

Science for the benefit of mankind

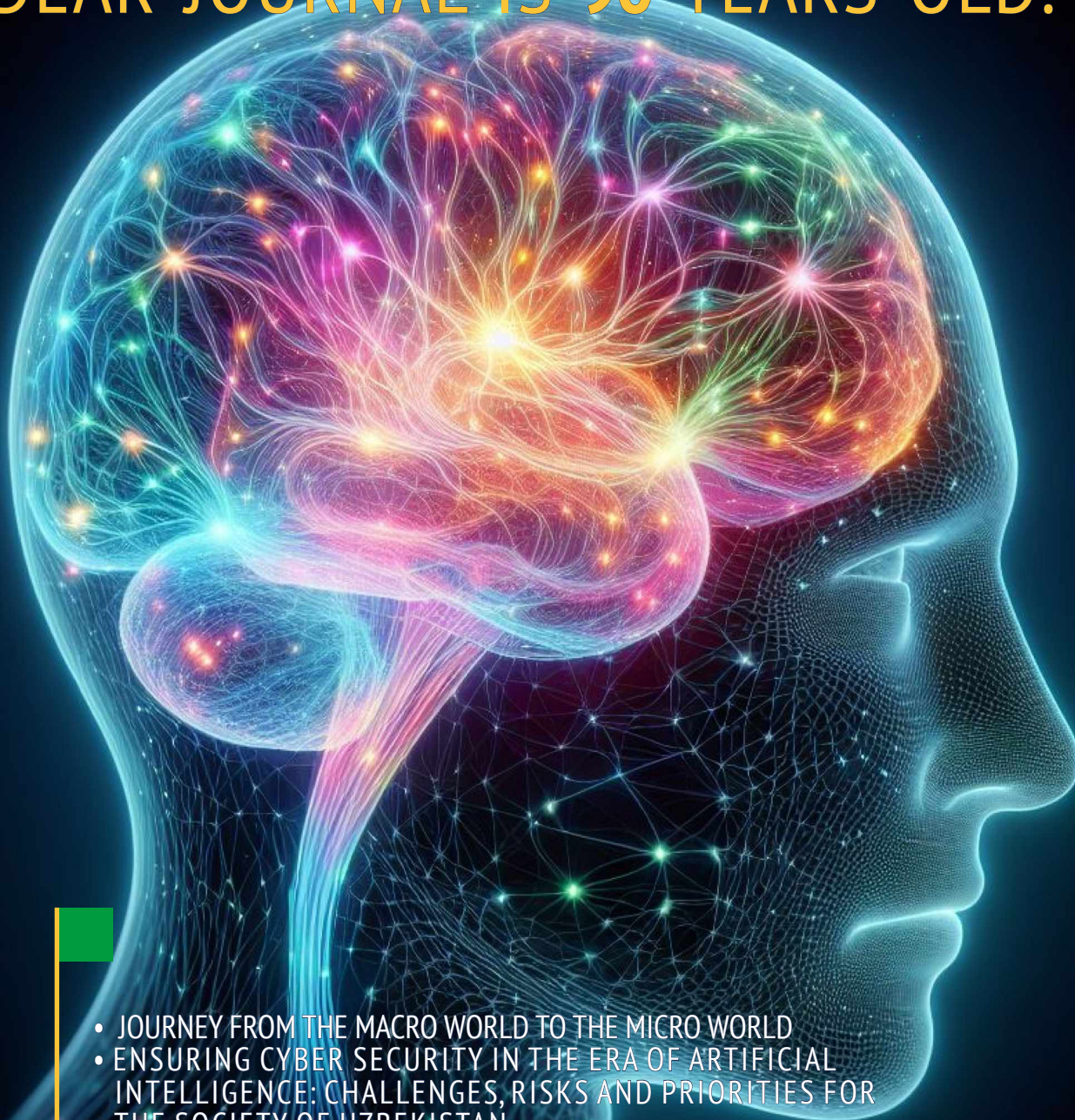
FAN VA TURMUSH

«Science and Life» popular science journal

Centre for Promotion of Science Uzbekistan Academy of Sciences

4/2023

DEAR JOURNAL IS 90 YEARS OLD!



- JOURNEY FROM THE MACRO WORLD TO THE MICRO WORLD
- ENSURING CYBER SECURITY IN THE ERA OF ARTIFICIAL INTELLIGENCE: CHALLENGES, RISKS AND PRIORITIES FOR THE SOCIETY OF UZBEKISTAN
- UZBEK IMPLICATIONS RELATED TO THE WOLF
- THE IMAGE OF ABU RAYHAN BIRUNI IN THE THEATER AND CINEMA
- NEW WAVE OF YOUNG SCIENTISTS AND SCHOLARS





DEAR JOURNAL IS 90 YEARS OLD!

When it comes to the journal “Fan va Turmush (Science and Life)”, the older and middle-aged generation remembers with deep melancholy and gratitude. Because the vast majority grew up reading the information contained in the pages of this magazine. “Fan va Turmush” is equally dear to both young and old. The magazine regularly publishes scientific news, interesting facts, materials on the use of science and technology in the life of the population, in agriculture, and in industry.

According to the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 652 dated November 8, 2022, a Center for the Promotion of Science was created as part of the country’s Academy of Sciences, and the consistent and effective activities of the journal “Fan va Turmush” were ensured.

The journal is published in a new format in Uzbek, Russian and English under the leadership of the editor-in-chief, Academician Akbar Khakimov. It contains several blocks, such as Numbers rule the world; Nature and man; Engineering and information technology; History, society, culture thus cover all subject areas. The platform for young researchers, scientific news from Uzbekistan, and interesting global columns are of great interest to many people.

Currently, the goal of the magazine is to form in the hearts and minds of its readers, especially the younger generation, a modern worldview based on universal human values and the latest achievements of science, as well as widespread promotion of world discoveries and scientific results of Uzbek scientists in order to make our people highly spiritual and enlightened.

We are confident that “Fan va Turmush” will make a worthy contribution to the foundation of the Third Renaissance. We wish the editors of the journal success in their scientific and creative work!

Dear journalists! May “Fan va Turmush” always be on your bookshelf and be a torch illuminating your life paths!

Bekhzod Yuldashev
President of the Uzbekistan Academy of Sciences, Academician

Dear readers!

Our 4th issue for 2023 is dedicated to the 90th anniversary of the publication of the first issue of the journal “Fan va Turmush” - the oldest popular science journal in our country. Over the many years of its activity, it has undergone a number of transformations - changing its name, content structure and design. But in the end, it managed to find his unique niche in the domestic publishing periodicals, becoming one of the most read and popular science journals in Uzbekistan.

In 1933, it was published in Uzbek as the journal under title “Sotsialistik Ilm va Tekhnika” (“Socialist Science and Technology”). Starting in 1935, the journal began to be published under the title “Sotsialistik Fan va Tekhnika”, and in 1939 the journal changed its name again and became known as “Sotsialistik Fan va Turmush”. Difficult times came during the war, when the journal’s editors had to suspend printing. But immediately after, the publication of the journal was resumed, but under the current title “Fan va Turmush”. The initiator of the restoration of the journal was the Academy of Sciences and its then president, Academician Khabib Abdullaev.

Its circulation, which once reached no more than two thousand, over the years of its activity has grown to five hundred thousand, which indicates how the journal has won the love and respect of a huge number of readers. The journal aroused their interest because its pages contained the latest achievements of world and domestic science and technology in an accessible form.

A distinctive feature of the journal “Fan va Turmush” is that famous scientists and scholars of the country have always been appointed as its editors-in-chief.

The first Chief Editor of the journal was Otajon Hoshim (1933). He was a literary critic, philosopher, and statesman. In 1933, Otajon Hoshim was appointed Chairman of the newly created Science Committee under the Uzbek Central Executive Committee, and at the same time headed the Institute of Language and Literature and the editorial office of the journal. Otajon Hoshim, along with knowledge of several Turkic languages and Farsi, was fluent in German. The latter cost him his life. On August 2, 1937, Otajon Hoshim was arrested. That same year, as an enemy of the people, he was expelled from the party and relieved of all his positions. On October 4, 1938, Otajon Hoshim was shot and was rehabilitated posthumously. For a short time from 1938 to 1939, the journal was headed by Ikrom Islomov (1906-1975), an optical physicist and specialist in the field of spectroscopy. In 1937, he was appointed rector of the Uzbek State University, in 1938-1940 he was Chairman of the Science Committee. In 1943, he was elected a corresponding member of the Uzbekistan Academy of Sciences. During 1957, the editorial board

of the journal was headed by a famous scientist, vice-president of the Uzbekistan Academy of Sciences, Academician, Doctor of Philosophy, Professor, Honored Scientist of Uzbekistan Ibrokhim Muminov (1908-1974).

The years 1937, 1940-1941 and 1958-1970 occupy a special page in the history of the journal. At this time, the Editor-in-chief of the journal was the famous scientist, teacher and popularizer of science, academician Tashmuhammad Kary-Niyazi (1897-1970). Over the years, he held important government positions: in 1931-1933 he was the rector of the Central Asian State University, in 1937-1938 he served as People’s Commissar of Education of Uzbekistan and Chairman of the Presidium of the Science Committee. In 1943, he was elected the first President of the Academy of Sciences of Uzbekistan.

Academician, Doctor of Technical Sciences, Professor, Muhammadjon Urazboev (1906-1971) took over the leadership of the journal from Kary-Niyazi, who headed the journal in 1970-1971. For many years he was Director of the Institute of Mechanics and Seismology of the Uzbekistan Academy of Sciences, Chairman of the Committee on Science and Technology under the Council of Ministers of Uzbekistan. From 1963 until the last days of his life he was the rector of the Tashkent Polytechnic Institute. He was replaced as the Editor-in-chief of the journal by Academician, Doctor of Technical Sciences, Professor, Honored Worker of Science and Technology of Uzbekistan Muzaffar Khamudkhanov (1916-1972), who also headed the journal for two years (1971-1972) and at the same time was the rector of the Tashkent Polytechnic Institute.

After M. Hamudkhanov, for many years, in 1974-1988, the Editor-in-chief of the journal was the famous biochemist, Academician Yolqin To’rakulov, Professor, Doctor of biology (1916-2005), (1959), (1962), (1966), honored scientist of Uzbekistan (1965), rector of the Tashkent Institute of Pharmacy (1939-1944), rector of Tashkent Medical Institute (1947-1950), deputy director of the Andijan Medical Institute (1954-1956), director of the Research Institute of Regional Medicine (1957-1960), deputy Director of the Institute of Nuclear Physics (1960-1962), Vice-President of the Uzbekistan Academy of Sciences, Chairman of the Department of Chemical Technologies and Biological Sciences (1963-1966), Member of the Presidium of the Uzbekistan Academy of Sciences (1963), Director of the Institute of Biochemistry (1967-1969), Rector of Samara State University (1970-1972). He was awarded the Lenin Prize for clinical and biochemical research using radioactive iodine in the treatment of thyroid disease (1964).

In 1988-1992 Komiljon Zufarov (1925-2002) was elected the Editor-in-chief of the journal, a Doctor of medical sciences (1963), Professor, Academician

(1968), Honored Scientist of Uzbekistan (1968), rector of Tashkent Medical Institute (1965-1971), director of the Institute of Regional Medicine (1971-1972).

Editor-in-chief of the journal in 1992-2002 was a famous scientist and public figure Murod Sharifkhujayev (1932), Doctor of Economics, director of the Research Institute of Economics at the State Planning Committee of Uzbekistan (1975), rector of the Institute of National Economy and the Tashkent Financial Institute, deputy prime minister, and in 2004-2006 Speaker of the Senate of the Oliy Majlis (Parliament) of Uzbekistan.

From 2002 to 2022, the Editor-in-chief of the journal was Shukhrat Egamberdiev, astrophysicist, Doctor of Physical and Mathematical Sciences, Academician. From 1995 to the present, he has been director of the Astronomical Institute of the Academy of Sciences. He was the Chief Scientific Secretary of the Academy of Sciences (2000-2006), Deputy State Advisor to the President of the Republic of Uzbekistan on issues of science, education and health.

In 2022, by decision of the Cabinet of Ministers of the country, the "Center for the Promotion of Science" was founded in the system of the national Academy of Sciences, which included the journal "Fan va Turmush" as the director of the center, and Academician, Professor, Doctor of art history Akbar Khakimov became the Editor-in-chief of the journal.

With the advent of new management, new life was breathed into the journal, general activities were

revised, from concept to design of a new format, tasks were expanded, and new strategic goals were noted. In order to expand the readership, it was decided to publish the journal in separate editions in Uzbek in Latin script, Russian and English.

The undoubted advantages of the journal are the high theoretical level of the published materials, the severity of the problems, the openness and sincerity of the points of view of the authors of the articles.

We are pleased to inform our readers and authors that the journal "Fan va Turmush" is formally included in the List of Higher Attestation Commission publications on the humanities, since in terms of the level of published materials, the variety of topics discussed, the variety of presented author's positions, it is not only not inferior to, but superior to many international publications.

Over the years, the journal has turned into an authoritative periodical, on the pages of which topical scientific problems are discussed. Publications in the journal are marked by high quality, fundamental presentation of the material, and deep scientific popularity. Publishing in "Fan va Turmush" has become prestigious for many specialists in various fields of science. The journal continues and develops the best traditions of popular science publishing and today stands among the well-known and authoritative Uzbek periodicals on science.



Otajon Hashim



Tashmuhammad Qori Niyazi



Ibrahim Muminov



Muhammad Urozbayev



Yolqin Toraqulov



Komiljon Zufarov



Murod Sharifkojaev



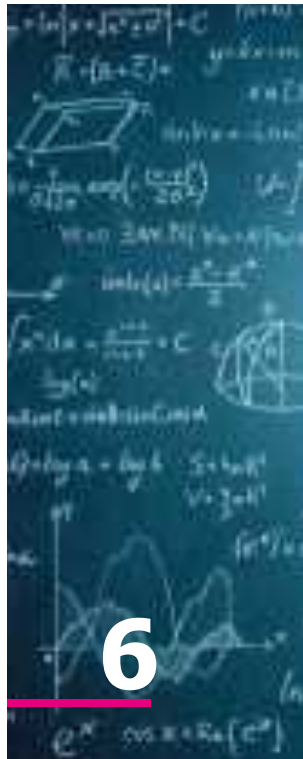
Shuhrat Egamberdiev



Akbar Hakimov



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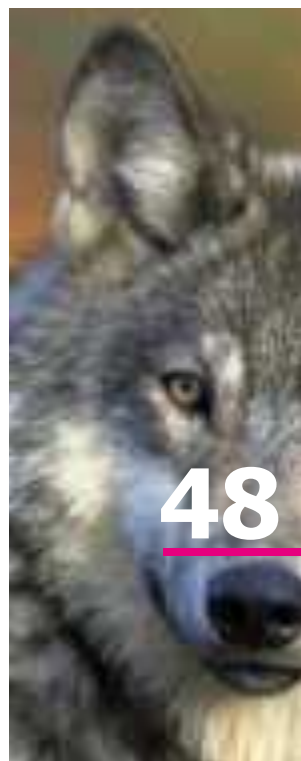
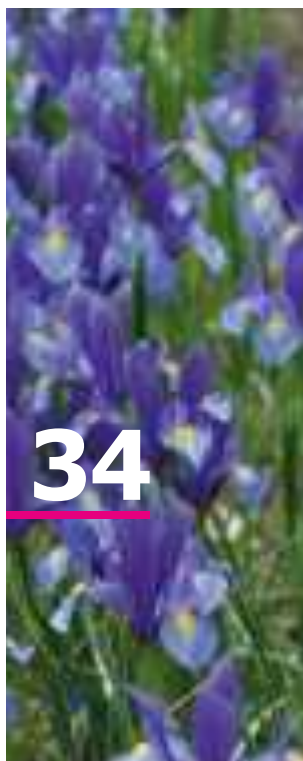
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Journey from the macro world to the micro world



Otabek Khakimov,
lead researcher V.I. Romanovsky Institute of Mathematics

We cannot imagine our daily life without numbers. Have you ever wondered which numbers are important to us? Natural numbers or integers? Rational numbers or real numbers? Someone thinks about the meaning of the number zero, and someone may think about the meaning of the famous number $\pi \approx 3.14$ or the number $e \approx 2.71$. In fact, each of the numbers you think about has a meaning. Our goal is not to talk about the advantages of numbers over each other, but about whether they are suitable or not for use at the right time.

Let's remember how we became acquainted with numbers and learned how to perform operations on them. First, let's get acquainted with the numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. Then we will become familiar with the numbers used for counting - the natural numbers: 1, 2, 3, ..., 10, 11, ... The set of natural numbers is denoted \mathbb{N} . The operations of addition and multiplication are defined with these elements. Although the results of this operation again refer to the specified set, even the simplest equations of practical importance do not always have a solution in the set of natural numbers. For

example, for given numbers $a, b \in \mathbb{N}$, the equation $a+x=b$ has no solution when $a > b$. In order for such linear equations to have a solution, there is a need to expand the set of numbers and a new set is formed, integers. This set is denoted by \mathbb{Z} and consists of numbers of the form ..., -2, -1, 0, 1, 2, ... called integers. Now for given numbers $a, b \in \mathbb{Z}$ the equation $a+x=b$ will have a solution in the set of integers, and this solution is precisely the number $b - a$. We also defined the subtraction operation, which in turn is the opposite of the addition operation. Unfortunately, the new set of numbers is also limited for practical problems. For example, for given numbers $a, b \in \mathbb{Z}$ other than zero, the equation $ax=b$ does not necessarily have a solution. As a result of the fact that such linear equations require a solvability condition, we obtain \mathbb{Q} , the set of rational numbers. The choice of the term of *rational numbers* for such numbers is also not accidental. We'll talk about this later. The set of rational numbers becomes a *number field* with the operations of addition and multiplication (and their opposite operations of subtraction and division). Now you can easily perform arithmetic operations in this field.

The next step is an *introduction to calculus by defining the concept of absolute value (metric)* in this field. An absolute quantity well known from elementary mathematics is *the modulus of a number*. It has the following important properties:

(i) For an arbitrary number $a \in \mathbb{Q}$ is applicable $|a| \geq 0$, and in this case the equality holds only for the rational number $a=0$;

(ii) $|a \cdot b| = |a| \cdot |b|$ is applicable for arbitrary numbers $a, b \in \mathbb{Q}$;

(iii) For arbitrary numbers the following $a, b \in \mathbb{Q}$ inequality is applicable $|a + b| \leq |a| + |b|$;

It is the three properties listed above that are taken to determine the absolute value in the field of rational numbers. The last property is called *the triangle inequality (The sum of the lengths of arbitrary two sides of a triangle is greater than the sum of the third side. This property is a criterion that determines whether a triangle can be made through three given segments. This implies that from two segments a third segment can be formed if the equality is appropriate)*.

Using any absolute value, you can define a metric such as $d(a, b) = |a - b|$. Therefore, the field into which the absolute value is introduced becomes a metric space, and the concept of approximation, which is one of the important concepts of analysis, can be introduced into it. By populating the field of rational numbers with respect to a metric defined modulo the number, a field of real numbers is created, which is denoted by \mathbb{R} . A real number can be a rational number or an irrational number. As you know, a rational number is a number that is expressed as an irreducible fraction using the method we formed from integers above! An irrational number cannot be expressed in this way. For example, real numbers π , e or $\sqrt{2}$ cannot be expressed as an irreducible fraction whose denominator is an integer. Just look at the decimal fractions of real numbers to show another difference between rational and irrational numbers. If the decimal is periodic (and numbers with a finite deci-



mal notation are also understood as 0-periodic!), it represents a rational number; otherwise, it represents an irrational number. We know very well that numbers can be rounded simply by looking at the decimal notation. And this means replacing a given real number with a rational number with sufficient accuracy. Although theoretically the result of an experiment may be an irrational number, in practice its value is considered sufficient with certain accuracy. Suppose the result of the experiment was the number π . Depending on the area in which the result of the experiment was obtained, you can get a value of 3.14 or 3.1415. Therefore, although the properties of real numbers are important from an analytical point of view, in practice rational numbers still come to the big stage.

At this point, it should be noted that replacing a real number with a rational number (i.e., rounding) means that the absolute value - the modulus of the number in the field of rational numbers - performs the main function. This means that the field of rational numbers can form a completely different field of numbers and a different analysis in nature when the absolute value is taken from the modulus of the number in the field of rational numbers. At first glance it may seem that there is no need for analysis other than that constructed in the field of real numbers. On the other hand, even when such a need arises, it is necessary to determine how many different number fields can be obtained from the field of rational numbers. Below we will try to answer similar problems:

At the end of the 19th century, the German mathematician Kurt Hensel introduced p-adic numbers. To do this, a new absolute value (p-adic norm) of a rational number is defined through a given prime number p. As is known, a number, $a \in \mathbb{Q}$ different from an arbitrary zero can be represented in one way as $a = p^r \cdot \frac{m}{n}$. Here, in $r, m, n \in \mathbb{Z}$ and m, n, p arbitrary two of the three are relatively prime. Using the singularity of such an expression, the following reflection is defined in the field of rational numbers:

$$|a|_p = \begin{cases} 0, & \text{если } a = 0; \\ p^{-r}, & \text{если } p^r \cdot \frac{m}{n}. \end{cases} \quad (1)$$

This reflection will be an absolute value in the field of rational numbers, which means it has properties (i)-(iii). This absolute value is called the p-adic norm of a rational number. The field \mathbb{Q}_p - P-adic numbers is created by filling the field of rational numbers using the P-adic norm.

The P-adic norm of a rational number has the following essential property, which differs from the modulus of a number:

(i) \rightarrow For arbitrary numbers the inequality $a, b \in \mathbb{Q}$ applies $|a+b| \leq \max\{|a|, |b|\}$.

Obviously, the relevance of inequality (iv) ensures the triangle inequality. Therefore this property is called the strong triangular inequality (It should be noted that implementing property (iii) does not guarantee that property (iv) will apply. For example, although the triangular inequality is appropriate for the modulus of a num-



ber, the strong triangular inequality does not.) At first glance, it seems that the difference in properties (iii) and (iv) is small. However, this small difference has actually led to additional theories.

