



John W. Suttie

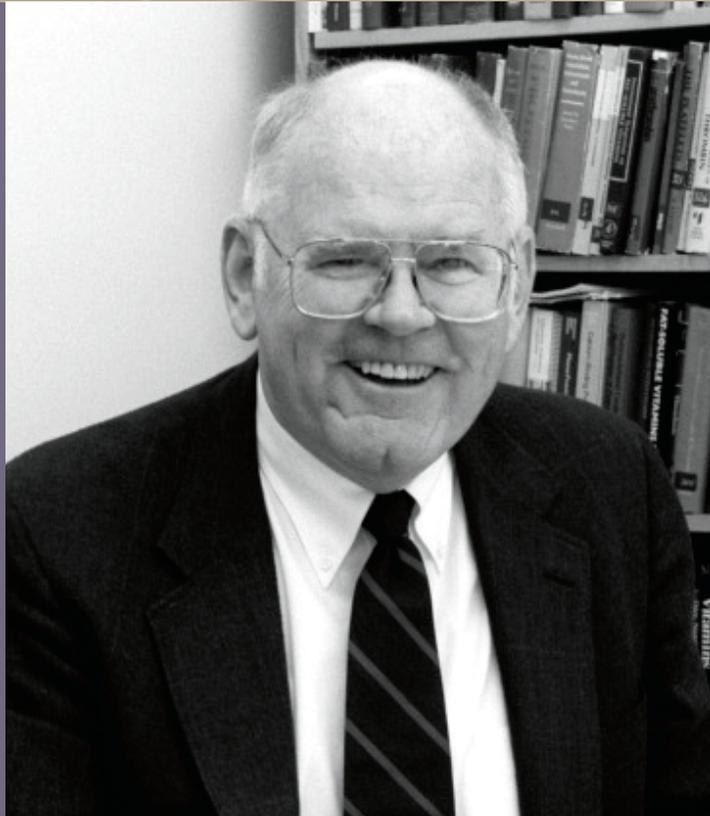
1934–2020

BIOGRAPHICAL

Memoirs

*A Biographical Memoir by
Robert J. Cousins and
Richard Eisenstein*

©2022 National Academy of Sciences.
Any opinions expressed in this memoir are
those of the authors and do not
necessarily reflect the views of the
National Academy of Sciences.



NATIONAL ACADEMY OF SCIENCES

JOHN WESTON SUTTIE

August 25, 1934–December 21, 2020

Elected to the NAS, 1996

John W. Suttie was in every way a true Wisconsinite. In the mobile society of today, few can say they were born, educated, and had a sterling scientific career in one state. John was one of the few with that distinction. Growing up on a family dairy farm, it was logical he would elect dairy science as an entry major at the University of Wisconsin–Madison (UW). Soon basic science prevailed, and he entered the field of biochemistry, igniting a lifelong career. John actually had two scientific interests. The first was fluoride toxicity in cattle, developed as an undergraduate and graduate student in the Biochemistry Department at Wisconsin. The second, in which he was a key player, was research on vitamin K, its mode of action, and its nutritional significance. Over his career John published about 250 papers on vitamin K and about fifty on fluoride. This research earned him his numerous awards. The vitamin K research established the need for vitamin K-dependent carboxylase to produce active prothrombin needed for blood coagulation. His group later also discovered vitamin K oxide reductase, needed for vitamin K recycling. His interest in nutrition-related research led him to the chairmanship of UW's Department of Nutritional Sciences. This in turn led to roles as president of the American Society for Nutrition and the Federation of American Societies of Experimental Biology. Recognition for his vitamin K research earned him election to the National Academy of Sciences in 1996.



Photograph courtesy of Journal of Biological Chemistry

By Robert J. Cousins and
Richard Eisenstein

Early Years

John Suttie was born in La Crosse, Wisconsin, on August 25, 1934, to William Vilas Suttie and Emma Suttie. He was raised on the family dairy farm near Galesville. He had two siblings, William (born 1929) and Ruth Hoff (born 1935). His early education took place in very rural west-central Wisconsin. He graduated from Galesville High School in 1952, in a class of fifty students. He was active in the Future Farmers of America and was headed for a career in agriculture. During high school, he met some UW faculty through participation on animal and meat judging teams.

