

**Aleksandr Mikhailovich  
Lyapunov**  
**(6 June 1857 - 3 November  
1918)**  
russian mathematician

The work was performed by a student of the group  
PRIB-221: Konovalov Nikita Alekseevich

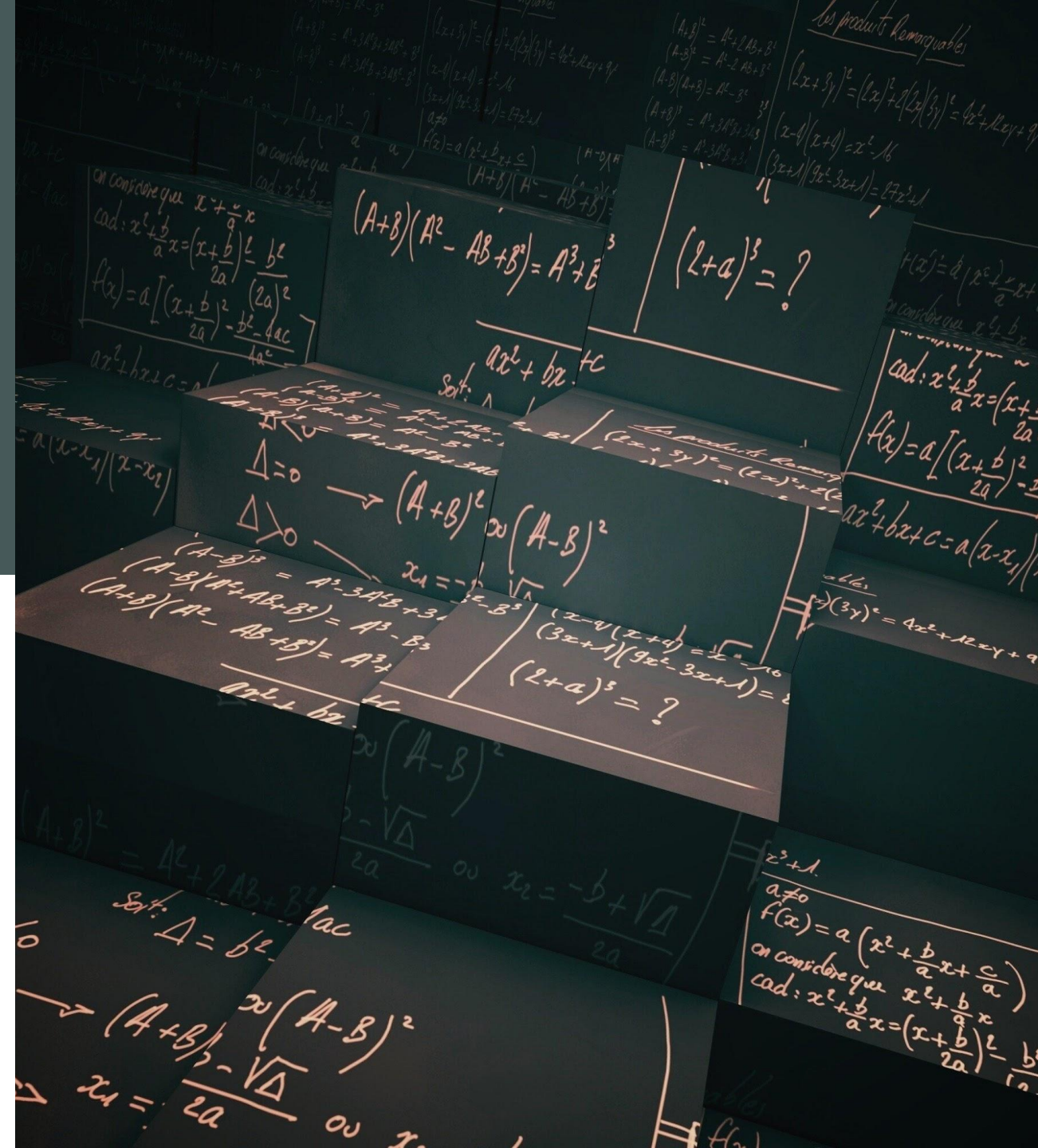


# FAMILY

Aleksandr Mikhailovich Lyapunov's mother was Sofia Aleksandrovna Shilipova and his father was Mikhail Vasilievich Lyapunov. Sofia Aleksandrovna and Mikhail Vasilievich had talented children for, in addition to the subject of this biography, they had two boys one of whom (Sergei) became a composer and the other (Boris) became a member of the Soviet Academy of Sciences through his expertise in Slavic languages.

