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General Concept of Mathematics and Its History

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Abstract: *Mathematics (Greek thematike, mathema - knowledge, science), Mathematics [1] - the science of knowledge based on clear logical observations. Because the first object was a number, it was often referred to as the "science of arithmetic" (in today's mathematics, calculations, even operations on formulas, play a very small role). Mathematics is one of the oldest sciences, with a long history of development, and at the same time, "What is mathematics?" The answer to this question has also changed and deepened. In Greece, mathematics means geometry. In the IX-XIII centuries the concept of mathematics was expanded by algebra and trigonometry.*

Keywords: analytical geometry, differential and integral calculus, late XIX and early XX centuries, mathematical models in physics, engineering and social sciences, complex numbers, research centers in St. Petersburg, Novosibirsk, Kiev, Yekaterinburg, planimetry and stereometry, KF Gauss describes the division of a pta linear multiplier (the basic theorem of algebra) in the field of l complex polynomial numbers.

I. INTRODUCTION

After analytical geometry, differential and integral calculus became central to mathematics in the 17th and 18th centuries, it was described as a "science of quantitative relations and spatial forms" until the early twentieth century. In the late 19th and early 20th centuries, objects of various geometries (such as Lobachevsky's geometry, projective geometry, Riemannian geometry), algebras (such as Bull algebra, quaternion algebra, Kelly's algebra), and infinite-dimensional spaces were very diverse in content, often artificial objects. and the above definition of mathematics is too narrow. During this period, as a result of the formation of a unique style and language of observation based on mathematical logic and set theory, the idea that the most important feature in mathematics is strict logical observation (J. Peano, G. Frege, B. Russell, D. Hilbert). In the mid-20th century, a group of French mathematicians who revised the definition of mathematics under the pseudonym Burbaki developed the idea, defining it as "Mathematics is the science of mathematical structures." Although this approach was broader and more precise than previous definitions, it was still limited - relationships between structures (eg, mathematics, series theory, algebraic topology), and applied and applied theories, especially mathematical models in physics, engineering, and social sciences, did not fit into this definition. In the last century, there has been a very deep relationship between the various mathematical objects, and the results based on this show that they will play a key role in the further development of mathematics. Along with electronic computing, the expansion of the application of mathematics (biometrics, sociometry, econometrics, psychometry, etc.) and the rapid penetration of mathematical methods into various spheres of life have expanded the subject of mathematics beyond comprehension. Thus, mathematics is a science that studies axiomatic theories and mathematical models, the relationships between them, and draws conclusions based on rigorous logical observations. Initially thematic knowledge, which began with simple numerical numbers and arithmetic operations on them, expanded and deepened with universal progress. Even in the oldest written sources (e.g., mathematical papyri) there are examples of operations on caissons and the solution of linear equations. Irrigated agriculture, the development of architecture, and the increasing importance of astronomical observations led to the accumulation of evidence for geometry. For example, in ancient Egypt, a triangle with sides of 3, 4, and 5 units was used to have a right angle. The greatest achievements of the mathematics of this period can be seen in the example of the rule for calculating the volume of a regular rectangular truncated pyramid (in the present notation V— (a2 + ab + b2) corresponds to the formula L / 3) and the approximate value of l = (16/9) 2. In Greece, it was discovered that geometric properties could be found not only through observation and experiment, but also from known properties, and the idea of deductive proof was developed (Fales, Pythagoras, etc.). The culmination of this idea was the axiomatic construction of geometry in Euclid's Fundamentals. This book had a great influence on the further development of mathematics and was a model for the perfection of logical expression until the beginning of the 19th century. The Greeks equated mathematics with geometry and elevated it to the level of art. As a result, planimetry and stereometry have reached a much more perfect level. The presence of only 5 different convex regular cubes (Plato), the lack of a common dimension with the side of the square (Plato) Pythagoras), the concept of number based on the theory of proportions (Eudoxus), the calculation of the face and length of curved shapes, the volume of objects by the method of coverage, Geron's formula, conic sections (Apollonius, Pergayos), sterographic projection (Ptolemy), geometric constructions and The study of various curves gives an idea of the level of development of Greek geometry. The problems of angle trisection, cube doubling, circle squaring, and regular polygon construction posed by Greek scientists were solved by the 19th century, and the problem of perfect and "friendly" numbers remains open. Greek Mathematics, in particular, was far ahead of its time in Archimedes' research, using the ideas of integral calculus and the center of gravity. Greek scholars also had early knowledge of trigonometry (Hipparchus, Ptolemy), and Diophantus' Arithmetic addressed issues in number theory.

