



University of Nebraska

A PRAIRIE UNIVERSITY AND ITS IMPACT ON RANGE AND FORAGE SCIENCE

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The University of Nebraska was established in the same era as numerous other land grant universities in the United States. It has had a unique impact on rangelands and cultivated grasslands because of some exceptional faculty and graduates. This is a brief summary of some of these people and how their lives interconnected

Range and forage science on the Great Plains began over a century ago. It is ironic that this occurred just as the successive booms of settlement were breaking the virgin tallgrass prairie. Nebraska became a state in 1867 and the University of Nebraska was founded two years later. This 1872 photograph shows University Hall on the noticeably treeless prairie. While many citizens looked immediately to the University for information on farming and new crops, some faculty were already busy preparing a Catalog of the Flora of Nebraska which was published in 1875.

The beginning of the study of the natural vegetation, the first generation of ecologists, dates back to 1884 when the botanist Charles E. Bessey was recruited to come to the University of Nebraska. While at Iowa State, he wrote the nation's first text book of botany, *Botany for High Schools and Colleges*. Published in 1880, the book has been characterized as the single most important book published in American botany. Bessey was a proponent of the "new botany" which was botany with a laboratory that emphasized scientific procedures.

Bessey came to Nebraska at an annual salary of \$2,500, but he had triple duties: Dean of the Industrial College which at the time included agricultural research, Professor of Botany and Horticulture, and Nebraska State Botanist. The Board of Regents expected Bessey to develop a strong academic foundation for the Industrial College and to develop the agricultural farm into a research station. By 1887, he had achieved these objectives. During this time, he had also helped write the Hatch Act of 1887 which established the Agricultural Experiment Stations.

Bessey created one of the Nation's leading departments of Botany at Nebraska and educated and inspired the students who became scientific leaders in grassland ecology and agricultural research. It has been said that "His greatest accomplishment was the creation of a spirited, educationally progressive, advanced botanical school." The "Bessey System" of instruction involving hands on laboratory work was copied nationally. This system can be described best by Bessey's own words "Botany is the study of plants - not the study of books"

Another of his contributions to education was the establishment of the famous "Seminarium Botanicum", a botanical seminar frequently identified at the "Sem. Bot." The Sem. Bot. recruited and focused the intellect and energy of an amazing group of gifted students. These included Roscoe Pound (later Dean of the Harvard Law School), Frederic Clements (a founder of plant ecology), Albert Woods (President of the University of Maryland), and H.B. Ward (Father of American parasitology). These individuals would become the second generation of grassland scientists at the University of Nebraska.

Roscoe Pound was the son of a judge and a native of Lincoln. He was recognized as being gifted by his parents who taught him at home. Roscoe Pound enrolled at the University of Nebraska at the age of 14 in 1884, the same year as Bessey arrived. He was attracted to the study of plants while enrolled in Bessey's Botany I course. Nearly all of the freshmen took Bessey's beginning botany course, but not because it was required. Bessey was an important figure, and the students wanted to learn from this distinguished professor. Pound was a leading member of Sem. Bot. during his undergraduate years and received his BS in 1888 at the age of 18. He followed the family tradition and spent 1888-1890 studying law at Harvard. He returned to Lincoln and practiced law by day, but spent evenings and weekends with the botany students and members of the Sem. Bot. While it was initially an informal group, Pound helped to formalize the organization in 1892 by accepting undergraduates who could pass an examination. The first to pass the exam and be admitted to membership was the eighteen-year-old sophomore Fredric Clements.

Fredric Clements also was a native of Lincoln. His father was a photographer, and he grew up in an apartment above the photography studio. As a child, Clements was the paperboy for the Pound family. Even though Roscoe Pound was four years older, the boys were casually acquainted. Clements entered the University of Nebraska in 1890 at the age of 16. At the University, Pound and Clements became friends. Always challenging each other, and first testing their developing theories on each other. Clements served as a cadet officer under R.O.T.C commander Lt. John J. Pershing (later to be known as General Black Jack Pershing who was in command of all forces in Europe during WWI). This service made a lasting impression on Clements because throughout the rest of his life, he frequently wore a campaign hat and other military clothing. Although not a starter, Clements played football for the University of Nebraska in the era of the "Bugeaters". The "Bugeaters" predated the "Huskers". Bessey could not have been pleased because the sign over his desk said "Football occupies the same relation to education that a bullfight does to farming." Bessey favored physical education for the student body rather than intercollegiate competition. Bessey complained that what had been entertainment and a weekend diversion was spreading into the school week and conflicting with his afternoon botany laboratories.

