival information for all biota. Its unique genetic traits, some now elucidated, await further investigation. Its fruits have shown full germination after heating at 85°C for 60 minutes (in replicated trials), and its thermostable proteins (100°C) have been sequenced and identified (2013).

When did you become a member of ASPP/ASPB?

I joined ASPP in 1960 after my MSU professor, Frederick G. Teubner, introduced me in 1958 to the meetings of the Society. In 2018, I received the same Charles Reid Barnes Life Membership Award as my grand mentors, Andrew E. Murneek and Felix G. Gustafson.

At my first ASPP meeting, I was thrilled to hear a lecture by A. Carl Leopold, as his book *Auxins and Plant Growth* had been helpful in my research, and to see the other "hormone greats," Folke K. Skoog, Kenneth V. Thimann, and Johannes van Overbeek. At Overbeek's retirement in 1978, I was invited to speak at Texas A&M. I contacted each of the above greats, plus more, who shared stories of Jan van Overbeek's time at Cal Tech, where U.S. "hormonology" originated. My five-minute talk extended to 40 minutes. In the *Avena sativa* spirit, the venerable Frits W. Went sent "Van O" (the name adopted for Overbeek by James Bonner) his camaraderie.

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

I served on the *Plant Physiology* editorial board from 1972 to 1977. Attending the ASPP/ASPB regional and national meetings became a yearly outing. In my research, I have collaborated with numerous ASPP/ASPB members, not only my three mentors (Teubner, Sylvan H. Wittwer, and Gordon), but also many others from UC Berkeley,

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UCLA, University of Illinois, University of Pennsylvania, USDA, Washington University in St. Louis, and more. I also interacted and collaborated with ASPP's international luminaries, including Leslie J. Audus and Jake MacMillan (U.K.), Lloyd T. Evans (Australia), Jan E. Graebe (Germany), and many more. My 60-year journey with ASPP/ASPB has nourished my science.

To become a member of the ASPB Legacy Society is a sure way to solidify the foundation of our Society, especially in support of upcoming plant scientists. For me, to be a Founding Member of the Legacy Society is a way of expressing my appreciation for what I have reaped from ASPP/ASPB.

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

I attend scientific meetings with the philosophy that whether or not travel support is provided, supporting oneself makes it all the more worthwhile (but never penalizing oneself for missing opportunities to acquire new knowledge and present lectures). "Nature is not compartmentalized" is an observation promoted by UCLA geologist-paleobiologist J. William Schopf (my spouse), who organized the innovative campuswide Wednesday Evening Evolution Group, a weekly dinner–discussion led by interactive scholars of diverse disciplines from near and far. This realization has led me to value cross-disciplinary learning, conversation, and collaboration. It is important to be broad, generous, and passionate about your science. My fellow ASPB members: do your best to make every workday a happy day, as you fulfill your journey with ASPB. And always bear in mind,

"Forget not the spring from whence your thirst is quenched!"

—Chinese Proverb

Academic Family Tree
https://academictree.org/plantbio/tree.php?pid=808666