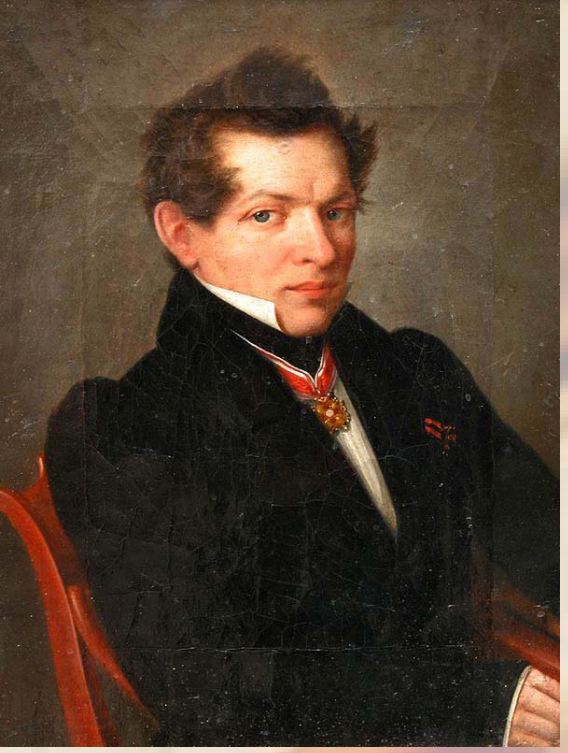


NIKOLAY IVANOVICH LOBACHEVSKY

COPERNICUS OF GEOMETRY

Н.И. Лобачевский

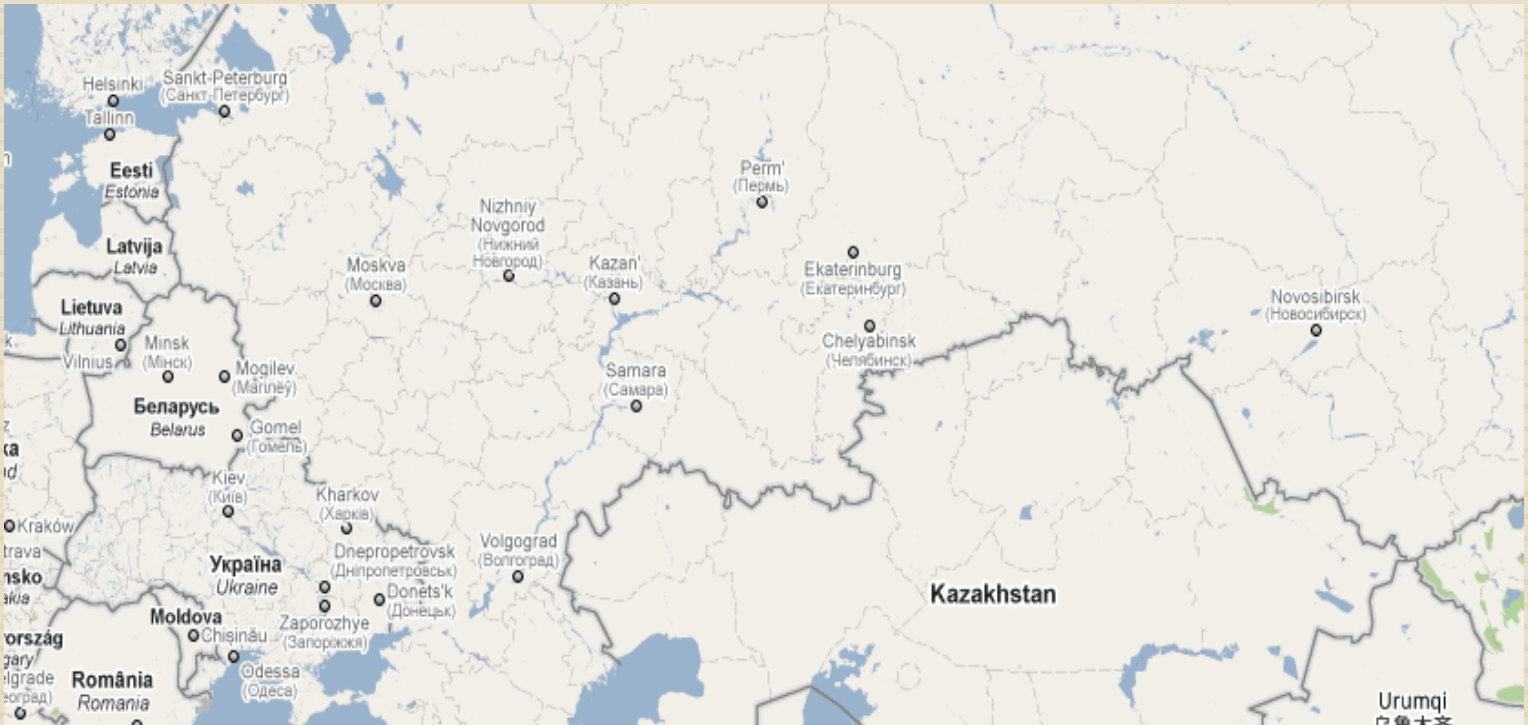
Sergey Alexandrovich Lapin
MATH 398

Famous quote

There is no branch of mathematics, however abstract, which may not some day be applied to phenomena of the real world.

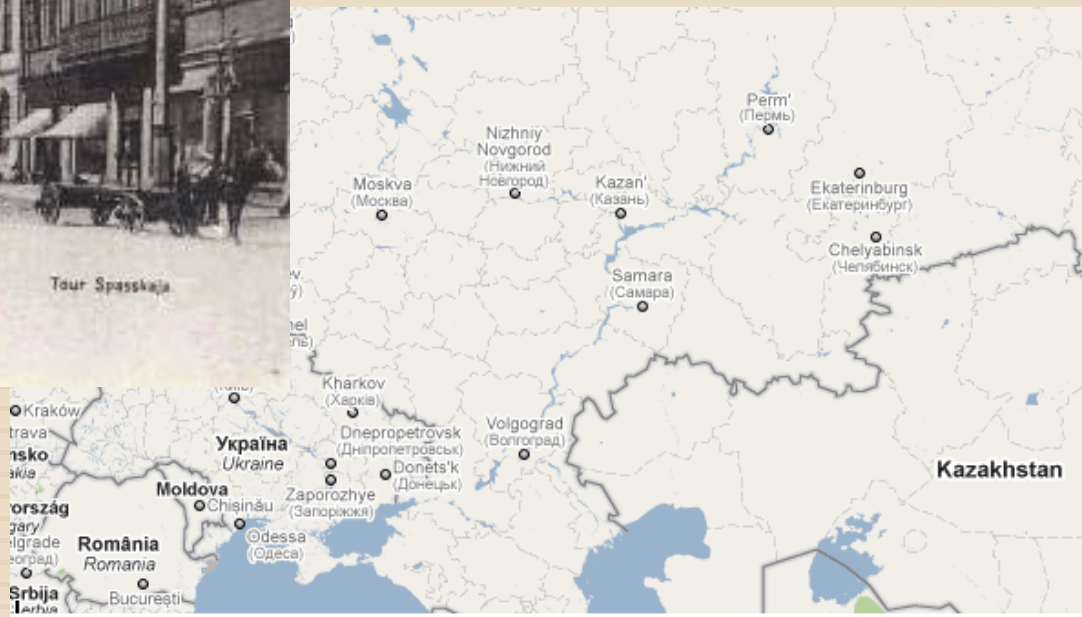
Childhood

Lobachevsky was born in 1792 in *Nizhny Novgorod*, Russia. His parents were Ivan Maksimovich Lobachevsky, a clerk in a land surveying office, and Praskovia Alexandrovna Lobachevskaya. Nikolay was one of three sons in the poor family



Move to Kazan

In 1800, Lobachevsky's father died and his mother moved to Kazan.



Kazan Gymnasium

In Kazan, Nikolay Ivanovich Lobachevsky and his two brothers attended Kazan Gymnasium. Their studies financed by government scholarships. Lobachevsky attended gymnasium from 1802 to 1807.