After graduation, Clements became a graduate student under Bessey. Pound maintained a full law practice, and took advanced courses in botany. The Sem. Bot. remained at the center of their social and intellectual life. The two main research topics of the Sem. Bot. were plant physiology and the floristics of Nebraska. In the mid-1890s, Bessey, Pound, and Clements reviewed Oscar Drude's *Plant Geography (Duetschlands Pflanzengeographie)*, and this book became the stimulus to examine the Nebraska floristic data they and other members of the Sem. Bot. had collected. Pound and Clements began work on the phytogeography of Nebraska in earnest. They worked together on it at night in the herbarium. At that time, only faculty members were allowed to be in the University buildings at night. With the aid of a janitor and probably with Bessey's knowledge, they came and went by crawling through a window. Bessey was a bit skeptical of their work because he was committed to the laboratory method of research. He initially refused to accept the scientific credibility of the new specialty of

ecology. These doubts spurred his students, particularly Clements, to rigorously quantify their field techniques. Only the most careful science was acceptable to Bessey, and he was one of the first scientists to use statistics and to base his arguments on statistical results. Clements and Pound submitted *Phytogeography* as their joint doctoral dissertation. It didn't include quantitative results, but the later book of the same name included data collected by the then new quadrat method. Pound received his doctorate in 1897 (the second awarded by the University of Nebraska - one awarded in physics in 1896 was the first Ph.D. awarded west of the Mississippi River). Clements' doctorate was held up a year while he completed a minor requirement in Spanish. In 1899, Clements married Edith Swartz (a language student turned botanist who was the first woman to receive a Ph.D. at the University in 1904). Bessey thought that it was a great match and said that Edith "humanized" Fredric because he was known to forget about eating and sleeping when he was involved in one of his quests for scientific knowledge.

Pound moved back into law, and Clements began teaching at the University of Nebraska as a staff member. Clements published two books (*Research Methods in Ecology* and *Plant Physiology and Ecology*), which brought him international recognition. As a result, Clements was offered a position as chairman of the University of Minnesota Botany Department. Bessey was not able to get him a sufficient raise, and he left for Minnesota. At about the same time (1907), Pound left to join the Northwest University School of Law. Pound later became Dean of the Harvard Law School, but always remained a student of botany.

A new face appears in the 1907 photograph of the Sem. Bot. Arthur W. Sampson began a long career with the U. S. Forest Service as one of the first two range technicians after graduating from the University of Nebraska in 1907. He initiated some of the first research in range management looking at deferred grazing and how grazing shifts plant cover and species composition. Many of the range management principles in use today can be traced, in part, to his early research and experience. In addition to many scientific articles, Sampson wrote four text books. Following his death in 1967, the University of Nebraska received a portion of his estate, and these funds are used for range research grants and a graduate fellowship giving him a lasting influence on range research.

While living in Minnesota, Clements occasionally made trips back to Nebraska to study the prairie. His book *Plant Succession* was published in 1916, and Clementsian succession was an important theory for the 20th century. By 1919, Arthur Sampson had adapted the concepts Clements' book to range management and published U.S.D.A Bulletin 791 *Plant Succession in Relation to Range Management* which was one of the founding papers of range management. The debate about succession continues today, but it has made people think and has influenced how people think. After all, Clements' peers recognized that he was more than a man of science; he was also a poet and a dreamer.

Charles Edwin Bessey died at the age of 70 in 1915, but not before having a profound influence on a member of the third generation of grassland ecologists. John Ernst Weaver earned his B.S. and M.S. degrees at the University of Nebraska. He became a botany instructor at the University of Minnesota in 1912 where he worked with Fredric Clements.

