

# CELEBRATIO MATHEMATICA

**R. L. Moore**

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## ROBERT LEE MOORE

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R. L. Moore was a leading research mathematician whose work in point-set topology early in the twentieth century was instrumental in laying the foundations of that emerging topic of topology. Over the next half century, he and his students developed this topic extensively. He was elected to the National Academy of Sciences in 1931.

He was also an outstanding teacher of mathematics, and in his career he supervised the Ph.D. theses of fifty students, many of whom went on to become outstanding research mathematicians and teachers. His goal was to develop a research ability, not knowledge alone. Beyond calculus there were no lectures; he challenged each student to prove the theorems of the course—easy or hard—on his or her own, without help from texts or others. His approach was called “The Moore Method,” and it often generated strong negative reactions from those who advocated more conventional methods.

R. L. Moore’s father, Charles, was descended from a long line of New Englanders, the first being one John Moore who emigrated from England to Massachusetts in 1642. R. L.’s paternal grandfather, a physician in Connecticut and Vermont, took his family to North Carolina in the mid-1850s so he could study natural drugs and remedies used by Native Americans. When the family returned to Connecticut, the eldest son Henry stayed and soon moved to Kentucky. Charles joined him in 1858. When the Civil War broke out, both brothers joined the Confederate Army. They survived the war, but the units they served in often suffered heavy casualties.

After the war, the brothers came in contact with a family in Virginia named Moore, and the brothers married sisters in this family. The social, economic and political disruption in the South led Charles to consider moving. At this point, he considered himself a Southerner, unable to return to the North, in part because two of his brothers had fought in the Union Army in the war.

In 1877, Charles Moore and his family of four children moved to Dallas, Texas, where he opened a hardware, grain and grocery store near the town square. Robert Lee Moore was born in Dallas on November 14, 1882, the fifth of six children.

At the time, Dallas was a rapidly growing frontier town, and public education in Dallas was practically nonexistent. When he was eight, R. L. was enrolled in a private school attended by two of his older brothers. He did well in school, early on showing a strong interest in mathematics, and making straight As in the subject. He was encouraged to attend the University of Texas, which had opened in 1883.

R. L. decided to go there and, in preparation for this, study calculus on his own. He obtained a copy of the textbook used by the University. One of his goals in studying calculus was to prove the theorems

of the course for himself. He would read the statement of the theorem, the proof covered with a sheet of paper, and try to prove the theorem. If, after a time, he hadn't progressed, he uncovered the first line of the proof, read it, and thought about how to continue. If he had to uncover several lines of the proof, he felt that he had failed. He mastered calculus to the extent that, when he enrolled in calculus at the University, he was quickly advanced to the next course.

Moore entered the University in 1898, shortly before his 16th birthday. There, he came under the influence of G. B. Halsted, head of the Department of Mathematics. One of Halsted's interests was the foundations of geometry, and he taught Moore non-Euclidean geometry. Moore received his B.A. and M.A. in 1901, and spent the next year as a teaching assistant at Texas.

Hilbert's book, *Grundlagen der Geometrie*, had appeared recently (the first edition was translated by Halsted). Halsted suggested to R. L. that he try to prove that a certain one of Hilbert's axioms was redundant. R. L. quickly did this, and it was written up and published by Halsted. It came to the attention of E. H. Moore (no relation), head of the Department of Mathematics at the University of Chicago, who had obtained the same result earlier. However, R. L.'s argument was shorter and, in the words of E. H. Moore, "delightfully simple."

R. L. spend the next year teaching mathematics in a high school in Marshall, Texas. E. H. Moore arranged for R. L. to come to Chicago for graduate study. Chicago had established a graduate program in mathematics in the 1890s, one of the first in the United States. E. H. Moore was a charismatic teacher and a leader who built a strong department and developed many of the first generation of mathematicians trained in the United States.

R. L. Moore spent the years 1903–1905 at Chicago. One of E. H. Moore's main interests was the foundations of geometry, and R. L. Moore's Ph.D. thesis, *Sets of metrical hypotheses for geometry*, was directed by Oswald Veblen, who had gotten his Ph.D. under E. H. Moore just two years earlier. No doubt E. H. Moore was the major influence on both Veblen and R. L. Moore.

For the next 15 years, R. L. taught at four different universities: Tennessee 1905–1906, Princeton 1906–1908; Northwestern 1908–1911; and Pennsylvania 1911–1920. At Pennsylvania, he had his first Ph.D. students, and among them, his first woman Ph.D. student.

Moore returned to the University of Texas in 1920, and was promoted to full professor in 1923. He taught until 1969; in most of these years he taught five courses: calculus, a sequel to calculus, a two-year sequence in graduate-level point-set topology, and a research seminar.

Several of Moore's early papers were on geometry. In the period 1916–1919, he developed axiomatic topological characterizations of the plane and the 2-sphere. He made numerous contributions to the theory of continua and to the study of continuous curves (locally connected, compact connected metric spaces). He invented the notion of upper-semicontinuous decompositions, and proved a seminal theorem concerning such decompositions of the plane, and an analogous result for the 2-sphere.

In 1929, Moore gave the Colloquium Lectures of the American Mathematical Society, and his volume in the AMS Colloquium series, *Foundations of point set theory*, appeared in 1932. In this volume, he gives an extensive development of basic point-set topology and a detailed treatment of the topology of the plane and the 2-sphere. In 1964, a revised and much expanded version of this volume appeared.

Moore was active in the affairs of the American Mathematical Society, serving as president from 1937 to 1938. He encouraged his students to serve the mathematical community, and many of his students followed his advice. Three of his students became presidents of the AMS, five of the MAA, and many served as elected officers of mathematical organizations and in numerous other positions in the mathematical community.

Moore's teaching technique seems to have been based on his strongly felt need to work out proofs of results for himself, with no outside help. E. H. Moore's teaching style was somewhat unconventional, and this may have encouraged R. L. Moore to move away from the traditional lecture method. Moore's teaching stressed the student's individuality and self-reliance, refined the student's intuition, and developed his or her confidence. He fostered strong competition in his classes, and there was always a race to see who could prove the theorems the fastest.

Because the retirement system for public employees in Texas was late in being established, the University of Texas allowed faculty beyond the age of 70 to go on "modified service" — half-time service and half pay. When Moore went on modified service in 1951, he insisted on continuing to teach his five courses each year until his retirement. He was forced to retire in 1969. He died in 1974 at the age of 92.

In October 1973, the new mathematics building at U. T. Austin was dedicated and named Robert Lee Moore Hall. A dedication conference was held and six of his mathematical grandsons spoke: James Cannon (C. E. Burgess), Daniel McMillan, Jr. (R H Bing), Thomas Chapman (R. D. Anderson), John Kelley (Gordon Whyburn), Frank Raymond (R. L. Wilder), and Robion Kirby (Eldon Dyer).

Moore married Margaret MacLellan Key in 1910. She survived him by one year. Throughout all of their Austin years, they lived on W. 23rd St. just a few blocks from campus. Mrs. Moore served as a gracious hostess for small social events at home, where often a few graduate students were invited. R. L. Wilder has said of her that "it can only be surmised how much her strong devotion to R. L. and his work contributed to his success."

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