He entered Kazan University in 1807

Kazan University

Kazan State University had been founded in 1804, the result of one of the many reforms of the emperor Alexander I.

At Kazan University

- Lobachevsky original intention was to study medicine but he changed to study a broad scientific course involving mathematics and physics.
- In the first years the atmosphere in the Department was quite favorable. The students were full of enthusiasm. The professors, mainly invited from Germany, turned out to be excellent teachers. Lobachevsky was highly successful in all courses he took.

Martin Bartels

At Kazan University, Lobachevsky was influenced by professor Johann Christian Martin Bartels (1769–1833), a former teacher and friend of German mathematician Carl Friedrich Gauss.

Career

- Lobachevsky received a Master's Degree in physics and mathematics in 1811.
- In 1814 he was appointed to a lectureship.
- And in 1816 he became an Extraordinary Professor. *(equivalent to the modern Assistant Professor)*
- In 1822 he was appointed as a full professor. He taught a wide range of topics including mathematics, physics and astronomy

Appointments

He was soon appointed to important positions within the university.

- The dean of the Mathematics and Physics Department between 1820 and 1825
- Head librarian from 1825 to 1835.
- He also served as Head of the Observatory and was clearly strongly influencing policy within the University

Rector of the University

- In 1827 Lobachevsky became rector of Kazan University, a post he was to hold for the next 19 years. The following year he made a speech

  On the most important subjects of education and this gives clearly what were the ideas in his educational philosophy:

- *... outlined the ideal of the harmonious development of the personality, emphasized the social significance of upbringing and education, and discussed the role of the sciences and the scientist's duty to his country and people.*

Rector of the University

The Kazan University flourished while Lobachevsky was rector, and this was largely due to his influence. There was a vigorous program of new building, with a library, an astronomical observatory, new medical facilities and physics, chemistry and anatomy laboratories being constructed

Rector of the University

He pressed strongly for higher levels of scientific research and he equally encouraged research in the arts, particularly developing a leading centre for Oriental Studies. There was a marked increase in the number of students and Lobachevsky invested much effort in raising not only the standards of education in the university, but also in the local schools.

Rector of the University

Two natural disasters struck the university while he was Rector of Kazan:

a cholera epidemic in 1830 and a big fire in 1842.

Because of the actions taken by Lobachevsky the damage to the University was reduced to a minimum. For his activity during the cholera epidemic Lobachevsky received a message of thanks from the Emperor.

Rector of the University

Despite this heavy administrative load, Lobachevsky continued to teach a variety of different topics such as mechanics, hydrodynamics, integration, differential equations, the calculus of variations, and mathematical physics.

He even found time to give lectures on physics to the general public during the years 1838 to 1840, but the heavy work-load was to eventually take its toll on his health.

In recognition of his work Lobachevsky was in 1837 raised to the hereditary nobility; he designed his own heraldic device (which is reproduced on his tombstone), depicting Solomon’s seal, a bee, an arrow, and a horseshoe, to symbolize wisdom, diligence, alacrity, and happiness, respectively.

In 1832 Lobachevsky married Lady Varvara Alexeevna Moiseeva who came from a wealthy family. At the time of his marriage his wife was a young girl while Lobachevsky was forty years old. The marriage gave them seven (or 15?) children and it is claimed that the children:

... and the cost of technological improvements for his estate left him with little money upon his retirement.

In 1846 despite being elected for the next four year term Lobachevsky was dismissed from the rector position and appointed to be assistant trustee for the whole of the Kazan educational district (until 1855).

After Lobachevsky retired (dismissed) in 1846, his health rapidly deteriorated.

A worsening sclerotic condition progressively affected his eyesight, and he was blind in his last years.

Nikolay Ivanovich Lobachevsky died Feb 24 1856 in Kazan

His great mathematical achievements were not recognized in his lifetime, and he died without having any notion of the fame and importance that his work would achieve.