At the same time Mathematics flourished in Ancient China and India as well. The Chinese source "Mathematics with Nine Books" (II-I centuries BC) provides rules for deriving squares and cubes from natural numbers. Later, Chinese scientists used the system of linear equations and the theory of deductions, in particular, the "Chinese theorem on residuals." In the 5th century, Szu Chun-chji showed that the number p ranged from 3.1415926 to 3.1415927.

In India, Mathematics was developed in the works of Ariabhata (5th century), Brahmagupta (7th century), Bhaskara (12th century). The universal achievement of Indian Mathematics was the invention of the decimal number system and the number 0. Indian scientists were also familiar with negative numbers and irrational expressions, and achieved important results in geometry.

II. METHODOLOGY

Greek, Chinese, and Indian mathematics existed almost independently of each other. By the 3rd and 4th centuries, science in Greece was in crisis, and existing works began to be forgotten. The period of European civilization from then until the Renaissance was called the "Dark Ages" (A. Mets). With the spread of Islam and the establishment of the Arab Caliphate in the 7th century, new conditions were created for the development of science and culture. During the reign of Harun al-Rashid, Baghdad, the capital of the caliphate, became a major city, and scholars from various regions began to come here. They originally translated works from Greek, Syriac, and Hindi into Arabic. Thanks to the knowledge of Ma'mun, the son of Harun al-Rashid, who was appointed governor of Khorasan and Movarounnahr, Central Asian scholars began to gather in Marv. In 813, Ma'mun took the caliphate to Baghdad and founded the famous Baytul-Hikma (Ma'mun Academy). It is said that this scientific institution was headed by Muhammad ibn Musa al-Khwarizmi. Baytul-Hikma also included many Central Asian scholars, such as Ahmad al-Farghani, Ibn Turk al-Khuttali, the son of the Abyssinian Hasib al-Marwazi, and Musa ibnShakir, who developed science in the country before the Arab conquest, especially at a young age. This shows that there is a favorable environment for talented scientists to come out. From the ninth century onwards, the history of science enters a new period of rise called the Muslim Renaissance. In Baytul-Hikma, the knowledge accumulated in Greece, India, Khorezm and China was synthesized, and Mathematics was gradually developed. Khorezmi organizes scattered knowledge and lays the foundation for algebra. Thanks to his work on the decimal system, this convenient calculator spread throughout the world. In order to make his works educated, Khorezmi used a clear and concise narrative style. Due to this, his works are widespread. The Khorezmian style is called an algorithm by the name of the author by European translators.

Muslim Orientalists also developed geometry (ThabitibnQurra, AbulWafa, Umar Khayyam) and established trigonometry as a science (Ibn al-Haytham, Beruni, Tusi), in particular, the proof of Ptolemy's theorem on stereographic projection by Ahmad al-Farghani in the Baghdad Academy of Geometry. showed that it had been studied. The mathematical solutions of the third and fourth degree equations by mathematicians who wrote in Arabic later led to the development of analytic geometry.

The Khorezm Mamun Academy (Ibn Iraq, Beruni) also played an important role in the development of mathematics. The peak of the development of Eastern Mathematics dates back to the Samarkand Scientific School. Ulugbek and his scientists (Qazizoda Rumi, GiyosiddinKashi, Ali Kushchi, MiramChalabi, Hussein Birjani, etc.) built a huge observatory, observed the coordinates of stars and the motion of planets with great accuracy, and interpreted the methods of calculating the spherical coordinates of lights. formulas, a method later called the Gorner scheme, and a method of serial approximations develop. Ulugbek's "ZijijadidiKoragoniy" also contains tables of trigonometric functions with high accuracy.

