Hans Jànos Kende

Hans Jànos Kende, a University Distinguished Professor Emeritus in the DOE Plant Research Laboratory (PRL) and the Department of Plant Biology at Michigan State University, East Lansing, died September 26, 2006, at the age of 69. Hans was widely known for his work on the biosynthesis and mode of action of plant hormones. In addition to being an excellent plant scientist, Hans had a strong sense of community and was a vigorous promoter of plant biology at Michigan State as well as at national and international levels. He was recognized worldwide as an elder statesman in plant science.

Jànos was born in Székesfehérvár, Hungary in 1937. A happy, comfortable life was interrupted in 1941, when his father was sent to forced labor camp as part of the Hungarian army, where he died in February 1943. In 1944, after Germany invaded Hungary, Jànos and his mother were evicted from their home and sent to a ghetto, then to the local brick factory to await deportation. When the train of boxcars arrived, thirty people, including Jànos, his mother, and a few relatives, were called forward from the group of nearly 3,000 people. This fortunate group of thirty was taken to Budapest instead of Auschwitz, where the other people were immediately exterminated. In Budapest, Jànos and his mother became part of a group that was to be sent to a neutral country as a "good-will" gesture by the Germans to support the rescue negotiations of Rezso Kasztner and Joel Brandt with Adolf Eichmann. The group, however, was first taken to Bergen-Belsen, where Jànos and his mother were kept for over six months until their rescue from almost certain death (due to starvation and disease). They were finally transported to Switzerland at the end of December 1944, where Jànos was given the name "Hans." His ordeal was not over, for after a few days, the children were separated from their mothers and sent to children's homes. This painful separation lasted almost three years for Hans, until his mother remarried and he could join her in Zurich. Although he had taught himself to read and write in Hungary, he had little formal education. One source of delight for Hans was learning the *Odyssey* by heart from a scholar at the children's home. In Zurich, Hans was enrolled in fourth grade and quickly made up for the slow start in his formal education, becoming the first student of that elementary school to pass the entrance exam to the Gymnasium.

When he was 16, Hans met Gabriele Guggenheim, who was to become his lifelong partner. They married in 1960 and, over forty years later, Hans related that not a day had gone by that he wasn't happy since they had gotten together.

Hans chose his field of study with care, as he did so many things in his life. When Hans and Gaby decided to live on an Israeli kibbutz after their marriage, Hans contacted the kibbutz and asked what skills were needed. The answer: agriculture and dietetics. Hans put aside his interest in becoming a brain surgeon (a decision he never regretted) and delved into plant science, while Gaby studied dietetics. In fact, they never made it to that kibbutz, which, fortuitously for the field of plant science, had changed the direction of this gifted scientist.

Hans earned his Ph.D. in 1960 from the University of Zürich. His research was focused on the biosynthesis of trigonellin in the coffee plant. His first postdoctoral work was with A.S. Holt at the National Research Council in Ottawa, Canada, where he studied chlorophylls in green photosynthetic bacteria. It was not until he moved to Caltech in 1961 as a postdoctoral research associate with Anton Lang that he started to work in the area of plant growth and development, the area in which he would make many major contributions.

Hans made his first major discovery while working at Caltech with gibberellins. In the 1950s, a group of chemicals known as growth retardants had been described; these chemicals caused dwarfing in plants, but their mechanism of action was unknown at that time. Hans tested the hypothesis that these chemicals inhibited gibberellin biosynthesis. Gibberellins in green plants were still poorly understood, so Hans chose to study the fungus *Fusarium moniliforme*, which produces copious amounts of gibberellin. His results demonstrated that growth retardants block gibberellin biosynthesis in the fungus, and later work showed that this is also the mode of action of the growth retardants AMO-1618 and CCC in green plants. This example illustrates Hans's approach to research throughout his career: he always asked specific, important questions and then selected the most suitable biological system in which to look for an answer.

During his two years (1963-'65) at the Negev Institute for Arid Zone Research, Hans focused on the role of cytokinin in senescence. He and collaborators showed that cytokinin is produced in the roots and transported to leaves, where it prevents leaf senescence. Thus, cytokinin could be assigned the role of Chibnall's hypothetical root factor. After joining the PRL in 1965, Hans continued his studies on the role of cytokinin in delaying senescence. During a sabbatical leave in Switzerland, he initiated work on the rapid senescence of morning glory flowers. This work resulted in a series of publications on the role of ethylene in the fading of flowers. It was established that ethylene regulates senescence by positive feedback, as evident from the observation that brief exposure to exogenous ethylene strongly induces endogenous ethylene production. Ethylene is derived from methionine and shortly after the discovery, by Shang Fa Yang's lab, that the immediate precursor of ethylene is 1-aminocyclopropane-1-carboxylic acid (ACC), the Kende lab quickly developed a chemical assay for ACC. This assay became widely used around the world.