Euclid (ca. 325 - ca. 270 BC)

Euclid's greatest accomplishment was the *Elements*, his 13-chapter book outlining everything he knew about geometry. He based all of his geometrical theorems on just five postulates, making the work very rigorous and complete

Euclid's Postulates

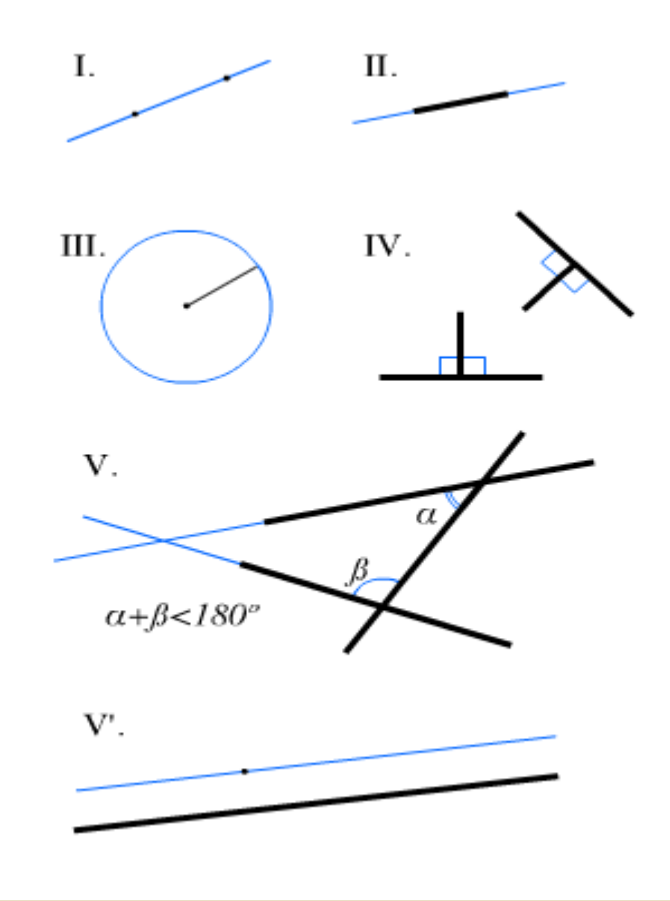
1. A straight line segment can be drawn joining any two points.

2. Any straight line segment can be extended indefinitely in a straight line.

3. Given any straight line segment, a circle can be drawn having the segment as radius and one endpoint as center.

4. All right angles are congruent.

5. If two lines are drawn which intersect a third in such a way that the sum of the inner angles on one side is less than two right angles, then the two lines inevitably must intersect each other on that side if extended far enough.



Equivalent fifth postulate

- Given any straight line and a point not on it, there "exists one and only one straight line which passes" through that point and never intersects the first line, no matter how far they are extended. This statement is equivalent to the fifth of Euclid's postulates, which Euclid himself avoided using until proposition 29 in the *Elements*.

Attempts to prove 5th postulate

- For centuries, many mathematicians believed that 5th postulate was not a true postulate, but rather a theorem which could be derived from the first four of Euclid's postulates.
- The part of geometry which could be derived using only postulates 1-4 is known as absolute geometry.

Saccheri formulation

In 1733, Saccheri published a two-volume work titled *Euclid Freed of Every Flaw*. Given a line and a point not on the line, there are exactly three possibility with regard of the number of lines through the point:

- there is exactly one parallel;
- there are no parallels;
- there are more than one parallel.

The three hypotheses are known as hypotheses of the *right*, *obtuse*, and, respectively, *acute* angles.

Hyperbolic geometry

- Lobachevsky's major work, *Geometriya* completed in 1823, was not published in its original form until 1909.
- On 11 February 1826, in the session of the Department of Physico-Mathematical Sciences at Kazan University, Lobachevsky requested that his work about a new geometry was heard and his paper *A concise outline of the foundations of geometry* was sent to referees.
- In 1829 the "Kazansky Vestnik" magazine published Lobachevsky's article, devoted to the non-Euclidean geometry. A famous academician M. V. Otrogradsky wrote in his review to Lobachevsky's work, that "the author seems to have a goal of writing in such way, that one can't understand him. He achieved his object. The major part of the book remains as unknown for me, as if I had never seen it".