Although the numbers introduced by Hensel were not very popular at first, the work published in 1916 by A. M. Ostrovsky made a great contribution to changing views on this issue. He proved that in the field of rational numbers, in terms of nonequivalent absolute values, one can introduce only p-adic norms for the modulus of a number or some of its prime numbers p (In this case, p-adic and q-adic norms for different prime numbers p and q will not be equivalent. From the fact that there are only a limited number of prime numbers, it follows that a numerical non-equivalent absolute value can be entered into the rational numbers field). This meant that as a field of prime numbers it is enough to consider only the field of real numbers or p-adic numbers. Therefore, given that the actual analysis was relatively well developed, it is now the turn to formulate the foundations of p-adic analysis.

A field with the absolute value property (iv) is called a field in which the non-Archimedean axiom holds, otherwise a field in which the Archimedean axiom holds. These axioms can be explained in the following geometric interpretation. Let's assume you have sticks of the same length (the number of which can also be infinite!). If you have the ability to compensate for an arbitrary length given to you by placing identical sticks in it, then you express the length as an absolute value in a field where Archimedes' axiom holds. Conversely, you express the length as an absolute value in a field where the non-Archimedean axiom holds.

Obviously, if you have never heard of a field in which a non-Archimedean analysis or a non-Archimedean axiom is performed before, it is quite natural that the above example will seem completely counter-intuitive to you. We continue to surprise you! The non-Archimedean field gives rise to its inherent geometry. For example, in this case two balls cannot partially intersect. In other words, either one of them lies inside the other, or they do not intersect. There is no scalene triangle in



this geometry. From the point of view of metric space, any ball in it is an open-closed set. If in classical analysis it was difficult for you to check the convergence of a series, then in non-Archimedean analysis it is relatively simple. That is, the approach of the common term to zero is necessary and sufficient for the convergence of the series. There are many examples of such differences from tutorials on p -adic analysis.

The original physical model, in which Archimedes' axiom is not satisfied, was described in 1987 by I.V. Volovich in the description of p -adic narrow equations. He suggested that the foundations of the microcosm (meaning distances smaller than the Planck dimension ($\approx 10^{-34}$ cm) are explained precisely with the help of non-Archimedean analysis. After this, many scientific studies were carried out in the field of non-Archimedean analysis, especially applications of the p -adic number field. As a result, p -adic analysis is widely used to study phase transitions for classical models of statistical mechanics, sequencing genetic codes, in questions of geology and psychology, and in information security issues such as high-resolution image reconstruction and information transfer.

A wonderful application of p -adic numbers can be found in Monski's theorem, proven in 1970. According to the theorem, a square cannot be divided into an odd number of equilateral triangles. In general, recently there have been increasing attempts to prove hypotheses using p -adic numbers that cannot yet be proven

based on the properties of real numbers. Perhaps the famous Collac conjecture $3n+1$ can also be proven using p -adic numbers.

As we mentioned earlier, the result of any experiment is in any case expressed in rational numbers with the desired accuracy. In this case, it is important to know by what absolute value it is advisable to obtain accuracy (rounding). Perhaps the value that results from an experiment should come from a p -adic analysis rather than from a real analysis, and vice versa.

Neither real numbers nor p -adic numbers are superior to each other. These are complementary numbers. According to Volovich's definition, one of them is the basis for describing processes in a macromolecule, and the other is the basis for a micromolecule.

Why should mathematicians ask politicians to avoid the ancient dilemma of pure and applied mathematics?

Mohammad Sal Moslehan

Due to the commercialization of science and technology, there is evidence of politicians paying attention mainly to research with immediate applications and benefits. Furthermore, unrealistic requests are made regarding the direct applicability of results in mathematics, a circumstance that may negatively affect all basic and theoretical studies. This paper not only shows that the distinction between pure and applied mathematics is historically and practically unnecessary and unhelpful, but also emphasizes the romantic idea that pure and applied mathematicians should constitute a community and work together to change politicians' minds.

The dilemma of “pure versus applied mathematics” dates back to ancient Greece, where the first studies the world of ideas and the second investigates the world of the senses.

Pure mathematics can be regarded as the study of abstract concepts independent of any application to the physical world; see [3]. This description goes back to Plato's metaphysical view of mathematics as the study of ideas or eternal unchanging abstract forms; cf. [4]. Although many of these concepts originate from the real world, the applicability of the results is not the primary concern of pure mathematicians. Mathematicians intend to show the truth of mathematical propositions. In fact, inventing or discovering mathematical structures, generalizing notions, solving important mathematical problems, and briefly seeking “beauty” motivates pure mathematicians to deepen, strengthen, and expand existing mathematics. Hardy [9, pp. 84–85] asserted that “a mathematician, like a painter or a poet, is a maker of patterns” and added: “The mathematician's patterns, like the painter's or the poet's, must be beautiful; the ideas, like the colors or the words, must fit together in a har-

monious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics”.

Pythagoras stated that “mathematics is the way to understand the universe”. It is mentioned in [10] that “someone who had begun to read geometry with Euclid, when he had learned the first theorem, asked Euclid, ‘what shall I get by learning these things?’ Euclid called his slave and said, ‘Give him a coin since he must profit by what he learns’”. None of the philosophical schools of mathematics – platonism, formalism, logicism, intuitionism – provide a completely convincing and comprehensive explanation of why mathematical structures do describe the real world. Recently, Max Tegmark [19], a mathematician-physicist, offered a different explanation. He believes that the universe itself is an abstract mathematical structure. He introduced the Computable Universe Hypothesis, stating that the mathematical structure that is the external physical reality is defined by computable functions. In addition to these views, the humanism of Reuben Hersh considers mathematics to be part of human culture and history, which originates from the nature of our physiology and physical environment. He believes that mathematical structures adapt to the world around us for the same reason our lungs adapt to the Earth's atmosphere.

Many scientific theories are formulated and expressed using mathematical concepts and symbols. A part of mathematics, named applied mathematics, deals with modeling and simulation of phenomena and related calculations and helps other scientists to better understand nature, and describe and control it. Applied mathematics develops those mathematical methods that are used in various sciences and technologies. The help that applied mathematics provides to other disciplines in order to solve their problems is sometimes so significant that it has given rise to specific branches of mathematics. Examples include data science, mathematical biology, and financial mathematics. Penelope Maddy [14], a contemporary mathematical philosopher, based on historical pieces of evidence in mathematics, says that an applied mathematician invents a model that corresponds to a physical phenomenon that not only is not clearly visible in the phenomenon itself, but is also more complex than it.

Applied mathematics can be regarded as the bridge between pure mathematics and concrete applications of mathematics in the world. It is generally recognized





that the practical value of mathematics lies in its applications, but that pure mathematics is indispensable to make such (future) applications possible, and that there are valid intrinsic reasons for doing mathematics, such as curiosity.

Pure mathematicians provide a solid framework and rigorous scientific basis which enables applied mathematicians to develop efficient methods or invent useful tools to assist physicists, computer scientists, engineers, biologists, medical researchers, economists, etc., in solving real-world problems. Sometimes this may be reversed in, for instance, physics, that is, mathematicians take ideas from physics and incorporate them into their abstract theorems and theories. Archimedes, for example, proved a geometric theorem while inspired by the law of levers in mechanics. Furthermore, some fields such as machine learning help mathematicians better understand the behavior of objects, structures and systems that are too large or too complex, discover patterns, and apply them to formulate conjectures; see [6] for examples in topology and representation theory.

In [7], the world of mathematics is described as a pyramid at the apex of which mathematical applications to other sciences, commerce, and industry are found. In the middle part of the pyramid, applied mathematics together with data science, mathematical biology, financial mathematics, computer science, scientific computation, information theory, etc., shine. The base of the pyramid is pure mathematics, consisting of logic, number theory, algebra, analysis, and geometry. There is, however, no clear boundary between these sections, and in various places, one can observe an entanglement between pure mathematics, applied mathematics, and mathematical applications. It is notable that if the base of the pyramid is not large enough, the pyramid may not be as stable as

required. Some of the achievements of pure mathematicians have found practical applications, while others, so far, have not, but also the latter are still needed to maintain and consolidate the pyramid. We cannot predict where, when, and how a specific piece of pure mathematics will become useful for applications. The bottom of the pyramid is made up of topics related to the fundamentals of mathematics, such as mathematical logic and set theory, which are not considered to be applied in the conventional sense, but without which the pyramid of mathematics cannot be properly erected and stabilized.

In addition, mathematics generally improves decision-making methods in students' minds when we teach them problem-solving techniques, modeling the real world, and cognitive skills. Therefore, it plays an important role in shaping what is named "logical thinking" in humans, apart from what we usually call applications. Mathematics goes freely beyond the bounds of thought, although it always has an eye for the nature of problems in other branches of science. Ideas in pure mathematics are based on a mental interest in problem-solving toward discovering, establishing, and exploring new structures. "There is nothing more practical than a good theory", said Kurt Lewin, a German-American psychologist [13, p. 169].

History of mathematics has shown that what were once considered mental, abstract, and useless results, were often used at other times by other sciences such as physics, chemistry, computer science, and engineering. To prove this claim, we take a brief look at the history of mathematics and mimic some ideas of [1,2,11,16].

- Number theory is one of the purest fields of mathematics and was considered by many to be a mental game. Fermat's Little Theorem (1600 AD) and Euler's Theorem (1800 AD) are together considered the backbone of the

RSA algorithm (named after Rivest, Shamir, and Adleman), which is a public-key crypto- system. RSA is widely used to secure data transmission, internet communications, e-commerce, and blockchains.

- Conic sections (circle, ellipse, parabola, and hyperbola) were introduced by Apollonius of Perga (250 BC). Some people thought about these as a playground for the mind, until Johannes Kepler (17th century) realized their practical application in describing the orbits of planets.

- In the 19th century, Klein, Beltrami, and Poincaré showed that the geometric structures developed by Nikolai Ivanovich Lobachevsky (hyperbolic geometry) and Bernhard Riemann (elliptic geometry) are as logically consistent as Euclidean geometry. It was a revolutionary discovery and a completely pure one, until in the 20th century Albert Einstein utilized Riemann geometry in his theory of general relativity, where the space-time is curved. Non-Euclidean geometries have since then found applications in cosmology to study the structure and evolution of the universe.

- The complex numbers appeared in the 16th century and were so abstract that they were called imaginary numbers. These numbers gradually found applications in mathematics themselves for polynomial factorization, and in signal processing and electrical circuit calculations. Also, the theory of functions of several complex variables developed by Weierstrass and others in the 19th century has found applications in quantum field theory in the second half of the 20th century.

- Probability theory was established by Girolamo Cardano in the 16th century for solving gambling problems

and was well developed by Kolmogorov in 1935 and then applied to statistical mechanics. Probability theory and statistics play a key role in current life, in particular in risk assessment, modeling, and reliability.

- The origins of graphs go back to 1732, when Leonhard Euler posed the seven-bridges problem of Königsberg. Recall that this problem asks whether the seven bridges of the city of Königsberg over its river Preger can all be crossed precisely once during a walk through the city that returns to its starting point. The field of graph theory is considered part of pure mathematics but found its first applications more than one hundred years later when in 1847 Kirchhoff studied electrical networks. Other applications in chemistry, computer science, and social sciences appeared subsequently.

In the early 20th century, Gottlob Frege analyzed the concepts of arithmetic to show why mathematical reasoning is applicable as a deductive procedure as applied to statements about the world; see [17, Chapter 1].

Matrix theory was introduced by Cayley in the 19th century with no connection with applications. In 1925, Heisenberg applied matrices to describe his understanding of the atomic structure, and they are now a key tool in all sciences including coding, economics, and wireless communications.

Linear algebra, developed in the early 20th century, is devoted to studying linear equations and linear mappings in the framework of vector spaces. It is a crucial ingredient in Google's PageRank algorithm and is used in developing artificial intelligence algorithms. In return, some topics of mathematics such as inverse problems



have been influenced by artificial intelligence; see [12].

Partial differential equations were developed in the 18th and early 19th centuries as applied mathematics, but were also pursued by mathematicians of pure temperament. Maxwell, a physicist, introduced a set of coupled partial differential equations, called now the Maxwell equations, and discovered that light is an electromagnetic wave and there must be other such waves with different wavelengths. Later, the radio waves that the theory predicted were found by Hertz.

The Radon transform is an integral transform that was introduced in 1917 by Johann Radon. About 50 years later, it was used for tomography, a visualization process in which an image is constructed from the projection data connected with cross-sectional scans of a part of the body.

The Fourier transform is a map of a function space decomposing a function of time or space into functions depending on spatial frequency. Its history goes back to the 19th century when Fourier expanded a function into an infinite series of sines and cosines. The wavelet transform was created by Alfred Haar and Norman Ricker in the first half of the 20th century. The wavelet transform represents a signal in both the time and frequency domains, whilst the Fourier transform represents it only in the frequency domain. The wavelet and Fourier transforms are now used in the design of computer graphics and in medical devices such as MRI machines, or heart, brain and diabetes monitors.

Group theory was introduced by Lagrange and Galois in their study of symmetry and symmetry transformations. It greatly influenced the development of cryptography, crystallography, and musical set theory.

The Entscheidungs problem was a challenge posed in 1928 by David Hilbert, asking whether there is a way to determine the correctness or incorrectness of mathematical statements in a finite number of steps. In the 1930s, Alonzo Church and Alan Turing answered his question in the negative. Turing formulated an abstract machine, called now the Turing machine, which is considered the basis of modern computers.

Lawrence Klein believes that economics is a mathematical discipline. John Keynes methodologically inspired his revolutionary economic theory from non-Euclidean geometry; cf. [5].

Classifying and specifying digital images of millions of finger-prints can take up a very large storage space. Wavelet theory makes it possible to compress information quickly, relatively, and simply in such a way that we can compare new individuals in an investigation. In addition, the theory provides faster information retrieval.

Linear algebra, mathematical analysis, probability, and statistics are used to analyze big data, that is, large or complex data sets. Big data is applied by information specialists, in particular in the modeling of financial markets.

Biomathematics is the field that uses mathematical models for understanding phenomena in biology. It uses mainly linear algebra, differential equations, dynamical systems, probability and statistics.

Our daily lives are tied to many advanced technologies such as computers, the internet, and smartphones,

while mathematics constitutes their scientific basis. For instance, mathematics is applicable in securing information in financial transactions, removing landmines and tumors, understanding climate change, developing advanced medical devices, redefining architecture, influencing human behavior, improving weather prediction, satellite communications, and searching for a second Earth.

Due to the commercialization of science and technology, most politicians pay attention only to research with immediate applications and direct profit. Such unrealistic requests have negatively affected all basic and theoretical studies and have caused controversy among some mathematicians concerning the importance of both pure and applied mathematics. Free thought is the nature of research at universities, and the demand for immediate application limits it and darkens the horizon for the advancement of science and ultimately technology. Obviously, usefulness is important for research in industrial fields, but in theoretical fields this concept is ambiguous. However, politicians are not usually impressed by the news about settling a conjecture or the eternal beauty of a certain theorem proved by a pure mathematician. And here, applied mathematicians can greatly help the community by convincing them about the importance of math.

In recent years, great resources (grants, projects) are concentrated on applied research; it is not surprising that this happens. In fact, applied mathematics (including statistics and computer sciences), as well as the speed of computer simulations, are now such that problems from other disciplines can be tackled these days that were completely out of reach a few decades ago. However, it is necessary to support basic research. Furthermore, applying scientometric indicators such as the h-index for granting mathematicians causes some unfair decisions, since not only such





indicators do not consider the “hardness” of the topics on which mathematicians are working, but also in some countries applied mathematicians usually have scientometric indicators higher than pure mathematicians, and therefore such a comparison is not appropriate. Also, the highly-visible Fields medals are traditionally awarded for research in pure mathematics, which is somehow annoying because it may split the community and drive applied people away from the general community.

In some countries, there is a cultural difference between applied and pure math departments, where each side may view the other with some sort of suspicion, sometimes even disdain.

Indeed, pure mathematicians are criticized by some of their colleagues who work in applied fields, along the following lines:

- The goal of pure mathematicians is to expand the boundaries of knowledge, while science, industry, and society have more serious problems to explore.
- Research in pure mathematics is not directly aimed at solving society’s problems.
- Pure research refers to a vague future in which applications may or may not materialize.

In contrast, pure mathematicians mainly argue as follows:

- Looking this deep into the immediate future applications of pure mathematics is not reasonable. Any kind of real innovative application of mathematics is based on basic research in pure mathematics.
- Pure mathematicians establish and develop precise and correct mathematics used in applications.
- Pure mathematicians ensure that mathematics can be reliably and confidently used in science, industry, and society.

The distinction made between pure and applied mathematicians comes back to their different criteria for doing mathematics. For example, an applied mathematician may use quasi-empirical arguments, such as a non-rigorous method to effectively solve an important problem, while a pure mathematician never does that; see [15]. However, computers and automated reasoning may help pure mathematicians formulate and prove their conjectures. For example, the proof of the Four-Color Problem by Kenneth Appel and Wolfgang Haken utilized

computers to test a large number of cases. Thus, pure and applied mathematics can interact with each other.

Practically, any discussion on the distinction between pure and applied mathematics makes a negative impression on the possible collaborations between pure and applied mathematicians aimed at solving deep problems and improving their faculty; see [20]. In the past there was no such distinction – Kepler, Euler, and Gauss were of course both. In mathematics departments of many prestigious universities, research in pure mathematics is considered as important as research in interdisciplinary and emerging disciplines in applied mathematics. Because they look at mathematics as an integrated system: a device in which the existence of each part, whether pure mathematics or applied mathematics, is essential for its proper functioning. Pure and applied mathematicians constitute a community that needs to work together.

We should pay attention to both pure and applied aspects of mathematics and measure their achievements solely based on depth, breadth, and impact. Ian Stewart [18] said that the very distinction between pure and applied mathematics is looking increasingly artificial, dated, and unhelpful. Sometimes at conferences, after a presentation of results in pure mathematics, a person in the audience may ask: “What is the application of these results?” There is no problem in asking this question as long as it is aimed at helping to connect more pure and applied branches of mathematics. But in many cases such a question arises from a misunderstanding of mathematics, its history, and its structure (a continuum), and shows superficial thinking; see [8].

It is better to consider pure and applied mathematics as two sides of the same coin and recognize and cherish all achievements that have rich and important mathematical content. Pure and applied mathematicians should stand together to explain the word of importance and make science effective progress.

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New species of north asian gektons found in Uzbekistan

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Roman Nazarov,
employee of the Zoological Museum of Moscow State University named after M.V. Lomonosov

The activities of the Institute of Zoology of the Uzbekistan Academy of Sciences are aimed at studying the species diversity of the fauna not only in Uzbekistan, but also in the Central Asian region as a whole. The main research areas of the Institute are:

- a comprehensive study of the fauna of Uzbekistan, assessment of the current state and development of scientific and practical recommendations for the sustainable use of wildlife;
- identification of key zoological territories, development of scientific bases for the conservation of rare and endemic species of the animal world;
- development and maintenance of a national information and analytical database of fauna, maintenance

nance of state records and the Cadastre of rare and endangered species of wild animals, monitoring of the animal world, as well as the Red Book - the fauna of Uzbekistan.

The collection of the Institute of Zoology of the Uzbekistan Academy of Sciences is a unique scientific object and the largest in Central Asia. It consists of 6 scientific collection funds: - entomological, - hydrobiological, - ichthyological, - herpetological, - ornithological and teriological. The funds are represented by dry, wet preparations, skins, skulls and animal derivatives. They contain more than 93,000 items belonging to more than 12,500 species of fauna of Central Asia, collected since 1935.

The scientists of the Institute determined the composition, status, distribution, identified factors affecting rare and endangered animal species of the fauna of Uzbekistan, assessed the risks of extinction of these species and proposed measures for their conservation. Based on this, the Cadastre was developed and the systematization of vertebrate species living in the territory of the republic was carried out, effective measures were developed for their conservation and sustainable use, taking into account existing threats and negative impacts on them and their habitats. Purposeful work is also being carried out to identify previously unseen, but potentially possible species of vertebrates, as well as regular replenishment and reprinting of the Red Book - the fauna of Uzbekistan.

The animal world of Uzbekistan is extremely diverse not only in terms of species, but also differs significantly in territory, geographical and climatic zones of the republic.

In this regard, the Fergana Valley, located in the eastern part of Uzbekistan, is of considerable interest to zoologists and botanists. It is an ancient region naturally isolated by mountain ranges with unique flora and fauna, most of which are endemic. The relatively small area of the Fergana Valley is home to several dozen endemic plant species, five endemic insects, and five endemic reptile species, most of which are associated with sandy massifs and foothills in the western and southern regions of the Fergana Valley.



A gecko on a sandy background



Characteristic habitats of *Alsophylax* sp. nov. emilia - clayey foothills





Due to the intensive development of agriculture, industry and the problems of global climate change, all these endemic species are under the threat of complete extinction due to the destruction of their habitat. Note that all five endemic reptile species are at risk. These are Strauch's roundhead (*Phrynocephalus strauchi* Nikolsky, 1899), Said-Aliev's roundhead (*Phrynocephalus saidalievi* Sattorov, 1981) and Fergana striped lizard (*Eremias scripta pherganensis* Szczerbak et Washetko, 1973), as well as armored gecko (*Alsophylax loricatus* Strauch, 1887). Of particular interest in connection with the research of scientists from the Institute of Zoology of the Uzbekistan Academy of Sciences are the armored gecko and plate-tailed gecko of Rustamov (*Teratoscincus scincus rustamovi*, Szczerbak, 1979) - gecko species that have practically become extinct due to land and agricultural work related to the irrigation of new lands, and included to the detachment of specially protected representatives of the fauna (1st category of protection according to the Red Book of Uzbekistan, 2009). It seems that the species composition of the animal world of the Fergana Valley has been studied quite well by zoologists for more than 130 years, but it turned out that the territory of the Valley still continues to hide its secrets.

An example of this is the new finds made in the Fergana Valley by zoologists quite recently. So, in the course of research conducted in 2021, organized by the Institute of Zoology of the Uzbekistan Academy of Sciences with the support of the WWF Wildlife Conservation Fund, the Russian Fund for Fundamental Research (RFBR) and National Geographic, an international group of scientists discovered two previously unknown unique relic species of reptiles in the Fergana Valley belonging to the gecko genus - *Alsophylax*. These unique vertebrate species are among the smallest lizards in Central Asia.

