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Vladimir Arnold Dies at 72; Pioneering Mathematician

By [KENNETH CHANG](#)

Vladimir I. Arnold, a Russian mathematician who discovered important theorems that found application in astronomy, mechanics and even weather forecasting, died June 3 in Paris. He was 72 and had homes in Paris and Moscow.

The cause was acute pancreatitis, his son Igor said.

Dr. Arnold's work ranged widely across mathematics. He was a founder of singularity theory, or, as it is sometimes more ominously called, [catastrophe theory](#).

Singularity theory predicts that under certain circumstances slow, smooth changes in a system can lead to an abrupt major change, in the way that the slipping of a few small rocks can set off an avalanche. The theory has applications in physics, chemistry and biology.

"He was a genius and one of the greatest and most influential mathematicians of our time," said Boris A. Khesin, a former student of Dr. Arnold's and now a professor of mathematics at the University of Toronto.

One of Dr. Arnold's biggest contributions was applying the methods of geometry and symmetry to the motion of particles. Dr. Arnold work on how fluids flow was applied to the dynamics of weather, providing a mathematical explanation for why it is not possible to make forecasts months in advance. Infinitesimal gaps or errors in information cause forecasts to diverge completely from reality.

A similar approach can also be applied to the motion of planets. If Earth were the only planet to circle the Sun, its orbit would follow a precise elliptical path, but the gravity of the other planets disturbs the motion. Scientists found that it impossible to calculate the precise motion of the planets over very long periods of time or even prove that Earth will not one day be flung out of the solar system.

Understanding the subtle and difficult-to-predict boundary between stability and instability is important not only in the study of planetary dynamics but also in other endeavors, like designing a nuclear fusion reactor.

In 1954, the Russian mathematician Andrey Kolmogorov figured out a key insight to calculating whether such systems are stable. Dr. Arnold provided a rigorous proof in 1963 for one set of circumstances. Another mathematician, Jürgen Moser, provided the proof for another. The work is now collectively know at the KAM theory.

“His work provided a framework for studying this type of question,” Alan D. Weinstein, a professor of mathematics at the [University of California, Berkeley](#), said of Dr. Arnold.

Dr. Arnold’s math explanations also exhibited playfulness. In one of his books, he explained a simple algorithm that stretches and rearranges an image, shredding it into a chaotic mess. In the book, Dr. Arnold illustrated the idea with a sketch of a cat’s head that is now known as [Arnold’s Cat Map](#).

Vladimir Igorevich Arnold was born June 12, 1937, in Odessa, now part of Ukraine. While a 19-year-old undergraduate at Moscow State University and supervised by Dr. Kolmogorov, he came up with the final piece of a proof answering the 13th problem on the list of 23 unsolved mathematical challenges that the mathematician David Hilbert compiled in 1900.

After completing his undergraduate, master’s and doctoral degrees, all at Moscow State, Dr. Arnold joined the Moscow State faculty in 1961. He was able to travel abroad several times in the 1960s but then ran into trouble with the authorities by signing letters criticizing the persecution of dissidents.

Dr. Arnold was unable to leave the Soviet Union again until the advent of perestroika under [Mikhail S. Gorbachev](#) in the late 1980s. He was not granted membership in the Soviet Academy of Sciences until 1990, after he had already become a member of similar academies in the United States, France and Britain.

In 1986 Dr. Arnold moved to the Steklov Mathematical Institute in Moscow. He had told friends that he would not join Steklov as long as Ivan M. Vinogradov, whom he thought anti-Semitic, was director. Friends and family said that stance stemmed not from Dr. Arnold’s heritage — his mother was Jewish — but from a principled insistence that people should be judged on their merits.

In 1993 he began splitting his time between Steklov and Dauphine University in Paris, spending spring and summer in Paris, fall and winter in Moscow.

His awards include the [Wolf Prize](#) in 2001, which mathematicians regard as the equivalent of a Nobel, and the Shaw Prize in 2008, another prestigious math award. He also has an asteroid named after him: Vladarnolda.

Dr. Arnold spoke out against what he considered the overly abstract teaching of mathematics. In a 1997 talk, translated into English, he said: “Mathematics is a part of physics. Physics is an experimental science, a part of natural science. Mathematics is the part of physics where experiments are cheap.”

Besides his son Igor, of Jersey City, he is survived by his wife of 33 years, Eleonora; another son, Dmitry, of Moscow; a brother, Dmitry, also of Moscow; a sister, Katya Arnold, of New York City; four grandchildren; and two great-grandchildren.

Like his thesis adviser Dr. Kolmogorov, Dr. Arnold had an unusual approach when he got stuck on a problem. Writing in the Russian online newspaper Gazeta.ru, his former students Askold Khovanskii and Yuli Ilyashenko recalled that Dr. Arnold would ski for 25 miles or more, wearing nothing more than swim trunks.

“According to him, this practice would always lead him to a new idea,” they wrote.