College Years

He entered UW in 1953 as a dairy science major. Coincidentally, he lived in a co-op for male students located in the former home of nutritional sciences pioneer Stephen M. Babcock. During his freshman year, the Dairy Science Department chair suggested that John pursue a basic science curriculum rather than one that was more applied. Soon thereafter John was enrolled in the Biochemistry Department and was fortunate to have Paul Phillips as his advisor. Suttie worked as an undergraduate researcher on one of Phillips' research projects. John stated that "his [Phillips'] students were given more freedom to push their projects ahead than most, and his approach seemed to work, as a large number of his students have had very successful careers." In 1957, Suttie graduated with a Bachelor of Science degree in biochemistry, a rare undergraduate degree at the time. Without really considering other graduate programs, as he has stated, he remained under Phillips for graduate work. His graduate research was on fluoride toxicity and earned him Master of Science and Ph.D. degrees in 1958 and 1960, respectively. The UW biochemistry faculty recognized his talents and offered him a faculty appointment after graduation—quite an accomplishment for a 26-year-old biochemist and quite atypical by today's standards. John accepted the position, but as other Wisconsin-trained faculty had done, he spent a year abroad for postdoctoral training. He chose the lab of T. S. Work at the National Institute for Medical Research, which was at the Mill Hill campus in London. This position was funded through a postdoctoral fellowship with the National Science Foundation (NSF). In an autobiographical prefatory chapter for the *Annual Review of Nutrition*, John described the contrasts between his time at Mill Hill and his experience back in Madison.

Early Academic Career

Upon his return from Mill Hill, he began teaching an undergraduate course in biochemistry for the fall 1961 semester. That effort included three lectures and two lab sessions per week. John stated how different that approach was compared to the current practice of giving faculty time to organize teaching duties and to write initial grant applications. He added that at the time the department had a cluster of young faculty, all Wisconsin-trained biochemists, who were involved with research related to nutrition.¹ That group included Hector De Luca, Alfred Harper, William Hoekstra, and Carl Baumann.

Research on Fluoride Toxicity

After John joined the Biochemistry Department, he took over the research on fluoride toxicity that Phillips had developed. Fluoride-related problems in cattle developed through fluoride emissions created from aluminum production needed during World

War II and through phosphate fertilizer production. These industries generated large amounts of hydrogen fluoride and fluoride-containing particulates that were consumed by cattle grazing nearby. Phillips received research support from some of these companies in a relatively informal arrangement that John was able to maintain for thirty years. Key to these studies was the demonstration that fluoride was incorporated into dental enamel that caused a discoloration of the teeth that could be scored and used as an indicator of fluoride intake. He stated that animal productivity was not tested, but herd owners were compensated for potential damage to their cattle. Throughout his career, Suttie continued to give advice and consult in the area of fluoride toxicity national and internationally.

Research on Metabolism and Mechanism of Action of Vitamin K

As is so common for young investigators, following a postdoctoral experience and with a new faculty appointment, John was in need of a project he could call his own. He reviewed the literature on mammalian protein synthesis. Regulation of specific proteins by hormones and nutrients was a new and fertile field at the time. John wisely focused on the role of vitamin K in prothrombin production. This capitalized on his experience with protein synthesis at Mill Hill. John was cognizant of the prominent reputation UW had acquired with the discovery, by fellow faculty member Karl P. Link, that the compound dicoumarol was an antagonist of vitamin K and thus served as an anticoagulant. He mentioned many times that his interest in vitamin K was not related to Link's research.

