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OBITUARY

# Virgil Leroy Woods, Jr. (1948–2012)

Virgil L. Woods, Jr., a pioneer of deuterium exchange mass spectrometry (DXMS), passed away on September 30, 2012 at the age of 64. He made significant contributions to the field of protein characterization through the development of DXMS, which stemmed from his unique vision and his perseverance.

Virgil was born on July 8, 1948 in Oakland, CA. His father had a military-related job, and his family moved around the globe when he was young, including stops in Morocco, Philippines, and Italy. He started showing his inquisitive mind by doing "experiments" when he was a teenager. He recalled that he could buy "reagents" at drug stores in some of those countries to do "fun stuff." His family settled in San Diego by the time he was in high school. He received his undergraduate training at UCSF (BS, medical sciences) and UCSD (BA, biochemistry) and his MD degree at UCSF. After interning and completing his residency at Barnes Hospital, Washington University in St. Louis, Missouri, he moved back to UCSD as a rheumatology fellow in 1979. He joined the Department of Medicine faculty in 1981, and served UCSD for 31 years.

Virgil was always one step ahead of everyone in ideas for advancing the applications of DXMS and its development. He envisioned that DXMS would be a high-resolution, high-throughput technology. He was the first one to build a fully automated data acquisition system and was first to develop automated data extraction software more than 10 years ago when the rest of the DXMS world was still pipetting, cooling with an ice bucket, and manually analyzing the data. He built a completely automated epitope mapping DXMS system by the late 1990s, which exceeds even the current most advanced systems in terms of extent of automation.

Recognizing the potential of DXMS, many UCSD faculty members wanted to collaborate with Virgil. When Susan Taylor of UCSD convinced him to collaborate in 2000, Virgil disassembled and simplified his original automated system for more general application. The simpler version is the prototype of the currently available DXMS automation system, which includes an immobilized protease column, reverse-phase analytical column, and three valves in a chilled box controlled by a sequence of signal commands. Virgil's group also developed the first software for DXMS analysis in 2001. All DXMS practitioners who use automation and software benefitted from his efforts to some degree, either directly or indirectly. He directed the DXMS Proteomics Resource at UCSD. His group has served as the DXMS core facility, providing its expertise to up to 20 different academic groups at a time.

Virgil filed several patents around DXMS methodology in the 1990s. He was also a scientific cofounder of ExSAR Corporation, which performs DXMS research on fee-for-service basis starting in 2002. He originally envisioned that DXMS would be a powerful tool to investigate protein–protein interactions and protein–ligand interactions for drug development. Currently, DXMS is used to determine higher order structures of protein therapeutics and to map epitopes of antibody therapeutics in the pharmaceutical industry.

Unmet needs from a physician's perspective drove Virgil's scientific interest. While he worked in the field of protein characterization by mass spectrometry, he was also an active and engaged rheumatologist. Virgil specialized in the management of complex rheumatic diseases, including rheumatoid arthritis and systemic lupus erythematosus, in his clinic practice. He loved to share exciting experiences about the patients' lives he saved on the days of his clinical

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work. Before he was involved in protein characterization by DXMS, he was one of the first to use monoclonal antibodies to examine the functional role of platelet cell surface receptors. He was then interested in using hydrogen exchange to characterize integrins, for which little structural information was available. He managed to lead a well-balanced career in both clinical duties and basic research.

DXMS was the fruit of Virgil's perseverance. In the late 1990s and early 2000s, his laboratory was not well-funded. His lab space was gradually shrinking. At one point he was "on vacation" without salary while he was present in the lab because his funding ran out. His work style in the lab was very intense and non-stop. Most collaborators who visited his lab were usually completely exhausted with his intensity after a day. Virgil's lab was also a unique place. He wanted his students to "camp in the lab." To help them do that, he brought a couch to take a nap and a plentiful supply of junk food to snack on.

Virgil was very generous in terms of sharing his knowledge. He used to say "I like to brag." Indeed, he liked to talk and it was difficult to stop him at times. This characteristic was a nice thing for his colleagues and his students alike because he was such a fountain of information and insight. One unfortunate thing is that he did not publish his technology sufficiently although he did share information. Eventually, others started publishing the things he had conceived and reduced to the practice first. He was a little bitter about it, although he understood that it is his own fault.

Virgil's generosity was not restricted to science. He helped many people around him using his medical expertise. He could give medical advice, seek experts for particular conditions, and be with them personally to go through difficult times together. He was a kind and generous person before being an outstanding scientist.

Virgil was diagnosed with glioma, a type of brain tumor, in March 2012 and died in September 2012. Virgil is survived by his wife, Betsy, and three teenage children, Anders, Erik, and Mary. He was a devoted husband and father. Virgil and Betsy were married for 20 years. He was often spotted in the UCSD campus with two children in a stroller and the youngest one on his back when his children were young.

Virgil was scientifically brilliant with a unique personality. One passion was DXMS, and he wanted to see it grow and become a major technology that would contribute to the development of better therapeutics and advance biomedical research. He had a vision that DXMS needed automation and software to realize its potential. He had perseverance to make it happen. He was driven and persistent; at the same time, he was very generous to others scientifically and personally. He said to his family members, "I had a great life," after his diagnosis. I believe he meant it. However, I wish he had the chance to see his children and his technology flourish.

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