ALFRÉD RÉNYI

Hungarian mathematician **Alfréd Rényi** (March 20, 1921 – February 1, 1970) was noted for his marvelous stories and his conversations with his daughter on the nature of mathematics. *Dialogues on Mathematics* (1967) consisted of three thought-provoking discussions, written as dialogues. The first, set around 400 BCE in ancient Greece, features Socrates giving an inspired description of the nature of mathematics. The second, staged around 212 BCE, consists of Archimedes' full discussion of the applications of mathematics. The final dialogue, from about A.D. 1600, has Galileo sharing his views on mathematics and science. After the success of the *Dialogues*, Rényi followed it up with *Letters about Mathematics* and *Diary on Information Theory.*

Buba, as Rényi was called, was born in Budapest. After finishing high school in 1939, he was a victim of the infamous racist *Numerus Clausus* laws that limited the number of Jews who could be admitted to the University. He worked at the Ganz shipyard for half-a-year before winning competitions in Greek and mathematics that allowed him to enter the University. After graduation in 1944 he was sent to a Fascist Labor Camp but managed to escape before his group was evacuated. Using false documents, he hid in Budapest for six months. Rényi was a brave and fearless resistance hero who saved potential victims from the Nyilas, Hungarian Nazis responsible for torturing and killing tens of thousands of Jews. At this time Rényi's parents were prisoners in the Budapest ghetto. Rényi boldly donned a Nyilas uniform, stomped into the ghetto and marched his parents out as if they were under arrest.

After the war, Rényi obtained a Ph.D. from the University of Szeged under the direction of the innovative functional analyst Frigyes Riesz. In 1946 Rényi traveled to Russia to study with top number

theorists Ivan Vinogradov and Yuri Linnik. He concentrated his efforts on proving the Goldbach conjecture. In 1742 a mathematician named Christian Goldbach wrote a letter to Leonhard Euler in which he speculated that every even number greater than 2 could be written as the sum of exactly two primes. Eventually Rényi was able to prove the quasi-Goldbach conjecture, namely that every integer greater than 2 is the sum of a prime number and an almost prime number, one with only two prime factors.

Rényi returned to Hungary, as a professor at the University of Budapest, where he founded the Hungarian Probability Theory School, and developed a new axiomatic foundation for probability. Several problems of physics, particularly in quantum mechanics, have been solved using his results. He published several joint works with an old Hungarian friend Paul Erdős, the most original of which was "On the Evolution of Random Graphs" (1959). A random graph is one constructed not by careful design but by chance events. Rényi and Erdős discovered that random graphs undergo a phase transition, which they called a "double jump," when the average number of neighbors exceeds one. Now viewed as a percolation transition, this is the description of a situation in which many small elements quickly merge into one giant component. Meant to be no more than an intellectual investigation, the work has become important in explaining a wide variety of real-world problems, even perhaps the origin of life. It has been speculated that some of the deepest truths about the world may be about organization, rather than about the things that make up the world and how these behave individually.

Rényi and Erdős gave a simple solution of the "small world" graph theory problem that has found a place in popular culture. MTV host Jon Stewart invented a game, inspired by the movie *Six Degrees of Separation*, in which one is to link any celebrity with actor Kevin Bacon by a chain of films in which both appeared in less than six moves. Some have been surprised at how often it is possible to do this

even with only moderately famous people. The link between Bacon and another celebrity is a random graph, of the type studied by Rényi and Erdős. That such links can be made between Bacon and so many other people has nothing to do with Bacon. If you are an adult you have gotten to know at least a thousand people. Each of these thousand knows a thousand others. Even with overlap, around 100,000 people know someone who knows you. Now each of these 100,000 knows a 1000 people, so by the second link there are possibly 10 million people who know someone who knows someone who knows you. Keeping this up, and remembering there are only 6 billion people on the earth, it's not so surprising that you can link yourself to someone else in six or less moves.

According to Bruce Schechter in *My Brain is Open* Rényi coined the well-known phrase, often wrongly attributed to Erdős: "A mathematician is a machine for converting coffee into theorems." Hungarian mathematician Paul Turán added the proposition usually attributed to Rényi: "But weak coffee produces only lemmas." Rényi was one of the creators of the "new math in school", a novel approach to the teaching of mathematics. He was the founder, and for 20 years the director, of the Mathematical Institute of the Hungarian Academy of Sciences, which at his death was named for him.

Quotation of the Day: "If I feel unhappy, I do mathematics to become happy. If I am happy, I do mathematics to keep happy." – Alfréd Rényi