# SCHOOL TIME

Aleksandr Mikhailovich began his education at home, then later one of his uncles R.M. Sechenov prepared him for entering the Gymnasium. Lyapunov was not the only one being coached by Sechenov who was teaching his own daughter Natalia Rafailovna Sechenov at the same time. In fact Natalia and Aleksandr married many years later when he was 29 years old. Some years after the death of Lyapunov's father, Sofia Aleksandrovna moved to Nizhny Novgorod (named Gorky from 1932 to 1990) in 1870 with her children and Lyapunov entered the Gymnasium in that city. He graduated in 1876 and entered the Faculty of Physics and Mathematics at St Petersburg University



# UNIVERSITY

At St Petersburg University he was taught by Chebyshev who, had a strong influence on him. Lyapunov graduated in 1880 and remained at St Petersburg to undertake research. He published two papers on hydrostatics in 1881: *On the equilibrium of heavy bodies in heavy liquids contained in a vessel of a certain shape*, and *On the potential of hydrostatic pressures*.

# Chebyshev 's question

In the following year Chebyshev posed a question to Lyapunov which would set the agenda for one of his main lines of research over many years:

*"It is known that at a certain angular velocity ellipsoidal forms cease to be the forms of equilibrium of a rotating liquid. In this case, do they not shift into some new forms of equilibrium which differ little from ellipsoids for small increases in the angular velocity?"*