He received his Ph.D. under Clements and returned to the University of Nebraska to teach and conduct research in the Department of Botany. Weaver's studies of the prairies of North America encompassed the Great Drought of the 1930s. People throughout the world are familiar with the studies of roots and the drawings of roots published by Weaver. Weaver dug a lot of holes or his students dug a lot of holes. It was rumored that if you wanted to be one of his students, you should come to the interview carrying a spade to prove your willingness to dig. J.E. Weaver wrote several books including *The North American Prairie*, *Grasslands of the Great Plains*, *Vegetation of Nebraska*, and *Prairie Plants and their Environment*. He was a co-author of two editions of *Plant Ecology* with Fredric Clements. The first was published before the drought and primarily shows Clements' approach to ecology. The second edition appeared after the drought and includes many changes attributed to the knowledge gained by Weaver and his students during the drought. Weaver authored over 100 scientific papers, but he is best known for educating graduated students. Forty students received PhDs under his direction. Among them were Stoddard, Dyksterhuis, and Heady.

In addition to having significant impact on grassland ecology and range management, the University of Nebraska also has had an impact on cultivated grasslands and forages via agronomists who worked under from Bessey and his colleagues in the early part of the last century, as well as the students they taught and mentored.

Franklin D. Keim was an undergraduate at the University of Nebraska during the later years of Bessey's life and received his education in basic plant sciences from Bessey and his botany faculty. He worked in the Agronomy Department for many years and was head for nearly 20 years. Although he did some research, his primary contribution was as a teacher. Through his teaching, he knew all the undergraduate students and he made it his business to know them well. In addition to teaching, the term that best applies to his work with students is "mentoring".

He had an uncanny ability to size up students and encourage them. He directed their careers faultlessly. According to George W. Beadle, "Some he sent back to the farm, some to be county agricultural agents, others to teach high schools, and a few to go on to graduate school". Many of his protégés made major contributions to science in the areas of grasslands and forages, genetics, and plant breeding. At one time, one-half of the professional plant breeders in the United States had one or more degrees from the University of Nebraska. His students also include people who made significant contributions to grassland agriculture including Lorenz Bredemeier, Roy Blazer, Milo Tesar and many others.

Theodore A. Kiesselbach was a contemporary of John Weaver in Botany and F.D. Keim in the Agronomy Department at the University of Nebraska. His Ph.D. was in Botany and Agronomy. It was the first Ph.D. associated with Agronomy. It also shows the strong linkages that existed between the Botany and Agronomy Departments at the University of Nebraska. The strong botanical training provided to Kiesselbach by Bessey

and his faculty is clearly evident by examining the publications of Kiesselbach, particularly, the classic "The structure and reproduction of corn".

George W. Beadle, a Nobel Prize winner in genetics, had his academic origins in the Nebraska grassland school. Keim recognized his potential and arranged for Beadle to work with him on some of his research projects. In 1927, he earned M.S. degree under Dr. Keim. His M.S. thesis was entitled "Identification of the more important graminaceous constituents of the prairie hays of Nebraska by means of their vegetative characters". His University of Nebraska Committee members were F.D. Keim, T.A. Kiesselbach, and J.E. Weaver. Beadle received the Nobel Prize in 1958 with Edward L. Tatum of Stanford for their research that proved the one gene-one enzyme theory which was one of the founding discoveries of molecular genetics.

The link between research leading to a Nobel Prize in molecular genetics and rangeland and grassland research may not be obvious, but the linkage is biodiversity. Molecular genetics technology is being used to examine the genetic structure and biodiversity of prairie plants. It is highly likely that research addressing genetic biodiversity of rangeland plants will become an increasingly important part of rangeland and grassland research. It should be recognized that some of the technology that is making this research possible was developed by a student trained by J.E. Weaver and F.D. Keim.

When Glenn W. Burton was completing his degree, F.D. Keim convinced him that he should continue with his education. After receiving his Ph.D., Burton went to Tifton, GA as a Research Geneticist with what is now USDA-ARS. He took a grass, bermudagrass, that was primarily noted as being a severe weed in cotton and developed it into the premier pasture plant of the south. Coastal bermudagrass and the cultivars that have been subsequently developed by Dr. Burton are planted on millions of acres in the southern one-third of the United States and climatic analogues throughout the world.

