

Harley William Moon (1936-2018)

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Harley William Moon, DVM, PhD, an outstanding researcher of comparative microbiology and pathology of intestinal diseases, died 7 Oct 2018 aged 82

Harley William Moon, DVM, PhD, an outstanding American person and researcher of comparative microbiology and pathology of intestinal diseases, the former director of the USDA, ARS, National Animal Disease Center (Iowa), of Plum Island Animal Disease Center (New York) and of Veterinary Research Institute of Iowa State University, member of the National Academy of Sciences (USA) passed away after some difficult and lonely last years of his life, on October 7, 2018 at the age of 82.

Harley was born March 1, 1936 on a southwest Minnesota farm, during the Depression. He lost his father in 1945 in Word War II, and was mentored by his stepfather, a local farmer, Melvin Lien. Harley earned his BS, DVM (1960), and PhD (on enteric colibacillosis of piglets) at the University of Minnesota (1965). In 1956 he married his first love from high school, Irene Casper. Their marriage was blessed with four children and the young family went on the move to follow Harley's post doc career at Brookhaven National Laboratory (Long Island, NY, USA), to University of Saskatchewan (Saskatoon, Saskatchewan, Canada) and to USDA National Animal Disease Center (NADC, Ames, Iowa, USA).

Harley's talent, enthusiasm and his profound interest in intestinal microbiology and the pathology of domestic animals and man brought him great success in research and in his scientific carrier. During almost three decades of research at the NADC he organized and led the work of excellent US scientists (e.g.: Whipp SC, Isaacson RE, Dean-Nystrom EA, Casey TA, Cornick NA, Donta S, Brinton CC, Samuel JE, Moseley SL, O'Brien AD). To our great pleasure, the undersigned European veterinarians and a medical doctor and several others (Awad-Masalmeh M, Heine J, Kausche FM, Pohlenz JF, Valpotic I) from six European countries, could also work with him. In addition to providing mentorship on comparative aspects of intestinal infectious diseases of young animals, he generously shared his knowledge, his

laboratory, and his professional network with them. As the undersigned fellows do not feel entitled to write a complete assessment of his scientific career and achievements (which would be published duly by members of the US National Academy of Sciences), this special obituary should only serve as a European tribute for his scientific achievements. European colleagues were included in and contributed to all three of the main areas of Harley's long-term scientific interests.

The first area of interest was enterotoxigenic *E. coli* (ETEC) infection of pigs and calves, which brought breakthroughs in establishing the requirements (adhesion and enterotoxin production) for pathogenicity of ETEC and establishment of the newborn pig model for studying the pathogenesis. These studies led to the discovery of new colonization factors of porcine ETEC (987P and 2134P pili, later designated as F6 and F18ac fimbriae), establishing their importance in host specificity and in vaccine production.

The second exciting area for his research focused on the enteropathogenic *E. coli* (EPEC), previously thought to occur only in humans. His most acknowledged contribution in this area was the finding that human EPEC strains can reproducibly develop similar pathogenic mechanisms and similar lesions in rabbits and pigs as they do in humans. For EPEC the term "attaching effacing *E. coli*" (AEEC) was coined by Harley and coworkers (1983). Thereby Harley and his colleagues opened a wide area for comparative studies on EPEC in different animal species and subsequently on their *Shigella*-like toxin producing counterpart enterohemorrhagic *E. coli* (EHEC) today known as the causative agent of one of the most feared foodborne zoonotic infections. They showed that typical EHEC also possesses the AEEC property. He successfully studied colonization, persistence and details of pathogenicity and prevention of EPEC and EHEC with his US and European colleagues for almost three decades.

The third major area of Harley's interest were the zoonotic protozoa cryptosporidia and cryptosporidiosis, especially in calves and in mouse models. On this area he also initiated a series of pioneering studies together with his European and US colleagues and established *Cryptosporidium parvum* as an important co-infective agent, mainly in diarrheal and immunosuppressed animals and humans.

As an acknowledgement of his contributions to comparative microbiology and pathology Harley Moon was a member and contributor of numerous editorial boards and professional societies. His honors and awards include membership to the National Academy of Sciences (1991), induction to the USDA's Science Hall of Fame (2000), and fellowship in the American Association for the Advancement of Science (2003). In Europe he was elected to be a „Doctor Honoris Causa” of the University of Zürich (1995) and of the University of Liege (2001) and an Honorary Member of the Hungarian Society for Microbiology (1995). Harley also received several other highly respected awards from the US and Canada and served on expert panels with the World Health Organization, the National Institutes of Health, and the National Academy of Sciences. He testified to the U.S. Senate about antibiotics in livestock feed and discussed threats to agriculture as chair of the National Research Council's Committee on Agricultural Bioterrorism.

Above all, however, Harley was an exceptionally cheerful and energetic character with great empathy for those who needed help and with a deep, inherent respect for the farming community. He projected a consequent ethical demand for good laboratory and animal work, for good research and for a well-focused clear cut reporting of the results. His positive and open-minded way of discussing scientific or technical problems gave young scientists a wide range of possibilities to pursue as well as keys for further thinking. All who knew him will agree with his son Mike stating that “Harley's energy and

enthusiasm were contagious.” Together with his family, especially with his wife Irene, they generously hosted and helped several colleagues and their families traveling to work with Harley for extended periods of time.

He remained intellectually influential for his young researchers long beyond their early years as well as for their students, and post docs at several universities and institutions in the US and in Europe.

Irene died six years before Harley and they are survived by four children and four grandchildren.

Acknowledgements

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No conflict of interest to be declared by the authors



Fig. 1. Harley W Moon at his microscope (mid 1990ies)



Fig. 2. Harley and Irene Moon at a festive dinner (University of Zürich, 1995)