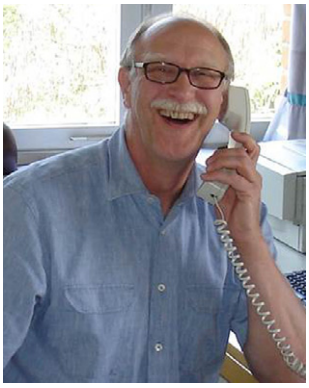
FEMS MICROBIOLOGY LETTERS

OBITUARY

Gerd Döring (1948–2013)

DOI: 10.1111/1574-6968.12508



Gerd Döring, Professor of Medical Microbiology and Hygiene at the University of Tübingen (Germany), was very much looking forward to attending the 14th International Conference on Pseudomonas, to which he had been invited and where he was going to chair a session on cystic fibrosis (CF) and lead a discussion on antibiotic therapy against *Pseudomonas aeruginosa* infections, in September 2013. But fate had it otherwise. Gerd died on 2 July 2013, after a malignant melanoma had spread to his lung with uncanny speed.

Gerd Döring was born in Nürnberg on 30 August 1948, and studied chemistry at the University of Tübingen, where he obtained a PhD for his work on transition metal complexes in 1978. From 1977 to his death, Gerd mostly worked at the Hygiene Institute in Tübingen, only interrupted by scientific visits to Niels Høiby's laboratory in Copenhagen in the 1980s and 1990s and by a study leave in Lyon in 1992. Under the guidance of the former director of the Hygiene Institute, Konrad Botzenhart, Gerd Döring developed a keen interest in *P. aeruginosa* and in the chronic infections that this bacterium causes in the lung of CF patients. His post doctoral 'habilitation' thesis published in 1986 dealt with pathogenic mechanisms of *P. aeruginosa* (in particular, proteases), their regulation, and consequences for inflammation.

In the same year, one of us (DH) met Gerd for the first time at a symposium that he organized on 'Basic research and clinical aspects of *P. aeruginosa*' in Tübingen. At that time, Gerd was intrigued by observations indicating that *P. aeruginosa* must be well adapted to hypoxic conditions, in particular in the CF lung, and so we decided to test whether the ability of *P. aeruginosa* to obtain ATP from arginine by fermentation via the ArcDABC pathway (thus without respiration) would confer an advantage on the bacterium when it colonizes host tissues. He quickly did these colonization tests in the rat lung and intestine and, while it appeared that a mutant deleted for the *arcDABC* operon had a lower colonization ability compared with the wild type, the effects measured were not significant and therefore not published. However, Gerd remained convinced that *P. aeruginosa* was a successful pathogen in the CF lung because of its ability to deal with hypoxic conditions. He eventually managed to assemble compelling evidence for the fact that the mucus layer in the CF lung becomes depleted of measurable oxygen and nevertheless supports persistent growth of *P. aeruginosa* (Worlitzsch *et al. J Clin Invest* **109:** 317–325, 2002). This important work has been cited more than 500 times and has led to further important discoveries, but has also been misinterpreted by some researchers who believed that *P. aeruginosa* would adopt a purely anaerobic lifestyle (i.e. using nitrate respiration and fermentation) in the CF lung. However, the main energy source of *P. aeruginosa* in this environment is still aerobic respiration, which occurs via the two cbb_3 terminal oxidases whose high affinity for oxygen allows the bacterium to grow at submicromolar oxygen concentrations. Such low oxygen levels are undetectable with a Clark electrode.

In more recent studies, Gerd and his collaborators found that the so-called mucoid conversion of *P. aeruginosa* is strongly stimulated by oxygen depletion. Mucoidy is due to overproduction of the exopolysaccharide alginate by *P. aeruginosa* and is a hallmark of persistent infection. It turns out that alginate export is controlled by a novel oxygen sensor acting at a post-translational level. As experiments on this mechanism are still ongoing, Gerd was not able to see their completion and publication, which saddened him a great deal. But he stayed optimistic and passionate about this work up to his last days.

Gerd was always keen to translate his research into the diagnosis, prevention, and treatment of infections with *P. aeruginosa*, particularly the chronic airways infections in individuals with CF. Gerd developed hygienic measures and devices to control the spread of *P. aeruginosa* in the hospital environment, and he and Christiane Wolz, his

PhD student at that time, were the first in the late 1980s who demonstrated the nosocomial transmission between unrelated CF patients at rehabilitation centers with a molecular probe. Based on his early discovery made in Niels Høiby's laboratory that in serial CF sera, antibody titers against secreted virulence effectors are inversely correlated with the clinical outcome, he commercialized an ELISA that still is the standard for *Pseudomonas* serology at central European CF centers. Gerd was involved in the first clinical trial on aerosolized tobramycin to eradicate *P. aeruginosa* from CF patients' lungs during the early phase of infection. Virtually as a one-man show, he conducted phase II and phase III studies on the efficacy of a *P. aeruginosa* flagella vaccine and lately he strongly pursued the concept of using nitric oxide (NO) inhalation therapy in CF patients, to help disperse *P. aeruginosa* biofilms in the lung.

Gerd Döring was the President of the European Cystic Fibrosis Society from 1998 to 2006, and thereafter until his death, the Editor-in-Chief of the Journal of Cystic Fibrosis. During these fifteen years, Gerd organized European Consensus Conferences that resulted in guidelines for the early intervention and prevention of lung disease, clinical trials, and the management of nutrition and infections. The first consensus paper was published in 2000 on the antibiotic therapy against *P. aeruginosa* in CF.

Gerd Döring was a very creative and inspiring scientist with a distinct sense of humor and a knack for nonconformity, which did not always facilitate his own academic career in Germany, but greatly helped him with international networking. Many of his publications are the fruit of international collaborations that he initiated. In discussions, Gerd could reach high-flying objectives and conclusions, often leaving his own ground staff puzzled. But when he was grounded again, with his hard-working attitude, he got do-able things done and this is amply reflected by his list of over 200 scientific publications. Apart from science, the company of Gerd was always enjoyable as he was fond of good wines and food, classical music, and his vintage car, a Citroën 15 familiale, which he used on special occasions.

Gerd was sorry that he had to leave so early – his wife Cornelia, his two sons, his friends, and his work and projects – but found comfort in looking back on a life well spent and on a scientific oeuvre fully recognized by his peers.

Burkhard Tümmler
Medizinische Hochschule Hannover Klinische Forschergruppe OE 6710, Carl-Neuberg-Straße 1 Hannover D-30625 Germany
E-mail: tuemmler.burkhard@mh-hannover.de

Dieter Haas
Département de Microbiologie Fondamentale Université de Lausanne Biophore Lausanne CH-1015 Switzerland
E-mail: dieter.haas@unil.ch