

Boyd L O'Dell, PhD (1916–2019)

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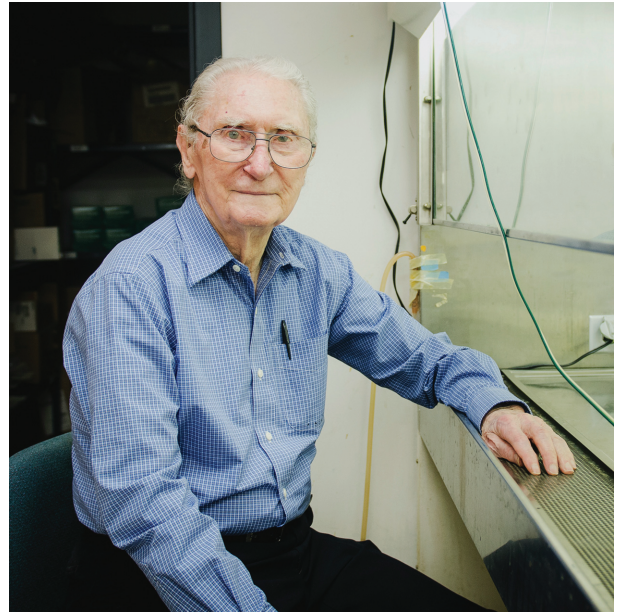
Dr. Boyd L O'Dell died April 21, 2019, at the age of 102. He was preceded in death by his wife, Vera, and a brother, Kenneth, and survived by his daughter, Ann O'Dell of Columbia, and son, David O'Dell of Walnut Creek, California. Throughout his life, those who interacted with him admired his remarkable and consistent set of academic, ethical, and human values.

Boyd was born on October 14, 1916. He grew up on a farm in rural Missouri near the town of Hale or, as Boyd proudly noted, "I hail from Hale, Missouri." As described in his autobiography, "Personal Reflections on a Galvanizing Trail" (1), Boyd witnessed and appreciated the importance of nutrition for animal growth and reproduction at an early age. He also developed a passion for learning at a time, the 1920–1930 depression years, when there were few resources. His early education started in a one-room schoolhouse.

Nevertheless, Boyd made the best of the situations presented to him. After graduating from high school at the age of 16, he wanted to teach. Boyd did so by earning a teaching certificate based on an examination and one summer at a local teachers college, the minimum required at the time. He subsequently taught grade school in Warrensburg, Missouri, until he had the resources to attend the University of Missouri, graduating with an undergraduate degree in chemistry in 1939.

At Missouri, Boyd next had the good fortune to have Dr. Albert G. Hogan as a mentor. Albert Hogan (2) had trained at the Sheffield Laboratory of Physiological Chemistry at Yale University in an environment dominated by Thomas Osborn and Lafayette Mendel. Likewise, in the environment created by A. G. Hogan at the University of Missouri, Boyd developed a commitment to and a keen appreciation for the importance of micronutrients to nutrition and metabolism. There was also a focus on the role of nutrition in reproduction and the periods of neonatal development, growth, and healthy maintenance. Using physical and biochemical indices related to the growth and development of chicks, Albert Hogan's research group, including Boyd as a principal graduate student, played a significant role in identifying the functions of what was presumed to be a new vitamin, designated Bc (3).

In discussions with Boyd, he emphasized that this period in his life was perhaps the most transformative. In addition to refining strategic analytical skills, he gained the ability to define given research problems and, as necessary, how to evaluate



Boyd L O'Dell, Ph.D. (1916–2019). Photo by Nate Compton-©2016–Curators of the University of Missouri

or resolve them with limited resources. Boyd also gained an appreciation for networking (i.e., connecting people with people along with their ideas and potential resources). In this regard, all of us who worked with him looked forward to the research discussions that focused on achieving the best resolution to a research question using the resources available.

In part, his research focus and the ability to network led to a position with Parke-Davis Pharmaceuticals in Detroit, Michigan. Boyd spent 4 y at Park Davis. Two milestones in his life occurred during this period. On the research side, he was a part of a team that isolated folic acid as a crystal, and for the first time, he was able to witness the previously elusive "Bc" as a pure chemical, folic acid (4). Second, he married his wife, Vera Stone, in Detroit in 1944.

The University of Missouri

Vera was also a student at the University of Missouri and, like Boyd, had close ties to the university and Missouri. Accordingly, when the opportunity presented itself in 1946, they returned to Columbia, the home for the University of Missouri. Boyd often recognized Vera as the most important influence in his

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Abbreviations used: FASEB, Federation of American Societies for Experimental Biology; IUNS, International Union for Nutritional Sciences.

life and career. Both were visible and ardent spokespersons for civil liberties and rights in a community and institution whose histories are best described as problematic in these areas.

Boyd assumed first the position of assistant professor of biochemistry and continued the pursuit of identifying new growth factors, vitamins, and other natural substances with critical nutritional properties. He also began to develop what became long-term collaborations with several colleagues; most notable was Dr. James Savage.