Previously, these two species were named *Alsophylax* sp.nov. (*ferganensis*) - in honor of the Fergana Valley, where this species was found, and *Alsophylax* sp.nov. (*emilia*) - in honor of the famous herpetologist of Uzbekistan - Emilia V. Vashetko, who devoted her whole life to the study of the herpetofauna of our country, including the Fergana Valley. Unfortunately, a tragic accident ended her life in 2022, and it was decided to perpetuate her bright name in the name of one of the found species. At the same time, according to the rules of the Code of Zoological Nomenclature, the Latin name of a species cannot be indicated in printed or Internet sources until an official article describing the taxon is published. As soon as this happens, we will definitely tell you about it.

Representatives of the first species of North Asian geckos were found in the vicinity of the village of Shorsu in low clay remnants near the southern border of the Fergana Valley, bordering on the territory of Kyrgyzstan. Representatives of the second type of geckos were found on Pap foothills in the vicinity of the Jidalisai reservoir. The discovery of new species of the genus *Alsophylax*, especially in one of the most densely populated regions of Uzbekistan - in the Fer-

ghana Valley, deserves special attention, and is truly sensational news.

The fact that new species of these small lizards were found for world zoological science was confirmed on the basis of subsequent comprehensive scientific research. Among other things, their morphological features were identified, an analysis of sound signals was carried out (males make certain sounds, and each species does it in its own way), in addition, molecular genetic DNA studies were carried out, which confirmed the uniqueness of these two found species. A scientific article describing this discovery has been prepared for publication and will be published in the near future.

The uniqueness of this find significantly increases the environmental significance of the territory of the Fergana Valley and confirms the need to preserve its natural landscapes. The development of a conservation strategy for this region is urgent, and the entire world community must be involved in solving this problem.

It should be noted that these species have been found so far only on the territory of Uzbekistan. Ongoing searches in areas adjacent to the discovery area in Uzbekistan and the adjacent part of the Kyrgyz Republic have not yet yielded results. This indicates an

extremely small habitat, a high degree of endemism of this species, and also that these are relict species, and, unfortunately, in connection with the foregoing, they are extremely vulnerable. The situation is aggravated by the great human pressure on the ecosystem of the Valley, where these new, extremely vulnerable species live. In this regard, it should be noted that the key and only known habitat of the "Fergana gecko" is being destroyed by quarries, and if these works are not stopped, then in the coming years we will lose this species, in fact, without having time to find it. This can be a great loss for the world zoological science, due to human activity and must be prevented by the state.

The duty of zoologists is not only to conduct scientific research and search for new species of the fauna of Uzbekistan, but also to warn representatives of state bodies in advance about the discovery of these species in order to take appropriate measures to preserve their habitats. In this we see the key to success in the further development of zoological science and the enrichment of the Red Book - the fauna of Uzbekistan.

Differences in morphology between two new gecko species of the genus *Alsophylax*



The microworld inside us

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We humans are always very concerned about our health, but we do not always understand well what exactly is important to maintain it. Scientific advances in recent years have shown that there is an organ in our body that we know little about and underestimate. Moreover, it weighs as much as our brain, is as important as the brain and, just like the brain, determines our personality. This is our intestines, or rather, its microbes. To be more precise, it is a microbiome, which is the totality of all the microbes that inhabit our intestines.

It's not just the microbes in our gut that are important. Microorganisms throughout our bodies create the differences that make people who they are. For example, have you ever noticed why some people are bitten by mosquitoes much more often than others? It turns out that the reason for this is that different people have different microbes on their skin that produce different chemicals that mosquitoes detect.

Nowadays microbes are also very important objects in the field of pharmacology. For example, the microbial composition in the intestines determines whether certain painkillers will be toxic to our liver. They also determine whether medications will work to treat our heart conditions. In fruit flies, microbes determine who they choose to reproduce. This has not yet been studied in detail in humans, but perhaps it is just a matter of time.

In fact, microbes perform a huge range of functions. They help us digest food. Help train our immune system. They help us with illnesses and can even influence our behavior. And what are they? Under a microscope they all look almost the same. So, instead of trying to identify them visually, scientists study the nucleotide sequences in the DNA. The US National Institutes of Health (NIH) funded the first major project, the Human Microbiome Project, with \$173 million, initiated in 2007, during which researchers worked to decipher all the microbial DNA in the human body. And over the past few years, scientists have discovered that microorganisms in different parts of the body are strikingly different from each other. When you look at the microbes in the mouth and gut of the same person, the difference between the two microbial communities is enormous. This is even greater than the difference between the microbial community on the ocean floor and the microbial community on the steppe. It seems simply incredible. That is, this means

Microbiome – the totality of all microbes that inhabit the intestines





Our microbial symbionts far outnumber by number the number of our own cells

that a distance of a few centimeters in the human body is more important for microbial ecology than a distance of hundreds of kilometers on Earth.

Scientists have found that people are almost all the same in terms of our human DNA. Moreover, your DNA is 99.99% identical to the DNA of the person sitting next to you. But in terms of your gut microbes, you may only be 10% similar to that person. That is, they can differ from each other in composition, just as the community of bacteria in the steppe differs from the community of bacteria in the forest.

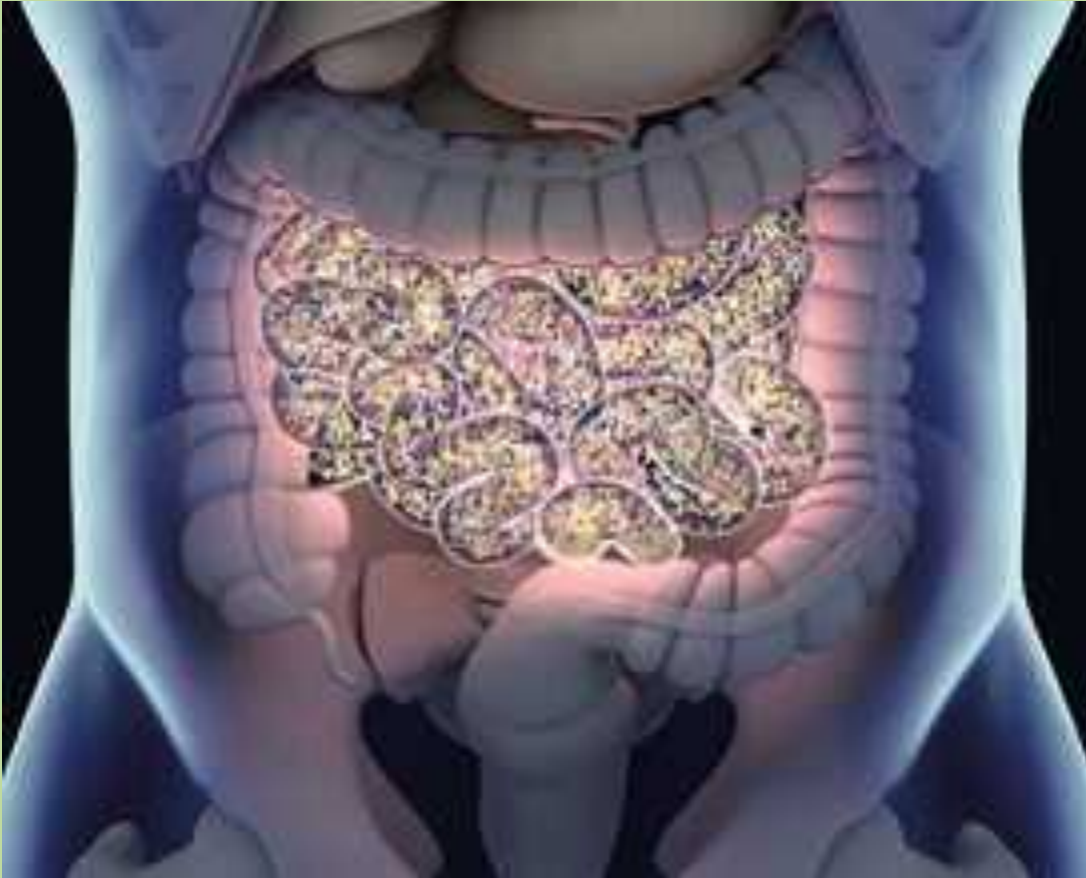
Thus, these distinct communities of microbes perform the various functions mentioned earlier - from digesting food to participating in various diseases, metabolizing drugs, etc. So how do they do it all? Part of the reason they can do this is because although we only have a kilogram and a half of these microbes in our intestines, there are actually more of them than the entire population of the Earth. How much they outnumber humans depends on which unit of measurement you use. Based on cells, the adult human body is made up of approximately 10 trillion human cells, but we are home to up to 100 trillion microbial cells. So, they outnumber humans by at least 10 times. If we consider that a person, as an organism, is determined by DNA, then it turns out that each of us has about 20 thousand human genes, but also contains from two to twenty million microorganism genes.

So, no matter how we look at it, our microbial symbionts far outnumber us. And it turns out that in addition to traces of our human DNA, we also leave traces of our microbial DNA on everything we touch.

In a study conducted several years ago, scientists showed that the composition of the microbial DNA of the palm can be used to determine with 95 percent accuracy the computer mouse that the owner regularly uses.

Just as scientists can match a person's common microbes to the microbes found in his computer equipment, they can match a host's microbial community to the microbes found on his dog. But it turns out that in adult humans, microbial communities are relatively stable. So, for example, even if you live with someone, you will retain your personal microbial identity for weeks, months and even years.

The question arises - where do our microbes come from? The composition of our first microbial community depends largely on how we were born. That is, in children who are born in the usual way, all the microbes are basically similar to the vaginal community of microorganisms of the mother, while in children born by Caesarean section, all the microbes are similar to the microbial communities living on the mother's skin. And this likely explains some of the health disparities associated with cesarean sections. These include increased rates of asthma and allergies, and even a higher risk of obesity—all of which we now know are linked to the microbiome. It is now known that a child's intestinal microflora finishes forming at the age of two. Surprisingly, it turns out that the way we influence the microflora at the initial stage of its formation has a profound impact on the microbial community of the intestines and on health in general, which we are only beginning to understand. For example, if parents give children antibiotics in the first six months of life, they are more likely to become obese later than those who do not receive antibiotics or re-



The microbial composition in the gut determines, for example, whether
Are certain painkillers toxic to your liver?

ceive them later in life. And this is important because one day we will finally understand that antibiotics not only spread microbial resistance, but can also critically change the gut microbial ecosystem, and this will make us more careful about taking them.

It was previously mentioned that microbes have many important functions for human health. Now, just in the last few years, they have already been linked to a number of different non-communicable diseases, including inflammatory bowel disease, heart disease, colon cancer and even obesity. As it turns out, obesity is very dependent on the composition of the body's microbial community, and today, by studying the microbes in the intestines, we can tell whether you are thin or fat with 90 percent accuracy. This sounds impressive, although it is a bit impractical as a medical test because we can visually identify a person who is obese without knowing anything about their gut microbes. But it turns out that even if we sequence the entire genome of human DNA, we can predict obesity with no more than 60 percent accuracy. And that's surprising because it means the 2 kilograms of microbes we carry around inside us may be more important for some health conditions than every single gene in your genome.

Of course, not all studies can be carried out on humans, and in such cases mice come to the rescue. Thus, the relationship of microorganisms with var-

ious health conditions, such as multiple sclerosis, depression, autism and, again, obesity, was studied in mice. But how can we know whether the microbial differences that correlate with a particular human disease are a cause or a consequence of that disease? To do this, scientists conducted the following experiment: they raised mice without any of their own microbes in a sterile chamber. Then they added certain microorganisms and watched what happened. When microbes were taken from an obese mouse and transplanted into a genetically normal mouse raised in a chamber without its own microbes, it became fatter than if it had received them from a normal mouse. I wonder why this happens? The fact is that sometimes microbes help more efficiently digest food from the diet assigned to these mice. As a result, this group of mice receives more energy from the same food than another group of mice with a different microbial composition in the intestines. But in other cases, the microbes actually affect the behavior of the mice, and they eat more than normal mice, since only they are allowed to eat as much as they want - these mice get fat.

And this is truly amazing. Scientists have realized that microbes can influence the behavior of mammals. The next question was, could similar experiments be carried out between unrelated species? And it turns out that if you take gut microbes from an obese per-

son and transplant them into mice that were raised without germs, those mice also become fatter than those that received the microbes from a thin person. And one can create a microbial community that needs to be vaccinated in mice so that they do not gain excess weight.

Plus, it turns out that microbes are not only important for figuring out the state of our health, but they can actually treat diseases. This is one of the newest discoveries that scientists have been able to visualize. The bacterium *Clostridium difficile* is known to cause a terrible form of infection that causes diarrhea up to 20 times a day. It can last for years and is not cured by antibiotics. Such patients were transplanted with part of the feces of healthy donors. So what happened? Fecal transplant patients immediately experienced dramatic changes in their intestinal community. And within a day after the transplant, all symptoms, including diarrhea, disappear, and they, in fact, recover. What has changed in their intestines? And this was the composition of the microbial community, which now became similar to the community of healthy donors.

So we now realize that we are only at the beginning stages of discovering microbial therapies. Scientists are just discovering that microbes play a role in various types of diseases, from inflammatory bowel disease to obesity and perhaps even autism and depression. Our own research has already helped to clarify and confirm the role of beneficial microorganisms for the treatment and prevention of not only diarrhea, but also poor appetite in children, stomach ulcers

caused by *Helicobacter pylori* infection, type 2 diabetes, and has successfully applied them in practice to improve the health of the residents of Uzbekistan.

Currently, the efforts of our scientists are aimed at studying the role of the oral microbiome in the occurrence of sore throat and its correction with the help of the necessary microorganisms to prevent infection. Very soon we will be able to offer something similar to “microbial” cookies that will help your throat suffer less from inflammation. Our next research will be aimed at finding an answer to the question - which microbes in the gastrointestinal tract of a resident of Uzbekistan mean a healthy state? How does their composition change during obesity and how should it be changed to reduce weight?

Despite the fact that I.I. Mechnikov first used microorganisms for treatment at the beginning of the last century, and much has already been studied, nevertheless, an even larger layer remains to be studied, explained and begun to be used for practical treatment. Probably, in the near future, the microbiome of the human body will be the most effective diagnostic object, and its correction will become an effective and widely used method for the prevention and treatment of a large number of various autoimmune and other human diseases.

We are now only in the early stages of discovering microbial therapies.



Scientific research in botany and its significance

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The research of scientists at the Institute of Botany occupies an important place in the scientific community of the country and the world. The Institute conducts comprehensive research in the field of relevant ecosystems of Uzbekistan and plant species. Scientists of the Institute study the taxonomy, distribution, ecology and conservation of plants of Uzbekistan and provide valuable information on the conservation of biodiversity worldwide. The Institute's researchers focus on the identification, classification and naming of plant species. They conduct research into the morphology, anatomy and molecular phylogeny of plants, identify their taxonomic relationships and develop reliable plant identification tools. This not only expands knowledge about the plant diversity of Uzbekistan, but also contributes to the recognition of plant species around the world.

Uzbekistan has rich traditions of using medicinal plants. The Institute of Botany conducts scientific research on medicinal plants, studying their chemical composition, healing properties and possibilities of use in folk medicine. These studies contribute to the general recognition and use of medicinal plants and their products. Uzbekistan is home to unique and fragile ecosystems such as steppes, mountains and *tugai* forests. Scientists of the Institute assess the condition and rarity of these ecosystems, identify threats to biodiversity and develop strategies for protecting nature.

In recent years, the Institute's scientists have made outstanding progress in the field of molecular biology, for example in the field of molecular phylogeny and plant evolution. In particular, in the laboratory of biogeography of Molecular Phylogeny of

the Institute of Botany, for the first time, the complete genome of chloroplasts and genetic material based on nrDNA of 150 species (290 samples) of one-seeded plants distributed in the flora of Uzbekistan were uploaded into the global data system of the National Center for Biotechnology Information (NCBI), and their phylogeny, biogeography and evolution were studied. This significant contribution to the NCBI database demonstrates the Institute's commitment to advancing scientific knowledge and making its research accessible to researchers around the world.

By sharing molecular data, the scientists not only made their research available for verification and further analysis, but also provided a valuable resource for future research in molecular biology and plant evolution. The availability of such a data set makes an important contribution to collective knowledge and enables collaboration and scientific progress. Their research efforts shed light on the genetic relationships and evolutionary history of different generations of plants and paved the way for further research in these areas.

The biogeographic evolution of plant species, including the EL3 evolutionary lineage of the *Allium* species and species of the suborder *Scorpiris* of the genus *Iris*, has been shown to be associated with a Central Asian origin. The discrepancy between the nuclear and chloroplast phylogenetic trees of the genera *Allium* and *Tulipa* was found to be due to their association with species hybridization. The results obtained allow the use of plants as genetically modular objects from species that have undergone hybridization during cultivation processes

The effects of global climate change in recent





years have led to a significant reduction in water resources and the expansion of deserts and semi-deserts around the world. This alarming trend has prompted scientists at botanical institutes to focus their efforts on studying and developing molecular ecological methods to mitigate the negative effects of desertification. The Institute's scientists study the resistance of plants in the wild to various unfavorable abiotic factors (salinity, high temperatures, dehydration, cold) using molecular ecological methods. These species are then cultivated and strategically planted in areas prone to desertification. By creating plantations of these resilient species, desertification can be stopped and biodiversity can be conserved.

Establishing plantations in areas experiencing desertification serves many purposes. First, it helps stabilize the soil and prevent erosion because the roots of these plants bind soil particles together, reducing the risk of wind and water erosion. Secondly, plantations help increase the amount of organic matter in the soil, increasing its fertility and water-holding capacity. Third, introducing different plant species into desertifying areas can help restore ecological balance and increase biodiversity. These plantations provide habitat for a variety of organisms, including insects, birds and small mammals, thereby helping to restore local ecosystems.

It is no secret that the growing demand for medicinal plants has led to an increase in the illegal export of these plants outside the state. Therefore, there is a need for effective methods to quickly identify these plants and curb such illegal situations. To solve this problem, scientists at the Institute of Botany





are actively working on developing medicinal plant detection methods that use SNP (single nucleotide polymorphism) molecular tags. SNPs are changes to one nucleotide base in an organism's DNA sequence. A large number of them are contained in genomes and they can serve as unique genetic markers for various plant species or varieties. By identifying specific SNPs associated with specific medicinal plants, scientists can create methods that can quickly and accurately identify those plants.

The process of developing detection methods using SNP molecular markers involves several steps. Researchers first collect samples of different species or varieties of medicinal plants from different geographic regions. These samples may include different parts of the plant, such as leaves, stems, or roots, depending on the plant being examined. Scientists then extract DNA from the collected plant samples and isolate regions of the genome that contain SNP markers. This is usually achieved using methods such as polymerase chain reaction (PCR) or next generation sequencing (NGS). The resulting DNA is then analyzed using specialized laboratory equipment and sophisticated bioinformatics tools to identify and characterize SNPs. Once SNP markers are discovered, scientists can develop specific markers that target those SNPs. To

confirm the accuracy and reliability of the developed detection methods, scientists compare collected plant samples with molecular data samples.

This verification process helps ensure that SNP markers clearly distinguish different species or varieties of medicinal plants, even if the plants have been processed or crushed. The ultimate goal of these efforts is to create a complete database or library of SNP marker data for a wide range of medicinal plants. This plays a critical role in combating illegal smuggling, protecting endangered plant species and promoting responsible and sustainable practices in the use of medicinal plants. This database can be used by regulators, law enforcement agencies and other interested parties to quickly and reliably detect illegally imported plants. In addition, it can help control the trade and cultivation of medicinal plants, ensuring their sustainable use and storage.

Scientists at the Institute of Botany are actively working to preserve rare and endangered plant species listed in the Red Book of the Republic of Uzbekistan. Considering the importance of preserving these species, they took upon themselves the task of creating a genetic bank in the laboratories of the Institute. The gene bank serves as a repository for the genetic material of many rare plant species. This



includes collecting and storing seeds, pollen, plant tissue and other genetic material. By preserving the genetic diversity of these rare species, the gene bank acts as a protection against their extinction. It also serves as an invaluable resource for future research and conservation efforts.

The process of creating a gene bank involves carefully collecting and documenting plant material from different locations and populations. Scientists carefully record relevant information, such as species characteristics, habitat and conservation status. They use special techniques to ensure the long-term viability of collected genetic material, such as storing seeds under controlled conditions, cryopreserving plant tissue, or creating living collections in botanical gardens. In addition to preserving genetic material, scientists are conducting research to better understand the reproductive biology, population dynamics, and genetic diversity of these rare species. They use molecular techniques to analyze the genetic makeup of populations, estimate degrees of relatedness, and identify any unique genetic traits or variations. This information can help develop effective conservation

strategies such as population strengthening, habitat restoration, or reintroduction programs.

The Institute of Botany's gene bank serves as an invaluable resource for researchers, conservationists and policymakers. This allows scientists to conduct further research on rare plant species, including their evolutionary history, adaptation to a changing environment, and potential for future resilience. The bank also enables the exchange of genetic material with other institutions, promotes joint research and strengthens common efforts to conserve rare plant species. In addition, the gene bank plays an important role in supporting ex situ (biodiversity) conservation initiatives. In cases where the natural habitat of an endangered species is under immediate threat or has disappeared, a gene bank provides a means to conserve genetic diversity outside its natural habitat. This includes future reintroduction programs or the possibility of creating botanical gardens dedicated to the conservation and promotion of rare and endangered plant species.

In general, the creation of a genetic bank by the Institute of Botany indicates the desire of its scientists to preserve rare and endangered plant species in Uzbekistan. Through their efforts, they contribute to global biodiversity conservation and lay the foundation for future research and conservation initiatives aimed at protecting these invaluable plant resources. The Institute of Botany's research work spans various areas of botany and molecular biology and makes important contributions to the understanding and conservation of plant diversity, medicinal plants and fragile ecosystems. Through their contributions, the institute plays a critical role in developing sustainable practices, protecting biodiversity and advancing scientific knowledge in the field of botany.

All conditions are available for scientists



Sherzod Juraev, Chairman of the Joint Trade Union Committee of the Academy of Sciences

In the matter of comprehensive social protection of the population of our country, a number of tasks have been set for trade union organizations of all enterprises and institutions. As a result of comprehensive reforms in recent years, our country has created the necessary political, legal, socio-economic, scientific and educational foundations for the formation of a New Uzbekistan.

In order to further strengthen actions on the path of development and their transition to a new qualitative level, at the initiative of President Shavkat Mirziyoyev, a Decree "On the Development Strategy of the New Uzbekistan for 2022-2026" was issued, dedicated to seven priority areas for the further development of the Republic of Uzbekistan in 2022-2026.