John wrote an NIH grant proposal entitled "Regulation of Prothrombin Synthesis by Vitamin K," based upon his view of how vitamin K was involved in blood coagulation factor production. The proposal was funded. He pointed out later that this was the only individual R01 grant he wrote, as subsequently his research was incorporated into a fat-soluble vitamin program project grant for which Hector DeLuca was the lead principal investigator (PI). John's initial studies focused on whether vitamin K increased the rate of synthesis of clotting factor proteins or aided in the conversion of precursors to active clotting-factor proteins. Key to these experiments was the skillful use of cycloheximide, a drug that blocks mRNA translation. These studies showed vitamin K aided in the conversion of a precursor to active prothrombin rather than de novo synthesis of the protein. By the mid-1970s, studies in the United States and abroad demonstrated the need of Ca^{2+} ion binding for biological activity of prothrombin and the involvement of a new amino acid, γ -carboxyglutamic acid (Gla). In John's words, the latter discovery was "a knowledge-changing event." John's lab soon demonstrated that $^{14}\text{CO}_2$ was incorporated into prothrombin and that carboxylation took place in the microsomal fraction

of cells when sufficient vitamin K was present. His lab established the existence of the vitamin K-dependent carboxylase. The name for the enzyme is still used. Reasoning that

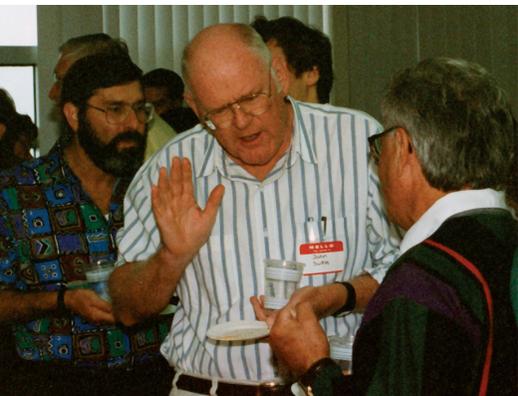


Figure 1. John at a UW Madison Biochemistry Department gathering in 1983 with colleagues Paul Ludden (left) and Hector DeLuca (right).

the excretion of Gla was rapid, but that stoichiometry predicted that a mole of vitamin K was needed to produce a mole of Gla, John led his lab to demonstrate that oxidized vitamin K (vitamin K 2,3-epoxide) was recycled to the reduced form. The enzyme identified was vitamin K epoxide reductase. Since then, the implications of the research on Gla proteins expanded into areas related to calcified tissue development and related diseases, such as osteoporosis.

Later in his career, he focused on menaquinone-4, a form of vitamin K that is not produced by intestinal microbiota. Less well recognized than phylloquinone, the predominant vitamin K, the Suttie lab demon-

strated mechanistically how menaquinone-4 was formed *in vivo* from phylloquinone. He also concluded that this form of vitamin K contributes more toward satisfying the vitamin K dietary requirement than gut-derived menaquinones.

Administrative Contributions and Political Biology

The Nutritional Sciences Department at Wisconsin, since its formation in 1969, was led by Alfred Harper, known for his work in nutritional biochemistry and amino acid metabolism. When Harper stepped down in 1982, it was difficult to find a consensus replacement, and two faculty members served relatively short times as chair. As John stated, “this is a particularly difficult problem at Wisconsin where faculty have a major input on the selection of chairs and are required to vote on their support of the current chair each year.” John was asked by the dean to take the position in 1988, which the faculty accepted, while still retaining his appointment in the Biochemistry Department. He successfully served as chair until 1997. During his chairmanship, the department hired five new faculty and obtained an NIH training grant and USDA training grants, all with John as PI. He strengthened the interdepartmental graduate program with additional mentors, established lab rotations, and revitalized the graduate curriculum while keeping it focused on nutrition. John quickly gained recognition within the nutrition

field and by 1993 was elected president of the American Institute of Nutrition (AIN). John served as the AIN representative to the board of directors of the Federation of American Societies for Experimental Biology (FASEB), in which AIN was one of the five constituent founding societies. At about this time the AIN changed names first to the American Society for Nutritional Sciences and then to the current American Society for Nutrition (ASN). He was elected by FASEB board as president for 1996–1997. The public affairs activities of



Figure 3. John at a FASEB Research Conference, 1997.