A special group - a special computing center - has been set up at the Ulugbek Observatory to perform large-scale computational work. For example, to determine x = sin G, first sin 3 ° was calculated geometrically, then the equation x3-45xf0,785039343364006 = 0 was constructed on the basis of the formula sin3a = 3sinacos2a - sin3a, and the value sinG = 0,0174524066437283571 was found. Cauchy calculated the number j after the comma with 17 chambers by regularly drawing 3-228 angles on the circle.

From the 16th century onwards, science in the East faced a crisis. The works of scholars of the Islamic world began to spread and be translated into Europe in the tenth and twelfth centuries, paving the way for the rapid development of mathematics in the sixteenth century. In particular, the works of al-Khwarizmi, al-Farghoni entered Europe through Spain and Italy, and Ulugbek's "ZijijadidiKoragoniy" entered Europe through Istanbul. As a result of these works, interest in mathematics increased in Italy (L. Fibonacci, L. Pacholi, N. Tartaglia). Arithmetic operations include degrees, roots, and logarithms. Although the roots of tertiary and quadratic equations are real, the fact that a negative number can only be solved by the square root requires complex numbers.

III. ANALYSIS AND RESULTS

The seventeenth century marked the beginning of a new era in the history of mathematics, with J. Vallis, I. Kepler, R. Descartes, B. Cavalieri, P. Fermat, F. Viet, and other Pascal names. Mathematical definitions are widely introduced. This, in turn, has a positive effect on the development of mathematics, laying the foundations for analytical geometry, projective geometry, probability theory, and number theory. Mathematics will become the main subject in the universities that have started to open one after another.

During this period, the first international team of mathematicians was formed through correspondence between scientists around the world through the French scientist M. Mersenn, and the scientific competition between them intensified. It was time to ask new questions about combinatorics, and to change functions, that is, to work with interrelated quantities. Due to the lack of elementary methods in solving such problems, they began to resort to infinitely repetitive actions. B. Cavalieri used the "indivisible method" in calculating the volume of rotating objects, F. Viet authentication, J. Vallis12.32.52.72 ,. equation, N. Mercator found the formula. I. Barrow observed the relationship between the curvilinear temperature surface and the change in motion. At the end of the seventeenth century, research in this area led to the creation of differential and integral calculus. G. Leibniz based his new account on the concept of "infinitesimal" quantities - although such quantities did not have a definite meaning in their own right, their ratios and infinite sums were equal to certain values. Leibniz showed that this method could solve many previously unsolved problems of geometry (1782-86).

I. Newton approached the idea of differential and integral calculus from the other side - through the problems of mechanics. Here, too, the situation was similar to geometry: for G. Galileo, who studied flat motions, elementary geometry was sufficient, but more complex motions required the study of more complex lines. In 1669, I. Newton presented his work, The Method of Fluxes, to I. Barrow and J. Collins, but it was published in 1736.

The development of M. in the 18th century was mainly associated with the development and application of differential and integral calculus. Many famous scientists, such as the Bernoulli family, Euler, D'Alambert, Lagrange, Legendre, and Laplace, developed the new field in detail and turned it into a powerful research tool in the name of mathematical analysis. Based on it, independent fields such as differential equations, variational calculus and differential geometry emerged.

During this period, the academies of Paris, Berlin, St. Petersburg, and Cambridge became major centers of science, and the first scientific journals were published, which accelerated the development of M. Projective geometry, probability theory, linear algebra, and number theory developed, complex numbers became widely used, and functions of complex variables began to be studied.

In the 19th century, the development of M. continued in two directions: both along the length and towards the roots. During this period, the fields of M.'s current undergraduate program: mathematical analysis, analytical geometry and linear algebra, differential equations, theories of functions of real and complex variables, were formed, and on the basis of them completely new ideas began to emerge.