In addition to his work on pasture and forages, he also made major contributions to those highly managed grasslands known as lawns, greens, fairways, and football fields. He developed bermudagrass cultivars that are the most widely used turf bermudagrasses in the south. The football fields in the Orange Bowl and the Fiesta Bowl on which the University of Nebraska football team won its most recent national championships were planted with bermudagrass cultivars developed by the Nebraska native, Glenn Burton.

Gerald O. Mott conducted research and graduate teaching on semi-tropical pastures. He was a leader in research in pasture management and an authority on the techniques in the evaluation of forages using large animals. He was a pioneer in the development and use of the in vitro rumen digestion technique for evaluating the digestion of forage samples.

Laurence C. Newell was a Keim protégé. While teaching high school, he developed an interest in plants of the tallgrass prairie and used them in his biology courses. This interest in native plants attracted the attention of F.D. Keim who persuaded him to attend the University of Nebraska on an assistantship and conduct research on grasses. He developed over 20 forage grass cultivars for use in the Great Plains and Midwestern states during his career from 1935 to 1974. He developed 'Lincoln' bromegrass, which is the most widely planted bromegrass in the United States. He was a pioneer in breeding cultivars of species native to the North American tallgrass prairie including switchgrass, big bluestem, indiangrass, little bluestem, sideoats grama, and sand lovegrass.

The University of Nebraska has had a unique and significant impact on grassland ecology, range science, and grassland science because of the efforts of well trained, highly motivated, and dedicated people. We should remember that the man who started it all, Charles E. Bessey, of all his numerous endeavors, gave his greatest effort to the teaching Botany I. Charles E. Bessey set both the teaching and research standards that were subsequently followed by others such as Clements, Weaver, and Keim. They taught. They conducted research. And, they mentored. They and their students' work on range and grasslands improved the environment and economics of this nation and the other nations of the world.

**John E. Weaver students who completed their M.S. or
Ph.D. Requirements at the Univ. of Nebraska**

John M. Aikman, Ph.D. 1928	Fred W. Albertson, Ph.D. 1934
Harold Biswell, Ph.D. 1935*	Abigail K. Blade, Ph.D. 1933
Farrel Allen Branson, Ph.D. 1952*	William E. Bruner, Ph.D. 1929*
Levi Turner Burcham, M.S. 1950	Orin R. Clark, Ph.D. 1939*
Harvey T. Cottle, Ph.D 1930	Robert T. Coupland, Ph.D. 1949
John W. Crist, Ph.D. 1923	Edward Everett Dale, Ph.D. 1951
Raymond W. Warland, Ph.D. 1947	Dyksterhuis, Edsko J., Ph.D. 1945
Robert L. Fowler, Ph.D. 1941	Morton T. Fredericksen, Ph.D. 1938
Ovidio Garcia-Molinari, Ph.D. 1948*	Glenn W. Goldsmith, Ph.D. 1924
Walter W. Hansen, Ph.D. 1942	Herbert C. Hanson, Ph.D. 1925
Harold Franklin Heady, Ph.D. 1949	Arthur E. Holch, Ph.D. 1930
Harold H. Hopkins, Ph.D. 1950	Frank C. Jean, Ph.D. 1925*
Joseph Kramer, Ph.D. 1931*	Frank Marsh, Ph.D. 1940
Mentzer, Loren W., Ph.D. 1950	Annie M. Mogensen, A.M. 1918.
Irene M. Mueller, Ph.D. 1940*	Warren W. Nedrow, Ph.D. 1936
William C. Noll, Ph.D. 1938*	Thomas Pavlychenko, Ph.D. 1941
Fernando De Peralta, Ph.D. 1934	Joseph H. Robertson, Ph.D. 1937*
Neil Warren Rowland, M.A., 1952	Arnold Max Schultz, Ph.D. 1951
Samuel B. Shively, Ph.D. 1940*	Theodore L. Steiger, Ph.D. 1929
Lawrence A. Stoddard, Ph.D. 1935	Albert F. Thiel, A.M., 1917
William A. Tolstead, Ph.D. 1942	Gerald w. Tomanek, Ph.D. 1951
John Wilber Voight, Ph.D. 1950*	Robert J. Weaver (son) M.S. (Ph.D. Chicago)
Warren W. Yocum, Ph.D. 1936	Ellen Zink, M.S. -1943

*Indicates M.S. or A.M. degree also received from the Univ. of Nebraska.