FASEB were steadily increasing during the time John was involved—an effort to which he contributed to significantly. These FASEB-led efforts helped with lobbying to get the NIH budget doubled during this period. During his service to the nutrition research community, John was interested in becoming editor of the *Journal of Nutrition* when Willard Visek stepped down as editor. That transition took place after some rancor within the ASN. He prevailed and served as editor of the journal from 1998–2003. John served on the editorial committee of the *Annual Review of Nutrition* for a term while one of us (RJC) was editor. That experience proved helpful to John as founding editor for *Advances in Nutrition*, an ASN journal for reviews and conference reports. John was also a member of the Food and Nutrition Board (IOM) from 2001–2007 during the period the Dietary Reference Intakes (DRI) for micronutrients were developed. He also served on additional nutrition-related committees for the National Research Council, the Food and Drug Administration, and the World Health Organization, among many others.

These professional activities reflected favorably on UW as a national academic leader.



Figure 2. John in the lab with Sherry Mills and Frank Greer.



Figure 4. John as FASEB President at a Consensus Conference with Rep. (D-CA) Nancy Pelosi.

Teaching and Mentoring

John taught a three-credit undergraduate course in biochemistry and other science majors, Biochemistry 501, for nearly twenty years and authored two editions of a textbook on the same subject. The course enrolled countless students over the years. He also contributed significantly to teaching graduate biochemistry in metabolism and related areas for twelve years. He trained forty-five graduate students and twenty-seven postdoctoral scientists.

Academic Philosophy

Institutional service was important to John, and he contributed widely to academic life at the UW. In a prefatory chapter for the *Annual Review of Nutrition* (2011), John reflected on how the scientific community in academia had changed during his career. Early on, he commented that departmental faculty knew generally where a department should place hiring emphasis. He became concerned that hiring now is done more by administrative directive rather than by faculty who know what department and discipline needs are. The new approach makes “it difficult for departments to maintain a strong research focus and to be recognized for it.”

Honors and Awards

John Suttie was widely recognized for his scholarly contributions throughout his career. These include awards from the ASN: Mead Johnson Award (1974), Osborne and Mendel Award (1980) and Conrad Elvehjem Award (2004). He was elected to membership in the National Academy of Sciences in 1996 and made a fellow of the ASN in 2000. He was the recipient of the Bristol-Myers Squibb/Mead Johnson Award for Achievement in Nutrition Research and was the W. O. Atwater Award Lecturer of the U.S. Department of Agriculture (both in 2002).

Plaudits from Colleagues

Hector F. DeLuca, Professor Emeritus, UW: “because of his great sense of humor, John made life pleasurable for everyone around him, yet he was strong and resolute when required. John Suttie is a largely unsung champion of the University of WI-Madison at all levels, one of the most highly regarded members of the Department of Biochemistry and of Nutrition. Both I and the University of Wisconsin will forever miss him.”

Howard H. Garrison, Public Affairs Director Emeritus, FASEB: “In addition to his outstanding contributions to science, John Suttie was an inspiring leader. He would ask penetrating and incisive questions, listen carefully, and then make clear and

decisive choices. When he was President of FASEB, he devoted his talents and energy to expanding the organization's influence by reaching out to federal agencies and other scientific societies."

Karen King, American Society for Nutrition, Publications Editor Emeritus: "I had the privilege of working closely with John Suttie while he was Editor-in-Chief of the *Journal of Nutrition* and later as Inaugural Editor-in-Chief of *Advances in Nutrition*. John's exceptional talents as a researcher and a scholar allowed him to address the needs of these different journals focused on meeting the evolving information needs of research and academic scientists."

Robert D. Steele, Retired Professor and Associate Dean, University of Wisconsin-Madison; Dean and Professor Emeritus, Penn State University: "John wholly embraced the 100-plus year old Wisconsin Idea where the boundaries of the university are the boundaries of the state and planet. Consequently, as his resume documents so well, he was highly recruited as a problem solver whether with a farmer/rancher, industry, laboratory, or governmental official and program. I once heard John introduced as the colloquium speaker by a colleague (UW colleague Bob Burris) as being as pure of a Wisconsin product as a finely aged cheddar cheese."