K. F. Gauss decomposes pta into a linear multiplier in the field of polynomials of degree l (algee). The basic theorem of bran) was proved by fluffy bones. For centuries, the problem of solving the 5-level equation has bothered mathematicians. P. Ruffini and N. Abel argued that the root of this equation could not be expressed by its four coefficients, the arithmetic operation, and the derivation. E. Galua, continuing the ideas of Lagrange and Legendre, showed that the problem of insolvability of an algebraic equation in this sense depends on the fact that the symmetric functions of the roots are expressed by the coefficients of the equation. Here, Galois was the first to use the concept of a group as a measure of symmetry. Earlier, on the basis of a similar idea, Gauss solved the problem of creating a regular polygon using a compass and a ruler. The field theory derived from Galois's ideas made it possible to solve the problem of such constructions in general.

Under the influence of Gauss's and Galois's ideas, previously independently developed fields began to interfere with each other: functions of complex variables were applied to differential equations and number theory, algebra - number theory, and crystallography. In particular, after Klein's lecture on the Erlangen program, based on the suitability of individual geometries for each group of substitutions, the fundamental principles underlying mathematical principles began to emerge.

At the same time, M.'s "roots" grew. The principle of firm proof of the Euclidean-era assertions has receded. The unreasonable use of differential and integral calculus, especially the free handling of infinite operations, has led to paradoxes and misunderstandings. Mac, I— I + 1 - 1 + 1 - ... the value of the sum is equal to 0, 1 or S, depending on the order of operations, log (- I) 2 = logl2 could not be applied to the equation log a "= nloga, etc. Long The terms "differential" and "infinitely small" have long been used interchangeably, and what is meant by "function" and "continuous" has also been debated.

At the beginning of the 10th century, O. Cauchy's theory of differential and integral calculus, based on the concept of limit and continuity, clarified the situation. But these concepts were lacking in proving the integral existence of a continuous function. Attempts to fill in the gap asked K. Weierstrass "What is a real number?" He asked. Meanwhile, millennial fruitless attempts to prove Euclid's famous fifth postulate ended with the invention of non-Euclidean geometry. This began to require an in-depth examination of the basics of geometry.

By the end of the 19th century, great strides had been made in strengthening the foundations of mathematics: the theory of real numbers was completed (Weierstrass, Dedekind), mathematical logic was formed (Peano, Frege), the theory of functions was developed (Riemann, Lebeg, Fubini, Stiltyes), and the system of axioms of geometry was perfected. (Hilbert), the importance of the concept of set was realized, and it was believed that the whole of mathematics, like geometry, was based on rigid axioms.

The end of the 19th century and the beginning of the 20th century were the years of unprecedented rise in the history of M. In 1893, on the occasion of the 400th anniversary of the discovery of the Americas, Chicago hosted an international M. Congress. The Congress recognized the need for world mathematicians to meet regularly and report on the latest results. The first official international congresses were held in Zurich in 1897 and in Paris in 1900. Poincaré's ideas were the main topic at the Zurich Congress, while Hilbert presented his famous 23 problems at the Paris Congress. Poincaré's ideas and Hilbert's concept had a profound effect on M.'s development throughout the 20th century.

However, as the foundations of M. were penetrated, the problems became more acute - in the early 20th century, the deepest crisis in M.'s history began - deep contradictions began to open up in M.'s foundations (Burali - Forti, Russell, Richard, Grelling paradoxes). Attempts to overcome them gave rise to the axiomatic theory of sets (Sermelo, Frenkel, Bernays, J. von Neumann) and restored Hilbert's view that "the M. building was built on the basis of a perfect design."

In the first quarter of the 20th century, the idea of solid proof was fully formed in M. On this basis, N. Burbaki began to publish a multi-volume monograph entitled "Elements of Mathematics" in order to present the main part of the whole M. in a single way - the results in the most generalized way. The style propagated by Burbaki gave a great impetus to the development of some (abstract) areas of M. In a number of countries (including the former Soviet Union), the teaching of M. began to be reformed in the style of "burbakism", but this failed experiment created unresolved problems in M.'s education.