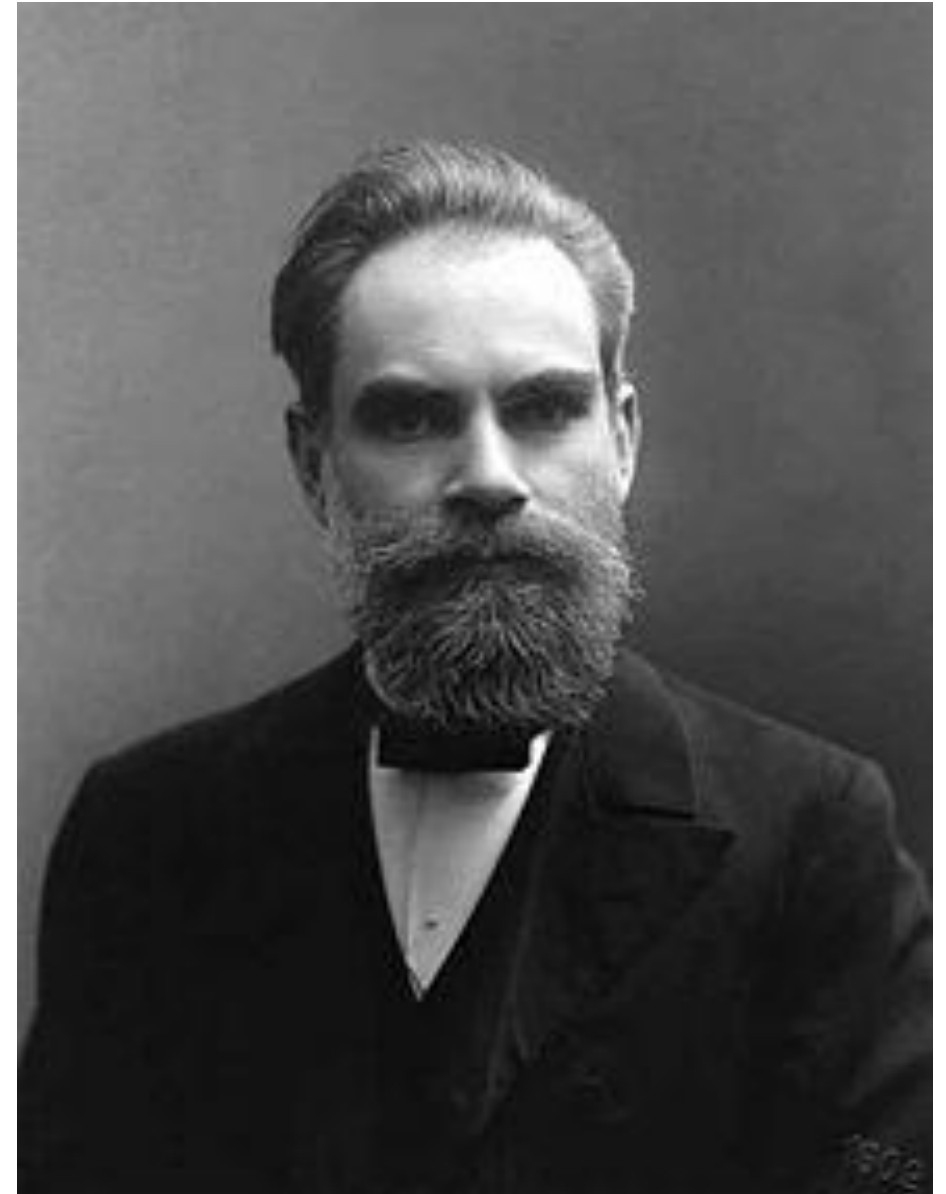


# Work on the Chebyshev problem

In Pavlovskaya looks at Lyapunov's work on the problem first posed by Chebyshev which we quoted above. The problem posed by Chebyshev concerning the existence of figures of equilibrium, in addition to ellipsoidal ones, of a rotating fluid under sufficiently small variations of angular velocity of revolution was first solved by Lyapunov in a first approximation. He later dealt with the problem of stability of fluid ellipsoids basing his investigations on the variational principle. He showed that a sufficient condition for stability is that the second and higher variations of the potential energy are positive. Lyapunov admitted that the imposition of certain additional constraints on the first variation reduced the generality of his method

Lyapunov established that with variation in the angular velocity of revolution Maclaurin ellipsoids pass into Jacobi ellipsoids.

The transition point is an ellipsoid of bifurcation corresponding in this case to a Jacobi ellipsoid of revolution.





# Other aspects

There are, however, other aspects of his work we should mention. One is certainly his contributions to probability which he became interested in because of courses he was teaching on that subject.