Marvin P. Wickens, Professor, University of Wisconsin: "I always enjoyed talking with John, about most anything—inevitable laughing, often at ourselves. I have missed our times together since he left Madison, even to the point of imagining him walking down the hall to drop by."

Bill Reznikoff, Professor Emeritus, University of Wisconsin: "John and I frequently took opposite sides on issues, but I really liked and respected him. He always listened to other views and changed his stand if the info showed otherwise."

Judith Kimble, Professor, University of Wisconsin: "I remember John in faculty meetings and on committees as thoughtful, even handed, respectful and collegial. His smile was unforgettable and heartwarming."

Roger Sunde, Professor, University of Wisconsin: "John had a knack for getting to the heart of a problem, bold enough to do something about it, and had fun doing it, both in research and in life."

Richard Eisenstein, Professor, University of Wisconsin: "John always had an 'institutional view' on how to move new initiatives and programs forward. His uncommon degree of



Figure 5. John with family, Joan, Leone and Colin.

commitment to the service aspect of his role as a faculty member had long-lasting positive impacts on UW-Madison and the national biomedical sciences research community. He was a strong advocate for young faculty and the Nutritional Sciences Department at UW-Madison.”

Bob Cousins, Professor, University of Florida: “John Suttie and I were friends for about 40 years. He had a feel for integrative biochemistry that was hard to match. With his wonderful sense of humor and scholarship, he

was a great person to have a drink and dinner with and we did so on many memorable occasions. He was very aware of best academic practices and did not ‘suffer fools gladly’.”

Family and Personal Life

John Suttie married Leone Stenberg on August 27, 1955, in their hometown of Galesville. They have two children, Joan (born 1958) and Collin (born 1961). They have four grandchildren and one great-grandchild. John and Leone were avid golfers and upon retirement spent time between Madison and Green Valley, Arizona. John and Leone were known for their collection of art by local artists as well as European and American prints in a variety of mediums. They particularly appreciated Depression-era art by American artists. He also enjoyed cooking, canoeing, and cross-country skiing. John Suttie passed away on December 21, 2020, in Green Valley from complications related to a Covid infection.

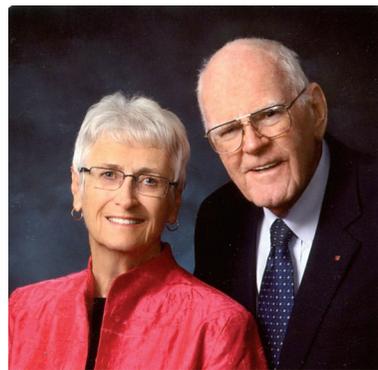


Figure 6. John and Leone Suttie.

ACKNOWLEDGEMENTS

One author (RJC) acknowledges primary sources as the prefatory chapter written by John Suttie and used with permission from *Annual Review of Nutrition*, personal conversations between RJC and John over a forty-year period, a curriculum vitae, and correspondence with Mrs. Leone Suttie. Input from faculty and staff at UW-Madison is gratefully acknowledged as is that from Howard Garrison, who provided a FASEB photo.

REFERENCES

1. Suttie, J. W. 2011. Nutritional scientist or biochemist? *Annu. Rev. Nutr.* 31:1–14.
2. Kresge, N., R. D. Simoni, and R. L. Hill. 2008. The function of vitamin K: The work of John Suttie. *J. Biol. Chem.* 283:e9–e10.
3. Suttie, J. W. 1992. Vitamin K and human nutrition. *J. Amer. Diet. Assoc.* 92:585–590.
4. Institute of Medicine (US) Panel on Micronutrients. 2001. *DRI: Vitamin A, vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium and Zinc*. Washington, D.C.: National Academy Press.
5. Eisenstein, R. S., and S. L. Booth. Biography of John W. Suttie, Ph.D. *J. Nutr.* January 11, 2022; <https://doi.org/10.1093/jn/nxac011>.