New trade unions of New Uzbekistan are also actively involved in the renewal and transformations carried out in our country, supporting reforms, they carry out systematic work to protect the socio-economic interests and rights of workers in various industries in the sphere of work, creating the necessary conditions for their effective work and providing moral and spiritual support.

Today, in the system of the Joint Trade Union Committee of the Uzbekistan Academy of Sciences (JTUC) there are 58 primary organizations, uniting 5,408 trade union members. JTUC and all primary organizations focused their main activities on the socio-economic and legal protection of engineering and technical personnel, spiritual and educational development, strengthening labor activity, restoring health and meaningful organization of their recreation.

A Collective Agreement for the period 2021-2023 on socio-economic issues was signed between the Uzbekistan Academy of Sciences and the Joint Trade Union Committee of the Uzbekistan Academy of Sciences. Within the framework of collective agreements, public agreements and government programs, which are an important means of social support for workers in 2021-2023 social support will be provided to 1,420 employees at the expense of the trade union. Every year, on the occasion of holidays in Uzbekistan, the Joint Committee and primary trade union organizations have developed a tradition to visit war and labor veterans, former employees, provide them with financial assistance and present valuable gifts.

On the eve of the holiday "March 8 - Women's Day" meetings are held in the institutions of the Academy of Sciences. Solemn congratulations to women working in Academy organizations are carried out by presenting gifts provided by the Joint Committee. On the occasion of the holiday, the Joint Trade Union Committee of the Uzbekistan Academy of Sciences organized a gala concert for women working in the system of the Academy at the Turkistan Palace of Arts. Vice-President of the Academy of Sciences Sirojiddin Mirzaev, Chief Academic Secretary Gairat Bakhadirov



From the activities of the Joint Committee of Trade Unions of the Uzbekistan Academy of Sciences



and Chairman of the Joint Committee Sherzod Zhu-raev spoke at the event and congratulated all women on the holiday. On June 1, on International Children's Day and on the occasion of the New Year, free New Year's gifts and invitations to New Year's holidays, distributed to the children of scientific staff, at the Tashkent State Circus, the Turkiston and Friendship of Peoples palaces were.

In this congratulation sent by the head of state to the participants of the Congress of Trade Unions, for the first time in the history of independent Uzbekistan, November 11 was declared "Trade Union Day" taking into account the great role and importance of the country's trade unions in the public life of the nation. On November 11, on the occasion of Trade Union Day, a visit to the Museum of Trade Unions of Uzbekistan was organized by employees of the Academy's research institutions; on the occasion of the holiday, trade union members and activists were presented with memorable gifts.

Trade union organizations constantly issue special vouchers to sanatoriums and recreation facilities for scientific workers who feel the need to restore their health. One of the main activities of the JTUC of the Uzbekistan Academy of Sciences is the issues of health improvement for employees and their children. Academy employees are provided with discounted vouchers to the sanatoriums "Zaamin", "Aktash", "Turan", "Botanika", "Chinabad", "Chartak", "Chimion", "Umid Gulshani" etc., as well as to such recreation facilities like "Ugam", "Kumishkan", "Charvak", "Navruz", "Beldersoy", which are administered by the Federation of Trade Unions of Uzbekistan. The Joint Committee regularly organizes day trips on weekends at the request of research institutions. In the summer season, children of employees of research institutions relax in children's health camps "Nihol", "Zilola", "Anor", "Happy Summer".

In order to familiarize Academy employees with historical monuments and attractions, national customs and traditions, study the heritage of ancestors, as well as within the framework of the "Travel New Uzbekistan" program, trips to Samarkand, Bukhara, Khiva and other interesting places were organized for Academy employees and members of their families throughout the country. The Joint Committee and primary organizations are carrying out systematic work to promote a healthy lifestyle by involving workers in mass sports. Competitions in various sports were held under the slogans "Academic", "Sport is the key to health", "On the way to health", "Employee-athlete", "Trade union tour-cycling marathon"; The winners were awarded by the Joint Committee. The winners will further take part in the Tashkent city and nationwide stages. Every year, in connection with the "Day

From the activities of the Joint Committee of Trade Unions of the Uzbekistan Academy of Sciences





From the activities of the Joint Committee of Trade Unions of the Uzbekistan Academy of Sciences

of Trade Unions of Uzbekistan,” a national marathon race is held among trade union workers. Members of the trade union of the Uzbekistan Academy of Sciences took an active part in this mass sporting event.

It has become a tradition at the Uzbekistan Academy of Sciences to annually hold sports competitions in various sports (academic cross-country, mini-football, table tennis, chess, darts) for the prize of the Joint Trade Union Committee within the framework of the “Academiada”.

In order to improve socio-economic, legal protection, labor protection, organizational and cultur-

al-educational work in primary trade union organizations, as well as increase the efficiency of their activities, the Federation of Trade Unions of Uzbekistan organized competitions “The most exemplary primary organization”, “Organization of public control for the protection labor and safety”, “Masters of their profession”, “The best primary trade union organization for saving electricity and fuel and energy resources.” Trade union organizations of the country’s Academy of Sciences took an active part in all exams and took honorable places.

In collaboration with the Council of Young Scientists of the Uzbekistan Academy of Sciences, the JTUC of the Academy of Sciences holds national scientific and practical conferences on various topics and, based on the results of competitions, rewards winners and prize-winners in the nominations “Best Scientific Article”, “Best Innovative Idea”, “Best Inventor of the Year”, Most young scientist-inventor”, “Best scientific supervisor” and in other nominations.

The head of our state declared 2023 the Year of “Caring for People and Quality of Education.” The Joint Trade Union Committee of the country’s Academy of Sciences will actively participate in the implementation of the tasks of the New Uzbekistan, based on the initiatives of the President and the theme of the year, protect the socio-economic interests of workers and their rights in the world of work, carry out active activities in the implementation of these tasks and make a worthy contribution to the development of our country.

From the activities of the Joint Committee of Trade Unions of the Uzbekistan Academy of Sciences



New domestic mobile device in the power industry

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In countries of the world where the reliability of power supply, determined primarily by the condition of electrical networks and the electrical equipment used in them, is considered important, special importance is attached to the issues of increasing the energy efficiency of equipment and improving the main indicators of energy resources. Currently, “on a global scale, special attention is paid to the development of technologies for complex purification of waste oils from power transformers with a total gross capacity of more than 10,000 GVA”. The operational reliability of such powerful power transformers is determined by in that it depends on the reliability of the insulation system, the main part of which is transformer oil. At the same time, much attention is paid to identifying and removing various impurities present in the liq-

uid insulation of power transformers, leading to their failure, as well as purifying transformer oils, which are then used for reuse purposes.

Currently, measures are being taken in Uzbekistan to develop and implement new equipment and technologies in the economic sectors for uninterrupted and high-quality provision of electricity to consumers. The development strategy of New Uzbekistan for 2022-2026 defines the tasks of “uninterrupted supply of electricity to the economy and the active introduction of green economy technologies in all sectors, increasing the energy efficiency of the economy by 20 percent.” One of the important issues in the implementation of these tasks is the study of power oil transformers under conditions of long-term operation, including the creation of innovative methods and installations for complex cleaning of power transformer oils on site and their cleaning for the purpose of reusing waste transformer oils.

The total number of power oil transformers currently in operation in the energy system of Uzbekistan, at all types of industrial enterprises, in agriculture, water management, railway transport and other industries, exceeds 100,000. It should be noted that the volume of new oil required for one power transformer ranges from 200 liters to 50 tons, depending on the dimensions of the transformer. Currently, the market value of 1 liter of new transformer oil is 15,000 soums. New oils necessary for the operation of power transformers are imported to Uzbekistan mainly from abroad in the form of petroleum products. Instead of buying new oil abroad, it is possible to achieve higher efficiency through high-quality purification of used transformer oils on site.

In countries around the world, various devices are used to purify waste oils from power transformers at the site of their operation. For example, the Russian company Elektrotekhmontazh is developing mobile devices for cleaning transformer oils. These devices use fluoroplastic as a filter element. Filter elements made of fluoroplastic make it possible to purify used transformer oils from mechanical impurities found in



Transformer





their composition with a size of 5 microns. In addition, these filter elements are replaced with new ones after contamination with mechanical impurities. These filters cannot be reused. The cost of the cheapest filter oil device from this company start from US\$ 40,000. Another example is the well-known German company GlobeCore, which is also developing mobile devices for cleaning waste oils from power transformers on site. These devices are capable of purifying oils from mechanical impurities with a size of up to 1 micron. These devices cost more than US\$ 100,000. High-quality oil purification devices from FLUIDEX (Australia), ENERVAC (USA) and FILTRVAC (Russia) are estimated at US\$ 400,000-500,000. The main problem for Uzbekistan is the lack of domestic cheap and effective devices for purifying power transformer oils and their forced import.

We were the first to develop a domestic mobile device that allows for comprehensive cleaning of power transformer oils on site (Fig. 1). In 2023, the Intellectual Property Agency under the Ministry of Justice of the Republic of Uzbekistan issued the author a patent of the Republic of Uzbekistan No. FAP 02334 for a utility model for “Method for regenerating transformer oil and a device for its implementation.” At the same time, based on local raw materials (bentonite, kaolin, etc.), ceramic filters were developed that allow deep purification of transformer oil from mechanical impurities.

The developed domestic mobile device was put into practice at the Zartransformator LLC enterprise (Fig. 2). The device was used to clean the oils of power transformers TM 40/10, TM 63/10 and TRDNS

25000/35, which were received by the enterprise for repair. As a result, economic efficiency was achieved: on a power transformer type TM 40/10 (oil volume 90 liters) - 1,066 million soums, on a power transformer type TM 63/10 (oil volume 160 liters) - 1,896 million soums and on a power transformer type TRDNS 25000/35 (oil volume 15 300 liters) - 181.305 million soums.

The designed domestic mobile device, which cleans power transformer oil on site, has the following advantages compared to existing foreign analogues:

1. When developing the device, local raw materials were used (bentonite, kaolin, etc.);

2. The domestic mobile device has an autonomous power supply, consisting of the “Solar panel + controller + battery + inverter” complex, which allows to clean the oils of power transformers installed and in operation in remote and hard-to-reach areas of our country;

3. The cost of cleaning waste transformer oils using this device averages 500-800 soums/liter.

The total number of oil-immersed power transformers currently in operation in Uzbekistan exceeds 100,000, as mentioned above. And this means the opportunity to get several billion sums of expected economic efficiency. Transformer oils required for the needs of these electrical installations are mainly imported. This means that if timely comprehensive purification of used transformer oils from various impurities for the purpose of their reuse leads, on the one hand, to reliable operation of power transformers (and therefore to the possibility of uninterrupted power supply to consumers), then, on the other hand, to a significant reduction in the import of transformer oils from abroad. Thus, the creation and increase in industrial production of this type of domestic mobile devices is now considered highly necessary.

It should also be noted that mobile devices for complex on-site cleaning of transformer oils are not produced not only in our country, but also in other countries of Central Asia. Thanks to the serial production of the proposed development in Uzbekistan, it is possible not only to meet the needs of the domestic market of our country, but also to organize export supplies to neighboring countries.



Processes of purification of used transformer oils at the Zartransformator LLC enterprise using a developed domestic mobile device (Patent of the Republic of Uzbekistan No. FAP 02334).

Ensuring cyber security in the era of artificial intelligence: challenges, risks and priorities for the society of Uzbekistan



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In recent years, cyber security has become an issue of major concern around the world as cyber attacks become more frequent and sophisticated. For Uzbekistan, developing robust cyber defenses is critical as the country continues rapid digitalization in sectors such as government services, healthcare, education and finance. However, the emergence of artificial intelligence (AI) creates new cyber risks that Uzbekistan must understand and address.

Currently, Uzbekistan's cyber security and AI adoption lags behind developed countries. According to ITU (2020), Uzbekistan ranks 87th in the world in cyber security readiness. Key challenges include limited technical capacity and low levels of cyber security awareness among citizens. When it comes to the use of AI, Uzbekistan is at an early stage, with most initiatives being implemented in areas such as smart agriculture, traffic management and education (ITU, 2021). However, as Uzbekistan moves towards the implementation of the "Digital Uzbekistan 2030" strategy, the implementation of AI is accelerating in all sectors.

This increases the need to assess Uzbekistan's preparedness for AI-based cyber attacks. As AI systems analyze massive amounts of data to identify vulnerabilities and develop sophisticated social engineering techniques, cybercriminals can more easily penetrate critical infrastructure networks, government databases and financial systems. Uzbekistan must determine where it is most vulnerable and develop evidence-based protection measures, policies and public awareness campaigns.

Thus, the purpose of this article is to assess the vulnerabilities of Uzbekistan's cyber systems in the context of the growing use of AI, study public attitudes towards cyber risks and develop recommendations for increasing the country's resilience to cyber threats. Addressing this issue will provide vital in-

sights into how Uzbekistan's society can ensure its security in the face of rapid technological change.

Analysis of the vulnerabilities of Uzbekistan's information systems to cyber attacks using AI

As Uzbekistan digitalizes in various sectors, the country's information systems are becoming increasingly vulnerable to sophisticated cyber threats caused by the use of artificial intelligence (AI). While comprehensive data on Uzbekistan's cyber landscape remains limited, analysis of global and regional trends highlights important areas of vulnerability that Uzbekistan must pay attention to as the country expands its digital footprint and integrates AI technologies.

Risks to critical infrastructure

Uzbekistan's critical infrastructure networks are prime targets for AI-enhanced cyber attacks aimed at causing widespread system disruption. These include energy supply, water supply, transport, finance and telecommunications systems. For example, hacking industrial control systems can cause power outages, manipulate railroad switches or dam gates, and lead to cascading infrastructure failures. AI is exponentially expanding the scope and precision of such sabotage by quickly identifying vulnerabilities in control systems, imitating authorized users using machine learning, and deploying multi-layered combinations of physical, digital, and psychological attacks.

The security of Uzbekistan's infrastructure is under threat due to the proliferation of low-cost, open-source AI tools that lower the barriers to non-sophisticated attackers. According to scientist Chang, basic machine learning modules for tasks such as speech synthesis and password cracking are readily available on hacker forums. Attackers can simply download and turn these AI capabilities into "cyber attacks" without the need for extensive data science knowledge. Thus, Uzbekistan's infrastructure is vulnerable even to small groups or individual hackers using available AI.

In addition, outdated industrial equipment with known flaws, but without reliable built-in security systems, remains widespread in key utility systems and transport networks of Uzbekistan. For example, more than 40% of Uzbekistan's electricity distribution infrastructure has been in operation for more than 20 years. Legacy programmable logic controllers and supervisory control and data acquisition systems are easy targets for AI hackers. Once inside, AI threats can spread across interconnected infrastructure, moving from the entry point to high-value assets such as power plants, rail traffic control centers or wastewater treatment plants.

Risks for data of government bodies and citizens

AI also extends the risks to data of government and citizens stored in Uzbekistan's growing digital databases. Government databases containing sensitive information about finances, assets, biometrics, travel and legal status are a treasure trove for cybercriminals. Moreover, Uzbekistan's limited investment in cyber security likely leaves databases protected with only basic, legacy security measures.

AI can help attackers bypass such protections through techniques such as spear phishing emails. By building profiles of targets and a model of trusted contacts using deep learning, AI makes social engineering attacks exponentially more convincing. Government officials are prime targets for tailored AI

phishing attacks aimed at manipulating the media or disrupting operational activities.

Additionally, applying AI analytics to stolen citizen data increases the potential for harm through micro targeting, discrimination, and surveillance. For example, AI can infer sensitive information from consumer data. It can also identify anonymous users by analyzing typing styles and other behavioral patterns. Used against Uzbekistan's population databases, such AI capabilities would seriously undermine civil liberties.

Risks for the financial sector

The accelerating adoption of digital payments and financial technologies in Uzbekistan creates vulnerabilities to AI attacks on the country's financial system. AI can bypass fraud detection models using techniques such as generative adversarial networks that learn to imitate legitimate transactions. Digital avatars and other AI models can fabricate convincing audio and video to bypass voice and facial authentication. Such AI threats put government revenue systems, central bank operations, commercial banks and personal accounts at risk.

Moreover, the majority of financial technologies and critical financial infrastructure in Uzbekistan relies on foreign technology providers. This dependency increases supply chain cyber risks as viruses may be embedded in imported software or hardware. Attackers can use AI to systematically probe third-party code and hardware for hidden vulnerabilities or remote access points not detected by standard scanning.

Socio-economic risks

On a broader scale, AI-powered cyber attacks pose serious risks to the stability and development trajectory of Uzbekistan, undermining trust in digitalization. For example, coordinated disinformation campaigns on social media using AI could inflame ethnic, religious or political divisions. Highly realistic AI-generated fake audio and video footage allows for the fabrication of highly provocative personalized content (Townsend, 2022). When used strategically,

such information operations can destabilize Uzbekistan by strengthening extremist groups, undermining trust in the government, or inciting panic.

Likewise, disruptive AI-powered cyber attacks on digitized government services could deter users and derail Uzbekistan's digitalization plans. People may avoid online services from government agencies or banks if AI hacking remains widespread. Prolonged disruptions also risk reversing private sector digitization as vulnerable companies may abandon online operations. On all fronts, cyber instability, enhanced by AI, threatens citizens' digital literacy and overall technology adoption.

In summary, Uzbekistan faces multiple vulnerabilities as AI spreads sophisticated cyber capabilities. Critical infrastructure, government data, financial systems and socio-economic factors are all at risk. While the current level of cyber threats to Uzbekistan likely lags behind developed countries, rapid digitalization coupled with weak legacy defenses is creating an environment conducive to escalating AI-enabled cyber exploitation. Implementing the Digital Uzbekistan 2030 vision requires proactive assessment and mitigation of AI cyber risks in vulnerable sectors.

Assessing public attitudes towards cyber security issues in Uzbekistan

Assessing Uzbekistan's public perception of cyber security and its involvement in this area is critical to developing effective policies and awareness programs. However, currently, limited research has focused on cyber security culture in Uzbekistan. Some conclusions can be drawn based on global surveys and digitalization trends in Uzbekistan, but in-depth public opinion research is needed. However, preliminary results highlight several priorities for improving public cyber readiness.

Gaps in awareness

Surveys consistently find serious gaps in cyber security awareness and digital literacy around the world, including in developing countries like Uzbekistan.

Microsoft's Global Survey (2020) documented high levels of risky cyber behavior, including poor password habits, lack of two-factor authentication, and susceptibility to phishing. Lack of awareness of cyber threats causes many to underestimate the risks and accept them. Similarly, a social survey conducted as part of U. Rakhmatov's dissertation research under the auspices of the Cyberlaw Department of the Tashkent State University of Law among 1,000 students (2023) showed that more than half of the respondents experienced difficulties with basic cyber hygiene, such as using strong passwords.

The high level of smartphone and social media use opens the door to cyber risks, especially among Uzbekistan's tech-savvy youth. However, this study found that only 5% of Uzbek citizens had completed cyber security training, indicating a minimal level of knowledge. In addition, Uzbekistan's limited integration into global cyber security initiatives is holding back increased public awareness. For example, Uzbekistan did not participate in major campaigns such as European Cyber Security Month.

Ambivalent attitude

Another key issue is ambivalence and apathy regarding cyber security. Around the world, many exhibit cognitive dissonance, abstractly acknowledging



cyber threats but downplaying personal risks. Complacency also remains high as cyber attacks rarely affect daily life in a noticeable way.

Without personal experience of serious hacks, citizens of many countries are likely to underestimate the danger of cyber attacks. For example, enthusiasm for the digitization of government services may outweigh concerns about privacy or security. Moreover, historically low trust in government institutions has plagued many countries, potentially preventing citizens from heeding cyber warnings. Along with the limited discussion of cyber issues in Uzbekistan, these trends contribute to ignorance or indifference to cyber threats.

Trust deficit

Lack of trust also hinders the adoption of cyber security solutions. Around the world, privacy concerns about security technologies such as contact tracing apps or cyber threat intelligence sharing platforms have made their implementation difficult. Doubts about the handling of data undermine trust, especially when organizations have a poor reputation for transparency.

Uzbekistan faces a similar trust deficit, which may prevent the adoption of appropriate security measures. Trust in proper data protection is essential to the adoption of technologies such as antivirus programs, automated access controls, or monitoring of critical infrastructure.

Compliance issues

Finally, ensuring full compliance with cyber security policies faces obstacles around the world. These include resource limitations for small businesses, indifference from top management, and lack of enforcement. Non-compliance seriously undermines the security of digital ecosystems, creating loopholes for attackers.

The study results indicate that Uzbekistan faces significant public awareness, behavioral and regulatory challenges in the field of cyber security, similar to global trends. Citizens lack knowledge of cyber hygiene and threats, displaying complacency and mistrust of digital security measures. Addressing these challenges through targeted education campaigns, confidence-building and strategic policies is critical to ensuring the security of Uzbekistan's society in the face of increasing dependence on digital systems. Future research should explore in detail the views of the population of Uzbekistan to directly inform initiatives to improve cyber readiness nationwide.

Development of recommendations on cyber security for the state and society of Uzbekistan

Drawing on an analysis of Uzbekistan's cyber vulnerabilities and public opinion research, this subsection proposes comprehensive policy, technology, and education recommendations to improve the country's resilience to AI-enabled threats. The recommendations are consistent with the Digital Uzbekistan 2030 strategy and global cyber security best practices, tailored to the country's capabilities and challenges. The proposed measures are aimed at ensuring the security of critical systems, improving threat monitoring and response, developing cyber skills and creating a culture of cyber security in government institutions and among citizens.

Infrastructure Security

Robust infrastructure security is fundamental to

managing growing cyber risks. Uzbekistan must:

- Set cyber security standards for industrial control systems: mandate the implementation of minimum accepted controls such as network segmentation, multi-factor access authentication, data transfer encryption, regular updates and upgrades, active monitoring and incident response planning for sectors such as energy, water and transport (Gulyamov et al., 2023).

- Incentivize managed security services for infrastructure companies: Encourage, subsidize, or require the provision of managed security services from domestic IT companies to overcome limited internal cyber forensics, monitoring, and response capabilities.

- Promote government-private cyber threat intelligence sharing: Establish mechanisms like ISAO (Information Sharing and Analysis Organizations) to securely share cyber threat intelligence between government and infrastructure owners for proactive response.

- Use Blockchain for Integrity Checking: Implement blockchain-based code and configuration integrity checking of industrial control systems to identify malformed updates that may indicate tampering or malware injection).

