



KARL H. NORRIS

1921–2019

Elected in 1980

“Research and development of systems for simple and rapid analysis of quality factors in food products and similar materials.”

BY ESSEX E. FINNEY JR.

KARL HOWARD NORRIS died July 17, 2019, at the age of 98 in Alexandria, Virginia. He was internationally recognized as both an authority on instrumentation and the founder of the field of near-infrared reflectance spectroscopy.

Karl was born May 23, 1921, in Glen Richey, Pennsylvania, to Blaine and Marjorie Rowles Norris. He grew up on the family farm with three brothers and three sisters. He graduated magna cum laude from high school, enrolled at Pennsylvania State University, and earned a BS degree in agricultural engineering in 1942. He entered the US Army Signal Corps and received training in advanced radio, electronics, and microwaves at the University of Chicago, which qualified him for a BS degree in physics in 1943. Upon completion of this training, he was retained as an instructor in the same program until he volunteered for service in the Office of Strategic Services and was sent to India for the remainder of World War II.

Back in the United States after the war, he worked as an electronics engineer for the Institute of Radiobiology and Biophysics at the University of Chicago (1946–49), developing instruments for biophysical research.

Before embarking on the next phase of his professional career, in 1948 he married Maxine Evelyn Thomas, whom he had met earlier at church. They raised two children.

In 1950 Karl began a pioneering career with the US Department of Agriculture. His combination of education, experience, and skills in farming, engineering, electronics, and computers uniquely qualified him for the challenges at the Beltsville Agricultural Research Center in Maryland. He was hired into a permanent position as a research agricultural engineer to lead the Instrumentation Research Laboratory, where he was asked to develop new instruments and methods for measuring the quality of agricultural produce and food commodities, especially those that enter marketing channels.

His initial project was to design, develop, and perfect instrumentation that would automatically sort eggs. At that time, this was a labor-intensive, error-prone process of visual inspection and candling by hand. Norris soon developed a new technique using light transmittance and reflectance principles to automatically sort eggs by shell color and detect the presence of internal bloodspots and bacteria that cause spoilage.

In 1953 President Dwight D. Eisenhower visited Norris's project during a tour of the Beltsville Center and was greatly impressed with the new sorting equipment. When he returned to the White House, Eisenhower wrote a letter to the Beltsville director complimenting Karl Norris on this new technology. In 1955 Karl received his first Superior Service Award from the USDA.

His early success with the use of light-transmittance principles with eggs led him to explore and learn that this technique could be used to test the interior quality of other agricultural products. He discovered, for example, that certain interior defects, such as browning in apples or hollow heart in potatoes, alter the transparency of the product to certain wavelengths of light. Prior to his work, it was assumed that such products were opaque. Karl used his instrumentation genius and imagination to show that they were not opaque and that measuring their transmittance characteristics could yield useful information about their interior. This was recognized as a major breakthrough in quality evaluation, led to the development of a number of commercial instruments, and became the basis for research in other laboratories around the world.

Karl then shifted his research to the near-infrared (NIR) radiation spectrum. Although he was not a spectroscopist, he combined his skills in physics, mathematics, and electronics with the newly developing digital-computer technology for quantitative analysis of agricultural samples.

He introduced and pioneered the development of NIR reflectance spectroscopy as a method for the rapid, inexpensive, and accurate estimation of protein, oil, moisture, and fiber content of products, especially cereal grains, soybeans, and forages. He built the first prototype instrument and demonstrated its capabilities to industry, federal, and state testing laboratories. The result revolutionized the system for marketing grain. The Canadian Department of Agriculture was among the first to adopt this technology for protein evaluation of wheat. The same basic instrumentation was adapted to measure other components of product quality.

For his contribution to the soybean industry he received a Service to Education and Research Award in 1972 from the Land of Lincoln Soybean Association. He also received the Alexander von Humboldt Award, with a \$10,000 prize, from the Alexander von Humboldt Foundation in 1978 for his distinguished research contributions.

Karl's unique and creative instrumentation skills have remained an asset to many scientists at the Beltsville Center. Sterling Hendricks, a member of the National Academy of Sciences and former president of the American Society of Plant Physiologists, worked at Beltsville and cited the importance of Norris's instrumentation contributions on the advancement of photobiology. For example, Karl developed the instrumentation and measurement technique that permitted the first spectrophotometric detection of phytochrome, the plant pigment that controls photoperiodic plant processes such as germination, growth, and flowering. The identification and measurement of phytochrome were some of the most important discoveries of plant sciences in the 20th century.

Karl also originated the Instrument News section of the *Journal of Agricultural Engineering* and edited the column for over 10 years.

Under Karl's leadership, the USDA Instrumentation Research Laboratory developed an international reputation for preeminence in the field of instrumentation. There was a continuing demand by scientists from other groups and countries (e.g., Australia, Canada, Hungary, Israel, Japan, and Romania) to come and work in his laboratory without compensation from the USDA.

Norris's USDA honors include a second Superior Service Award in 1963, a Distinguished Service Award in 1986, and induction into the Agricultural Research Service's Science Hall of Fame in 1989.

His numerous other honors and awards include being named a fellow of the American Society of Agricultural Engineers in 1967 and receiving its Cyrus Hall McCormick Medal in 1974 for his "exceptional and meritorious engineering achievement in agriculture." In 1975 he was an honoree of the American Academy of Achievement, celebrated at a Banquet of the Golden Plate. He was elected to the National Academy of Engineering in 1980. Karl was highly honored in 1986 when his alma mater, Penn State, named him an Outstanding Engineering Alumnus and, 2 years later, an Alumni Fellow. The American Association of Cereal Chemists gave Karl its Thomas Burr Osborne Medal (1986), and from the Spectroscopy Society of Pittsburgh he received the Maurice F. Hasler Award at the 1991 Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy.

In 1995 members of the International Committee on Near-Infrared Spectroscopy (NIRS) selected Karl as its honorary First Fellow, "for excellence in research, mentorship to the NIRS community, and a continuing distinguished career." In 2002 he received the Sir George Stokes Medal of the UK Royal Chemical Society. A year later, the Japan Council of NIRS established a new annual award and bestowed it on him: the Karl H. Norris Award in Near-Infrared Spectroscopy. He received another such medal in 2014. He was very pleased to see his lifetime contributions recognized in this manner.

Over the years as Karl's professional career flourished, he and Maxine maintained an active civic and religious life

in their community. He served as president of the Beltsville Rotary Club, president of the Parent-Teachers Association, and institutional representative for the Boy Scouts of America. In the Emmanuel United Methodist Church of Beltsville, he headed many committees and served as head usher. Maxine sang in the church choir and was a tireless leader for the Girl Scouts of America.

In 2017 Maxine's health deteriorated and she passed away August 28, 2017, with Karl by her side. They are survived by their children Deborah Norris DeVore (Carl) and Mark Norris.

At the end of a lecture on "The Birth of NIR Spectroscopy and the Future" that he gave in Japan in 2000, Karl said, "My story does not have an ending." His statement certainly remains true in a professional sense, as ongoing advances in NIR science and engineering continue to improve the lives and well-being of people everywhere. But it also remains true in a personal sense, for as long as those of us with memories of him live on.

Karl was an innovator who delighted in discovery and invention, who also encouraged and generously shared his expertise with colleagues young and old, near and far. His gentle, positive spirit will be missed.