Hyperbolic geometry

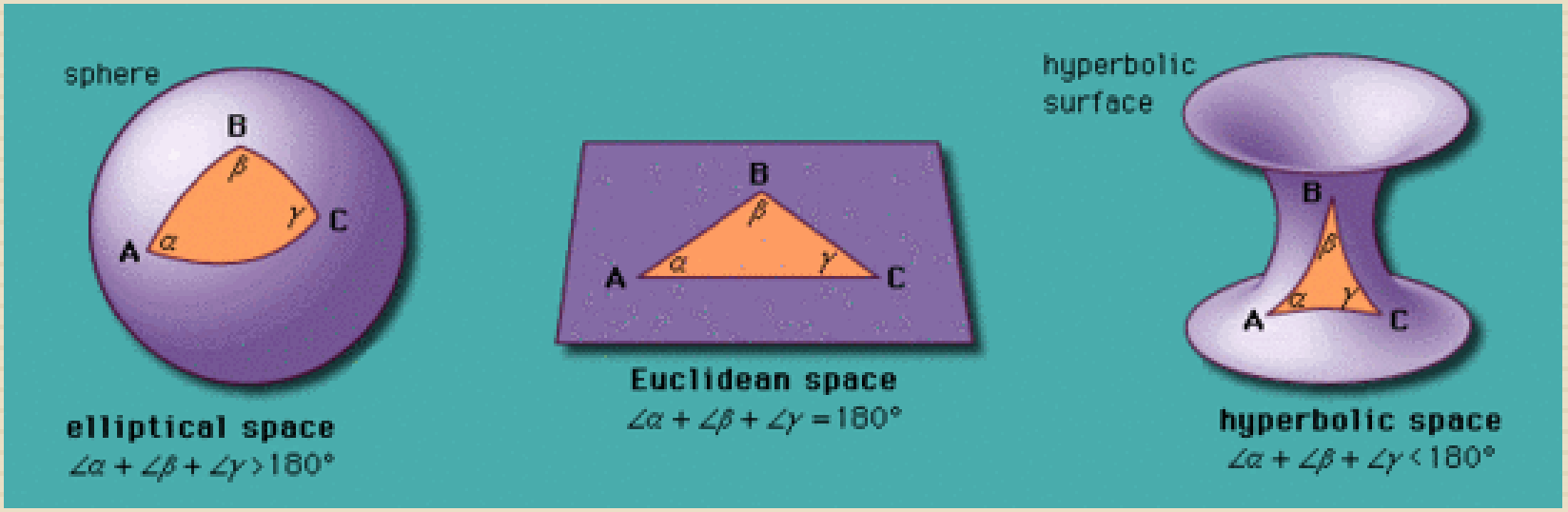
In 1835 Lobachevsky published article *Воображаемая геометрия (Imaginary geometry)* in Scientific notes of Kazan University.

In 1837 Lobachevsky published his article *Geometrie imaginaire* and a summary of his new geometry *Geometrische Untersuchungen zur Theorie der Parellellinien* was published in Berlin in 1840.

Acceptance

- In 1866, ten years after Lobachevsky's death, Houel published a French translation of Lobachevsky's *Geometrische Untersuchungen* together with some of Gauss's correspondence on non-euclidean geometry.
- Beltrami, in 1868, gave a concrete realization of Lobachevsky's geometry.
- Weierstrass led a seminar on Lobachevsky's geometry in 1870 which was attended by Klein and, two years later, after Klein and Lie had discussed these new generalizations of geometry in Paris, Klein produced his general view of geometry as the properties invariant under the action of some group of transformations in the Erlanger Programm.
- There were two further major contributions to Lobachevsky's geometry by Poincare in 1882 and 1887.

Non-Euclidian geometry



Dandelin-Graffe method

In 1834 Lobachevsky found a method for the approximation of the roots of algebraic equations.

This method is now known as the Dandelin–Gräffe method, named after two other mathematicians who discovered it independently. In Russia, it is called the Lobachevsky method.

