

## ASPB Pioneer Member

### Hans Bohnert

Hans J. Bohnert was born September 8, 1944, in Heilbronn, Germany, which is about 45 miles SE of Heidelberg. Following the devastation of WWII, his parents did their best to raise Hans and his younger brother. Even at a very young age, Hans was strong-willed; for example, he refused to attend Kindergarten due to its rigid class structure and supervised playtime. He was much happier spending time with his grandfather, helping him tend to his garden and orchard. Hence his life-long passion for plants and early desire to be a forester.

In the shadow of the ornate 16<sup>th</sup> century astronomical clock at City Hall in Heilbronn, Hans was always comfortable expanding on the concept of time (especially for his researchers many years later)! In first or second grade, Hans stubbornly insisted there should be 100 seconds to a minute and 100 minutes to an hour, following the conventions of the metric system. Even though regularly beaten with a stick, Hans continued to rebel. In one of his upper-level classes in high school, Hans refused to actively participate in a math class taught by a new teacher who was formerly a Nazi. It was agreed during a meeting between the school principal, the math teacher, and Hans and his parents that Hans would remain silent in class. Even though he would not be called upon, he was still required to attend class and take all the written exams. Never



content with such boredom, Hans decided to read Margaret Mitchell's "Gone with the Wind" during math class.

In 1966, starting his first semester at the University of Heidelberg, Hans had no clear idea of what to study. Selecting a psychology class, he quickly discovered that subject was not right. Visiting other classes recommended by students, he searched and searched for something interesting and motivating. That day finally arrived after he listened to a lecture by Prof. Dr. Franz Duspiva, Zoologisches Institut, who taught biology – zoology, to be precise. That was it! Despite spending a great deal of time in school studying human biology, a single lecture by an unknown lecturer convinced Hans to turn his attention to botany and plant physiology. Continuing at the University of Heidelberg, Hans obtained his Staatsexamen, Diploma, and lastly his Ph.D. (Biology, Chemistry,

and Biochemistry) in March 1972; his dissertation was entitled: *Nucleic acids from mitochondria of Acanthamoeba castellanii, their expression during growth and development*. During his studies, Hans served concurrently as a Research Assistant within the Zoologisches Institut at the Universität Heidelberg,

In March of 1972 Hans began a postdoctoral fellowship at the Max-Planck-Institut für Zellbiologie, Ladenburg, until September, afterwards becoming a Wissenschaftlicher Assistent at Universität Düsseldorf, Botanisches Institut. In 1977, he successfully completed his Habilitation (which Hans refers to as an anachronistic "rite of passage") in General Biology in the Faculty of Sciences at the Universität Düsseldorf. It was during this time that Hans made friends with the very talented and dedicated people in the Universität Düsseldorf "glass lab". who made whatever gadget, flask, container, or bottle scientists needed." Hans and his family continue to cherish the glass items those artisans made for him.

Until June 1982, Hans was a fellow at the European Molecular Biology Laboratory (EMBL) in Heidelberg; he was at the MPI Züchtungsforschung Department with Jeff Schell in Köln until April 1983. In May 1983, Hans moved to the Department of Biochemistry and Molecular Biophysics at the University of Arizona (U of A) as an Associate Professor and was

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promoted to Professor in July 1989. When Hans interviewed for the Associate Professor position at the U of A, and probably as a courtesy, he visited with several members of the Plants Sciences Department, including Dr. Frank Katterman and his graduate student, John Thomas. During his interview, Hans enthusiastically discussed the recent evolutionary evidence for genomic exchange between organelles and the nucleus. It seemed DNA was quite literally “flying around” inside plant cells!

Hans’ lab at the U of A on the fifth floor of the BioSciences West Building was not your typical workplace. While he probably would not admit it, Christine Michalowski expertly attended to the careful management of lab resources, procedures, and ordering. One of the early undergraduates in Hans’ lab, Eric DeFrancis, created the Bohnert lab logo depicted below. Hans’ facial expression is spot on.

In Tucson, visiting scientists often dropped by for brief or more extended sabbatical-like visits. They included Dr. Carl Price (Rutgers University), Dr. Jurgen Schmitt (Botanisches Institut der Universität, Würzburg), and Dr. Wolfgang Loeffelhardt, (University of Vienna), among many others. Together with graduate student Bob Ramage and Postdocs Bernd Reiss and Kathy Wasmann, Hans led the research charge, while managing publications and grant proposals as well as his other academic responsibilities.

A typical day in the Bohnert lab usually included Hans’ preparation of extremely strong coffee (Peets) around dawn, lab meetings, and regular grant award or birthday celebrations. While listening to NPR, referred to as “all things repeated”, lab members were often given a manuscript to review for *Plant Physiology* or some other journal (due by 9am the next day).

One particular day was quite extraordinary. Hans was a bit irritable, exclaiming that non-crop plants might contain molecular secrets for us to discover, but most scientists had to focus on crops to justify research support. But which non-crop plant was best? Hans vanished in the morning to comb through books and journals in the Science Library. The normally sedate fifth floor BioScience West hallway, crowded (illegally) with bicycles of various lab folks, was suddenly awakened as Hans appeared around 1:30 PM. Pacing back and forth and waving a photocopy high in the air, Hans made quite a ruckus. The paper by Klaus Winter described the C<sub>3</sub> photosynthesis to crassulacean acid metabolism (CAM) switching and the remarkable stress tolerance displayed by the “ice plant”, *Mesembryanthemum crystallinum*. That was it! Around this time, Hans was an Associate Editor on the Editorial Board of *Plant Physiology*. He also served as the Program Director of Integrative Plant Biology at NSF from 1995 to 1997.