Protection of data of government agencies and citizens

Ensuring the confidentiality of government department data and protecting the lives of citizens requires measures such as:

- Enact data protection legislation: Comprehensive laws on responsible data handling, defining rights and restrictions on collection, storage, use, transfer and destruction.

- Designing systems that are secure by design: Integrating data security and privacy as key requirements from the outset of any new government databases, services or applications.

- Using AI to control access to data: Using AI techniques like metadata, user behavior analytics, and middleware encryption to control access and identify insider threats.

- Establish a Breach Notification Policy: Legally require government agencies and companies to promptly notify individuals affected by any loss or unauthorized use of data, allowing them to take protective action.

- Launch public cyber hygiene campaigns: nationally promote the use of strong passwords, avoidance of phishing traps, and careful disclosure of personal information through channels such as social media and advertising.

Financial Sector Security Measures

To ensure financial security, the priorities are:

- Modernizing banks' cyber defenses: introducing advanced capabilities such as AI fraud detection, rapid exchange of threat intelligence, cyber security audits, and more.

- Regulation of financial tech providers: development of special licensing and protection standards for technology companies in the financial sector, which are often less prepared than traditional financial institutions.

- Improving the resilience of digital payment systems: encouraging distributed architectures open APIs and platforms to maintain the continuity of crit-

ical payment transactions during cyber attacks.

- Using blockchain-based systems: Implementing distributed ledger solutions for tasks such as recording transactions to improve the integrity of financial data and prevent manipulation.

National Cyber Resilience

Finally, improving national resilience involves strategic policy measures such as:

- Developing a National Cyber Security Strategy: Creating a unified national strategy covering risk, governance, public-private collaboration, workforce development, R&D, and international partnerships.

- Strengthening the cyber capacity of law enforcement agencies and the military: developing cybercrime investigation skills, strengthening cyber units, and encouraging intelligence sharing with international agencies to counter threats.

- Fostering R&D ecosystems: Invigorating cyber security research and innovation through academic centers, competitions, partnerships, and funding for priorities such as AI security and protecting next-generation intelligent systems.

- Accelerating IT workforce development: Expanding higher education, training and certification programs in the areas of secure software development, network security, and data science and incident response to build Uzbekistan's human capital.

This broad set of recommendations provides a blueprint for Uzbekistan to strengthen cyber defense as it advances digitalization. Implementation requires strategic vision from leaders, coordinated government and industry action, and investment.

Promising directions for research in AI and cyber security

The advent of AI is opening new frontiers for cyber security research around the world. Several promising areas include:

- AI Hacking Testing: Simulating attacks to identify AI vulnerabilities can lead to more secure development. Scenario modeling will also show the risks (Brundage et al., 2020).

- AI to combat misinformation: Machine learning can help identify fake data and synthesize credible rebuttals (Badawy et al., 2022).

- Secure and Trustworthy AI: Principles of data regulation, access control and algorithmic transparency will be critical (Gulyamov et al., 2021).

- Geopolitical analysis: Research into global AI competition, cyber regulations, and managing rising risks can inform policy making (Townsend, 2022).

- Human factors: the study of user interaction with AI security technologies and the ethics of AI cyber capabilities will become increasingly relevant (Majot et al., 2022).

For Uzbekistan, targeted projects in these areas will help shape the dynamics and development of digital ecosystems transformed by AI. Focusing on national strengths and public-private partnerships maximizes contributions on a global scale. Building research capacity now will pay off as AI-enabled cyber security will become a top priority around the world in the coming decades.

This study highlights the critical insights needed to move Uzbekistan toward cyber readiness in the face of increasing cyber attacks and AI-enabled threats. As Uzbekistan digitalizes economically and socially, developing national resilience through policy, technol-

ogy, education and public awareness will shape the country's trajectory. The implementation of the proposed recommendations, adapted to local conditions, can significantly improve Uzbekistan's preparedness. However, long-term security requires establishing cyber security as a priority at all levels of society.

For the government of Uzbekistan, the key imperatives are to provide leadership and resources to protect critical systems, improve monitoring and response, adopt data protection regulations, and support the development of cyber skills. Central coordination, private sector partnerships and sustainable investments are critical. Deploying strong defenses now is more prudent than waiting for a major incident to spur action. It is also recommended to recognize cyber risks affecting infrastructure networks, data systems, financial technology and society. Comprehensive safety and risk management should be the guiding principles.

At the institutional level, public and private organizations need a deeper understanding of today's cyber threats and vulnerabilities, especially around AI and automation. Comprehensive audits, infrastructure upgrades, strengthened management systems, staff training and process reviews are critical to improving readiness. Prioritization of cyber security and compliance must proceed hierarchically. Additional regulation may be needed to raise standards across different sectors.

For Uzbekistan's emerging cyber community, the key is to seize opportunities for global collaboration while cultivating local talent. Joining initiatives like Interpol, sharing threat information, forming industry associations, and holding conferences can accelerate learning. At the same time, support for higher education, grants and professional programs develops indispensable technical and research competencies. A vibrant, integrated cyber community is a critical asset.

Ultimately, promoting cyber hygiene and vigilance among the citizens of Uzbekistan reinforces the resilience of the society. Through schools, media, cultural institutions and targeted campaigns, people must become aware of cyber risks, adjust their behavior and demand responsibility from organizations. Cyber security is essential to securely practicing digital citizenship in today's world. Public opinion must inform policy making.

Cyber attacks are therefore an inevitability that Uzbekistan must be prepared for as digital systems proliferate. Awareness, accountability, resources and ownership are critical to ensuring progress. The government of Uzbekistan, the private sector, academia, civil society and citizens all play a critical role in improving cyber defense. Investing today in comprehensive cyber security creates a digitally empowered yet secure Uzbekistan community for generations to come.



History of weights



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In the archeology of Central Asia there are several unique objects that, although they were discovered a long time ago, have not yet been fully studied. Among these finds are several measuring stones, accidentally found in different places on the territory of Uzbekistan and still unknown in the world of science. Finds related to the weight system are considered “weight stones” - “weights”. In the Explanatory Dictionary of the Uzbek Language, the expression “qadoqtosh” is recorded as “a measuring stone that is placed on scales when weighing things.” Also the root of the term “qadoqtosh” is the word “qadoq”, which is an ancient unit of weight equal to 1 pound (1 pound = 409.512 g).

It is difficult to completely attribute all random finds to “qadoqtosh”, since scientists have expressed different opinions about these objects. However, there are several reasons why we should accept such findings as a “measure of weight.”

The first such finds were discovered in ancient agricultural settlements of Southern Turkmenistan. Researcher V.A. Alyokshin points to the appearance of such stones in the monuments of the Anau culture in the complexes of the Namozgokh I period (4800-4000 BCE). He also points out that such finds in these places are of a later period, dating back to the Bronze Age, noting that measuring stones were discovered in the upper layers of the Oltintepa monument. The researcher is one of the first to try to carry out a historical reconstruction of stone products, drawing attention to the fact that their weight sizes are different.

According to his research, the weight of six “measuring stones” found in the Oltintepa and Karatepa monuments in the south of Turkmenistan was measured, their weight was a 4; 5.5; 7; 10; 19 and 26.5 kg.

V.A. Alyokshin, based on the fact that the difference in weight between them depending on the fact that the weight between them is a multiple of 1.5 kg, suggested that if stones are a special unit of measurement of weight, then there were measuring stones of 8.5; 11.5; 13; 14.5; 16; 17.5; 19; 20.5; 22; 23.5; 25 kg. Accordingly, he was one of the first to report the findings to science as measuring stones. However, it should be noted that calling such stones “measured stones” - “weights” was suggested even earlier by R. Pompelli, who examined the Anau monument in 1908.

Further research into the scale system was carried out by Akira Hori of the Museum of Ancient Orient in Tokyo. He conducted a special study of ancient objects measuring weight in Iran and Afghanistan based on museum exhibitions. According to the study, he claims that stones found in the city of Kerman in Iran, hewn from chlorite ore, are a measure of weight, and compared them with stones found in other areas. He also carried out an original analysis of the ancient Indian and Iranian-Afghan weight systems, establishing their origin in the 5th millennium BCE, and came to the conclusion that the Iranian-Afghan weight system is their common ancestor. In our opinion, the author had in mind the system of scales that emerged and developed in the territories between ancient Iran and Afghanistan. Because in the diagram given in the article about the weight system, the proto-weight system of Turkmenistan comes first. Another article published recently on this topic also notes that the earliest known “measure stones” date back to the 6th, or more accurately dated to the 5th millennium BC, and that they have been discovered at sites such as Munchoklitema and Chaksoklitema in areas located on the foothill plains north of the Kopet Dag mountain range in southern Turkmenistan.

The first finds of such items on the territory of Uzbekistan date back to 1893-1894. This find is considered the world famous Sokh find. M.E. Voronets was the first to report on the find in his article, who described its dimensions and made a comparative analysis. But he did not provide information about its function and weight. Today, a number of studies have been carried out on the Sokh find, some researchers associate this object with religious beliefs, some scientists - with grinding or squeezing (pressing) plants, and some - with a unit of weight, some scientists recognize it as an example of high art.

Another “measuring stone” was reported by G.A. Pugachenkova in 1970 while searching for examples of art associated with monuments of antiquity and the early Middle Ages in the territory of Southern Uzbekistan. In the course of her research, she made finds of a much more ancient period in the village of Mirshodi, Shurchi district, Surkhandarya region. These finds were discovered in 1969 by local residents during arable work. Among the finds were objects made of stone; G.A. Pugachenkova noted that one of them was a round measuring stone. G.A. Pugachenkova noted that, according to a comparative analysis of the finds, they are close to the Bronze Age cultures of

Southern Turkmenistan and the Indus Valley. Unfortunately, it is currently unclear where this measuring stone is kept.

Another find was made by V. Makroborodov during excavations of the Gishtepa monument of the 4th-3rd centuries BCE, located in the Pashkhurd oasis in southern Uzbekistan. The researcher wrote that the dimensions of this object are 25x25 cm and the weight is 11.5 kg, but he did not give a full description. Although the researcher identified this find in a layer of the indicated monument, we believe that it belongs to an older period. Considering the preservation of stone objects for a long time, the Gishtepa monument allows us to put forward the opinion that the measuring stone was reused by the people of that time.

Another find of a similar appearance was presented to the senior researcher of the National Center of Archaeology S. Ilyasova by a representative of the local population during an inspection of the Bobomochin monument in the Parkent district of the Tashkent region. This find, weighing 3.405 kg, is currently kept on display at the Tashkent City Museum. The first information about this measuring stone was published in 2020 by G.I. Bogomolov. However, no information was provided about the size and weight of the stone. The height of the stone is 14.5-15 cm, thickness 11 cm, length 11 cm, handle width 3.5 cm, handle hole size 7.5x2.5 cm. The weight of this measuring stone does not correspond to the V.A. Alyokshin scale system mentioned above.

One of these measuring stones is currently kept in the museum created by Academician A. Askarov at the history department of the Nizami Tashkent State Pedagogical University. The weight of this item is 13.590 kg. This measuring stone has not yet been fully studied and the location of its discovery is unclear.

One such item is kept on display at the State Museum of History of Uzbekistan. The weight of the measuring stone is 8 kg, it is recorded in the museum finds book under No. 337/15. The item was found in the Sopollitep monument of the 2nd millennium BCE, located in the Surkhandarya region. However, in the works by A. Askarov, who widely described the culture of Sopollitepa, there is no information about the measuring stone. It should be noted here that A. Askarov has a unique view on such subjects. The scholar gives two different opinions about such objects: the first says that the discovery of such stones is associated with ancient roads and trade, and the second claims that such stones were used for catapult shooting.

Another stone object of a unique egg shape was found by A. Muhammadiyev; according to his information, in 2022 it was discovered in soil brought to the houses of local residents of the village of Totkent, Kattakurgan district, Samarkand region. The weight of this find is 3,955 kg. This find has not been fully studied and additional research is currently being carried out to establish its origin. At the same time, geologists are working to determine the mineral composition of the stone in order to determine the region of its original formation.

The next find was discovered in 2023, when the local population was building a house in the village of Achchi, located in the Zaamin district of the Jiz-zakh region. According to O. Mamirov, this measuring stone weighs 15.945 kg. This chance find has not been fully studied.

The Fergana Valley occupies a special place among the areas where a large number of measuring stones were discovered. Today, we can list the measuring stones from the famous Sokh find (Sokh district of the Fergana region), found in Karasu, Pakhtaabad, the city of Andijan, Andijan region, in the village of Shomollisoy (Kyrgyzstan), and currently stored in the exhibition of the State Museum of History and Culture of the Namangan Region, as well as two measuring stones from the exposition of the Suleimontog Museum in Osh.

The weight of the measuring stones found in the Fergana Valley varies; the heaviest of them is considered to be the stone stored in the State Museum of History and Culture of the Namangan Region. Its recorded weight in today's condition is 12.344 kg, and there are chipped areas on the side and bottom. In this regard, it is possible that this find at one time weighed 13 kg. One of the measuring stones stored at the Suleimontog Museum in Osh weighs 10.340 kg, and the other weighs 7.880 kg. Considering that one side of the second stone is badly damaged, it should be noted that it could weigh about 10 kg, like the first. The weight of the measuring stone from the funds of the State Museum of History and Culture of the Andijan Region is 9.7 kg. Some parts of it are partially damaged. This means that we can assume that in total once it weighed 10 kg. The weight of the measuring stone found in the Pakhtaabad district of the Andijan region is 9 kg. The weight of one of the most famous finds - Sokh, stored in the State Museum of History of Uzbekistan, is 4.806 kg. Although the extant weights of the above-mentioned measuring stones have been measured by some researchers, most of the newly discovered finds were measured by the author. But what measurement system was used in ancient times, the name of the measure of weight is a big question awaiting its solution.

Unfortunately, there are no sources that record the names of measures of weight in Central Asia



A map of the locations where the weighing stones have been identified

during the Eneolithic and Early Bronze Ages. However, it can be emphasized that the metrology of the ancient period is close to such weight measures as shekl, mina, which were common in the Middle East. For example, the weight of the small weights of Troy and gold items corresponded to the weight system common in the states of the Mediterranean, Egypt, Anatolia and Mesopotamia during the Bronze Age. In Akira Hori's research, it can be seen that in Mesopotamia there was a system of weights that were multiples of 60, in Akkadian they were called as follows: 1 sigulu was just over 8 grams, 60 sigulu was 1 mina (just under 500 grams), 60 min - 1 bultu (just under 30 kg).

There are several opinions among researchers about the functions of stone objects considered random finds. Initially, such stone objects were used for recording and internal exchange of agricultural prod-

ucts, and later, probably, these weight measures were widely used in foreign trade and exchange. Measuring stones with unique designs are associated with religious beliefs, and we believe they were kept in temples as a standard unit of weight.

It can also be said that such products served as standard weights for long-distance export trade of metal ores, precious stones and especially tin ore from the areas between Ancient Iran and Afghanistan to consumer regions.



Weighing stones

1. The weighing stone of the Bobomochin monument is an exhibit of the Tashkent Museum
2. The weighing stone of the Gishtepa monument - the place of storage is unknown
3. Osh weighing stone - an exhibit of the Sulaymontog Museum of Osh, Kyrgyz Republic
4. Osh weighing stone - an exhibit of the Sulaymontog Museum of Osh, Kyrgyz Republic
5. Pakhtaabad weighing stone - found in the yard of the village of Boymakhalla, Pakhtaabad district, Andijan region (now an exhibit of the «Babur» International Public Fund Museum)
6. Shamollisoi weighing stone - an exhibit of the State Museum of History and Culture of Namangan Region
7. Andijan weighing stone - an exhibit of the State Museum of History and Culture of Andijan region
8. The Sokh find is an exhibit of the State History Museum of Uzbekistan
9. Unknown weighing stone - exhibit of the Museum of History Faculty of Nizami Tashkent State Pedagogical University
10. Achchi weighing stone - an exhibit of the museum of the Zomin district of the Jizzah region
11. Sopollitepa weighing stone - an exhibit of the State Museum of the History of Uzbekistan
12. Qorasuv weighing stone - an exhibit of the 5th school museum of the city of Qorasuv, Andijan region (now an exhibit of the «Babur» International Public Fund Museum)
13. Totkent museum stone - found by local residents of Totkent village, Kattakurgan district, Samarkand region

The ruler who united the khiva khanate

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At the beginning of the 19th century, a policy of centralization was pursued in the Khiva Khanate. **Eltuzar** (1804-1806), son of **Avaz-inaq**, who ascended the throne in 1804, was the first of the Uzbek Kongrat family to be officially proclaimed khan. Khan, who was educated in one of the madrassas in Khiva and paid more attention to military affairs, strained relations with Bukhara. As a result, in 1806, the troops of Emir Haydar began a campaign against Khorezm, defeating the Khivan troops in the Battle of Shabbaz. **Eltuzar Khan**, who was trying to cross to the left bank of the Amu Darya, drowned as a result of the boat capsizing. Khan was 37 years old at that time.

The defeat in the war with the Bukhara Emirate undermined the military-political position of the Khiva Khanate. Some officials stopped recognizing the central government. In 1806, the population in the Beshqala region ("five fortresses") (Chimbay, Kipchak, Mangyt, Khojeyli and Kungrat), dissatisfied with the abundance of taxes, rebelled. The troops of the Kazakhs and Karakalpaks, who declared themselves independent of the Khanate and moved to Khiva, were disarmed. The introduction of a monetary tax, called «solgut», instead of a tax levied on products («kharaj»), made it possible to at least slightly reduce the discontent of the population. Taking advantage of this situation, **Muhammad Rahim Khan** took over the government in place of **Abulghazi V**, who had been on the throne for four months. For almost 20 years of his reign, the new khan paid special attention to the economic and political situation in the country and achieved certain positive results in unifying the khanate. The Russian ambassador **N. Muravyov** wrote in his report: "We can say that **Muhammad Rahim Khan** built a completely new state. Now this state is

one of the most powerful khanates in Central Asia."

Muhammad Rahim Khan I, who ascended the throne of Khiva in 1806, taking control of the state, "sent Sultan Mirab, Munis Mirab and Bekali Mirab to a place called Tuinukli to find out whether it was necessary to clear the beginning of the Kheivak (Polvon-yop) canal", wrote historian Bayani.

Muhammad Rahim Khan sought to create a powerful army and, with its help, expand the territory of the Khanate. In particular, in 1809, **Muhammad Rahim Khan I** with a 10,000-strong army went to conquer the population of the outskirts of Kongrat and built huge dams on two full-flowing branches of the Amu Darya - Changli Bozsu and Chumanae (Shumanae), diverting the water to the other side. The Khan instructed **Munis-mirab** and **Kara Bahadir-mirab** to organize and supervise the construction of these dams. The dams were erected in the shortest possible time. However, unable to withstand the pressure of water, after 20 days they were destroyed, and the river again began to flow along its old channels, as a result of which the dwellers of Kongrat and their crops were saved. According to the testimony of **Muhammad Yusuf Bayani**, in the regular cavalry of the Khiva Khanate, the main place was occupied by Uzbeks, Turkmens and Karakalpaks. Warriors received land plots for their military service and were exempt from paying taxes. From spring to late autumn 1810, Khiva warriors raided Kazakh and Karakalpak villages along the banks of the Zhanadarya (New River). As a result, with the help of **Aidosbiy**, **Kechenekbiy**, **Orinbiy**, the



Muhammad Rahimkhan I



Karakalpaks living along the banks of the Zhanadarya were subordinated to Khiva Khanate

By the order of Muhammad Rahim Khan, from February of 1811, troops began to be sent against the Uzbeks of the Aral Sea region. At the same time, military actions began against the Kongrat province, which had already existed within the Khanate for 18 years as a virtually independent possession, as a result of which the leader of the Kongrats, Tura Murad-sufi, was killed.

Later, in 1818-1819, the troops of the Khiva Khanate organized military campaigns on the lands of Southern Turkmenistan and Khorasan. In one of the battles near Chardzhuy, the Khiva army was defeated by the army of the Bukhara Emirate. In 1820-1824, Muhammad Rahim Khan, having gathered new forces, launched several campaigns against Bukhara. The fortresses of Kokishtuvan and Ogar, belonging to Bukhara, were captured, and the Turkmen tribes of the Mary and Tejen oases (Chovdurs, Geoklens, Tekins, Sars and Yomuds), subordinate to the Bukhara Emirate, came under the authority of the Khiva Khanate. By order of Khan, part of the Akhal-Teke Turkmen was resettled in the vicinity of the fortresses of Kunya-Urgench and Ilanli-qala. Subject to military service in the Khiva troops, the Turkmen were allocated land and a lower amount of taxes was established.

Paying serious attention to the regulation of the tax system, Muhammad Rahim Khan was looking for ways to replenish the state treasury. Now the amount of the tax was determined depending on the acreage owned by the owners, as well as on the

size of the harvest received. Tax collection activities were transferred from the hands of local rulers to the central government. The task of collecting state taxes was assigned to the Qushbegs and Mehtars, and the collection of zakat was assigned to the Devanbegis. Income and expenses coming to the treasury through "salgut" from subjects were recorded in special books and were under the control of the khan.

Munis writes that after Muhammad Rahim Khan I seized the power, his relative Muhammad Riza Bey refused to obey him. He and his people took refuge with the Kongrats of Kath. Then he captured the Kipchak fortress and killed its ruler Allaberdy-bek. He asked the ruler of the Aral, Tura Murad-Sufi, to help in the fight against the khan. The Khan first sent Qutlugmurad-Inaq against the Kipchak fortress, and then besieged it himself. Muhammad Riza-bek was assisted by Muhammad Niyaz-bek and Muhammad Niyaz-atalyq. The ruler of the Aral, Tura Murad-Sufi, also helps him in this fight. Suyunbek and Oraz Alibek arrived from the Aral to help. Having failed to achieve results, Muhammad Rahim Khan returned to Khorezm.

Following the Kipchak fortress, Muhammad Riza-bek attacks Gurlan, besieging it. Here he is also helped by large landowners Muhammad Niyaz-bek and Muhammad Niyaz-atalyq. Having received help from Bukhara, they also captured Kath and approached Khiva. Muhammad Riza-bek under the pretext of negotiating a truce, together with his supporters, tried to enter into Khiva with the aim of killing the khan. Having learned about this intention, the khan captured those who arrived in the capital and executed

Muhammad Riza-bek, and imprisoned his supporters.

