Marion Leroy Jackson

November 30, 1914–December 21, 2002
Elected to the NAS, 1986

A Biographical Memoir by Phillip Barak

Figure 1 ML Jackson.

Marion Leroy Jackson, known as "ML," was a pioneer in the identification and properties of soil minerals and the role of soil minerals in environmental processes. He was active in the Department of Soil Science at the University of Wisconsin-Madison between 1937 and 1989, with a prodigious published output, and he was an advisor and teacher of a who's who of young scientists (graduate students, postdoctorates, and visiting professors) worldwide. He was an eclectic scholar of the mineralogy of Wisconsin, the United States, and the world, particularly as it related to their geomorphologic and glacial history as well as to fertility and food supply and quality.

ML was born on November 30, 1914, on a farm near Reynolds in Jefferson County, Nebraska, the son of Cleveland Jackson and Belle Josephine (Hanson) Jackson. He was reared on a farm in York County, Nebraska. An award of a tuition scholarship for the University of Nebraska enabled him to enter the College of Agriculture there. In the summer of 1935, after his junior year, he was employed as a soil surveyor with the Conservation and Survey Division of Nebraska and assigned to explore wind-erosion damage in Kimball County. In 1936, he graduated with a bachelor of science degree with high distinction.

He worked for over a year as a land classification aide for the U.S. Department of Agriculture's Resettlement Administration, headquartered in Lincoln, Nebraska. He did fieldwork in northwestern South Dakota and earned a master of science degree in soil science from the University of Nebraska in 1937, with his thesis, "Sample area method of approach to land use planning in the Northern Great Plains." That same year, he began Ph.D. graduate work in the Department of Soils at the University of Wisconsin-Madison under Emil Truog, who himself was a prodigious author and mentor of soil scientists nationwide and worldwide. ML earned his Ph.D. in 1939 with a dissertation entitled, "Influence of grinding soil minerals to near molecular size on their solubility and base exchange properties."

He remained in the department as a postdoctoral appointee and then was hired as an instructor in 1941. He would progress through the professional ranks, becoming a full professor in 1950, and was named the Franklin Hiram King Distinguished Professor in 1974. ML was awarded professor emeritus status in 1986 upon his retirement. He taught courses at the undergraduate and graduate levels, including soil chemical analysis, soil physics, physical chemistry of soils, and soil mineral weathering. He was regarded as a most lucid and stimulating lecturer who understood the important impact of visual aids in an era of transparencies and slides, giving as much thought to oral and illustrated presentations as to written communication. He supervised fifty-nine Ph.D. students and eighteen master's degree students who went on to occupy numerous positions of importance in clay, soil, and environmental science in industry, government, and academia. His students in academia have trained at least another generation of soil chemists and mineralogists, who are themselves training students at prestigious institutions. ML also trained thirty-eight postdoctoral scholars from countries around the world and published more than 240 scientific papers and two textbooks: *Soil Chemical Analysis* and *Soil Chemical Analysis: Advanced Course.* He authored or coauthored individual chapters and sections in more than a dozen books, symposia, and encyclopedias. He was on the organizing committee for the monograph *Minerals in Soil Environments*, published in 1989 by the Soil Science Society of America. He was elected to the National Academy of Sciences in 1986. He was a fellow of the American Association for the Advancement of Science, the Soil Science Society, the American Society of Agronomy, and the Mineralogical Society of America. He served as president of the Soil Science Society of America and the Clay Minerals Society. He received the Soil Science Achievement Award of the American Society of Agronomy (the society's highest scientific award) in 1958. The Soil Science Society of America conferred on him the status of Distinguished Member in 1983 and gave him the Bouyoucos Soil Science Distinguished Career Award in 1986.

ML married his sweetheart, Chrystie Marie Bertramson, in 1937 while in graduate school, and she was his lifelong companion. Through the years, Chrystie' s dedicated support in field observations, editorial and logistical work, and joint attendance at professional meetings made important career contributions. Together, they endowed and established the Marion and Chrystie Jackson Soil Science Award for mid-career soil chemists and mineralogists. They had four children: Marjorie L., Virginia L. (Conlon), Stanley B., and Douglas M. Jackson. ML Jackson died on December 21, 2002, in Madison, Wisconsin.

Research Career

Jackson's academic career as a mineralogist is tightly connected to the development of X-rays as a technology to determine the interatomic distances in mineral lattices and, in tandem with chemical analyses, to develop qualitative and quantitative mineralogical methods to tease apart the heterogenous mixes of minerals that make up soil clay and other soil fractions.