Mid-20th century Since then, M. has developed in two directions: on the one hand, differential equations with the need for scientific and technological development, mathematical physics, finite M., probability theory, computational M., classical fields have expanded and become more branched, and on the other hand, M.'s internal development laws The most pressing, abstract, and very abstract fields (such as general algebra, differential and algebraic geometry, topology, and functional analysis) have given rise to a variety of disciplines. The major scientific schools formed in the developed world began to be divided into narrow disciplines. Until the 20th century, M. was the object of study of individual scholars, but in the last hundred years it has become the nature of collective activity. The number of scientific journals, pamphlets, scientific collections, and articles began to grow exponentially. This, in turn, complicated another problem in M.'s development - the weakening of the relationship between the various directions, the difficulty of the narrative method, the difficulty of checking the accuracy of the evidence, and the certainty of the correctness or inaccuracy of the results. The whole "mathematical" profession began to be divided into dozens of specialties, such as "algebraist", "geometry", "topologist", "probability" and "functionalist", each of which was divided into hundreds of narrow branches, each of which almost did not understand each other. M. Klein described this event as "M.'s new crisis."

Although this organizational crisis by nature has not yet been completely overcome, a new upsurge took place in M. at the end of the 20th century, in particular, Fermat's great theorem (E. Wiles) was proved, and deep connections began to be opened between distant branches of M. The fact that most of the works awarded the International Fields Medal in the field of M. were the result of the application of concepts and methods in three or four independent fields of M. revived the concept of "M. - a holistic science". The development of the universal Tex text editor by the American mathematician D. Knut and the advent of electronic communication open up new horizons for the development of M. in the 21st century. Today, P. Dirac's most symbolic description is even more appropriate: "M. is a weapon specially adapted to work with abstract concepts of any nature. There is no limit to its power in this regard."

IV. DISCUSSIONS

In the Middle Ages, the development of M. science, which flourished in the territory of present-day Uzbekistan and the surrounding region, stopped in the 16th century. The second quarter of the 20th century marked the beginning of a new era of upsurge in the field. Founded in 1918, VI Romanovsky became a professor at the first university in Central Asia (now the National University of Uzbekistan). Prof., who has a deep respect for Eastern national values and studied the Uzbek language. began to train professional mathematicians from talented young people and founded the Tashkent School of Probability Theory and

Mathematical Statistics. From this school T. A. Sarimsakov, S. H. Sirojiddinov, T. Azlarov, Sh. More than a hundred specialists like Farmonov have been trained. The first congress of the Bernoulli International Society was held in Tashkent (1986) as a result of the international recognition of research in this field in Uzbekistan. From the 50s of the 20th century, scientific schools were established in other areas of the republic. In the field of functional analysis TA Sarimsokrv, IS Arjanix, MS Salohiddinov and TJ Jo‘rayev - Theory of Mathematical Physics Equations, IS Kukles - Theory of Simple Differential Equations, TN Qori-Niyaziy, SH Sirojiddinov, GP Matviyevskaya - History of Mathematics, VQ Kobulov, FB Abut , T. Buriyev, AF Lavrik laid the foundations of computational M. and numerical theory. In the last quarter of the 20th century, the theory of optimal control (N. Yu. Sotimov), the theory of invariants (J. Hojiev), functional methods of mathematical physics (Sh. O. Alimov), operator algebra and mathematical methods of quantum physics (Sh. A. Ayupov) Research in the most modern fields, such as the theory of functions of many complex variables (AS Sadullayev), has given Uzbek mathematicians new opportunities in addition to their traditional contacts with research centers in Moscow, St. Petersburg, Novosibirsk, Kiev, and Yekaterinburg. The works of Uzbek mathematicians were regularly published in research centers in Great Britain, France, and the United States.

V. Conclusion

In 1999, the Society of Mathematicians of Uzbekistan was established (chairman - T. J. Jo‘rayev), in 1991 - "Uzbek Mathematical Journal - Uzbek Mathematical Magazine", in 2001 - "Mathematics, Physics and Informatics" for students. Today (2001) there are more than 70 doctors of sciences and more than 300 candidates of sciences in the republic.

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