

Wilhelmus Nicolaas Konings (1937–2014)



Wilhelmus Nicolaas Konings (known as Wil), Emeritus Professor of Molecular Microbiology at the University of Groningen in the Netherlands, passed away unexpectedly at the age of 77 on Saturday 5 July 2014. He was born and grew up in Maastricht, one of six children, including a twin brother Thees. At age 15, a high-school science teacher aroused his interest in biology, and particularly in biochemistry. As a young man, Wil was a long-distance swimmer, competing in the Netherlands, Belgium and France; he also competed in long-distance skating and was head of the debating club. He took up sculpture as an adult. Wil is survived by his wife of over 50 years, Ine Konings-Stolte, a lawyer, and three children, Karen (a general practitioner), Wouter (an industrial designer) and Lill (a psychiatric social worker) and eight grandchildren.

Wil Konings received his PhD from the University of Groningen in 1969. From 1969 to 1971 he worked at the National Institutes of Health (NIH), in Bethesda, Maryland, as a postdoctoral fellow. In 1971, he was appointed Lecturer at the University of Groningen, and in 1980, he became Professor of Microbiology. In 2002, he retired as Professor Emeritus, leaving a legacy of more than 440 scientific papers and seven patents, as well as numerous students and postdoctoral scientists who were trained in his laboratory. After retiring from the University of Groningen, he became

associated with the University of Stellenbosch in South Africa where he lectured for more than 10 years.

Wil had an engaging and striking personality, and from the mid-1970s, he played a prominent role in the field of microbiology, especially in membrane biology. He was an outstanding researcher with an international reputation and stature in the rich tradition of Dutch microbiology. Scientifically, he will be remembered best for his extensive work on substrate transport in bacteria and archaea.

He developed an interest in bacterial transport while doing postdoctoral research in the laboratory of Ernst Freese at the NIH, where he was studying sporulation in *Bacillus subtilis*. One evening, he attended a seminar given by Ron Kaback, who had just started his own laboratory at the NIH, and their meeting set the course for the rest of Wil's career. Kaback had just begun to develop cytoplasmic membrane vesicles from *Escherichia coli* as a model system in which to study transport. He showed Wil how to prepare and assay transport with the vesicles before anything was published, which impressed Konings immensely. So much so that he later dubbed the vesicles "Kabackosomes" and decided to study transport in *B. subtilis* vesicles rather than sporulation. Shortly thereafter, Konings discovered how to energize transport with an artificial electron donor system, which allowed the generalization of the vesicle system to many bacteria in addition to *E. coli*¹. As a result of these and many more experiments, the two became lifelong friends and scientific colleagues.

In the early 1960s, Peter Mitchell initially presented his chemiosmotic theory for which he was later awarded the Nobel Prize. However, when it was introduced, the theory was highly controversial, particularly with respect to active transport, let alone oxidative phosphorylation. When techniques were developed subsequently to quantitate membrane potentials, pH gradients and concentration gradients of multiple substrates in the vesicles, it became clear that chemiosmosis is the best explanation for both phenomena.

In 1980, Wil proposed a model of energy recycling by product secretion, where a transporter catalyzes efflux of metabolic end products and thus conserves metabolic energy². Other work included the identification of specific antiport systems that play a role in energy conservation as part of simple metabolic pathways³. Further hallmarks of his work are discoveries on the regulatory effects of intracellular pH⁴ and redox potential⁵ on the activity of transport proteins. His research on amino acid and peptide transport and the proteolytic system of lactic acid bacteria⁶ initiated intense contacts with the dairy industry and the organization of a European network on lactic acid bacteria. After his retirement, Wil continued to work as co-founder of the Biotechnology company IMENZ Bioengineering.

Central to Wil's work was the use of well-defined model systems, such as isolated cytoplasmic membrane vesicles, which could be fused with liposomes reconstituted with an energy-generating source such as cytochrome *c* oxidase⁷. These systems were used to study transport processes with membranes derived from strictly anaerobic bacteria and plasma membranes from yeasts and fungi. Later, he employed liposomes in which purified transport proteins were embedded in a functional

state, including the functional reconstitution of membrane proteins into liposomes composed of tetra-ether lipids isolated from extremophilic archaea⁸. In the community of extremophilic research, Konings is best known for his contributions on how microbes adapt the lipid composition of the cytoplasmic membrane to extreme conditions and how cells deal with an increased ion permeability at elevated temperatures^{9,10}.

Another highlight is his work on bacterial multidrug resistance transporters involved in the secretion of a wide variety of unrelated toxic compounds, including antibiotics from the cell. He identified a bacterial multidrug transporter that is a structural and functional homolog of human P-glycoprotein that plays an important role in the resistance of cancer cells to cytotoxic drugs¹¹. He discovered that lipophilic substrates of multidrug transporters are transported from the inner layer of the cytoplasmic membrane into the extracellular milieu¹².

During his academic career, Konings regularly spent sabbatical leaves with colleagues and friends. In 1972, he was a visiting scientist with Ron Kaback at the Roche Institute of Molecular Biology in Nutley, New Jersey. In 1977, he was a visiting professor with Frank Gibson at the Australian National University in Canberra. In 1981, he visited Peter Mitchell at the Glynn Research Institute at Bodmin in the United Kingdom. In 2001, he was a visiting scientist at the University of Stellenbosch in South Africa where he worked with Jacky Snoep. The period in South-Africa inspired him to continue teaching at the University of Stellenbosch following his retirement in 2002. In 1997, Wil Konings was elected to membership in the Royal Dutch Academy of Art and Sciences (KNAW). In 2001, he was knighted by Queen Beatrix in the Order of the Dutch Lion. We will remember Wil Konings as an important, versatile and passionate scientist who inspired many young researchers. He will always remain among our dearest memories as a wonderful scientist and a great friend and close colleague. ■

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