

In Memoriam

George P. Georghiou

1925 - 2000

Professor of Entomology, Emeritus

Professor George Pavlos Georghiou, a native of Famagusta, Cyprus, who became an entomologist and insect toxicologist respected worldwide, passed away at the age of seventy-four at his home in Riverside, California on November 6, 2000. He is survived by his second wife, Lois, his son Paul Georghiou MD, his daughter Evelyn, and five grandchildren. His first wife, Claire, a native of Belgium to whom he was happily married for thirty-two years and was the mother of his children, passed way in 1985.

George exemplified the most positive traits of a European upbringing combined with the opportunities presented in the United States. He was born in Cyprus in 1925 and raised in a humble, devoted and loving family whose struggle resulting from the hardships of World War II strengthened his already strong character and sense of responsibility. He worked hard as a young boy and teenager, yet found time to spend in his father's orange orchard, where, as a keen observer, he became fascinated with biology, especially with insects. His life in Cyprus, particularly the warm interactions among the members of his extended family and their interests in education imparted in him a deep respect for family life and culture. His love of culture led to a life-long interest in history, languages (he spoke three fluently - Greek, French, and English), art and music. George enjoyed singing and played the mandolin. According to his son Paul, as a young man in Cyprus, he and his brother Takis were well known for serenading the girls of Famagusta.

George's formal career in entomology began when he won a scholarship after the war from the government of Cyprus to attend a college abroad. He used this scholarship to enroll at Cornell University in Ithaca, N.Y., where he received his BS (with distinction) in 1952, and his MS in 1953, both in entomology. After receiving his MS, he returned to Cyprus for five years as part of his scholarship commitment, where he worked for the Department of Agriculture as the Entomologist in charge of Plant Protection. Subsequently, he returned to the U.S. where he enrolled at the University of California, Berkeley, receiving his PhD in insect toxicology in 1960. He joined the faculty at the University of California, Riverside, as an assistant professor of entomology in 1960, becoming a full professor in 1969, where he remained until his retirement in 1993.

While growing up in Cyprus, George saw firsthand the tremendous suffering caused by malaria, a disease that afflicted both his mother and brother. This stimulated an interest in controlling the mosquito vectors that transmitted malarial parasites and other disease agents. Synthetic chemical insecticides were developed during World War II, and were especially important for mosquito control. But by the 1950's it became clear that mosquitoes and other insects could develop resistance to chemical insecticides. Based on these findings, George decided to make insect toxicology, and particularly the management of insecticide resistance, the focus of his professional career.

George's research on insecticide resistance was pioneering, and led quickly to worldwide recognition. He combined the disciplines of chemistry, entomology, physiology and genetics, taking a holistic approach to understanding the mechanisms of resistance, while at the same time developing important strategies for managing insect resistance that remain practiced and highly relevant today. The principles and resistance management models that he developed through his research became the forerunners of other pesticide management strategies, and

even for managing resistance to antibiotics. George's numerical statistics are that he published over 220 scientific publications during his career including two books, and a third for which he served as editor. Two of these, *Pest Resistance to Pesticides in Arthropods* (1981), and *The Occurrence of Resistance to Pesticides in Arthropods* (1991), are classics in the field of insecticide resistance. With respect to students, he was greatly admired as a major professor, and guided 20 students to the PhD, and 8 to the MS degree. George's impact through teaching was global, as his students were often from foreign countries and returned to their homeland after obtaining their degrees. Many of George's former students hold important positions in academia in the U.S. and other countries, or can be found in leading positions in industry and government.

Until his death, George was widely regarded as the leading authority on pesticide resistance in the world. This respect was based on his significant contributions to understanding the mechanisms and genetics of insecticide resistance, his elucidation of the evolutionary dynamics of resistance, and strategies he developed for managing resistance to chemical as well as bacterial insecticides. Among the most important resistance management principles that emerged from George's research were the use of insecticides in rotation, combining insecticides with different modes of action - together and in rotation, and the use of refugia. In the latter, portions of the target pest population are not treated to maintain insects with genes for sensitivity to insecticides within the population to avoid the rapid development of resistance. The refuge concept has recently been adopted by the U.S. and Australian governments for delaying the development of resistance to genetically engineered insect resistant corn and cotton. Such crops now account for more than 50 million acres of cropland in the U.S. Thus, George's concepts and influence will carry on well into the future.

During his career, George was recognized with a wide variety of awards for his outstanding research. These included election as a Fellow of the American Association for the Advancement of Science (1964), a Guggenheim Fellowship (1967), the Woodworth Award for outstanding research from the Pacific Branch of the Entomological Society of America (1980), an Honorary Ph.D. from the University of Thessaloniki, Greece (1981), Scholar-in-Residence Award - Bellagio Conference Center - from the Rockefeller Foundation (1985), Faculty Research Lecturer Award from the UCR Academic Senate (1986), J. E. Bussart Memorial Award for outstanding research from the Entomological Society of America (1987), election as a Fellow of the Entomological Society of America (1989), USDA Superior Service Award (1989), and the International Award from the American Chemical Society (2000). A quote from the USDA Superior Service Award captures the long-lasting significance of George's research, "with remarkable consistency over the past two decades, Dr. Georgioui has conceived the guiding principles and charted the worldwide direction of research on insecticide resistance." For George these accolades were minor compared to the realization that his research extended the usefulness of many chemical insecticides, thereby benefiting the lives of millions of people, especially those in developing countries where vector borne diseases remain so important.

Concomitant with the recognition for his research, George also served his profession locally, nationally, and internationally. For many years, he served the World Health Organization on a variety of panels, and in many countries, as an expert on insecticide resistance in vector populations, especially mosquitoes. He was a member of WHO's Expert Panel on Vector Biology and Control for two decades, and also served on its Expert Committee on Insecticides. He provided advice for WHO in many countries including Iran, China, Mexico, Cuba, Columbia, and Venezuela. His research was also relevant to control of crop pests, and led to consultantships for the Food and Agriculture Organization of the United Nations in

Egypt, Greece, Sri Lanka, and Thailand. Closer to home, he served on the National Academy of Sciences Panel on pesticide-resistant pest populations, and on numerous committees for the Entomological Society of America. At UCR, George was the Head of the Division of Toxicology and Physiology from 1975-1983, and then served as Chair of Entomology during the 1983-1984 academic year.

Although George credited UCR, his students, and his profession for much of his satisfaction with life, his greatest rewards came from his family here in the U.S. and his extended family of brothers and sisters and nieces and nephews in Cyprus. George will be remembered by his colleagues for the high quality of his science and productivity, and by all for his dedication, sincerity, warmth, and capacity to enjoy life to its fullest.

Brian A. Federici
Sarjeet S. Gill
Mir S. Mulla