Hans's group was the first to purify ACC synthase from tomato fruit tissue and to generate monoclonal antibodies specific for ACC synthase. Wound-induced ACC synthase proved to be synthesized *de novo* and to be the rate-controlling enzyme for ethylene synthesis. When molecular biology techniques came on the scene, Hans's lab quickly adopted them to isolate a cDNA clone encoding ACC synthase. They then used this clone to demonstrate that ACC synthase is encoded by a small gene family whose members are differentially expressed during wounding. Hans and his colleagues continually adapted their approaches as new techniques became available; his work on ethylene shows a remarkable transition from physiological to biochemical to molecular approaches.

As a postdoc, Hans had found that dark-grown dwarf peas were much more responsive to applied gibberellin than light-grown seedlings. This kindled Hans's life-long interest in plant hormone receptors. During his early years at the PRL, he synthesized cytokinin and gibberellin of high specific activities, but failed to detect specific binding by classical biochemical methods. Much later, Hans saw the possibility that hormone receptors might be found in Arabidopsis by isolation of hormone-insensitive mutants. In collaboration with Somerville's lab a screen for ethylene response mutants was designed. The picture of the ethylene-insensitive *etr* mutant seedling towering above a canopy of dwarfed seedlings, whose growth is suppressed by ethylene, is a classic one that has been widely reproduced. This work led in turn to isolation of the *ETR* gene (in the Meyerowitz lab). Subsequent work demonstrated that the *ETR* gene encodes an ethylene receptor, the first plant hormone receptor to be identified.

Hans's lab initiated pioneering work with the semi-aquatic plant deepwater rice, in which ethylene has a growth-promoting effect – quite the reverse of its effect in terrestrial plants, where it inhibits growth. Hans's group unraveled the chain of events that leads from submergence to accelerated growth. Three hormones – ethylene, abscisic acid, and gibberellin – participate in response to changes in the internal gas composition. Low oxygen tension promotes ethylene synthesis, which reduces the level of abscisic acid and stimulates synthesis of gibberellin, the immediate growth-promoting hormone. Elongation of internodes is based on increased cell division in the intercalary meristem and subsequent elongation of these newly formed cells. Cell expansion is made possible by relaxation of the cell wall, and this cell-wall loosening is at least partially mediated by expansins. Further evidence in support of the role of expansins in growth and development was obtained with transgenic plants over-expressing *EXPANSIN* genes. Such transgenic plants grew taller, whereas antisense plants shorter than control plants. Another important finding in the work with deepwater rice was made by Hans's graduate student Ilya Raskin, who showed in elegant experiments that aeration of partially submerged leaves takes place by mass flow through air layers along the leaves. Until this seminal work, aeration had been thought to occur through internal air spaces.

Hans received numerous honors for his outstanding contributions to science, including election to the German Academy of Natural Sciences, Leopoldina (1985), to the American Association for the Advancement of Science (1990), and to the National Academy of Sciences, USA (1992). He was awarded a University Distinguished Professorship at Michigan State University (1990) and the Stephen Hales Prize from the American Society of Plant Physiologists (1998).

Hans was a dedicated advocate for plant biology. For example, when in 1998 the Nobel Prize for Physiology or Medicine was awarded for "*nitric oxide as a signalling molecule in the cardiovascular system"*, representing a new principle – signaling by a gaseous molecule – Hans was quick to point out in a letter to *Science* that plant biologists had discovered ethylene as a gaseous signaling molecule much earlier.

Hans served the plant sciences, and science in general, in many different ways: as a member of grant review panels and journal editorial boards, as a representative on

national committees—including the American Society of Plant Biologists (formerly Plant Physiologists), and on many committees for the National Academy and the National Research Council. Hans was an effective member of the Board of Trustees of ASPB during the critical period when the Society was in transition from a semi-volunteer to a professional organization. He also chaired the Membership Committee of the Society, which led to a significant increase in the membership. Hans further promoted the plant sciences during the early 1990s when funding was dismal: he took the initiative in organizing groups of plant biologists to meet in Washington D.C. with congressional delegations to request increased funding for agencies that supported plant biology.

Hans is survived by his wife Gaby, sons Benny (Pamela) and Michael (Caroline), daughter Judi (Rael Mazansky), and seven grandchildren. Hans was a kind and giving person with high professional standards and a keen sense of humor. Few of his colleagues would be unable to recall an occasion that was made memorable by Hans's sparkling wit. He was always generous in giving credit to his associates. His altruism in helping and promoting others, especially younger colleagues, is legendary.

More than anything, Hans enjoyed spending time with his family. He and Gaby often traveled to Switzerland, their "other home," for hiking or skiing in the Alps, and visiting friends and family. A passionate fan of classical music, he often scheduled his vacations to take greatest advantage of Europe's summer music festivals. Hans put much effort into taking care of his health, taking care of his family, and planning for a full and active retirement. It is unfortunate that he wasn't given more time to enjoy it. He is greatly missed by his family, friends, and colleagues, but his legacy lives on through his published work and through the careers of the associates and students he mentored.