My Science Pilgrimage

Yasuyuki Yamada, Professor Emeritus, Nara Institute of Science and Technology

Most scientists can point to several important milestones in their careers. Looking back on my journey through the realm of science, I find there have been five important turning points.

The first was the period from 1962 to 1965 that I spent as a Fulbright Research Associate at Michigan State University (MSU). In the Department of Agricultural Chemistry at Kyoto University I had been studying foliar absorption of nutrients, in particular ion penetration through isolated cuticular membranes. As I was the only graduate student in our laboratory who was interested in this topic, I felt that I needed to be in more motivating surroundings. So, I decided to go abroad to study plant sciences in a place that would offer a stimulating atmosphere. I wrote several application letters. The first response came from MSU offering a postdoctoral fellowship with a stipend of $6,000 per year, and I decided to take their offer. MSU, however, could not provide travel funds, but I was fortunate in being able to pass the examination for a Fulbright travel grant.

That is how my first experience of foreign living came to be in the midwest of the United States—in East Lansing, Michigan. The experiences that I had at MSU changed many of my ideas about life, and I found myself viewing things with wider eyes and a much more open mind. I believe that this opportunity to expand my understanding of the world by living in another country helped sharpen my perceptions and understanding of science as well as broadening my personal outlook.

At that time, I was interested in constructing a cuticular membrane model of the leaf based on the use of green leaf mesophyll cells. I began by using macerating enzymes to isolate mesophyll cells. These experiments failed because the isolated cells always became contaminated with bacteria during the absorption experiments. Therefore, I decided to experiment with tissue culture techniques in hopes of being able to get sterile, cultured green cells and began tissue culture of tobacco in order to obtain large amounts mesophyll cells. This was productive and was the basis for the later successful photo-autotrophic culture of green cells in liquid suspension.

By the time I returned to Kyoto University in 1965, my research interests had taken a new turn, now being focused on the then novel area of plant cell and tissue culture. I was one of only about a dozen scientists in Japan working in this area. My aim was to succeed in the tissue culture of monocot plant cells and protoplasts, one of the most difficult subjects in this area.

Over time, I and my group of students and visiting researchers succeeded in inducing callus from the rice (*Oryza sativa*) and oat (*Avena sativa*) using completely synthetic media and an extremely high concentration of auxin. This led to the regeneration of viable plants from rice and oat callus at a time when redifferentiation and plant regeneration from monocot calluses was still a rarity. This was the second stage in my science career.

On reflection, had I not gone to MSU, I might have continued with the familiar (foliar absorption) and never ventured into what was then research of unknown value. My time and studies in the United States taught me to value challenges and change and led to my entering what was to become an area of great consequence in plant cell biology.

At Kyoto University, each laboratory had one full professor, one associate professor, and two instructors (equivalent to assistant professors in the United States). Only if the full professor retired or moved could the associate professor be promoted. By 1967, I had become an associate professor, but as the full professor was only four years older, there was little chance of promotion in that laboratory. Then, in 1982, the Ministry of Education and Science together with Kyoto University established a research center for plant tissue and cell culture to house our group, and I became a full professor. Having a facility devoted solely to our research interests made possible intensive work, resulting in some major contributions.

During the late 1970s, our group had proved that cultured plant cells are heterogeneous for the formation of chloroplasts and secondary metabolites and that to obtain cells that yield large amounts of desirable products, it is essential to select specific cells capable of producing those products. This led to a part of our research moving into the area of plant biotechnology. We were able to establish basic jar fermentation systems that made possible the commercial production of large amounts of useful alkaloids and pigments. Before this, there was general belief in the homogeneity of cultured plant cells, but we confirmed that to express a specific function, specific cells must be selected and cultured.

Based on our understanding of the difference in potential shown by cultured cells of the same type, our research on secondary metabolites resulted in...
several breakthroughs. We established a number of cell lines that produce large amounts of isoquinoline and tropane alkaloids. Using these cell lines, we studied the regulatory mechanisms that govern secondary metabolite biosynthesis in cultured plant cells and roots. Our research interests now extended to the pathways that control metabolite biosynthesis, taking us into the area of molecular biology. During this period we collaborated domestically and internationally on a number of exciting and successful cutting-edge research projects.

This was the third major period in my career. It taught me to persevere even when circumstances at first appear unlikely or difficult.

The year 1991 brought the fourth turning point in my science journey when I was asked to take part in the planning and establishment of a new graduate school university, the Nara Institute of Science and Technology. While helping in its organization, I realized that this novel institution would provide a flexible, challenging sphere for creative plant research. The new university’s staff had been gathered from different types of universities and industries to ensure the availability of wide-ranging, on-going, imaginative topics of research.

Therefore, in 1994, I moved there with half of my laboratory group, and we continued with secondary metabolite research. Some of our researchers took up crystallography studies, others gene analyses, which provided new ways for us to deepen our investigation of plant metabolism.

The year 1997, when I was elected president of the Nara Institute of Science and Technology, ushered in the fifth stage of my journey. During this period, I was privileged to be able to contribute on the administrative level to the university’s further development. At the end of March 2001, I retired as president. Reflecting on those four challenging years spent as an administrator, I am proud to have been a part of bringing about still further revolutionary changes in teaching and research. It has been my good fortune during my science pilgrimage to have had a career in which the successes in research, teaching, and administration have far outweighed the failures. I wish the same for you in your journey.

Yasuyuki Yamada
Professor Emeritus
Nara Institute of Science and Technology
8916–5 Takayama
Ikoma City, Nara 630–0101, Japan