Definition of a function

- Lobachevsky gave the definition of a function as a correspondence between two sets of real numbers (Dirichlet gave the same definition independently soon after Lobachevsky).

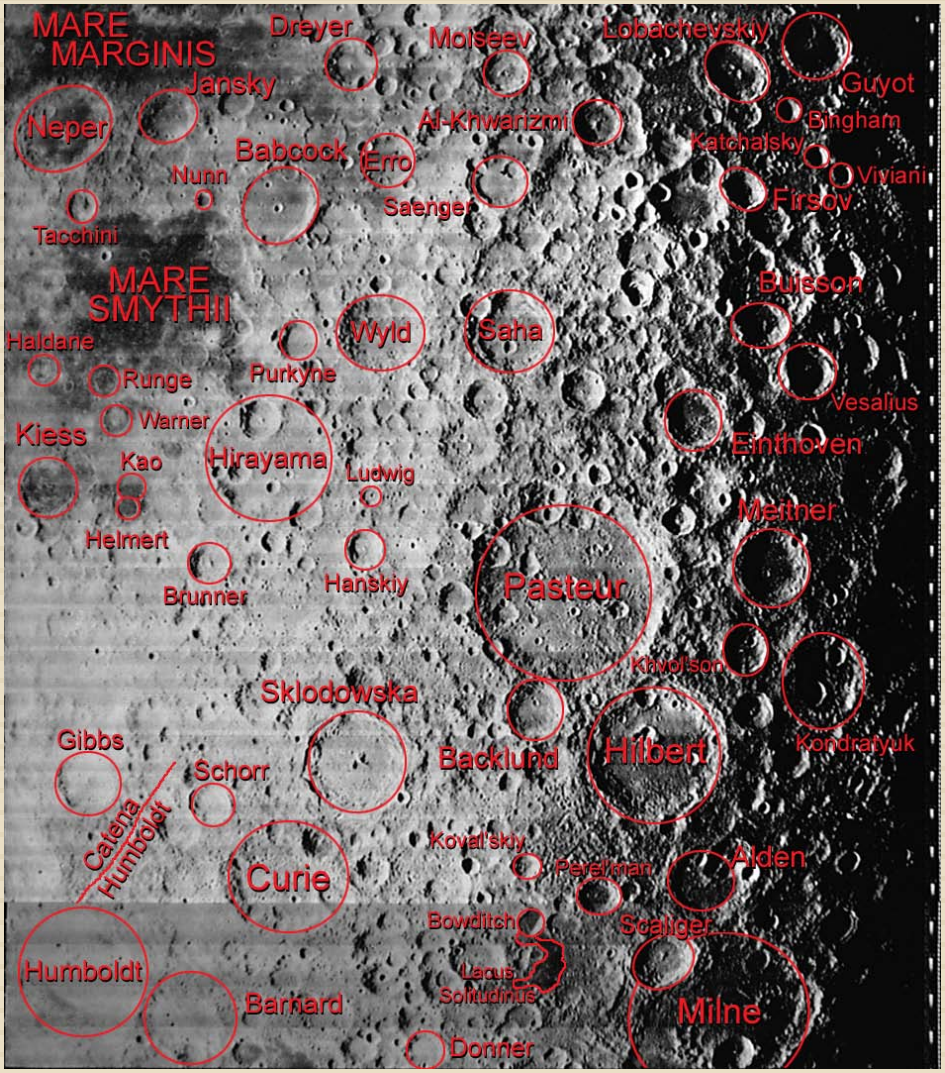
Lobachevsky Prize

- The *Lobachevsky Prize*, awarded by the Russian Academy of Sciences, and the *Lobachevsky Medal*, awarded by the Kazan State University, are mathematical awards in honor of Nikolay Ivanovich Lobachevsky.

- Sophus Lie, 1897
- Wilhelm Killing, 1900
- David Hilbert, 1903
- Ludwig Schlesinger, 1909
- Friedrich Schur, 1912
- Hermann Weyl, 1927

Chemistry department (former Kazan Gymnasium) building

Lobachevsky lunar crater



Granddaughter and great granddaughter in 1956

Monument in front of the Academy of Sciences

Kazan State University