In their early studies, O'Dell, Savage, and associates observed that the growth factor in distillers' dried solubles was not a vitamin, as initially expected, but an inorganic nutrient, zinc (5). Over the next 20 y, their work led to essential observations on zinc's roles in growth, reproduction, and the influence of diet composition on the nutritional availability of zinc.

Additional observations also underscored that nutritional copper deprivation could lead to extracellular matrix defects (6). Mechanistic perspectives were also provided that focused on copper as a potential cofactor for enzymatic activity essential to the stabilization of structural proteins, such as elastin and collagen. This work offered seminal observations in the eventual appreciation for elastin and other matrix proteins' role in normal and pathologic vascular and lung functions (7). O'Dell's research group's other notable accomplishments were demonstrations using animal models that nutritional deficiencies could affect learning behavior and brain development (8). In the areas critical to our current understanding of nutrient bioavailability, it was demonstrated that phytic acid, as a zinc chelator, impairs normal growth in the chick (8). Moreover, these studies set the stage for other studies related to functions of phosphorus, calcium, magnesium, potassium, and dietary fiber.

Although Boyd retired as an emeritus professor in 1987 at the age of 71, he remained actively engaged in research over the next 3 decades. His last research paper as the principal author was published in 2014 when he was 97 (9).

The Physiological Chemist

When asked about his vocation, Boyd preferred describing himself as a physiologic chemist and teacher. He had an excellent understanding of using animal models as essential "instruments" for fundamental nutritional studies. Like many of those who were successful in identifying new food-derived biofactors, he had insights into how to use reproductive efficiency, changes related to neonatal development, and alterations in animal behaviors in assessing their nutritional importance. In approaching a research problem, his first question was often, "What are the best set of objective endpoints to use?" An essay by Boyd that addresses some of these points was presented at a USDA workshop on recommended daily allowances in 1995 entitled "Endpoints for Determining Mineral Element Requirements: An Introduction" (10). Boyd offered that the validation or establishment of appropriate endpoints and the understanding of their related mechanisms were always essential components in assessing a nutritional intervention's success. Research discussions with Boyd always focused on the best possible selection for the experimental design and controls and approach to best achieve the validation of results.

Recognitions

Boyd's first research award was the American Feed Manufacturers Award (1967), followed by Sigma Xi and Phi Beta

Kappa awards from their University of Missouri affiliates. In 1980, he was awarded the Borden Award from the American Institute of Nutrition and became an AIN fellow (now the American Society for Nutrition) in 1985. He is also a recipient of the American Society of Chemistry's Spencer Award by the ACS Kansas City chapter (1988) and a Klaus Schwarz Medalist awarded by the International Association of Bioinorganic Scientists in 2001. These awards recognized his exemplary contributions to agricultural and food chemistry as well as a long and highly successful career. Also noteworthy were sabbaticals at the Enzyme Institute at the University of Wisconsin, at the University of Cambridge supported by a Guggenheim Fellowship, at Harvard Medical School supported by an NIH fellowship, and at the Commonwealth Scientific and Industrial Research Organisation (CSIRO, Australia's federal agency responsible for scientific research). At the CSIRO, his research efforts were supported by a Fulbright Fellowship. As meaningful to Boyd, however, was having 1 of 2 lectures named in his honor by the Department of Nutrition and Exercise Physiology at the University of Missouri. Appropriately, the other lecture was named in honor of his mentor, Dr. Albert G. Hogan.

Service to the Nutrition Community

The late 1960s and early 1970s were periods of dynamic change for the American Institute for Nutrition. Dr. Boyd O'Dell served as president for the society in 1969. In a presidential address, summarized in Nutrition Notes, "How Can AIN Best Serve?" (11), Boyd suggested that the society needed to move in several new directions. He strongly advocated that AIN should broaden its scope and become more inclusive (i.e., facilitate better interaction between its basic scientists, clinicians, and those with more humanistic and nutrition policy aspirations). The establishment of a long-range planning committee was promoted. There was also the admonition for better coordination of the society's 2 journals at that time, the *Journal of Nutrition* and *American Journal of Clinical Nutrition*. Further, he urged that AIN should play a more visible and broader role in nutrition education and population-based surveillance and become more involved in legislative policymaking.

In addition to Boyd, AIN was guided by the efforts of others who were forward thinking and inclusive. As a consequence, several forums were organized to discuss and better articulate new directions for AIN. As an example, during this period, there was the first joint meeting of the AIN, the American Society for Clinical Nutrition, the Nutrition Society of Canada, and the Nutrition Society of Mexico. A long-range planning committee was set into motion. The *Journal of Nutrition* was reorganized, and the AIN began to play an active role in the newly formed publications committee for the Federation of American Societies for Experimental Biology (FASEB).

