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Obituary for Academician Professor Vladimir Igorevič Arnol'd

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Arnold was born in 1937 in Odessa (Ukraine) as son of the Russian mathematician Igor Wladimirowitsch Arnold. At the age of 17, he started to study mathematics at the Moscow State University. Already in 1956, he solved Hilbert's 13th problem as part of his intermediate diploma under the supervision of Andrej Nikolaevič Kolmogorov. This problem was also the topic of his PhD thesis "On the representation of continuous functions of 3 variables by the superposition of continuous functions of 2 variables".

For his Master thesis, he investigated the mappings of a circle to itself, a problem that had already been treated by Henri Poincaré, who proved that for every rational rotation number, two distinct periodic orbits exist. Arnold proved that any orientation preserving analytical diffeomorphism of a circle with Diophantine rotation number μ, which is sufficiently close to a rotation by the angle $2\mu\pi$, can be analytically reduced to this rotation. The close collaboration with his supervisor Kolmogorov leads to the famous KAM (Kolmogorov, Arnold, Jürgen Moser) theorem, which marks a milestone in dynamical systems and celestial mechanics theory.

The central question in conservative dynamical systems was whether quasi-periodic motions would be destroyed by weak nonlinear perturbations. The KAM theorem states that trajectories with "sufficiently irrational" frequencies survive, while the other ones are destroyed.

A further result of this work is "Arnold's diffusion", which explains an important instability phenomenon in Hamiltonian systems. For systems with one or two degrees of freedom, the quasi-periodic orbits, which survive the nonlinear perturbations, also restrict the evolution of the destroyed trajectories. These can only evolve in the narrow bands between the quasi-periodic orbits. But in higher dimensions, these trajectories may escape and exhibit arbitrarily large growth in the action variables.

A major field of his work was singularity theory. In this area, he investigated and classified for a large variety of mathematical objects, like equilibrium points of differential equations, periodic solutions of dis-

crete maps, critical points of smooth maps, and caustics of wave fronts, the changes or "perestroikas" in the topological structure, if parameters in the system are varied. He realized that all these different structures are closely related to the Dynkin diagrams of the simple Lie groups A_k, D_k, and E_k and the exceptional groups B_k, C_k, F_k and H_k.

Arnold's singularity theory had a major impact on the development of "Catastrophe Theory" and Bifurcation Theory. These theories soon were successfully applied to many areas in applied mathematics and mechanics. The normal forms for matrices depending on parameters helped to understand sometimes the strange scenarios for the loss of stability of stationary and periodic solutions. Especially in structural mechanics, the classification of bifurcations with a small number of parameters contributed significantly to the treatment of stability problems. Of course, these developments also had a major impact on dynamical systems and nonlinear oscillations. Arnold frequently complained that the contributions of Russian scientists were not sufficiently appreciated by the mathematical community.

In 1965, Arnold became Professor in the Faculty of Mechanics and Mathematics at Moscow State University, a position he held until 1986 when he took up the position of principal researcher at the Steklov Institute of Mathematics in Moscow. In addition to his Russian positions, in 1993 he was appointed as Professor at the University Paris Dauphine in France. He held this position until 2005.

Arnold's Moscow Seminar, which he started in 1960, consisted of about thirty mathematicians, mostly his former graduate students, but also other renowned colleagues. In this seminar, the participants had vivid discussions about new developments. Since 1993, the Parisian branch of the seminar meets at the same time in the Jussieu Mathematical Institute (formerly in Ecole Normale Superieure).

Arnold was a highly gifted book writer. His textbooks "Ordinary differential equations", "Geometrical methods in the theory of ordinary differential equations", and "Mathematical methods of classical mechanics" explain the underlying concepts very intelligibly. His credo was that mathematics should be understood intuitively and not be obfuscated by blind calculations.

He was also interested in the history of mathematics; his book "Huygens und Barrow, Newton und Hooke" is an entertaining survey of the history of the origins of mechanics.

Arnold has been honored throughout the world. He has been elected to membership of the London Mathematical Society (1976), the National Academy of Sciences of the United States (1983), the Academy of Sciences of Paris (1984), the Academy of Arts and Sciences of the United States (1987), the Royal Society of London (1988), Accademia Nazionale dei Lincei in Rome (1988), the Russian Academy of Sciences (1990), the American Philosophical Society (1990), the Academy of Natural Sciences of Russia (1991), and the Academia Europaea (1991). He has received many prizes, for example the Young Mathematicians Prize of the Moscow Mathematical Society (1958), the Lenin Prize (with Andrei Kolmogorov) (1965), the Crafoord Prize of the Swedish Academy of Sciences (with Louis Nirenberg) (1982), the Lobachevsky Prize of Russian Academy of Sciences (1992), the Harvey Prize, Technion, Haifa, Israel (1994), the Petr L. Kapitsa Medal for Scientific Discoveries, Russian Academy of Natural Sciences (1997), the Dannie Heineman Prize for Mathematical Physics (2001), the Prize of the American Institute of Physics (2001), and the Wolf Prize in Mathematics (2001).

The Fields Committee recommended in 1974 to award Arnold the Fields medal. But since Arnold was prohibited to leave the Soviet Union at that time, the Russian vice president of the International Mathematical Union, Pontryagin, was ordered not to allow the award to Arnold.

With Arnold one of the greatest mathematicians of the twentieth century passed away during his visit in Paris in his 73rd year of age, but his achievements "will remain cornerstones of mathematics forever"!

Alois Steindl and *Franz Ziegler* (member of RAS, Co-Editor) TU-Vienna

Sources:

http://www.ams.org/notices/199704/arnold.pdf
http://www-history.mcs.st-andrews.ac.uk/Biographies/Arnold.html
http://en.wikipedia.org/wiki/Arnol%27d
http://de.wikipedia.org/wiki/Wladimir_Igorewitsch_Arnold