When Hans began his career, his research focused on how

proteins are imported into chloroplasts. Besides several key scientific publications, he authored a patent describing how transit peptides can be used to introduce heterologous proteins into the chloroplast. After moving to the USA, Hans’ research direction evolved to embrace the harsh Sonoran Desert environment that surrounds Tucson, AZ. There, drought stress and salt tolerance are essential plant adaptations. Along with his longstanding interests in photosynthesis and chloroplast biology, Hans incorporated research on drought tolerance and salt stress biology. His publications and collaborations, including work with his colleague, Richard Jensen, played to this interest. Hans and his collaborators dissected the expression of genes in pathways intersecting carbon-flow and stress biology, resulting in publications describing the biochemistry, molecular biology, and evolution of Rubisco and PEPcase.

Hans early research on plants that live in extreme environments focused on the unique C<sub>3</sub> to CAM photosynthesis-switching halophyte, ice plant (*Mesembryanthemum crystallinum*). Later, his attention shifted to a salt tolerant cousin of Arabidopsis, salt cress (*Thellungiella halophila*). These studies revealed the diversity of mechanisms utilized by plants to create salt tolerance, including water channels, sensing and signal transduction, and synthesis of alternative sugar alcohols such as sorbitol and ononitol-pinitol. Never

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content with simply describing molecular mechanisms of stress adaptation, Hans applied genetic engineering to test the role of specific genes in the drought tolerance strategies of glycophytes. Among his notable publications on this topic was a paper with Mich Tarczynski, Richard Jensen, and several others (*Science* 259: 508-10. PMID 17734171 DOI: 10.1126/Science.259.5094.508), that demonstrated gene expression and water maintenance as key facets regulating salt/drought stress in higher plants.

Hans' publication record reflects the diversity of research topics he explored:

1. Expression of environmentally induced genes and proteins;
2. Engineering of plants for increased salinity stress tolerance;
3. The biochemistry and molecular biology of Rubisco and PEPcase, and the evolution and expression of genes for pathways involved in plant carbon allocation;
4. Definition of promoter elements controlling cell-specific gene expression;
5. Functional analysis of genes affecting inositol and C1 carbon metabolism in plant salinity and drought stress tolerance; and
6. Multi-gene transfer vectors for engineering metabolic pathways.

One clearly important publication, *Plant cellular and molecular responses to high salinity*, was written

by Hans, together with R Bressan and Jain Kang Zhu, for the Annual Review of Plant Biology (2000) 51: 463-499. PMID 15012199 DOI: 10.1146/annurev.arplant.51.1.463. It has over 6000 citations and is a bedrock reference for research in the field of plant stress biology. This inclusive review set the stage for the next generation of Systems Biology, where pathway interactions helped establish the diverse research approaches used in the plant world.

Ray Bressan recalls his experience working with Hans. He met him in 1985 at a NATO meeting in Norwich, England. Hans was quite excited about his new project on *Mesembryanthemum*, but no one at the meeting was the least bit interested in halophytes. True believers, Ray Bressan and Andrew Hansen were convinced Hans was going to change the direction of stress biology research. Later, Ray spent a sabbatical in Tucson, writing two successful research proposals at a desk right outside Hans's office. Thus began their thirty-year collaboration with Ray often trekking to Tucson. Once, Ray stayed with Hans while his wife, Regina, was visiting Germany. Arriving late from Europe, Wolfgang Loffelhardt also showed up at Hans' home. Hans, of course, was still working in the lab. Ray and Wolfgang searched the refrigerator for something to eat, only to find some yogurt and a half bottle of wine. "Without Regina, Hans is living like a Monk," exclaimed Ray. Wolfgang replied, "No way, No way! A Monk lives much better than Hans!" Years later, after

Hans had moved to the University of Illinois, Hans and Ray continued their collaborations for five years in South Korea, where they shared their knowledge of plants with Korean scientists. Employing Pearson coefficients and zillions of insertion mutants, their studies in Systems Biology confirmed that everything is indeed connected to everything!

The year 2001 heralded Hans' move to the Department of Plant Biology & Department Crop Sciences at the University of Illinois in Champagne-Urbana (UIUC), where he worked until his retirement July 2011. While at UIUC, Hans held several prestigious positions, including Interim Director of the Keck Center for Comparative and Functional Genomics, Director of the Graduate Program in Plant Mol. Physiol. & Biochem., Faculty Fellow in the Institute for Genomic Biology (IGB), and Director of the Center of Comparative and Functional Genomics. In addition, Hans held a visiting professorship at Gyeongsang National University, Jinju, Korea, and was a visiting scientist at the King Abdulla University of Science and Technology (KAUST), in Jeddah, Saudi Arabia.

Hans was a prolific scientist. Research Gate Publications reports 373 peer-reviewed publications, but this list is no doubt incomplete, as many reports, book chapters, and research abstracts were likely not counted. Other professional honors bestowed

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upon Hans include a Heisenberg Fellowship from the Deutsche Forschungsgemeinschaft; the Research Scientist Award from the College of Agriculture, University of Arizona; and a Senior Research Fellowship from the Smithsonian/Carnegie Mellon Foundation. He was both an ASBMB Fellow and a Pioneer of ASPB.

After he retired, Hans and Regina returned to Tucson, AZ,

where he spends time keeping Javalina (small but ferocious peccaries) out of their beautiful desert botanical garden. One of Hans' favorite sayings to those in his group was "If the day is not enough, take the night." Hans helped us all expand our concept of time as we continue to progress as productive members of the Plant Biology community. We are delighted at Hans' recognition as a Pioneer of the American Society for Plant Biology.

