Tien Chioh Tso

T.C. Tso

1917–2013

Dr. T.C. Tso or as he was called, T.C., passed away April 9, 2013 in Silver Springs, Maryland. He was born half a world away in Hubei Province, China. He is survived by his wife of 63 years, Margaret, children Betty and Paul, two grandchildren, and two sisters living in China. T.C. came to the United States in 1947 to study tobacco biochemistry with Professor C.O. Jensen at Penn State University. With his brilliant mind, extreme motivation and dedication to long hours of work T.C. completed the requirements for his Ph.D. in only two years. Following a post-doctoral position at General Cigar Research Laboratories he joined the United States Department of Agriculture as a tobacco scientist/plant physiologist at the Beltsville Agricultural Research Center in Beltsville, Maryland in 1952 and remained with USDA at Beltsville for the rest of his career. T.C. retired from USDA in 1983, but maintained an active office at Beltsville until near his death. It was from this base that he became the leader in the field of health effects related to tobacco use and was instrumental in getting many agencies and institutions working together on this issue, including other branches of USDA, National Cancer Institute, American Cancer Society and American Health Foundation. He was the leader of a Congressional mandated tobacco and health research program with emphasis on the plant and smoke with much of the research done at the University of Kentucky.

Some of T.C.'s early research was published in a series of papers on location and metabolism of tobacco alkaloids. He demonstrated that nornicotine was detected in the roots earlier than in the shoot. The reason for this has just recently been elucidated with molecular techniques as he had envisioned in his later writings. In converter plants of *N. tabacum* nicotine biosynthesis was accelerated much more than demethylation of nicotine by topping and again the biochemistry of this observation has just been described. Using ^{15}N he demonstrated that tobacco alkaloid bio-

synthesis follows a stepwise series of reactions. Nornicotine was formed in both the leaf and root and with the higher excess of ^{15}N in nornicotine than nicotine suggested that it was formed independently in root and leaf of tobacco and not just in the leaf via demethylation. Again, suggesting a somewhat different demethylation in root and leaves that recently has been confirmed with newer technologies. In further experiments using triple labels - ^{14}C , ^3H and ^{15}N - he found a high percentage of label in alkaloids other than nicotine, including nornicotine, anatabine and anabesine. Anatabine had greater incorporation than the other minor alkaloids indicating that biosynthesis of anatabine was more closely related to nicotine biosynthesis than anabesine.

A basic physiological phenomenon of plant growth including tobacco is the relationship between essential mineral nutrients and organic constituents of plants and especially as they related to tobacco as a commodity. The results graphically illustrated changes in alkaloids, carbohydrates, proteins and organic acids with several mineral deficiencies. Free and protein hydrolyzate amino acids increased in mineral deficient plants, especially the free amino acids. The measured increase in glutamic acid may have been the first indicator of its role in nicotine biosynthesis.

These studies led to the determination of source and amount of radioelements present in tobacco as they may relate to health effects of tobacco smoke. His research efforts had the objective of identifying the source of radiation and finding means for reduction or removal. In a set of well crafted experiments, Dr. Tso and associates examined the source of ^{210}Po and ^{210}Pb in tobacco leaf. His conclusions were that cultural practices for the production of tobacco, especially the amount of phosphate fertilizer applied and the cropping system were the main contributors to the accumulation of the radioelements in the leaf.

Dr. Tso's research expertise was recognized early in his

career as a tobacco scientist and just after six years he was invited to write a chapter on "Physiology of the Tobacco Plant" for the prestigious Annual Review of Plant Physiology. His first reference book "Physiology and Biochemistry of Tobacco Plants" was published in 1972. This was an extremely valuable contribution to the whole tobacco industry as it covered research, utilization and economics. A second reference book "Production, Physiology and Biochemistry of Tobacco Plant" was a revised and expanded version. These have been the reference books for over three decades of tobacco research. When CORESTA chose to publish a book on tobacco in 1999, Dr. Tso was invited to write the first chapter, "Seed to Smoke".

Many honors and awards came to T.C. during his career and perhaps most significant among them were the first CORESTA Prize in 1978, appointment as a Charter Member of the Senior Executive Service by USA President Carter in 1979, Presidential Rank Award for Meritorious Executive in the Senior Executive Service in the United States by USA President Reagan in 1984, Lifetime Achievement Award from the Tobacco Science Research Conference, the United States Superior Service Award and induction into the USDA Agriculture Research Service Hall of Fame.

Dr. Tso was not just an excellent tobacco scientist as he had a strong desire to lead and assist with agricultural development in other countries, especially his homeland. He founded the nonprofit Institute of International Development and Education in Agriculture and Life Sciences (IDEALS) in 1984 and was the executive director of the organization until 1997. "Agriculture in China, 1949–2030" published in 1998 covered the period from the founding of the People's Republic of China to his ideas of what must come in the near future. His emphasis was on the education of the younger generation to improve quality of life for the future. In a more recent book "Dare to Dream - Vision of 2050 Agriculture in China," published in 2004, T.C. emphasized that the three major concerns to face the world in the next 50 years are food, natural resources and the environment and concludes that agriculture holds the key to resolve all of these. To accomplish these objectives, he believed that agriculture must proceed from the Green Revolution into the Gene Revolution. Importantly, he deduced that agricultural education offers key means to link farmers' production to consumer demands. His vision and hope for the future was in the imagination and accomplishments of the next generations. This was expressed in the prologue to Dare to Dream book "*Many unexpected events have forced us to soar above the trees of*

tradition. We can glimpse the fresh fields far beyond our imagination. Our eyes must continue to be those of youth, seeing vision, for around us spread new horizons - unlimited."

T.C. personally encouraged those he mentored to seek knowledge diligently and to apply that knowledge in our professional and personal lives to the benefit of humanity. His contributions to tobacco science are readily apparent, but his contributions to the lives of others, both in and out of science, were probably more significant

The above is a brief biography of T.C.'s professional life in the United States. However, his personal experiences prior to coming to the United States must be briefly described to really understand and appreciate his contributions to science and humanity. T.C. attended a Christian boarding school from age nine and it was here that he was first introduced to the English language. After receiving his high school diploma he entered Nanking University to study agriculture. Most of the text books were in English and his early English instruction was very useful. He enjoyed his first year at Nanking University but in fall of 1937 the Japanese army began a push to take Nanking. Chinese officials decided to relocate the University ahead of the Japanese troops and they moved to Chengdu, Sichuan Province in southwest China. The move was made mainly on the Yangtze River amid much movement of war materiel. T.C. received his B.S. degree in agriculture and M.S. degree in agricultural chemistry from Nanking University over the next seven years. His first employment was with the War Area Service Corps, a combined U.S./China military program to fight the Japanese. Again this was possible because of his English skills. After the war he became Director of Agriculture for an Experimental Academy for Relief and Rehabilitation to help deal with refugees coming from other parts of war-torn China. In 1947, T.C. received an offer for graduate study from Penn State University to study tobacco biochemistry under Professor C.O. Jensen and thus his coming to the United States. You may read more about his fascinating life in his autobiography "Comfort ye, my people! My journey in science and life" published in 2007.

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