Starting from 1808-1809, Muhammad Rahim Khan I waged wars, trying to strengthen his power among the Turkmens, Karakalpaks and Uzbeks of the Aral Sea region. In 1810, Muhammad Rahim Khan, in an effort to resettle some of the rebel Uyghurs from the vicinity of Gurlan, gave the order to clear the lower part of the Yangiariq canal to supply water to the Ak-Mechet area and develop new lands for agriculture.

When in 1810-1811 the Kazakhs and Karakalpaks of the Aral Sea region were subordinated to Khiva Khanate, an agreement on tribute and taxes was concluded with them. "Muhammad Rahim Khan, in order to dispel all disputes," wrote A.L. Kun, "decided this way together with the elders of the Karakalpaks: 1. Regardless of how much land the Karakalpaks use, they pay the khan 20 thousand "kichik tilla (small gold)" every year; 2. They provide the khan with 2 thousand soldiers; 3. Every year, 6 thousand people are provided for public works; 4. Residents of Kongrat and Nukus pay 2 thousand gold coins each, residents of Khojeyli - 500 "kichik tilla" in the form of solgut."

In 1814, by order of the Khan of Khiva, the surroundings of the Shavat canal were improved, and another part of the Uyghurs from Gurlan were resettled here. And the following year the city of Tashauz was built here. A special customs service was introduced in the border towns of the Khanate, on caravan and shipping routes. The revival of agriculture, crafts, domestic and foreign trade in the Khanate contributed to the growth of state treasury revenues. Russian ambassador N. Muravyov, who arrived in Khiva, reported that the khan's annual income exceeded 4 million rubles.

The economic progress of the Khiva Khanate was due to the correct arrangement of irrigation structures. From this point of view, the Pitnak oasis is considered the first region in Khorezm to receive water from the Amu Darya. In ancient times, when the river did not yet flow through the Tuyamuyun village, it flowed from the Sultan Sanjar salt mine towards the Karakum Desert, forming the Pitnak oasis. The waters of the river flowed near Chingiz-Tepa and Qoratosh, forming the Pitnak and Yakka-Chigir oases. "The Pitnak oasis was separated from other lands," wrote Yahyo G. Gulyamov - It is separated from the Khorezm oasis by the high Toshsaqa hills. In the south and southwest it borders the Karakum Desert. Pitnak is irrigated by the small Khon-yopi Canal. According to legends, this canal was dug by the Khiva Khan Mohammed Rahim Khan (1806-1825). The oasis of Pitnak, convenient for irrigation, was probably inhabited even in earlier times."

Residents of Izmukhshir, known as the birthplace of the famous Mahmud al-Zamakhshari, at that time suffered greatly from lack of water. Canal, dug by order of the Khan of Khiva Muhammad Rahim Khan I, made it possible to revive life in this city.

According to Munis and Ogahiy, in 1815, Muhammad Rahim Khan ordered his younger brother Muhammad Nazar Bek to dig a canal from Boz in the

Gurlan district. The said bek, according to the order, ordered to dig the Bogolon canal, through Kath, through the gardens of Orazi Ali in Boz, through Boz, and led it through Yangiqalayi-Khitoy. And received the praise of his brother. This canal is now known as the "Qilich Niyaz-bai canal."

Muhammad Yusuf Bayani writes about the same event: "From Bogolon, through Kath, Boz, through the southern part of Qalayai-Khitoy, he built a canal and reached his goal. The canal reaches Shorkirovuk, it is called the Qilich-bai canal."

Yayho G. Gulyamov mentioned: "Bayani showed on the left side of the Qilich Niyaz-bai - Beshoily canal, on the right - Gurlan, Nukus, Uygur, Palvanbek." Also Yahyo G. Gulyamov wrote: "The Qorakuz and Qilich Niyaz-bai canals were built by two military leaders of Muhammad Rahim Khan - Qilich Niyaz-bai and Davlat Qorakuz.»

Muhammad Rahim Khan, first of all, considered one of his main tasks to be the end of disunity in the country, the centralization and strengthening of state power. Entrusting work in accordance with the abilities of the people, the khan gathered around him reliable, influential functional officials, clergy and military personnel to carry out events of national importance. He brought closer to himself rich and influential figures of the Turkmens, Kazakhs and Karakalpaks, who became subjects of the Khiva Khanate, and granted them land properties and high positions. Considering the authority of the Muslim clergy among the people, in order to get closer to them, he married a girl from the family of Seyids, considered





the descendants of the Prophet. He provided places and positions in the palace to major religious figures, granted them property, and exempted many from taxes and fees.

Muhammad Rahim Khan, who was seriously engaged in reforming the affairs of state administration, changed the order of government introduced under Abulgazi Bahadur Khan. The administrative centers of the Khiva Khanate were identified as Khiva, Khazarasp, Khanqa, Gurlan, Anbar, Manaq, Shabbaz, Mangit, Qipchaq, Qilich Niyazbai, Khojeyli, Qitay, Tashauz, Taza Urgench, Ilanly, Gazavat. Later Kongrat and Chimbay joined them. Now, instead of city elders and others, the rule of governors and religious figures was introduced. At the same time, in some places, governors appointed from representatives of local clans. The fact is that in the Khiva Khanate, clan relations were much stronger than in other states.

Muhammad Rahim Khan built a mint building in Kuhna Ark and began to issue gold and silver coins bearing his name. The new money improved commodity-money relations in the Khanate and played an important role in regulating tax payments. For palace servants and provincial officials who were on the state service, a salary was established - salary, depending on the position. This put an end to the existing arbitrariness of the rulers in the distribution of income. Among government officials, the position of representatives of the Uzbek Kongrat family became increasingly stronger, their number grew. Yusuf Mehtar Agha was appointed prime minister under Khan's court as a representative of the Uzbeks.

Captain N. Muravyov, who arrived from the Caucasus as an Ambassador on October 6, 1819, was forced to wait 47 days for a meeting with Khan in the village of Ilgaldy in Qoshkupir due to the fact that Khan did not receive him, suspecting that he "must be a spy." On November 20, 1819, N. Muravyov was invited to Khiva and during negotiations tried to agree on the safety of trade caravans, as well as on borders.

On May 7, 1825, at the age of 50, Muhammad Rahim Khan I died. His son Allaqli Khan (1795-1842), who ascended the throne, continued to work to expand the territory and strengthen the borders of the Khiva Khanate.



Linguistic and artistic metaphor

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The main goal of any science is to find and explain new knowledge. Of course, there are several ways to achieve this goal, which have been known for several thousand years. Analogy is one of the most important methods of such heuristic scientific knowledge, which is based on the similarity of properties, characteristics or relationships of different objects; according to this similarity, information about one object is transferred to another object. This cognitive process is undoubtedly the essence of the phenomenon of metaphor.

It should be noted that although the phenomenon of metaphor has been studied in world philology for more than two thousand years, it has not gone beyond the scope of artistry, stylistics and rhetoric. More precisely, until the beginning of the last century, interpretation of metaphor as a phenomenon alien to science, scientific language, and terminology was given priority.

Almost all philosophers of antiquity studied metaphor, mainly as a decoration of speech, speech movement, and an artistic tool. If in the traditional sense the term “metaphor” means replacing one word with another, today most researchers recognize that metaphor is literally a manifestation of fundamental cognitive activity. In accordance with this fact, it is also emphasized that “metaphor is a fundamental property of language.” As you can see, metaphor is a multifaceted and incredibly complex phenomenon, and its interpretations have many different aspects. According to the two-sided nature of metaphor, there are two main types of this phenomenon: linguistic metaphor and artistic (poetic) metaphor. Today, all researchers have come to a consensus about the

two-sided nature of metaphor as a linguistic device and as a poetic figure.

A completely new word does not give anything to native speakers, so the scholar is forced to use existing vocabulary, where each word carries a corresponding meaning. To make this understandable, the researcher chooses a word whose meaning has the potential to lead to new understanding. This word (term) acquires a new meaning, through which the old meaning is preserved. This is a metaphor. According to the writer, the second type of use of metaphor is associated with the expression of more mental, abstract concepts. Mental objects are difficult not only to name, but even to imagine; they have no physical dimensions.

For example, in the expression ‘depth of the soul’ it is difficult to specifically imagine the place denoted by the word depth, that is, it is difficult to imagine the meaning; Of course, in the phrase ‘depth of the vessel’ we clearly imagine this place as the place that this word means in the expression bottom of the vessel, that is, when transferring the same word to a mental object on the basis of the corresponding association that allows it to be represented.

According to the writer, it is here that the deep and important function of metaphor in cognition is revealed; it is clear that “metaphor is not only a means of naming and expression, but also an important tool of thinking.” Familiar objects and concepts become metaphorical intermediaries that make these difficult-to-imagine concepts their own. In other words, “metaphor lengthens the ‘arm’ of the mind; its place in logic can be compared to a fishing rod or a gun.”





Uktam Saidov. Lovers

José Ortega y Gasset paid special attention to the role and poetic function of metaphor in poetry, comparing it with science. In his opinion, metaphor exists in both poetry and science, only in the first it is associated with the basis, and in the second it is in an auxiliary status. But the general approach to scientific and poetic metaphors from the same point of view has led to erroneous conclusions. For example, in aesthetics, metaphor was considered only as a magical flash that illuminates beauty with its light, therefore the concept of truth was not attributed to it and it was not considered an instrument of cognition of existence. This did not allow us to realize that research purposes are not alien to poetry. In fact, in both poetry and science, metaphorical thinking is used in order to get to the essence of a certain object or event, but in the first the poetic goal comes to the fore, and in the second - the definition of truth.

A good and well-founded metaphor clearly embodies objects-images that cannot be directly seen or imagined, creates the opportunity to enter into them, to “touch with your hands” their essence-mechanism. Of course, it cannot be denied that these worlds are developed through metaphors, that we learn the secrets of these worlds through this phenomenon, and on this basis various large and small concepts in this world are based and named.

It should be noted that metaphor is present in almost all languages and represents a limitless resource that significantly expands the richness of the language and the limits of expressive capabilities. This is why American philosopher and logician Nelson Goodman's description of strong metaphors and words states that “metaphorical usage is the working of words by interchangeability.”

Of course, there are several types and forms of metaphor, one of which is synesthetic metaphors, which have not been systematically studied, in particular, in our philological science.

The famous Hungarian linguist Stefan Ullmann, in his interesting article “Semantic Universals,” made the following points: “...The essence of the phenomenon called synesthetic metaphor is that a word whose meaning refers to one sense organ is used in a sense related to another sense organ, that is, for example, there is a transition from the perception of touch to the perception of hearing or from the perception of hearing to the perception of vision, etc. Symbolists elevated such transitions to the level of aesthetic teaching. Baudelaire spoke of the “relationship of smells, colors and sounds,” and Rimbaud wrote a sonnet about the color of vowels... But the current fashion for synesthesia should not prevent us from noting that this phenomenon represents an ancient, widespread, perhaps even universal form of metaphor. It is found in the works of Homer, Aeschylus... Synesthesia is also recorded in the languages of China, Japan, India, Iran, Arabia, Egypt, ancient Babylon and Palestine. Modern “cultural” languages abound in such metaphors. This case shows that synaesthetic metaphors can be viewed as semantic universals. The semantic composition of the term “synesthesia”, which names this phenomenon, also deserves special attention. A.A.Zabiyako, who studied this phenomenon in detail, in his book “Synesthesia: the evolution of the artistic image”, based on the meaning of the Greek word *aesthetics* (*aisteticos*) in this term - “relating to feeling”, and the meaning of the particle *syn* - “together”, very correctly interprets the meaning of this term in the form of “intuition, cooperation of the senses.” On this basis, he defines artistic synesthesia as “a way of creating an artistic world based on depicting the totality of the author’s sensory perceptions (vision, hearing, smell, tactile, emotional) in a figurative form and having a creative character.”

In general, synesthesia (we traditionally prefer to write this way) is a transfer between meanings, an associative connection between meanings, cooperation, which always receives linguapoetic emphasis in the text and acquires originality and charm. That is why the Tatar scientist B.M. Galeev describes synesthesia as “a miracle of poetic thinking” (Galeev B.M. Synesthesia is a miracle of poetic thinking // Scientific Tatarstan. -1999. -N3. -P.19 - 23).

Synesthesia, which is a miracle of thinking, fully demonstrates the desire for sensations and feelings and being based on the unusualness of not only the world of feelings, but also the world of relationships between words that are their representatives, which leads to the appearance of unexpected flashes of words, these sparks, without a doubt, illuminate the stages of artistic perfection.

Excellent examples of synesthetic metaphors can be seen in the following excerpt from the poem “The Poet’s Heart Listens to the World” by one of the most

famous representatives of Uzbek literature Maqsur Shaikhzoda:

*Small and big sounds
Sounds have a smell.
Cold, warm sounds,
Sounds have color.
Sweet, bitter sounds
There are even soft and hard ones.
If the poet were an artist,
He would draw pictures from there.*

The unusualness, “novelty” of such combinations as the *small and large sounds/smell given in the passage, the aroma of sounds/coldness, the warmth of sounds/the color of sounds/bitterness, the sweetness of sounds/softness, the hardness of sounds* are clearly felt. These unusual combinations, as it turned out, are synesthetic metaphors, that is, the result of the transfer of different meanings, the interaction of different meanings.

When a synesthetic metaphor arises, the artistic-aesthetic, expressive-emotional emphasis intensifies, which often arises as a result of a shift in the content of words from concreteness to abstraction. Artistic taste, expressed as a result of the interaction of various sensations or sensory perceptions of the

reader with taste, first of all, will give harmony to the senses of taste.

Let us pay attention to the following quatrain, taken from the poem “Yana qaytib keldim... (I’m back again...)” by the unique and great poet R. Parfi, who considered the word the world of his entire soul:

*I feel blue in my heart
The excitement on my eyelashes
Love (round) in my eyes
I’m fine too, mom.*

As we see, synesthetic metaphors in such combinations as *blue sensation, wet excitement, round love*, take us to the emotional state of the lyrical hero, to his spiritual world at this moment.

This subtle emotional state “infects” us too, but we understand the abstraction of the words *blue, wet and round* differently, we fill them with meaning in our own way, therefore their expressive-emotional qualities are also felt at different levels, for example, the *blue feelings* is “simple, pure youth”, *wet excitement* - “tears of surprise/longing”, *round love* - “love that cannot be achieved or gotten rid of.”

The use of synaesthetic metaphors in literature is noticeable in the works of most poets, but the truly national poet Rauf Parfi regularly, with enviable skill, used them in his works; in his poems, various manifestations of this miracle show the inexhaustible logical-poetic possibilities that manifested themselves in the implementation of the poet’s highest artistic intention.

A well-known literary critic who deeply studied the work of Rauf Parfi, Prof. N. Rahimjanov, in a large preface to the poet’s collection “Sakina” entitled “The Most Beautiful Secret,” emphasized the essence of his poetry: “The issue of human spiritual freedom forms the basis of the works by Rauf Parfi. For this reason, the depiction of the life of feelings, the landscape of experiences, the picture of situations and moods has become a special principle in the poet’s lyrics. That’s why he is called an artist of emotions (Parfi R. Sakina (poems). – T.: “Muharrir”, 2013. – P.17).

Rauf Parfi, who perfectly knew how to make mental landscapes clear and bright, enlivening them with unique lines, was able to demonstrate in his poems the incomparable linguapoetic capabilities of synesthetic metaphors that ensure the artistry of the image.

Metaphor is one of the most basic ways to understand the world, create artistic images, describe and characterize any concept at the level of practical experience and a very effective and never outdated source of our language. The range of linguapoetic possibilities of synesthetic metaphors is much wider than that of other types.



Uzbek implications related to the wolf

Adhamjon Ashirov,
Professor

In the past, many peoples considered the wolf to be their totem - their ancestor. In particular, in ancient legends the wolf was considered a sacred animal, as it was revered as the great ancestor of the Turkic peoples. When the wolf was adopted as a totem, it became known as a creature, like parents, who guides the path, the helper of heroes, the valiant, the courageous, benevolent creature. In addition, in the myths and tales of many Turkic peoples associated with the wolf, he is also depicted as a patron, protector, protecting people from all troubles, diseases and evil.

The ancient Turks called the wolf by color the Blue Wolf, the White Wolf, the Red Wolf. In Turkic legends he bears the names Bo'ri, Borta, Borju, Ossano, Sino, Gino, Gina, Jinu, Yashkar, Kashkir, Kurt. Among the Turks, the wolf is considered a sacred creature of Tengri (the supreme deity of the Turkic pantheon), analogues of which can be observed in other cultures. For example, in the mythology of the Scandinavian peoples, the wolf is embodied as Fenrir.

Sinologist N.Ya. Bichurin writes that the ancient Turkic tribe was completely exterminated during a surprise attack by invaders. Only one ten-year-old child survived. The attackers did not kill him, but cut off his arms and legs and threw him in a meadow near the lake. A she-wolf found the crippled child and began to feed her. Upon learning that the boy is alive, the ruler sends a man to kill him. The she-wolf, who found out about this, took the child, ran to the mountains in the East and, living there, and gave birth to ten sons from him. Having matured, each of them laid the foundation for a separate clan. This legend is widespread in the world. In particular, the legend of Prince Kunmak (Kunmuo), who was suckled by a she-wolf, was popular among both the Turkic peoples and

the Chinese. Also, with some changes, it is mentioned in the work "Primitive Culture" by E. Taylor.

Formed worship and veneration of the wolf existed in the Stone Age in Central Asia and North America, and the ancient Turks directly connected the wolf with the sky. According to Chinese authors, in the 6th century the words Wolf and Khan among the Turks meant a synonymous concept. Among the Bashkirs, based on this concept, tribal leaders, later khans, sometimes elders, wore a symbol with the image of a wolf's head as a symbol of their power.

"Oghuznoma", a unique historical monument of the 11th-13th centuries, is full of legends and tales associated with the cult of the wolf. According to the information contained in it, the Oghuzes worshiped the Grey Wolf, since the legendary Oghuz Khan was considered the legendary ancestor of the Turks, born of a grey wolf. For this reason, the Blue Wolf was the battle cry (*uran*) of Oghuz Khan. Moreover, in the 10th-11th centuries the main totem of the Oghuz-Qipchaks was the white wolf.

Along with the fact that the representatives of the Ashina clan among the Turks associated themselves with the wolf, the terms "Asha", "Ashin" meant the wolf among the Turks. Also on the flags of the Turkic Kaganate a golden head of a wolf was depicted. The image on the flag is a symbol of the fact that the Turks connected their ancestor with another world-sky. The Turkic peoples living in the area of Baikal, Yenisei, and Irtysh attacked the territory of Mongolia and Manchuria and occupied these lands. Based on the indicated settlement, the image of a wolf later migrated to the Mongolian flag. According to Mongolian legend, Genghis Khan also descended from a grey wolf.



The wolf was an animal that also occupied an important place in the lifestyle and way of life of the Uzbeks. In particular, one of the ethnic components of the Uzbek people is the Bayburi clan among the Kongrats and the Bayburi clan among the Karakalpaks, whose name is probably also associated with the totem of wolf. It is interesting that although the Uzbeks did not preserve the ethnonym wolf in its pure form, it came to us in the form of a toponym. In particular, in the Kurgantepa district of the Andijan region there are villages called Burilik, in the Payaryk district of the Samarkand region - the village of Buri. Researchers who study toponymy claim that the name of these villages comes from the generic name "Burilar, i.e. wolves". It should be noted here that the ethnonym of the Bashkirs, Turkic in origin, is also associated with the wolf - "bash kurt", and means "main wolf" or "wolf head". Also among the Turkmen there are such ethnonyms as Buri (wolf), mejdek (meaning wolf), gurt (wolf).

Folk ideas about the wolf can be found in various customs and rituals of the Uzbek people. For example, according to a common point of view among Uzbeks, whoever sees a wolf on his way early in the morning will have a good day. In family rituals conducted by our people with the wish for a newborn to avoid untimely death and various misfortunes, the rune images associated with the wolf totem to some extent coincide with the totemistic views of the Turkic peoples. At the birth of a child, the Turkic peoples had a custom of asking: "fox or wolf?" Thus, the gender of the child was indicated: boy or girl. Even today, the use of this expression is common among residents of the Fergana Valley.

The connection of the wolf totem with the concepts of family and child is obvious in the fact that until the beginning of the 20th century in the Fergana Valley, childless women wore necklaces made of wolf teeth. In Andijan, with the intention of facilitating childbirth, the expectant mother was fed a small piece of dried wolf heart or a wolf tendon was placed on the right side of the mother's bed. After the child was born, he was kept in this place for seven days. Then they were placed in a hanging cradle somewhere in the house or in a child's cradle. If children in a family died in infancy, the wolf was treated as a creature that gave life to the next children. This was manifested in the fact that a woman who had lost a child who died was wrapped in wolf skin. In addition, various parts of the wolf's body were attached to the child's cradle as a kind of protection. The Kongrat Uzbeks living in the Surkhandarya region had a custom of hanging a wolf tooth, a claw and a piece of wool at the head of a child as protection. In general, the use of wolf amulets as a talisman is widespread in the lifestyle of the Uzbek people.

Among the Uzbeks, both children and adults wore wolf amulets. The Barlas Turks carried wolf calluses with them. Previously, in the Fergana Valley, men had the custom of wearing wolf claws and teeth as a tal-



isman against the evil eye, and also sitting on a wolf skin. The Uzbeks were forbidden to sell amulets made from parts of a wolf's body; they were only given as gifts. When such a talisman was given to a woman, she responded with a gift. That is, she sewed a belt scarf (*belbagh*) or a skullcap for the donor. In our opinion, this custom is probably associated with ancient exogamous marriage (which prohibited marrying someone from one's tribe or clan).

Various parts of the wolf's body were also widely used in folk medicine. The Turks have long used wolf meat and fat to treat tuberculosis. Among the Uzbek-Qipchaks, fear and emotional unrest were overcome by drinking water in which wolf calluses were placed. And among the Kirghiz, rashes (urticaria) on the body were treated by wearing a bracelet made of wolf claws. The method of treating itchy rashes by rubbing a wolf's tail was widely used among the Kongrat Uzbeks, Kazakhs and Tatars. The Samarkand Uzbeks had a custom when, in the process of treating patients, *bakhshis* drew a line with a wolf's paw or claw on the patient's head with the intention of driving away the evil spirits that tormented them.

Among the Uzbeks, eating the meat of animals touched by wolf teeth was considered beneficial for newlyweds and childless women.