Like others of his stature, Boyd was also very active on editorial boards of highly visible nutrition journals (e.g., the *Journal of Nutrition*, *Federation Proceedings*, *Physiological Reviews*, *Experimental Biology & Medicine*, *Annual Review of Nutrition*, and *Nutrition Reviews*). Further, he served on the US National Committee to the International Union for Nutritional Sciences (IUNS) from 1987 to 1989. The IUNS is the forum for the broad field of nutrition and its major academic societies worldwide. Of the many FASEB meetings he helped plan, a notable example was initiating the concept of and

chairing the first FASEB Summer Conference (now the FASEB Research Conferences) on trace elements. The initial successful meeting at Saxons River, Vermont, led to 15 subsequent FASEB trace element conferences in venues across the United States.

Retirement

A retirement celebration was held for Boyd O'Dell in 1987. One of us (Robert Rucker) had the pleasure of speaking at the event, along with K. Michael Hambridge (University of Colorado), Roger Sunde (University of Wisconsin), Robert Cousins (University of Florida), Ed Harris (Texas A&M University), Forrest Nielsen (Grand Forks Human Nutrition Research Center), and Bert Vallee (Harvard University). Boyd had interacted with each of us in significant ways, as a mentor, colleague, friend, or collaborator. The event was in keeping with the spirit a festschrift symposium and attended by many of his former students, for whom he would often describe as those “who have helped him light the darkened path.”

In 2016, a 100th birthday party was organized for Boyd, which coincided with the 40th anniversary of the University of Missouri's Biochemistry Department's consolation between the programs in the College of Agriculture, Food and Natural Resources and the School of Medicine. At the event, it was announced that Boyd would be honored by naming the bridge that connected Schweitzer Hall and the Schlundt Annex as the “Boyd O'Dell Bridge of Discovery.” Many of the event's speakers emphasized Boyd's tenacity and an impressive commitment to research. Others were impressed that well into his 90s, he bicycled daily to the campus and local events.

During this period (1987 to 2016), he made contributions to over research 50 papers and summaries that addressed topics ranging from the potential causes of the biphasic platelet aggregation in rat plasma to the role of zinc and calcium in peripheral nerve function. It was also demonstrated that zinc deficiency impairs calcium's entry into cells by modulating Zn-dependent plasma proteins. In particular, his contributions with Jim Browning (Division of Animal Sciences, University of Missouri) exemplified Boyd's commitment to lifelong learning (i.e., the use of modern cell biology and 21st-century approaches in resolving questions related to zinc's role in cell signaling and signal transduction) [cf. O'Dell and Browning (9)].

As Boyd's research home for a significant part of the 7 decades that he was active, Schweitzer Hall, deserves comment. When Boyd responded to questions about the secret of his longevity, with a smile and twinkle, Boyd's answer would often be the “radiation” in Schweitzer Hall. Schweitzer Hall was named after Paul Schweitzer, the first full-time professor of chemistry and first chairperson of the Department of Agricultural Chemistry. Schweitzer Hall and Pickard Hall, which housed the Department of Chemistry, were locations of studies that focused on the isolation of radium. In the 1920s and 1930s, chemists who worked in the buildings produced radium from materials, such as pitchblende. All of us who worked in the building 30–40 y later appreciated this history. The drainpipes in Schweitzer emitted radiation. As a consequence, lab coats with a film badge dosimeter were never left in the vicinity of such pipes. Also, some of us had the distinction of isolating enzymes in a basement abattoir in Schweitzer

Hall that existed because of meat processing and preservation-related research carried out in the early 1900s. As Boyd would admonish, “It was your challenge to achieve the best with the available resources.” As a postscript, however, it is important to point out that with the renovation of Schweitzer Hall and construction of Schlundt Annex, the biochemistry research facilities are now at the state of the art, although linked to an extradentary history of physiologic and biochemical research.

Personal Notes

Both of us have had the good fortune to be influenced by outstanding and influential mentors. Robert Rucker worked in Dr. Boyd O'Dell's laboratory as a postdoctoral fellow to identify copper-containing enzymes essential in the crosslinking and maturation of collagen and elastin proteins (12). Barry Starcher received his PhD from North Carolina State University under the direction of Dr. Charles Hill. Barry Starcher also worked with Dr. S. M. Partridge at the University of Cambridge as a postdoctoral fellow (13) shortly after Dr. Boyd O'Dell's sabbatical visit with the Partridge research group as a Guggenheim fellow (14). Our paths became linked because of the research focus on copper in the Charles Hill and Boyd O'Dell laboratories in the late 1960s. Before the 1980s, little about the process of effectively communicating science was virtual or could be done anonymously. Participating in meetings and forums was essential to be effective. At such meetings, both Charles Hill and Boyd O'Dell unreservedly shared their professional knowledge and expertise. They encouraged interaction between those in the formative stages of their careers. Both were excellent in empowering students and junior associates to make positive choices, prioritizing goals, and honing interpersonal and communication skills. We previously provided a biography focusing on Dr. Charles Hill's academic career and life (15). We are grateful to be able to do the same for Dr. Boyd O'Dell.

In summary, descriptors such as tenacity, curiosity, creativity, and objectivity easily apply to Boyd O'Dell. During his more active periods of research, he was one of the more impactful leaders in the field of micronutrient metabolism, contributing seminal observations related to the physiologic importance of zinc, copper, and, in his earlier studies, folic acid.

Acknowledgments

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