

bio.1 Julia Robinson

his:bio:rob:
sec

Julia Bowman Robinson was an American mathematician. She is known mainly for her work on decision problems, and most famously for her contributions to the solution of Hilbert's tenth problem. Robinson was born in St. Louis, Missouri, on December 8, 1919. Robinson recalls being intrigued by numbers already as a child (Reid, 1986, 4). At age nine she contracted scarlet fever and suffered from several recurrent bouts of rheumatic fever. This forced her to spend much of her time in bed, putting her behind in her education. Although she was able to catch up with the help of private tutors, the physical effects of her illness had a lasting impact on her life.



Figure 1: Julia Robinson

Despite her childhood struggles, Robinson graduated high school with several awards in mathematics and the sciences. She started her university career at San Diego State College, and transferred to the University of California, Berkeley, as a senior. There she was influenced by the mathematician Raphael Robinson. They became good friends, and married in 1941. As a spouse of a faculty member, Robinson was barred from teaching in the mathematics department at Berkeley. Although she continued to audit mathematics classes, she hoped to leave university and start a family. Not long after her wedding, however, Robinson contracted pneumonia. She was told that there was substantial scar tissue build up on her heart due to the rheumatic fever she suffered as a child. Due to the severity of the scar tissue, the doctor predicted that she would not live past forty and she was advised not to have children (Reid, 1986, 13).

Robinson was depressed for a long time, but eventually decided to continue studying mathematics. She returned to Berkeley and completed her PhD in 1948 under the supervision of Alfred Tarski. The first-order theory of the real numbers had been shown to be decidable by Tarski, and from Gödel's work it followed that the first-order theory of the natural numbers is undecidable. It was a major open problem whether the first-order theory of the rationals is decidable or not. In her thesis (1949), Robinson proved that it was not.

Interested in decision problems, Robinson next attempted to find a solution to Hilbert's tenth problem. This problem was one of a famous list of 23 mathematical problems posed by David Hilbert in 1900. The tenth problem asks whether there is an algorithm that will answer, in a finite amount of time, whether or not a polynomial equation with integer coefficients, such as $3x^2 - 2y + 3 = 0$, has a solution in the integers. Such questions are known

as *Diophantine problems*. After some initial successes, Robinson joined forces with Martin Davis and Hilary Putnam, who were also working on the problem. They succeeded in showing that exponential Diophantine problems (where the unknowns may also appear as exponents) are undecidable, and showed that a certain conjecture (later called “J.R.”) implies that Hilbert’s tenth problem is undecidable (Davis et al., 1961). Robinson continued to work on the problem throughout the 1960s. In 1970, the young Russian mathematician Yuri Matijasevich finally proved the J.R. hypothesis. The combined result is now called the Matijasevich–Robinson–Davis–Putnam theorem, or MDRP theorem for short. Matijasevich and Robinson became friends and collaborated on several papers. In a letter to Matijasevich, Robinson once wrote that “actually I am very pleased that working together (thousands of miles apart) we are obviously making more progress than either one of us could alone” (Matijasevich, 1992, 45).

Robinson was the first female president of the American Mathematical Society, and the first woman to be elected to the National Academy of Science. She died on July 30, 1985 at the age of 65 after being diagnosed with leukemia.

Further Reading Robinson’s mathematical papers are available in her *Collected Works* (Robinson, 1996), which also includes a reprint of her National Academy of Sciences biographical memoir (Feferman, 1994). Robinson’s older sister Constance Reid published an “Autobiography of Julia,” based on interviews (Reid, 1986), as well as a full memoir (Reid, 1996). A short documentary about Robinson and Hilbert’s tenth problem was directed by George Csicsery (Csicsery, 2016). For a brief memoir about Yuri Matijasevich’s collaborations with Robinson, and her influence on his work, see (Matijasevich, 1992).

Photo Credits

Julia Robinson, p. 1: Portrait of Julia Robinson, unknown photographer, courtesy of Neil D. Reid. The Open Logic Project has obtained permission to use this image for inclusion in non-commercial OLP-derived materials. Permission is required for any other use.

Bibliography

- Csicsery, George. 2016. Zala films: Julia Robinson and Hilbert’s tenth problem. URL <http://www.zalafilms.com/films/juliarobinson.html>.
- Davis, Martin, Hilary Putnam, and Julia Robinson. 1961. The decision problem for exponential Diophantine equations. *Annals of Mathematics* 74(3): 425–436. URL <http://www.jstor.org/stable/1970289>.
- Feferman, Solomon. 1994. Julia Bowman Robinson 1919–1985. *Biographical Memoirs of the National Academy of Sciences* 63: 1–28. URL

<http://www.nasonline.org/publications/biographical-memoirs/memoir-pdfs/robinson-julia.pdf>.

- Matijasevich, Yuri. 1992. My collaboration with Julia Robinson. *The Mathematical Intelligencer* 14(4): 38–45.
- Reid, Constance. 1986. The autobiography of Julia Robinson. *The College Mathematics Journal* 17: 3–21.
- Reid, Constance. 1996. *Julia: A Life in Mathematics*. Cambridge: Cambridge University Press. URL <https://books.google.ca/books?id=1RtSzQyHf9UC&lpq=PP1&pg=PP1#v=onepage&q&f=false>.
- Robinson, Julia. 1949. Definability and decision problems in arithmetic. *Journal of Symbolic Logic* 14(2): 98–114. URL <http://www.jstor.org/stable/2266510>.
- Robinson, Julia. 1996. *The Collected Works of Julia Robinson*. Providence: American Mathematical Society.