Belief in the wolf as a divine patron can also be seen in the custom of finding a thief using spells. In particular, to expose a suspected thief, wolf tendon was thrown into the fire and various spells were recited. Our ancestors believed that it was in this state that the thief goes into convulsions and returns what was stolen. In Andijan they believed that if a wolf's tendon was thrown into the fire, the thief's arms and legs would experience such severe cramps that as a result he would contract incurable illness. Therefore, before burning a wolf's tendon, the surrounding residents and the rural community were notified. In addi-



tion, it was believed that a wolf's skull, if hung at the entrance to a house, would protect against the evil eye and various disasters.

There has long been an opinion among Uzbeks that killing a wolf never leads to good. There is also a widespread point of view according to which, under the influence of Islam, the belief has taken root in the minds of the Turkic peoples that "the wolf-dog of Hazrat Ali, the one who kills him will suffer." In addition, the Uzbeks use the expression "I saw a wolf."

In the Orkhon inscriptions, along with Alpamysh's father, Bayburi, there are also people named Buri (wolf). The famous linguist Mahmud Kashgari comments on the word "bai" (rich) as "clan", "tribe", "community". This means "Bayburi" means "Wolf Tribe", a clan that worships the wolf. For this reason, Bayburi is the name of one of the ancient Turkic clans, which later became a name, an ethnonym. Names such as Buri, Burivoy, Buritosh, Burigul, common among the Uzbeks, are also associated with the original wolf totem, since the history of human names is connected with the history of mankind and ethnography.

So, along with the sacred veneration of the wolf by the ancestors of the Uzbek people, various beliefs associated with it were formed. Various rituals and customs associated with the wolf reflected not only the deification of this creature, but also the worldview system, the relationship between man and nature, man and the animal world of our ancestors. True, today the Uzbek people have not preserved the original idea of purely totemistic views on the wolf. For after the advent of Islam, belief in monotheism was established among our ancestors, and the mentioned beliefs were called false. But some views associated

with the wolf have been preserved in the rituals and customs of the Uzbek people, intertwined with Islamic views. Moreover, in the traditions associated with the wolf, one can see not only the deification of this creature, but also the relationship between man and nature, humanity and the animal world, and a system of worldviews.



On the history of the formation of Uzbek dance schools

Shirin Jalilova
Researcher

The first experiments in defining and classifying the Uzbek dance art were carried out by I.G. Bakhta (late 1920s - early 1960s). According to available data, he, together with the playwright G. Zafari and the poet Khislat, compiled a dictionary (50 words in total), which revealed the meaning of the names of some dances, positions, plasticity and the meaning of gestures; in collaboration with ethnomusicologist E.E. Romanovskaya, he collected ancient dances belonging to various genre groups, and also recorded the Ferghana suite "Katta O'yin (The Major Dance)" by hand; collected historical information about famous old national male and female dancers.

Since the middle of the last century, art scholars from the Institute of Art History and other specialists began a planned study of the national choreography of Uzbekistan.

Scientific expeditions were organized to the regions of the country, the history of the creation and development of Uzbek dance and theater art was studied, the creative and production activities of famous figures of our national dance were studied (Tamara Khanum, Mukarrama Turgunbaeva, Galia Izmailova, Isakhar Akilov, Qunduz Mirkarimova, Gulnora Mavaeva, etc.), as a result, scientific and scientific-methodological works were published in a number of specialties.

The point of convergence of opinions among experts is the definition of dance as a type of "spatial-periodic art in the form of an artistic image, in which visually expressive movements of the human body are created with the help of music." All of them make up a dance "vocabulary", that is, a set of human body movements, among which researchers highlight the following features of traditional Uzbek choreography:

a) repeated emotional and visual movements of the human body in life and work ("honey", "cup", "game", "surma/herbal cure for eyes", "hunter", "cocoon", "somersault", "seamstress", "shoulder movement", "look in the mirror", etc.);

b) emotional and visual actions in imitation of animals, birds, fish, plants ("bird", "rooster", "sparrow", "fish", "snake", "flexible neck", "horn of a gazelle", "flight of a bird", "the deer fled from the hunter", "the wind bends the tulips", "play of colors", "tulip", etc.);

c) graphically depicted objects or natural phenomena ("light breeze", "big wave", "water path", "sun", "sky", "dawn", "petal", "opening of a flower", "wide field" and others);

d) expression of various mental states of a person ("fear", "bashfulness", "turn away", "peeping", etc.);

e) symbolic actions with hidden meaning (for example, the action of "smell" - blowing flower petals from the palm) mean "accept the desires of my heart"; folding your hands in a ring, making circular movements - means "my beloved's hair, like a snake, wraps around her slender figure", etc.). The meaning of such actions is to describe the state of a person, his feelings, moral qualities and behavioral characteristics ("bud" - a symbol of a girl's virginity, "radiance of the soul", "fantasy", "moon-faced", "lips like a bud", "sweet-lipped", eyebrows like a bow", etc. personify female beauty, "slender like a cypress" - symbolizes pride and invincibility; "peak", "storm" - indicate such qualities as a climax, a surge of emotions.

It should be noted that Uzbek dances are very figurative and expressive. The peculiarity of Uzbek dance is imagery, since the performer describes the



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movement of living and inanimate nature, labor activity, expresses the character, emotions, and “heart” of a person.

Schools in Uzbek dance were formed at the end of the 19th and beginning of the 20th centuries. It is known that Uzbek dance has local characteristics associated with three schools of dance - Fergana, Bukhara and Khorezm. Each of them consists of unique rhythmic-plastic images and basic dance forms and represents unique dance complexes that are important both for the study of dance and for practical training. Knowledge about these systems, preserved mainly in the memory of dance masters, was passed down from generation to generation orally, based on the tradition of “Ustoz-Shogird (“Master to Student)”. Famous performers, musicians, teachers, such as Yusufjan-qiziq Shakarjanov, Usta Olim Komilov Ota Khoja, compared Fergana dances with a blooming spring, Bukhara dances with a hot summer, Khorezm dances with a generous autumn.

Below are the main dance styles specific to the regions of our country, which are to one degree or another reflected in the dances of national professional ensembles of Uzbekistan.

Fergana dance school (Fergana style).

Fergana classical dance consists of body movements and postures, movements of the head and shoulders, facial expressions, postures of the hands and their decorative, connecting and additional movements, postures of the legs (walking, posture, rotation), general (connecting, additional, figurative) movements, etc. Traditionally, Fergana dance is based on movements counterclockwise in a circle (along the line of the circle, into the circle, out of the circle), along the line “back and forth”. The basis of the forms of this school is the figure of the performer, the peculiarities of the movement of the upper part of his body. The position of the figure (straight, natural) and the direction of muscle strength (from the legs and slightly from the shoulders to the waist) determine the nature of the movement of the upper body (the waist is looser) and the movements of the arms and hands, which are the main means of expression. Fergana dance steps are performed by changing the legs, sliding, lightly bouncing on the heel, low, medium and high movements of the soles and “palms”. Jumps, transitions, battement and other movements are not performed, since Ferghana dance is a dance of situations in motion, and its expressiveness mainly corresponds to the upper part of the figure. Consisting of various dance elements, Ferghana dance involves slow movements that seem to flow one after another, creating the image of a dance flow and sliding on a surface. Often in Fergana dance (especially in the forms of the “major dance”) the *doira* (similar to tambourine) is used, the tone it creates allows for light movements (smaller forms, as a rule, are accompanied by musical instruments that correspond to the rhythm of the dance with melodies - *lapar*, *yalla*, songs). The relationship of internal

artistic logic with actions, situations and gestures shows that Fergana classical dance is a complex and developed system of choreographic images.

Bukhara dance school (Bukhara style).

Bukhara dance plasticity is also based on moving situations, but it is distinguished from the Ferghana style by a specific figure (movement of shoulders drawn back from the back line), other movements - tensely outstretched arms, gracefully bent fingers. Semi- and full leg turns, movements with crossed legs, semi-*plié* and even deep *plié* are characteristic features of the Bukhara school of dance. Movement of shoulders, arms, upper body; elastic vibrations, shudders, trembling of the muscles of the whole body; a sharp or, conversely, imperceptible change of position in the dance; a lot of rotations in a circle and on the spot (as well as on your knees); movement on the lower, middle and upper soles are the main means of expressing the Bukharian style.

Performance of Bukhara dances requires energetic movements of the whole body and all muscles. The plastic character, the directed-holding flow of movements and sharp linear turns of the body, geometrically precise movements of the arms, hands with bent fingers, and sometimes the movements of turned legs are the decoration of Bukhara dance and show its uniqueness. Bukhara dance is a flow of figurative movements, delicate situations, gently “continuous” turns and a variety of wind-like rotations.

Khorezm dance school (Khorezm style).

According to experts, the concept of “animal style” (a term of fine art) can be applied to Khorezm dance, since such basic elements as poses, movements and posture are directly related to the animal world and natural phenomena, and the manner of imitating them has been preserved. Various movements of semi- and fully rotated legs - battement, flick-flies, half- squats, squats, jumping movements, throwing legs back, forward, to the sides - are clear signs of the Khorezm style. The developed plasticity of the legs, characteristic of the Khorezm dance school, requires the dancer to tense the body, shoulders, direct muscle force to the waist, etc. This dance is characterized by small, trembling movements of the hands and relaxed fingers.

As a rule, pronounced poses reflected in the pause emphasize the originality of Khorezm dance. The indispensable accompaniment of musical instruments (*tar*, *bulamon*, *doira*, etc.), among which the accordion occupies a special place, shows the originality of the Khorezm dance. Often alternating movements of the body, legs and toes in both men’s and women’s dances express the unique features of the Khorezm dance.

“The first public stage compositions were created from Fergana dance forms, so Fergana dance became a model and indicator of stage dance art in general. The reason why Ferghana dance was so quickly adapted to public performance (in the form



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the fact that the transition of Bukhara and Khorezm dances to public performance did not arise from the internal essence of dance forms, but was adapted to Fergana stage dances.

At the same time, as Uzbek choreographers specifically noted, despite the updates, “the dances remained Uzbek both in content and form, since dance movements represent a real national melody, body movements remained characteristic of Fergana, Bukhara and Khorezm, and, most importantly, hand movements have not lost their variety, expressiveness, uniqueness... Movements of hands and even fingers, synchronously performed by dozens of performers, awaken a vivid imagination, and therefore the image of dance remains an important part of it.

The public form of women’s dance of Fergana, Bukhara and Khorezm found its vivid expression in the dance compositions of the «Bahor» ensemble, organized by the choreographic talent of Mukarrama Turgunbaeva.

A true professional, an artist with a profound knowledge of dance, she knew how to find the main “root” of each dance and creatively used each dance style, organically developing her own characteristics and creative capabilities.

The choreography of Uzbekistan has accumulated extensive experience in the study of images and forms of national dance. Experts have identified local features of dance schools in three large regions, described their specific features, taking into account their form and musical dimension, which has not only theoretical, but also educational and practical significance.

On December 13, 2019, Khorezm dance was included in the UNESCO Representative List of the Intangible Cultural Heritage of Humanity under the title “Khorezm Dance - Lazgi”. Of course, this had a good reason. Because the art of dance not only represents a nation or region, but also speaks the language, inherent in all humanity.

of a “major dance”) is because of the “circular... linear, chain-like ” movements it contains, as well as the “movements, formations and permutations... expressive synchronized movements of the hands. In our opinion, a certain role in this may have been played by the fact that the first dances were created by such artists as Tamara Khanum, Mukarrama Turgunbaeva, Usta Olim Komilov, who are prominent representatives of the Fergana dance school, in those days, joining groups was at the level of state policy.

However, Bukhara, and especially Khorezm dances were greatly damaged by mass performance. It is noted that “Bukhara mass dance is based only on actions, formations and reorganizations, therefore it lacks spatial originality, it loses its colorfulness. In particular, the Khorezm dance... without taking into account the movements of the legs, becomes “stylized”, complicated, in which only the body “moves”, as in the Fergana dance. Experts see the reason for this in

The image of abu rayhan biruni in the theater and cinema

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Many theater and film figures referred to the figure of the great thinker, a polymath Abu Rayhan Biruni, and in these works, along with historical sources about the personality of Biruni, fictional images and artistic plots were used. It should be noted that the creators tried to express not only the scientific activity and heritage of the scientist, but also his human feelings and experiences.

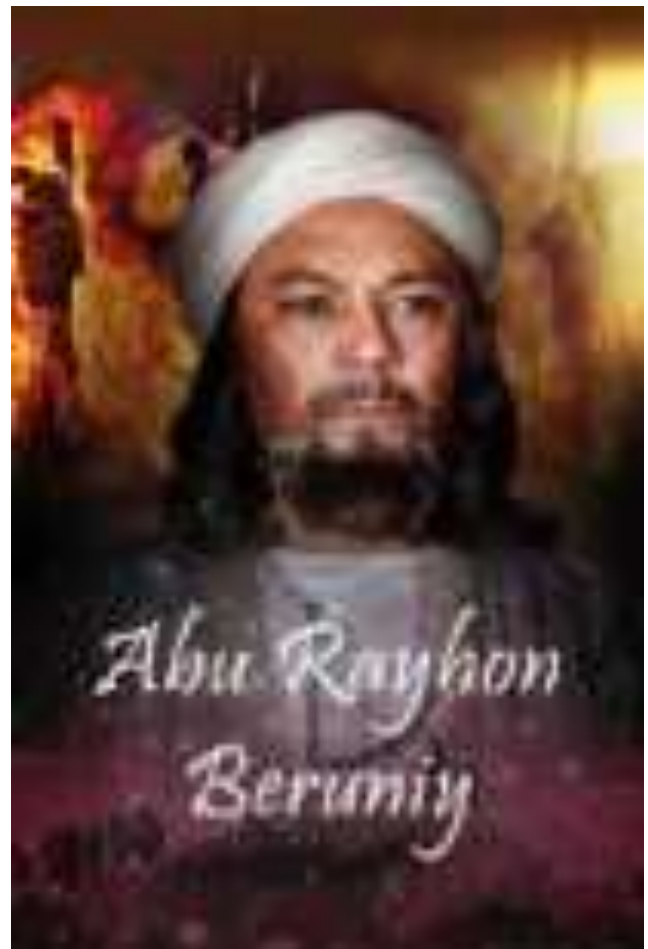
Staged in 1973 at the Khamza Theater (now the Uzbek National Academic Drama Theatre), the play "Abu Rayhan Biruni" (directed by O. Khojaev and B. Yuldashev) based on the drama by Uygun, is the first stage work dedicated to our great ancestor. The performance reflects the image of Beruni with his unique complexity and character; the scientist's search for knowledge, adversity, life conflicts, and personal qualities are artistically comprehended. "The playwright and the theater focused not on the scientist's contribution to science (these features are more widely disclosed in the literary version of the work), but on his spiritual and moral courage to express his worldview" [D. Rakhmatullaeva. History and theater - Tashkent: Gafur Gulyam Publishing and Printing Creative House, 2022, 201 pages].

The image of Biruni was embodied by famous actors - Zikir Muhammedjanov and Yaqub Akhmedov. The interpretation of the image by both actors is original in its own way: in particular, Z. Muhammedjanov focuses on the scientific potential of his hero, and Y. Akhmedov's performance shows the lyrical sides of the character. Both actors create the image of an enlightened man fighting ignorance.

In the drama and play, the tension between Biruni and the fanatical society defines the main conflict. While studying geography, the scientist comes to

the conclusion that the Earth has a spherical shape, and religious scholars seriously oppose this opinion. This conflict takes on a social connotation and becomes a struggle between progressive ideas and a reactionary environment. This is reflected already in the first scene of the play - scientific debates in the palace of Sultan Mamun. The meeting is attended by the ruler, his associates, theologians, Biruni and Ibn Sina. During the discussion, it becomes clear that both scientists adhere to progressive views, that they stand above the dogmatic views of society and have a healthy worldview and thinking. In particular, Biruni speaks with delight about the science of astronomy, that is, the study of heavenly bodies, and notes that many scientists around the world had been discovering the sky. And the court theologians - Sheikh-ul-Islam and 'Alam - declare them infidels (kafirs). It is during this conflict that the worldview and life missions of Biruni and the theologians collide; this confrontation develops during the action of the play and gives rise to true drama.

The dispute between the intellectuals led by Biruni and the supporters of Mahmud Ghaznevi lies at the heart of the conflicts in the work, and the idea of the triumph of enlightenment over ignorance is promoted. This fact is especially clearly manifested in the scene of mutual conflict between Biruni and Ghaznevi. This scene is the most exciting, impressive,





culminating scene of the play, in which Biruni is embodied as a truthful, unbending, firm and strong-willed person. "You are the sultan of ignorance, I am the king of enlightenment," Biruni reproaches Mahmud Ghaznavi. Even when he is sentenced to death, he knows no fear, his courage and bravery amaze Ghaznavi.

In the drama, Uygun uses many fictitious events and images. In particular, to conquer Khorezm, Ghaznavi relies on the help of his treacherous sister Sayyora, marrying her off to Shah Mamun, supposedly to make peace. Having penetrated the enemy's palace, the girl uses various tricks and ultimately kills the

Shah by plunging a dagger into his chest. Also one of the notable fictional characters of the drama is the character of Kaplan-batyr, a simple peasant from the people. He appears as an honest, brave and courageous man who protects Biruni from enemies. In the finale, he dies heroically, protecting the thinker from enemies.

Special attention in the drama is paid to Biruni's love. A scientist falls in love with Gulsanam, a simple maid. Their love gives a lyrical spirit to the social drama. Of course, this image is also a figment of the playwright's imagination, and it is unclear whether there was such a girl in Biruni's life.

It should be noted that the drama was created based on the requirements of socialist realism, therefore the images of most historical figures were not reflected impartially and truthfully. Our opinion is confirmed, for example, by the negative image of Mahmud Ghaznavi, an enlightened ruler who valued Beruni as a scientist and created all the conditions for him to practice science. One of the main principles of the socialist realism style was to oppose the progress of the monarchs of the past, depicting them as people with a primitive worldview, ignorant and spiritually poor. However, it is well known from history that Khorezmshah Mamun greatly respected Biruni and appointed him to one of the influential positions, then he lived in Ghazni for thirty years at the palace of Mahmud Ghaznavi and created priceless works. Therefore, Biruni's confrontation with Ghaznavi was undoubtedly the result of the demands of the time and the influence of ideology.

Now let's talk about the interpretation of the image of Abu Rayhan Biruni on the screen. In 1974, on the occasion of the 1000th anniversary of Biruni's birth, famous film director Shuhrat Abbasov shot





a two-part film “Abu Rayhan Biruni”. With its epic scope, covering the difficult and tragic years of the life of the great scientist, the power of its realistic image and expressiveness, the involvement of a team of professional actors and other features, the film took its rightful place in the history of Russian cinema. The film received recognition not only in our country, but also in the international cultural community. In particular, it was shown at the 4th International Tashkent Film Festival of Asia, Africa and Latin America and received a positive assessment from viewers and experts. In 1976, the film received the Golden Dolphin award at the Tehran Film Festival, and also won the main prize at the 8th All-Union Film Festival (1975).

This picture can be considered a historical-biographical film. It reveals the most dramatic, controversial episodes of the scientist’s life from childhood to old age. The main goal and intention of the director was to fully reveal the conflict between enlightenment and ignorance using the example of Biruni and the era in which he lived. In this sense, the approach to the film is reminiscent of the interpretation of a play. However, in contrast to the stage work, the picture touches more deeply on the same problem, the plot and line of images expand, and qualities of the scientist as a person, his fortitude, will, position, and moral courage are further enhanced.

The film shows two periods of Biruni’s life: youth (Bakhtiyor Shukurov) and the period when he reached heights in science and developed as a personality in all respects (Pulat Saidkasymov). Creating the image of Biruni, the talented actor Pulat Saidkasymov directs all his talent and potential to reveal the psychology

of his hero, to express his feelings, suffering as a person and a scientist, as well as his relationship with the people and society. The actor with feeling, without fuss, reflects the character of the image through thoughtful glances, meaningful silence and psychological experiences. Biruni, embodied by him, appears as a mature scientist of his time, an intellectual and, at the same time, a courageous and selfless person fighting for the fate of the nation and country.

There are several colorful characters in the film. In particular, People’s Artist of Uzbekistan Razzak Khamraev plays the role of Ibn Iraq, Biruni’s teacher and close friend. It is known that Abu Nasr ibn Iraq is one of the founders of the Mamun Academy, a mathematician and astronomer; he regularly communicated with Biruni and Ibn Sina in the palace of the Khorezmshah and at one time was awarded the title of “Batlimusi Sani” (“Second Ptolemy”). Ibn Iraq, performed by Razzak Khamraev, appeared as a real scientist, a wise teacher and a generous person. He notices Biruni’s innate potential even in childhood, properly nurtures his talent and makes a great contribution to his development as a mature scientist. Over time, when he saw that his student had matured in all respects, he wished him good luck and said that he should now study science on his own.

The role of Sultan Mahmud Ghaznevi is played by the famous actor Bimbolat Vataev. As in the play, Ghaznevi is shown as a cruel, despotic, bloodthirsty and autocratic ruler, since the image of the ruler was approached based on the requirements of Soviet ideology. Especially the episode during his reign in Ghazni, in which adherents of the old regime were



brutally killed and burned, is one of the climactic, dramatic scenes of the film.

At the end of the film, Biruni and Ghaznavi confront each other. A scientist, commissioned by the monarch, writes a book about his life and reign, and reveals the whole truth in it. That is, he openly talks about the aggressive policy of Ghaznevi and that he shed the blood of many innocent people. Enraged by this, the Sultan expels Biruni from the palace and angrily shouts that his name will remain on the pages of history and that the future generation will definitely remember him. Actor Bimbolat Vataev skillfully reveals all the shortcomings of Mahmud Ghaznevi.

Another remarkable character in the picture is the maid Rayhona. The girl, who came to Beruni with a desire to study, attracted the attention of the scientist with her knowledge, enthusiasm and hard work. He first teaches the girl, and then, without realizing it, he falls in love with her. As Biruni's student and lover, Rayhona becomes a close confidant of the scientist and helps him in many difficult situations. Unfortunately, at the end of the film, the girl tragically dies at the hands of fanatics. The famous actress Dilorom Kambarova, who played this role, creates the image of an innocent, faithful and brave girl. With her

dramatic abilities and psychological experiences, the actress reveals through the image of the oppressed Rayhona, who became a victim of that era, the terrible essence of the feudal system.

