

## Julia Bowman Robinson

**Julia Bowman Robinson** (December 8, 1919 – July 30, 1985) was the first woman mathematician to be elected to the National Academy of Sciences and the first woman to be president of the American Mathematical Society (AMS). She was born in St. Louis, Missouri.

When Julia Bowman was nine she contracted scarlet fever, followed by rheumatic fever, forcing her to spend a year in bed at the home of a



practical nurse. Despite these setbacks she skipped grades and graduated from high school at age 16, winning the Bausch-Lomb medal for all-around excellence in science. Mathematics was the subject she enjoyed above all others and in her last two years of high school she was the only female in the mathematics classes.

Bowman enrolled at San Diego State College with the idea of becoming a high school mathematics teacher. During her sophomore year her father, whose savings had been wiped out in the Depression, committed suicide. Somehow she was able to continue her education with the financial assistance of her sister Constance. In her senior year she was able to transfer to the University of California, Berkeley, where there was a better mathematics department. It was at Berkeley that she met Raphael M. Robinson, an assistant professor who taught her number theory. He became her mentor, her friend and in December 1941 her husband.

With the country at war, Julia Robinson worked in the Berkeley Statistical Laboratory on secret projects for the government under the direction of statistician Jerzy Neyman. Eager to start a family, the Robinsons were delighted when they discovered she was pregnant. A few months later, however, she lost the baby due to the build up of scar tissue in her heart, a result of her rheumatic fever, and was

advised not to try to have any children. Devastated, she was depressed for a long period of time, only coming out of it when at her husband's urging she returned to the study of mathematics.

Julia Robinson received her Ph.D. in 1948 from Berkeley for a thesis "Definability and decision problems in arithmetic", supervised by Alfred Tarski. In it she proved that the arithmetic of rational numbers is undecidable by giving an arithmetical definition of the integers in the rationals. That same year she began work on Hilbert's Tenth Problem: to find an effective way to determine whether a Diophantine equation is solvable in integers. A Diophantine equation is an indeterminate equation in which the coefficients of the variables are integers. The problem is to find the integral values of the variables that satisfy the equation. This major problem occupied Robinson's time most of her professional career.

In a 1961 paper, Robinson, Martin Davis and Hilary Putman proved that every recursively enumerable set is existentially definable in terms of exponentiation and that; therefore, there is no algorithm for deciding whether an exponential Diophantine equation has a solution in natural numbers. Robinson earlier had proved that exponentiation is existentially definable in terms of any function of roughly exponential growth. If an existential definition of such a function could be given, Hilbert's problem would be answered negatively. Robinson desperately wanted someone to solve the problem, claiming she "couldn't bear to die without knowing the answer."

In 1970, a 22-year-old Russian mathematician, Yuri Matijasevič, completed the proof. Robinson immediately wrote to him to offer her congratulations, saying, "... now I know it is true, it is beautiful, it is wonderful. If you really are 22, I am especially pleased to think that when I first started [working on] the problem, you were a baby and I just had to wait for you to grow up!" Davis wrote: "A striking characteristic of Julia was her insistence on always being very sure to give appropriate credit to others.

She and Yuri each refused to accept credit they felt inappropriate – such a refreshing change from all too familiar tales of quarrels over ownership of ideas.”

During the 1950's Julia Robinson devoted much of her time to working for political causes. She supported Adlai Stevenson's presidential campaigns, labored in California state elections, and opposed Berkeley's "loyalty oaths." In 1961, her heart was operating so poorly that the only alternative to a life as an invalid was a newly developed operation technique to remove the built-up scar tissue in her heart. After the surgery her health improved dramatically and she took up bicycling as a new form of exercise. Over the next few years she bought increasingly better bicycles and enjoyed outings and cycling trips both in the U.S. and Europe.

Throughout the 1960's and much of the 1970's, she held the lowly rank of part-time lecturer in mathematics at Berkeley because of a ban against two members of a family teaching in the same department. One of her colleagues Elizabeth Scott related a revealing story about Robinson and mathematics. At one point, Robinson was required to submit a description of what she did each day to the Berkeley personnel office. Her report read: "Monday – tried to prove theorem, Tuesday tried to prove theorem, Wednesday tried to prove theorem, Thursday tried to prove theorem; Friday – theorem false." In 1976, when Robinson became the first woman mathematician elected to the National Academy of Sciences, Berkeley quickly promoted her to a full professorship with the duty of teaching only one-fourth of the time because of her health.

In 1980, Julia Robinson gave the American Mathematical Society Colloquium Lectures on Computability, Hilbert's Tenth Problem, decision problems for rings and fields, and non-standard models of arithmetic. Three years later, she was awarded a MacArthur Fellowship, with its substantial award for a five-year period, in recognition of her contributions to mathematics. She was also elected

Chair of the Council of Scientific Society Presidents, but had to decline because of her poor health.

During the last decade of her life Robinson devoted her time and energy to the AMS and human rights problems. In 1984, while presiding over the summer AMS meeting in Eugene, Oregon, she was diagnosed with leukemia. She underwent prolonged hospital stays and treatment, and in the spring of 1985, she enjoyed a few months of remission. But the disease returned and she died in Oakland, California on July 30, 1985.

About a month after his 83<sup>rd</sup> birthday, Raphael Robinson was totally incapacitated by a massive stroke and died of ensuing complications eight weeks later on January 27, 1995. During their 44 years together the Robinsons shared mathematical interests and enriched the work of each other. Although they never published a joint paper they frequently wrote on the same topic. In 1996 Julia Robinson's sister Constance Reid, the popular mathematical biographer, published a moving tribute to her sister, the prize winning *Julia, A Life in Mathematics*.

**Quotation of the Day:** “I think that I have always had a basic liking for the natural numbers. To me they are the one real thing. We can conceive of a chemistry that is different from ours, or a biology, but we cannot conceive of a different mathematics of numbers. What is proved about numbers will be a fact in any universe.” – Julia Bowman Robinson