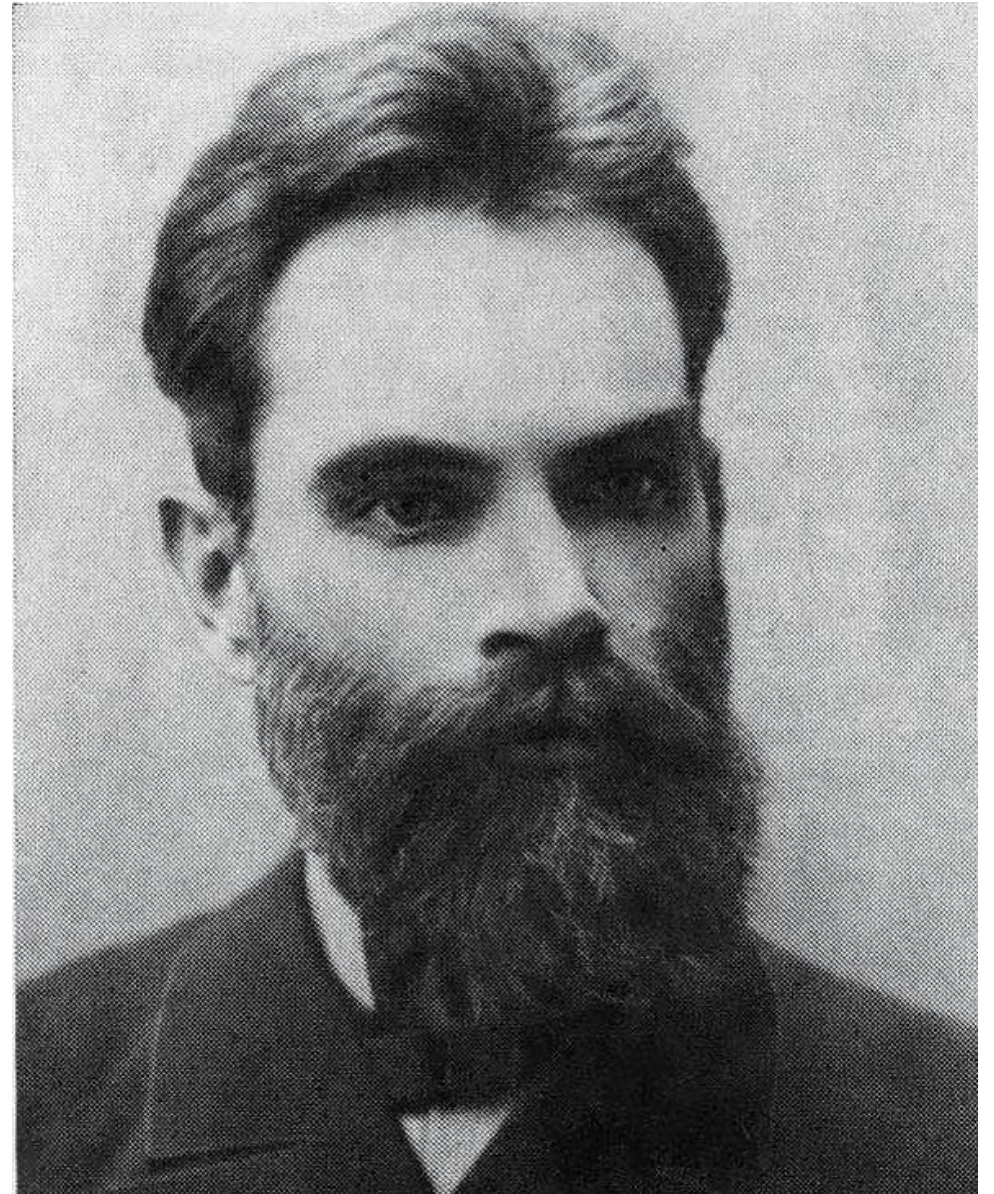
In particular in two papers published in 1900 and 1901, he proved the central limit theorem using a technique based on characteristic functions. Another contribution which we should mention is that as editor for two volumes of Euler's collected works.

$$\lim_{n \rightarrow \infty} P \left( \frac{X_1 + X_2 + \dots + X_n - \sum_{k=1}^n m_k}{\sqrt{\sum_{k=1}^n \sigma_k^2}} < x \right) = \Phi(x)$$

# The end of life.

In 1917 Lyapunov left St Petersburg to take up a post at the university in Odessa, on the Black Sea coast. He taught at the university but in the spring of 1918 his wife's health began to deteriorate rapidly. Natalia Rafailovna suffered from a form of tuberculosis and Lyapunov was greatly disturbed to watch her health fail. On 31 October 1918 Lyapunov's wife died and later that day Lyapunov shot himself. He died three days later in hospital.

He was honoured for his outstanding contributions by election to various academies such as the Accademia dei Lincei (1909) and the French Academy of Sciences (1916). He was also given honorary membership of the universities of St Petersburg, Kharkov and Kazan.



# Sources

- 1. Aleksandr Mikhailovich Lyapunov (1857 - 1918) - Biography  
- <https://mathshistory.st-andrews.ac.uk/Biographies/Lyapunov/>
- P C Parks, A M Lyapunov's stability theory - 100 years on, *IMA J. Math. Control Inform.* (4) (1992), 275-303.
- J Mawhin, The centennial legacy of Poincare and Lyapunov in ordinary differential equations, *Rend. Circ. Mat. Palermo Suppl.* (1994), 9-46.