JULIA ROBINSON   (December 8, 1919 – July 30, 1985)

by HEINZ KLAUS STRICK, Germany

JULIA HALL BOWMAN was born the second daughter of RALPH B BOWMAN, owner of a machine tool factory in St Louis, Missouri, and his wife, HELEN HALL. When JULIA was two years old, her mother died and her father placed his two daughters in the care of their grandmother, who lived in a remote desert settlement near Phoenix, Arizona. BOWMAN lost interest in continuing his business, and having amassed a considerable fortune in previous years, he considered he could live financially without further employment. After remarrying, he put his plans into action and moved with his second wife to Arizona to be with his two daughters.
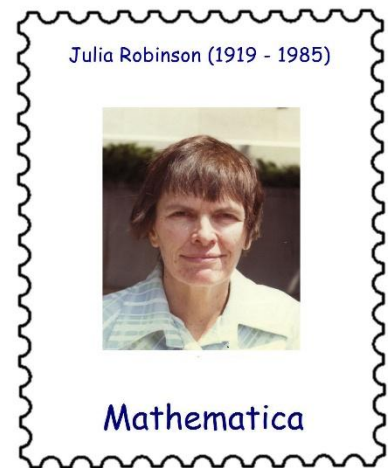
JULIA was a headstrong child; she spoke slowly and, when she did, it was barely understandable. When it was time to learn to read, write, and do arithmetic, her stepmother, who herself had previously taught her older sister CONSTANCE, insisted that the family move to a place with a regular school. The new housing estate was not very large either, so children of different ages had to be taught together in the primary school; however, this had a decidedly positive effect on the development of both girls.

When JULIA was nine years old, she contracted scarlet fever. Barely recovered, she suffered another serious illness, this time rheumatic fever. Without the penicillin treatment that is standard today, it took over a year before she could return to her family from her prescribed isolation. With the help of a retired elementary school teacher, JULIA then caught up on the curriculum of four missed school years in just one year. After junior high school, she transferred to senior high school in San Diego, where she was the only girl in the maths and physics classes – and she excelled. Although she scored only 98 on an IQ test at school, she was hopeful of succeeding at college, and so the 16-year-old decided to attend the local *state college* with the goal of becoming a maths teacher.
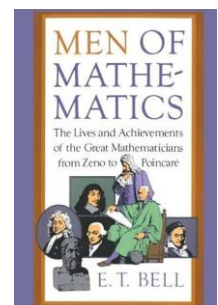
The college's academic offerings were not very extensive and deteriorated even further during the first year, as several students changed their course of study. Meanwhile, JULIA's motivation to learn what mathematics *truly* is, grew – a desire fuelled by a newly published book (1937): ERIC TEMPLE BELL's *Men of Mathematics*. Here she learned about the questions that famous mathematicians had grappled with and she was particularly fascinated by the problems in number theory described in the book.

For her second year of college, JULIA HALL BOWMAN planned to transfer to the University of California at Berkeley, but her family situation changed dramatically. As a result of the Great Depression, the family's original fortune was wiped out and in despair, JULIA's father committed suicide. Her stepmother had to find a new home for the remaining family. Thanks to the financial support of an aunt, Julia was still able to transfer to Berkeley.
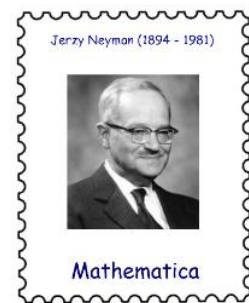
Here she blossomed – surrounded by students who were genuinely interested in the subject and with competent professors, including the young assistant professor RAPHAEL ROBINSON, with whom she was one of four students attending lectures on number theory. Their contact did not stop at the lecture hall: on long walks, RAPHAEL, eight years her senior, introduced the student to various subfields of mathematics.
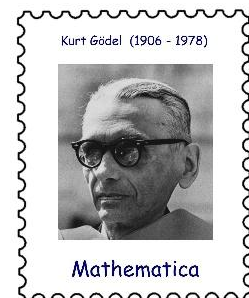
After passing her bachelor's exam, Julia looked for employment but female maths teachers were suddenly no longer in demand, and she was only offered a position as a typist. When Jerzy Neyman, a statistics professor at Berkeley, heard about this, he offered her a teaching assistant position, which at least allowed her to support herself ($35 a month). In 1941, she received her MA degree, and at the end of the year, Julia Hall Bowman and Raphael Robinson married.

The young couple were soon looking forward to becoming parents when their dreams were shattered by a miscarriage – worse still, it turned out that Julia Robinson would be unable to have children due to the health problems she had suffered in childhood. This news plunged her into a deep depression, from which she only emerged in 1946 through her involvement with mathematics. Her husband had accepted a visiting professorship at Princeton and there she assisted him in writing a paper on recursive functions. The topic eventually interested her so much that she expanded upon her husband's work and published it. Newly motivated, she reconnected with Alfred Tarski in Berkeley, whom she had met in 1943 during a seminar on Kurt Gödel.

