# Biographical Encyclopedia of Astronomers



## Friedmann, Alexander Alexandrovich

Born Saint Petersburg, Russia, 4/16 June 1888

Died Leningrad (Saint Petersburg, Russia), 16 September 1925

Alexander Friedmann was a mathematician and cosmologist who first proposed the idea of a "Big Bang" Universe. His father, also Alexander Alexandrovich Friedmann, was a dancer and composer of ballet music; his mother, Ludmila Ignatievna Voyachek, was a pianist and music teacher. In 1906, Friedmann entered the University of Saint Petersburg, where he studied mathematics with Vladimir Andreyevich Steklov and theoretical physics with Pavel Sigizmundovich Ehrenfest. In 1911, he married Ekaterina Petrovna Dorofeyeva, a well-educated woman who was very devoted to him and offered her assistance by translating articles, reading proofs, and so forth. However, Friedmann divorced her after falling in love with Natalia Yevgenievna Malinina, a geophysicist, whom he married in 1923

In 1913, after a series of examinations, Friedmann became a candidate for a master's degree in pure and applied mathematics. That year, he obtained a position at the Aerological Observatory in Pavlovsk, a branch of the Main Physical (later Geophysical) Observatory of the Russian Academy of Sciences. During World War I, Friedmann served as a meteorologist and even learned to fly his own observational airplane. In 1917, he was put in charge of the aviation instruments plant, Aviapribor, in Moscow. But the following year, he joined the Department of Mechanics of the new Perm branch of Petrograd University. In 1920, Friedmann returned to the Main Geophysical Observatory in Petrograd as senior physicist in charge of the mathematical bureau. His dissertation, "The Hydro-mechanics of a Compressible Fluid," was completed in 1922 and later published.

While in Petrograd, Friedmann began a study of Albert Einstein's general theory of relativity With Vsevelod Konstantinovich Frederiks, he undertook the writing of a textbook on the subject, of which only the first part, on tensor calculus, was ever completed (1924). Friedmann's fundamental contributions to relativistic cosmology are contained in two papers, "On the Curvature of Space" and "On the Possibility of a World with Constant Negative Curvature," which were published in the *Zeitschrift für Physik* (1922, 1924). Friedmann's notion of an expanding universe was at first rejected by Einstein, who asserted without proof that his conclusion rested upon a mathematical error. Einstein later withdrew this statement in another brief notice. Evidence supporting Friedmann's model of the expanding universe was later supplied by Edwin Hubble's announcement of the velocity-distance relationship, although the mathematician did not live to see his ideas vindicated. Friedmann also published a semi-popular book, *The World as Space and Time* (1923).

In 1925, Friedmann became director of the Main Geophysical Observatory, which had been responsible for the meteorological service of the Russian Republic since 1921. On July 17, 1925, he mounted a meteorological balloon with Pavel Fyodorovich Fedoseyenko and climbed

to an altitude of 7,400 m, thus breaking the former Russian record of 6,400 m for balloon flights. However, Friedmann fell ill with typhoid fever and died in the Pervukhin Hospital. His death prevented him from completing his scientific report on the balloon ascent.

*Roberto Torretti*

**Selected References**

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