The seat of soil acidity, the proton (hydrogen) donors, which required the application of agricultural lime, had been of interest to soil scientists. Jackson elucidated the role of the exchangeable aluminum as a proton donor by hydrolysis, and this helped clear up a controversy concerning "acid clay." The presence of polymeric hydroxy aluminum in soils was shown to confer hysteretic pH-dependent charge, previously attributed to the "broken edges" of silicates. He and his associates showed that positively charged hydroxy aluminum, which neutralized the permanent negative charge of the clay layers, progressively lost its positive charge (deprotonated) with the rise in soil pH caused by liming, thus activating "latent acidity," the source of which had long been a puzzle.

Analytical methods developed in ML Jackson's laboratory for fractionation and quantitative determination of different forms of soil phosphorus are still used by scientists throughout the world. The full spectrum of phosphates was determined, from calcium to iron and aluminum phosphates and iron-oxide-occluded forms, the latter having wrongly been called the "silicate lattice" form. An important finding was that liming, by changing the soil pH, increased phosphate availability by lowering the iron and aluminum activity and not, as previously taught, by conversion of the phosphate to a calcium phosphate form.

Jackson's success in obtaining support from the National Science Foundation and the Atomic Energy Commission led to an emphasis on basic research. His investigations of chemical weathering of soil minerals led to a description of the stability sequence of clay-sized minerals. Weathering release of potassium, magnesium, aluminum, and other ions was shown to influence soil pH, soil cation exchange capacity, and the availability of plant nutrients. That climate, vegetation, and geomorphic sites determine the solute composition of the soil matrix solution was shown to prevail rather than an equilibrium with the inherited minerals in soils. He and his students found that the solute composition in the soil then determined the minerals forming or formed authigenically. The wedge configuration formed by crystal layers at the lateral boundaries of vermiculite and mica was shown to be the site of fixation and release of the plant nutrients potassium and ammonium, as explained in his lectures and publications.

In the 1960s and 1970s, he led interdisciplinary investigations of wind-blown minerals in cooperation with the Universities of Chicago, California, and Hawaii and the National Center for Atmospheric Research at Boulder, Colorado. He and his colleagues developed a method for isolation of quartz from soil. By means of the oxygen isotope ratios, the quartz contained in the fine silt of shales, silt stones, loess, and till was found to be a composite of quartz from low-temperature origin (cherts and overgrowths) with that from high temperature origin (igneous and metamorphic). Large areas of aerosol-derived soils were found to originate in dusts from arid lands of the continents. For example, continental dust was brought down in rain to Pacific pelagic sediments and added to the soil composition on Hawaiian and Korean mountain tops. Also, dusts from the Sahara, transported across the tropical Atlantic Ocean to the Canary and Caribbean islands, were also found in soils in the southeastern United States. The proportions of quartz of high and low temperature in silts in the Northern Hemisphere were found to be different from those of the Southern Hemisphere, as a very distinct reflection of the fact that continents in the Northern Hemisphere traversed across the tropical and equatorial zones during the post-Precambrian period, whereas the southern sections of continents in the Southern Hemisphere did not. Therefore, the lower oxygen isotopic ratios of quartz in the latter reflect a higher proportion of igneous rocks than in the sediments of the Northern Hemisphere, wherein a higher proportion of cherts was found. ML showed by fission track dating that micas in Antarctica were formed by weathering four million years ago. He discovered by electron microscopy that microspherules from space deposited on the snows of Antarctica had nanometeoritic impact craters on their surfaces, with iron oxide crystals exposed in the crater bottoms.

In addition to conducting soil research with X-ray diffraction and teaching an X-ray diffraction course in the University of Wisconsin's College of Engineering in the 1940s, ML also carried out extensive field experiments. His experiments in Clark, Sauk, and Dane Counties, which involved combinations of liming with high rates of fertilization with phosphate and potassium, produced spectacular responses in corn and alfalfa crops. High rates of fertilizer application on corn, combined with high stand densities of 17,000 plants per acre increased corn yields in four experiments and exceeded 140 bushels per acre, despite Wisconsin's cool, moist weather. This work gave impetus to the College of Agriculture programs through which the average corn yield in Wisconsin increased from forty-four to more than ninety bushels per acre. ML's research included analysis of the nutrients carried away from soils in runoff waters under various crops managed by the Soil Conservation Experiment Station at La Crosse, Wisconsin.

Having witnessed the devastating and fatal effects of diseases of the cardiovascular system and cancer on students, colleagues, and relatives (he was orphaned by age twelve), ML spent several years in the 1980s investigating possible soil nutritional deficiencies as partial influences on death rates.

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