Tarski had travelled from Poland to the USA in August 1939 to attend a conference at Harvard but after the outbreak of war, he was unable to return home. It took considerable effort for the highly qualified scholar to finally find a suitable position at Berkeley. Tarski had a knack for inspiring his students to study the logical foundations of mathematics. Among them was Julia Robinson, who received her doctorate from him in 1948 with her dissertation *Definability and Decision Problems in Arithmetic.*

In mathematical logic, an operation or a relationship is considered *definable* if it can also be described in other ways. In her doctoral thesis, Julia Robinson showed, among other things, that addition can be replaced by the operations "$\cdot$" (multiplication) and "S" (successor of):

For any positive integers a, b, c, $a + b = c \Leftrightarrow S(a \cdot c) \cdot S(b \cdot c) = S[(c \cdot c) \cdot S(a \cdot b)]$

She was even able to show that addition *and* multiplication can be replaced by the operations "successor of" and "divides", whereby the equality $x = y$ of two numbers x and y can be defined by $x = y \Leftrightarrow (x / y) \wedge (y / x)$.

Regarding the decidability of problems, she succeeded in proving that it makes no difference whether one considers the natural numbers or the rational numbers as the base set.

With her contribution, Julia Robinson had made an important step towards solving Hilbert's 10th problem:

- *Is there a procedure by which one can determine in a finite number of steps whether a given Diophantine equation has a solution in integers*?
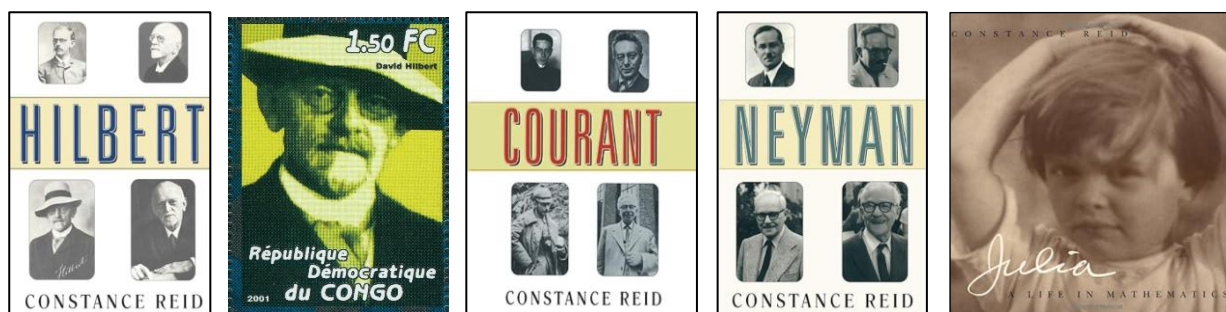
(This is not about the actual solution, but solely about the question of whether one can determine in a finite number of steps *whether* the equation has a solution.)

Over the next twenty years, she continued working on this question, making further progress, including in collaboration with Martin Davis and Hilary Putnam, until in 1970 she learned with great joy (and without envy) that the then 22-year-old Russian mathematician Yuri Matiyasevich had finally solved the century-old problem: Such a procedure does not exist!

In the specialist literature, this result is called the *MRDP theorem* – corresponding to the importance of the contributions of Matiyasevich, Robinson, Davis, and Putnam.

In recognition of her achievements, JULIA ROBINSON was elected to the *National Academy of Sciences* in 1975, becoming the first female mathematician to receive this honour. The Berkeley University administration was surprised by this news, as she was known only as the *wife of professor RAPHAEL ROBINSON*. Due to a nepotism policy, she had previously been prohibited from working at the same university. Nevertheless, they decided to immediately offer her a full professorship so that they could share in her fame. Due to her failing health, she was only able to fulfil this position to a limited extent. Further honours followed; among them, in 1976 she became the first woman elected to the board of the AMS (*American Mathematical Society*), and in 1982 she was elected its president.

In 1984, she was diagnosed with leukemia and her health deteriorated rapidly. When it became clear that she did not have long to live, she asked her sister CONSTANCE REID, who had made a name for herself with biographies of DAVID HILBERT, RICHARD COURANT and JERZY NEYMAN, to write her life story as well: *Julia: A Life in Mathematics*.

CONSTANCE REID quotes her sister JULIA, who never wanted to be the centre of attention:

"All this attention was gratifying, but also uncomfortable. In truth, I am a mathematician. Rather than being remembered as the first woman in this or that field, I would prefer, as befits a mathematician, to be remembered simply for the theorems I have proven and the problems I have solved."

JULIA ROBINSON died on July 30, 1985, at the age of only 65.

Here is an important hint for philatelists who also like individual (not officially issued) stamps. Inquiries at europablocks@web.de with the note: "Mathstamps".