Ruminant Nutrition Symposium: Burk Dehority—Swimming in the Rumen with Protozoa

601 Burk Dehority: An introduction. S. Loerch*, *The Ohio State University, Wooster.*

Burk A. Dehority is recognized worldwide as a leader in the field of rumen microbiology. Early research focused on the isolation and identification of those species of rumen bacteria primarily responsible for degradation and utilization of the structural carbohydrates of forages. His classic 1961 paper reported the effect of forage particle size and lignin on cellulose digestion. This work was fundamental to his later discoveries on the synergism among microbial species for digestion of structural carbohydrates. In more than 15 papers, Burk published the most complete characterization of the microbial ecology and digestive capacity of newly-weaned calves after feedlot arrival. Other studies explored microbial digestion in the hindgut of both ruminant and non-ruminant animals (guinea pigs, sheep, capybara, horse, Blue Duiker, and turkey) and its contribution to overall diet digestibility. Burk has published more than 40 papers on the rumen protozoa, with special emphasis on protozoal taxonomy and the effects of ration composition on protozoal ecology and activity in the rumen. Dr. Dehority has studied environmental effects on rumen protozoal populations around the world, working with over 25 domesticated and non-domesticated animal species. His studies in Australia on microbial populations in the forestomach of marsupials led to his discovery of a new family of entodiniomorph protozoa with descriptions of a new genus and 5 new species. Two protozoa species have been named in his honor: *Dasytricha dehorityi* – a new species found in the eastern gray kangaroos by Australian scientists and *Eudiplodinium dehorityi* – a new species isolated from the rumens of cattle by Turkish scientists. Burk has developed novel methods for the cryopreservation of rumen ciliate cultures, ensuring that more detailed studies of rumen protozoology can be undertaken worldwide, with a genetically more stable line of organisms. Burk's research on the microbial population of the rumen has opened this "black box" to scientists worldwide. For these achievements, Burk Dehority is recognized as a world authority on protozoa that inhabit the mammalian digestive tract.

Key Words: rumen, protozoa, bacteria

602 Protozoa taxonomy and morphology. J. L. Firkins*, *Ohio State University, Columbus.*

Burk Dehority was an international expert on rumen ciliated protozoa because their taxonomy was based on their morphology. He characterized ciliates from >10 different species of herbivores. His artistic talent was evident in his 2003 textbook; his seminal 1994 paper on subsampling, fixing, and counting; and in handouts from ruminant microbiology courses across the world. Although multiple species of rumen protozoa primarily are classified within the families Isotrichidae and Ophryoloscolecidae, Burk characterized ranges in size and morphology both among and within species. One compelling intersection between the art and science of protozoal taxonomy is his 1994 characterization of the multiple lineages of *Entodinium dubardi* in the Blue Duiker. Clearly, morphology-based taxonomy must catch up with molecular systematics. For example, caudal projections are "morphotypes" (depend on environment), but what about skeletal plates, macronucleus shape and location, and other morphological features used for current speciation? Burk's scientific curiosity led him to cultivate various single or mixed species of ciliates in vitro and in situ (inside a meshed apparatus within the rumen) and to improve cryopreservation protocols. Although long-term cultivation of the isotrichids was elusive for him, he contributed seminal work on their migration and chemotaxis in vivo. He determined differing generation times and other features such as minimum pH values for species in several genera. He wasn't afraid to ask anti-dogmatic questions such as, do protozoa really have a role or are they successful inhabitants of the rumen just because they can be? He looked for the simplest explanation of an observation and branched from there. For example, he always considered the roles (prey vs competitors for substrate) of the bacterial and sometimes fungal co-inhabitants in cultures characterized as a single protozoan species. Thus, Burk characterized live versus killed bacteria to enhance protozoal growth. My colleague considers his legacy to motivate others to "love science and appreciate the thrill of discovery." He did and will—and not just because at least 2 species are named after him!

Key Words: protozoa, ciliate, rumen

603 The "ebb and flow" of cultivation based studies. R. I. Mackie*[1], I. K. Cann[1], and M. Morrison[2,3], [1]*University of Illinois, Urbana,* [2]*The Ohio State University, Columbus,* [3]*CSIRO Animal, Food and Health Sciences, St Lucia, QLD, Australia.*

This presentation seeks to describe and highlight Dehority's contributions to cultivation-based studies of rumen ecology. We also place these contributions in the context of modern molecular microbial ecology and cultivation-independent approaches to the study of microbial ecology and biology. Hungate was the first to propose that a complete ecological analysis of a natural habitat such as the rumen required answers to 3 questions. What kind and numbers of organisms are present (who's there)? What are their activities (who's active)? And, to what extent their activities are performed (what are they doing)? These principles featured prominently in Burk's research career spanning more than 50 years (1957–2012) and 172 peer reviewed journal publications; most of his research used cultivation-based approaches. His initial research focused on growth requirements of rumen bacteria and techniques for the study of mixed and pure culture fermentations. These studies translated into work that focused on optimizing rumen fermentation of dietary components of forages such as pectin, cellulose and hemicellulose. These studies were followed by isolation of fiber-degrading bacteria and description of ciliate protozoa in the rumen of cattle sheep, moose, musk ox, and other animal species. He is still one the few scientists to have studied the vitamin requirements of cellulolytic bacteria, essential to the formulation of chemically defined media. Cultivation based approaches have limitations and attempts to improve the proportion and diversity of bacteria in culture occupied Burk over the years. One of his innovations was the use of pre-incubated rumen fluid medium to reduce the non- specific background counts for functional groups of rumen bacteria. He made an important contribution to the study of interactions between rumen bacteria during degradation of plant biomass. Over the past 20 years, cultivation independent approaches have become well established and have become a requirement for publication. However, it is clear that this approach also has limitations and the best method is to combine cultivation based techniques with molecular approaches to advance the study of rumen biology.

Key Words: rumen bacteria, cultivation, Dehority

604 International efforts and collaborations, especially with exotic herbivores. A.-D. G. Wright*, *Department of Animal Science, University of Vermont, Burlington.*

Prof. Burk Dehority has studied the rumen/gut protozoa from a wide range of herbivores on 5 different continents, from Moose to Alaskan Dall sheep, to Zebu cattle and Blue and Black wildebeests, to capybara, llamas, and alpacas, to Cypriot domestic horses, to kangaroos and quokkas, just to name a paltry few. Burk spent many years patiently peering through a microscope at his beloved rumen ciliates, taking meticulous notes and measurements, and eloquently making detailed hand-drawings. This eventually led to his laboratory writings and line-drawings being published in 1993 as a 120-page "Laboratory Manual for Classification and Morphology of Rumen Ciliate Protozoa," which is still widely used today and a must for anyone venturing into the world of rumen protozoa. After all, Burk has identified no less than 21 new species of rumen microorganisms. This presentation seeks to highlight some of Burk's international efforts and collaborations, especially his work with exotic herbivores and their rumen ciliates. Even though Burk retired from The Ohio State University more than 5 years ago, he still continues to collaborate and publish today, thereby extending his research career to 56 years (1957–2013), and more than 170 peer reviewed journal publications. Burk credits his collaborations as a good way of keeping his research stimulated. Of course, collaborations are all the more stimulating when they involve travel, and his collaborative work took him several times to Australia and Brazil for a couple of months each as well as to Alaska, Ethiopia, and Kenya for shorter stays. I hope to capture his 3 visits to Australia, especially the last 2 visits (2004 and 2006) with me in Perth, West Australia.