SELECTED BIBLIOGRAPHY

- 1957 With R. W. Miller and P. H. Phillips. Studies of the effects of dietary NaF on dairy cows. I. The physiological effects and the developmental symptoms of fluorosis. *J. Nutr.* 63:211–224.
- 1962 With D. B. Roodyn and T. S. Work. Protein synthesis in mitochondria. 2. Rate of incorporation in vitro of radioactive amino acids into soluble proteins in the mitochondrial fraction, including catalase, malic dehydrogenase and cytochrome c. *Biochem. J.* 83:29–40.
- 1969 With M. J. Thierry. Distribution and metabolism of menadiol diphosphate in the rat. *J. Nutr.* 97:512–516.
- 1969 Air quality standards for the protection of farm animals from fluorides. *J. Air Pollut. Control Assoc.* 19:239–242.
- 1971 With D. V. Shah. Mechanism of action of vitamin K: Evidence for the conversion of a precursor protein to prothrombin in the rat. *Proc. Nat. Acad. Sci. U.S.A.* 68:1653–1657.
- 1972 With G. L. Nelsestuen. The purification and properties of an abnormal prothrombin protein produced by dicumarol-treated cows. A comparison to normal prothrombin. *J. Biol. Chem.* 247:8176–8182.
- 1973 Mechanism of action of vitamin K: Demonstration of a liver precursor of prothrombin. *Science* 179:192–194.
- 1975 With C. T. Esmon and J. A. Sadowski. A new carboxylation reaction. The vitamin K-dependent incorporation of $H^{14}CO_3^-$ into prothrombin. *J. Biol. Chem.* 250:4744–4748.
- 1976 With C. T. Esmon. Vitamin K-carboxylase: Solubilization and properties. *J. Biol. Chem.* 251:6338–6243.
- 1976 With J. M. Hageman, S. R. Lehrman, and D. H. Rich. Vitamin K-dependent carboxylase: development of a peptide substrate. *J. Biol. Chem.* 251:5827–5830.
- 1977 With J. A. Saowski and H. K. Schnoes. Vitamin K epoxidase: Properties and relationship to prothrombin synthesis. *Biochem.* 16:3856–3863.
- 1978 With D. V. Shah, J. K. Tews, and A. E. Harper. Metabolism and transport of gamma-carboxyglutamic acid. *Biochim. Biophys. Acta* 539:209–217.

- 1981 With A. E. Larson and P. A. Friedman. Vitamin K-dependent carboxylase stoichiometry of carboxylation and vitamin K 2,3-epoxide formation. *J. Biol. Chem.* 256:11032–11035.
- 1983 With J. J. McTigue. Vitamin K-dependent carboxylase: Demonstration of a vitamin K- and O₂-dependent exchange of 3H from ³H₂O into glutamic residues. *J. Biol. Chem.* 258:12129–12131.
- 1988 With G. M. Wood. Vitamin K-dependent carboxylase: Stoichiometry of vitamin K epoxide formation, γ -carboxyglutamyl formation, and γ -glutamyl-³H cleavage. *J. Biol. Chem.* 263:3234–3239.
- 1991 With F. R. Greer, S. Marshall and J. Cheery. Vitamin K status of lactating mothers, human milk and breast-feeding infants. *Pediatrics* 88:751–756.
- 2009 With N. Binkley, et al. Vitamin K treatment reduces undercarboxylated osteocalcin, but does not alter bone turnover, density or geometry in healthy post-menopausal North American women. *J. Bone Miner. Res.* 24:983–991.

Published since 1877, *Biographical Memoirs* are brief biographies of deceased National Academy of Sciences members, written by those who knew them or their work. These biographies provide personal and scholarly views of America's most distinguished researchers and a biographical history of U.S. science. *Biographical Memoirs* are freely available online at www.nasonline.org/memoirs.