Undoubtedly, it should be noted that in addition to the director and actors, other creators also made a great contribution to ensuring the success of the film. Particularly important is the skill of the famous cinematographer Khatam Fayziev in recreating the atmosphere of bygone days when Biruni lived, immersing the viewer in the spirit of that time. The cinematographer creates an artistic-aesthetic, pictorial-visual expression of the film through majestic, epic-scale shots, close-ups, contrast and allegorical solutions. The creative tandem of film director Shuhrat Abbasov and cameraman Khatam Fayziev reached a high level in this film. It should also be noted the merits of the artist of the picture, Emmanuel Kalantarov, and the composer, Ravil Vildanov. Especially, the music specially written for the film by Ravil Vildanov serves to reveal the spirit of the times and the character of the protagonists, and deeply express dramatic situations and social conflicts.

Although this film and play about the great scientist, a prominent representative of the Eastern Renaissance, Abu Rayhan Biruni, were created based on ideological requirements, it should be noted that the creators have achieved significant success in terms of artistry and skill. Over the years of independence, new studies of Biruni's life and work, scientific heritage have been carried out, and attitudes towards the scientist and the time in which he lived have changed significantly. Consequently, based on today's artistic, aesthetic, social and ideological views, the shooting of new feature films and the staging of performances dedicated to Abu Rayhan Biruni are becoming relevant. This, in turn, places a special responsibility on Uzbek theater and film masters. We hope that in the future, official organizations and artists will take the initiative in this regard and create new works of art that reflect the image of Biruni, artistically and ideologically, and serve as an example for our people, especially the younger generation.

Probiotiklar – akvakultura kelajagi istiqbollari



Mastura Xidirova,
Doctoral student of the Institute of Microbiology

Butun dunyoda akvakultura doimiy ravishda o'sib borayotgan va aholining oziq-ovqatga bo'lgan talabini qondirish uchun rivojlanayotgan sanoat sohadir. Ushbu sohaning rivojlanishi, aynan baliq xo'jaliklari sonining ortishi baliq ozuqalariga talabning oshishiga, tabiiy suv manbalarining kamayishiga hamda zich muhitda boqilayotdan baliqlarda baliq kasalliklarining ko'payishiga olib kelmoqda. Bunday holatlarda mahalliy baliq yetishtirishda sifatsiz yemlardan foydalanish tez-tez kuzatilmoqda. Baliqlarning sifatsiz yem yeyishi natijasida baliqdan najas ajralishining ko'payishi, ortiqcha ozuqaning suvda ko'payishi natijasida suvdagi mikroflora o'zgaradi va immuniteti past baliqlarda kasallikning rivojlanishiga olib keladi. Bunday holatni oldini olish uchun yem tarkibida sifatli oqsil, mikro va makroelementlar solinishi shuningdek yem hazmini yaxshilovchi biologik vositalardan foydalanish maqsadga muvofiqdir.

Yem qanchalik yaxshi hazm bo'lsa ortiqcha axlat hosil bo'lmaydi va suvning tez ifloslanishini oldi olinadi, shuningdek baliq immuniteti yaxshilanadi. Biroq, sifatli ozuqaning yetishmasligi va baliq kasalliklarining avj olishi akvakulturaning asosiy muammosiga aylandi, bu esa akvakultura sanoatiga katta iqtisodiy zarar keltiradi. Davolash uchun qimmatbaho kimyoterapevtik preparatlardan foydalanish suv muhitiga salbiy ta'sir ko'rsatsa, ozuqa sifatining past ekanligi baliqlarning stress sharpoitlarga chidamligining kamayishiga, immun tizimi faolligining pasayishiga sabab bo'ladi. Shuning uchun kasalliklarni davolash uchun boshqa xavfsiz, antibiotik bo'lmagan va ekologik toza muqobillarni topish tashvishi va foydaliligi jihatidan yuqori samarali ta'sirga ega ozuqalarni yaratish va qo'llashga qiziqish ortib bormoqda.

O'zbekistonda ham so'nggi yillarda akvakultura rivojlanmoqda va baliq yetishtirishni ko'paytirish, baliq mahsulotlarining sifatini yaxshilash sohasidagi sa'y-harakatlarga davlat tomonidan alohida e'tibor va ko'mak ko'rsatilmoqda. O'zbekistonda akvakulturani rivojlantirish uchun qulay sharoitlar mavjud bo'lib, daryo, ko'l va suv omborlari akvakultura mahsulotlarini yetishtirish uchun keng imkoniyat yaratadi. O'zbekistonda akvakulturani rivojlantirish ichki ehtiyojni qondirish uchun baliq yetishtirishni ko'paytirish va mamlakatning baliq importiga bog'liqligini kamaytirishga qaratilgan. Davlatimiz akvakultura sohasining o'sishini qo'llab-quvvatlash bo'yicha turli chora-tadbirlarni amalga oshirdi, jumladan, baliq yetishtiruvchilarni moddiy rag'batlantirish va texnik yordam ko'rsatishni ta'kidlash mumkin.

Probiotiklar jonli mikroorganizmlar bo'lib, ular yetarli miqdorda iste'mol qilinganda sog'liq uchun foyda keltiradi. Ular odatda ma'lum oziq-ovqat va oshqozon-ichak traktida mavjud bakteriyalar hisoblanib, ichakdagi mikroorganizmlarning muvozanatini ta'minlash orqali ishlaydi. Akvakulturada probiotiklardan foydalanish zamonaviy tendensiya bo'lib, uning suv muhitida samaradorligi chuqur o'rganilmagan. Probiotiklarni qo'llash yuqumli agentlarni nazorat qilish va kasalliklarni davolash uchun istiqbolli muqobil yondashuv bo'lishi mumkin.

Probiotiklar baliqlarni turli patogenlarga qarshi kurashish uchun tayyorlaydi va umumiy salomatlikni yaxshilaydi, chunki ular bakteriyaga, zamburug'larga va viruslarga qarshi immunitetni rag'batlantirish xususiyatlariga ega. Akvakulturada qo'llaniladigan probiotik bakteriyalar turli joylardan, jumladan, suv hayvonlarining ichaklari, jabrasi va teri shilimshiqalaridan, shuningdek yashash joylaridan va tijorat mahsulotlaridan olinishi mumkin. Bakteriyalar (gram-musbat va gramm-manfiy), bakteriofaglar va achitqilar akvakultura uchun potensial probiotiklar hisoblanadi. Ularning qo'llanilishiga kelsak, ular og'iz orqali yoki suv orqali, eng keng tarqalgan usul ozuqa qo'shimchalari orqali amalga oshiriladi. Probiotiklar mono yoki bir nechta shtammlar sifatida ishlatilishi, shuningdek, ularning ta'sirini kuchaytirish uchun prebiotiklar, immunostimulyatorlar va sinbiotiklar bilan birlashtirilishi mumkin.



Akvakulturada probiyotiklardan foydalanish bir qancha afzalliklarga ega ekanligi tadqiqotlarda isbotlangan. Ular suvda yashovchi organizmlarning o'sishini yaxshilaydigan o'sish stimulyatorlari sifatida harakat qilishi, patogen bakteriyalarga qarshi immunitetni kuchaytirishi va shu bilan kasalliklarga chidamliligini oshirishi mumkin. Bundan tashqari, probiotiklar fermentlar bilan ta'minlash orqali yemdan foydalanish va hazm qilishni yaxshilaydi. Akvakulturada ishlatiladigan umumiy probiotiklarga *Lactobacillus spp.*, *Bacillus spp.*, *Enterococcus spp.* kabi sut kislotasi bakteriyalarini va *Saccharomyces cerevisiae* achitqisini nasash mumkin.

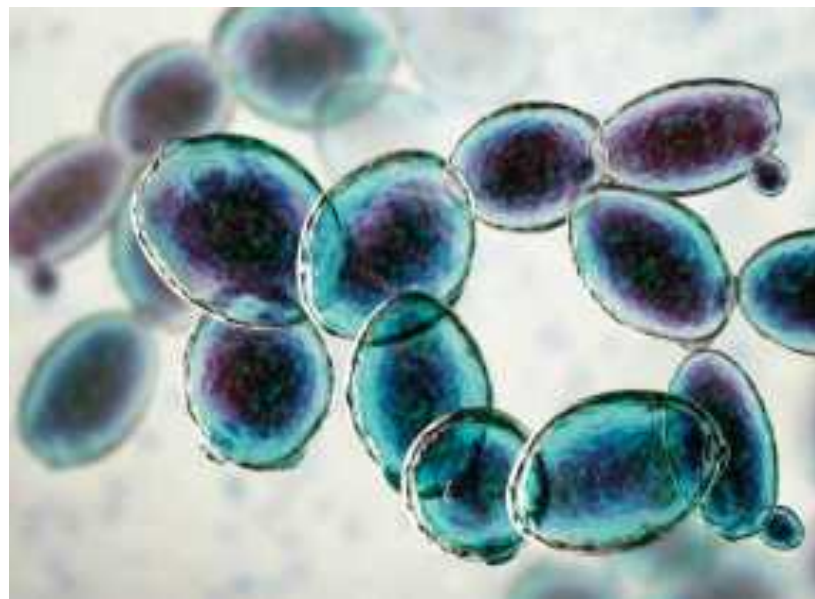
Probiotiklar antibakterial ta'sirga ega bakteriotsinlar, sideroforlar, fermentlar (lizotsimlar, proteazalar) shuningdek vodorod peroksid, organik kislotalar ishlab chiqarish va ichakning pH qiymatining o'zgarishi bilan yuqori antimikrob faollik ko'rsatishi aniqlangan bo'lib, tadqiqotlar probiotiklar baliq patogen bakteriyalari *Aeromonas hydrophila*, *A. salmonicida*, *Flavobacterium psychrophilum*, *Photobacterium damsela* spp. va *Vibrio* infeksiyalariga qarshi antagonizmi borligi isbotlangan. Bundan tashqari, probiotiklar immun tizimini rag'batlantiradi, antibiotiklar uzoq vaqtdan beri akvakulturada kasalliklarni oldini olish uchun ishlatilishi, hayvonlar to'qimalarida antibiotik qoldiqlarining to'planishi, antibiotikka nisbatan bakteriyalarning ko'nikib qolishi va ularning oshqozon-ichak mikrobiotasi muvozanatining buzilishi kabi turli muammolarni keltirib chiqarib, ularning sog'lig'iga salbiy ta'sir qiladi.

Shu sababli organizm uchun zarar keltirmaydigan, tabiiy, antibiotiklarga alternativ bo'la oladigan biologik terapevtik vositalarga talab bor. Tavsiya etilayotgan probiotiklar akvakulturalar uchun eng samarali vositalardir. Ular bir vaqtda suv hayvonlarining ovqat hazm qilish jarayonlariga foydali ta'sir ko'rsatadi, chunki probiotik shtammlar proteazalar, amilazalar va lipazalar kabi fermentlarni sintez qiladi, shuningdek, vitaminlar, yog' kislotalari va aminokislotalar kabi o'sish omillari bilan to'yintiradi. Shuning uchun probiotiklar ozuqaga qo'shilsa, ozuqa moddalari samaraliroq so'riladi, hazm bo'ladi. Moriarti ma'lumotlariga ko'ra, *Bacillus* keng doiradagi ekzofermentlarni ajratadi, bu esa baliq faoliyatini yaxshilaydi

va fermentativ hazm qilishni kuchaytiradi. Shuningdek suv hayvonlarining ovqat hazm qilish traktidan ajratilgan bakteriyalardan xitinazalar, proteazalar, sellyulazalar, lipazalar va tripsin fermentlari aniqlanganligi buni yaqqol isbotidir.

Probiyotiklarning yana bir ta'siri suv muhitini yaxshilash hisoblanib, ular organik moddalarni parchalashi, chiqindilarni kamaytirishi va suv muhitining umumiy salomatligini yaxshilashi mumkin. Bugungi kunda dolzarb muammo bo'lgan suv sifatini yaxshilashda ham probiotik bakteriyalarning o'rni beqiyosdir. Bir qator tadqiqotlar probiotik shtammlarni, ayniqsa gram-musbat *Bacillus* avlodini qo'shish orqali suv sifatini nazorat qilishi o'rganildi. Ayniqsa, bu bakteriyalar guruhi organik moddalarni CO₂ ga aylantirishda gramm-manfiy bakteriyalarga qaraganda samaraliroqdir. Ishlab chiqarish havzalarida probiotiklarni yuqori darajada ushlab turish orqali baliq yetishtiruvchilar vegetatsiya davrida erigan va dispersion organik uglerodning to'planishini minimallashtirishi mumkin, deb taxmin qilinadi va bu tadqiqotlarda isbotlangan, jumladan, Lalloo va boshqalar *Cyprinus carpio* dan *Bacillus*ning bir nechta shtammlarini ajratib olib, suv sifatini yaxshilash va *Aeromonas hydrophila* o'sishini bostirish uchun sinovlar o'tkazganlar va samaradorligini tasdiqlaganlar.

Shu bilan birga, Vang va boshqalar *Bacillus sp.*, *Saccharomyces cerevisiae*, *Nitrosomonas sp.* va *Nitrobacter sp.* dan tayyorlangan tijorat mahsulotini tadqiq qilishganida *Penaeus vannamei* qisqichbaqalarining foydali bakterial mikrobiotasini ko'paytirish qobiliyatiga ega bo'lishi hamda noorganik azot konsentratsiyasini kamaytirishi aniqlangan. Probiotiklar baliq kasalliklariga asosiy sababchi bo'lgan stress omilini kamaytirishi orqali ham akvakulturada foydali ta'sir ko'rsatganligini ta'kidlash mumkin. *Danio rerio* (zebrafish)dagi surunkali stress mushak oqsili sintezining umumiy pasayishiga olib kelishi haqida xabar berilgan. Natijada, probiyotiklar yordamida stressga chidamliligini oshirishga harakat qilindi. Ushbu sohadagi birinchi rasmiy hisobotlardan *Lactobacillus delbrueckii ssp* qo'shilishini o'rganib chiqdi. Probiotik *Sacharomyces cerevisiae* va *Clostridium butyricum*, *Lactobacillus acidophilus*, *Bacillus subtilis* bilan davolangan guruh nazorat guruhiga qaraganda tijoriy





probiyotik qo'shilgan baliqlar probiotik qo'shilmagan baliqlarga qaraganda stress testida ko'proq bardoshlik ko'rsatdi. *Pediococcus acidilactici* MA 18/5 ning *Litopenaeus stylirostris* qisqichbaqasining oksidlovchi stressga qarshi antioksidant faolligi o'rganilib, tadqiqotda antioksidant fermentlardan superoksid dismutaza va katalazaning yuqori faolligi ko'rsatgan. Ma'lumotlarga ko'ra, probiotiklar baliqlarning ko'payish jarayonida ijobiy yordam beradi. Akvakultura naslchilik turlari ozuqa moddalariga yuqori talablarga ega, shuning uchun reproduktiv qobiliyat lipidlar, oqsillar, yog' kislotalari, C va E vitaminlari va karotinoidlarning tegishli konsentratsiyasiga bog'liq. Bundan tashqari, ushbu komponentlarning o'zaro ta'siri ko'payish, urug'lanish, tug'ilish va lichinkalarning rivojlanishi kabi turli jarayonlarga ta'sir qiladi. *B. subtilis* bilan oziqlantirish barcha to'rt turdagi urg'ochilarda gonadosomatik indeks, unumdorlik, yashovchanlik va ikra ishlab chiqarishning oshishiga olib keldi.

Ushbu ma'lumotlarga asoslanib aytish mumkinki, akvakulturada probiyotiklarning salohiyati juda beqi-

yos. Ular hayvonlar salomatligi, o'sishi va mahsuldorligini yaxshilash, antibiotiklar va boshqa kimyoviy moddalarga qaramlikni kamaytirish uchun barqaror, ekologik toza yondashuvni taklif qiladi. Tadqiqotlar davom etar va me'yoriy-huquqiy bazalar rivojlanib borar ekan, biz ushbu kichik ittifoqchilarning ko'proq qabul qilinishini kutishimiz mumkin, bu esa akvakultura uchun yanada sog'lom va barqaror kelajakka yo'l ochib beradi. Probiyotiklar akvakulturada muhim rol o'ynaydi. Ular baliq va boshqa gidrobiont sog'lig'ini saqlashga yordam berish uchun akvariumlar yoki hovuzlarga qo'shilishi mumkin bo'lgan jonli mikroorganizmlardir. Probiotiklar ovqat hazm qilishni yaxshilashga, immunitet tizimini mustahkamlashga va suv hayvonlarida kasallik xavfini kamaytirishga yordam beradi. Akvakulturada ishlatiladigan eng keng tarqalgan probiyotiklardan *Lactobacillus*, *Pediococcus*, *Enterococcus*, *Bifidobacterium* va *Bacillus* avlodi vakillari keng miqyosda foydalaniladi. Ushbu probiyotiklar *Aeromonas* va *Pseudomonas* kabi patogen bakteriyalarga qarshi kurashishda yordam beradi, shuningdek, *Bacillus* avlodi vakillari jumladan *Bacillus subtilis* suv sifatini yaxshilash va ifloslantiruvchi moddalarni kamaytirishga yordam beradi.

Akvakulturada probiyotiklardan foydalanish bir qator afzalliklarga ega, jumladan baliqlarning omon qolishini oshirish, o'sish va rivojlanishni yaxshilash va kasalliklardan yo'qotishlarni kamaytirishga yordam beradi. Ammo shuni hisobga olish kerakki, probiyotiklarning samaradorligi ko'plab omillarga bog'liq. Masalan: baliq turi, saqlash sharoitlari va probiyotik mahsulotlarning sifati va boshqalar. Umuman olganda, probiotiklar suvda yashovchi organizmlarning sog'lig'i va ishlashini saqlash uchun akvakulturada muhim vositadir. Probiyotiklarni ishlatishdan oldin, tajribali mutaxassislar bilan maslahatlashish va ulardan foydalanish bo'yicha tavsiyalarga qat'iy amal qilish muhim.



New wave of young scientists and scholars



A'lo Isakova,
executive secretary of the journal "Fan va Turmush"

Since ancient times, our ancient land has given the world many great scientists and polymaths. In particular, the Mamun Academy, founded in 1004 by the Mamunids, operated in Khorezm. The scientific environment and the conditions created by the ruler led to the arrival of scientists and scholars from different regions of the world who were engaged in research activities within the walls of the academy. There were constant scientific discussions with scientists and scholars from the Near and Middle East.

In the history of our statehood, the period of Amir Timur and the Timurids was the highest point in the development of science. Amir Timur gathered scientists and scholars in his palace. Arabshah notes that



"Timur was kind to scholarly people, he brought the sayyids and sharifs closer to him. In paying tribute to scientists, he honored them more than any other person. By placing each of them in the appropriate position, he thereby expressed his respect." During this period, there was a rise in many fields of science in Transoxiana and Khorasan. World famous scientists and scholars, religious figures and poets made their presence known. Particular attention was paid to medicine, mathematics, geometry, history, literature, geography, pedagogy, logic, philosophy, ethics and other sciences.

Today in our country a huge amount of work is being done to develop science in order to lay the foundation of the Third Renaissance. In this regard, on November 18, 2022, on the initiative of the Center for the Promotion of Science, created by Cabinet Ministers' Resolution No. 652, a competition in the field of science and innovation "Eureka" was organized with the aim of worthy encouragement of young scientists and scholars who contribute to the development of





society, leaders in scientific fields and achieving great results. The main goal of the competition is to search for young scientists and specialists aged 18 to 40 years, to familiarize the public with the scientific work they perform and, of course, to reward young specialists for their achievements in science and innovation.

The competition was attended by researchers working at research institutes of the Academy of Sciences system. Contestants competed among themselves in 5 areas: 1. Numbers rule the world (exact sciences); 2. Man and nature (natural sciences); 3. The world of technology and IT (the field of information technology and other technologies); 4. Society, history, culture (social sciences and humanities) and 5. Young active female scientist/scholar (especially for women). The competition was held in 2 stages. While Stage 1 was an institute-wide competition, the Stage 2 was inter-institutional. Members of the jury, consisting of academicians and professors working in the Academy of Sciences system and contributing to the Uzbekistan and the global science, interviewed each participant. In their presentations, the participants

substantiated the relevance and scientific significance of their research work.

Based on the results of the competition in the first direction, the places were distributed as follows: 1st place: Khakimov Otabek - V.I. Romanovsky Institute of Mathematics, 2nd place: Yuldashev Kudratulla - Astronomical Institute, 3rd place: Yuldasheva Nargiza - V.I. Romanovsky Institute of Mathematics.

Second direction: 1st place: Yusupov Ziyauddin - Institute of Botany, 2nd place: Ruzmetov Abrori - Institute of General and Inorganic Chemistry, 3rd place: Yuldashev Sherzod - Institute of Chemistry and Physics of Polymers.

In the third direction, the following researchers took prizes: Yusupov Dilmurad - Institute of Energy Problems, 2nd place: Khamdamov Muzaffar - Institute of Mechanics and Seismic Strength of Structures, 3rd place: Turakhojaeva Fazilatkhon - Institute of Ion-Plasma and Laser Technologies.

Fourth direction: 1st place: Rakhmanov Zafar - National Center of Archeology, 2nd place: Siddikov Mirshad - Institute of History, 3rd place: Abdurasulov Shahruxh - Institute of Art History.

The fifth direction 5 was specially created with the aim of improving the position of women in society and science, supporting young women scientists and scholars: 1st place: Khidirova Mastura - Institute of Microbiology, 2nd place: Pecherskaya Maria - Institute of Materials Science, 3rd place: Eshniyazova Ayimkhan - Institute of the Uzbek Language, Literature and Folklore.

The award ceremony for the winners of the competition was solemnly held on November 28, 2023 by the Uzbekistan Academy of Sciences, the Center for Promotion of Science of the Uzbekistan Academy of Sciences and the partner organization, the World Society for the Study, Preservation and Popularization of the Cultural Heritage of Uzbekistan.

The Eureka competition further increased the interest of young people in science. The expansion of the ranks of young scientists serves to strengthen their faith in the future.



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Apple has made its own adjustments to the field of mobile telephony. It completely changed the world by making smartphones easier to use.

Today, almost everyone recognizes Apple products by the logo, which depicts a bitten apple, but this was not always the case.

The company's very first logo depicted Isaac Newton sitting under an apple tree. This image was created by one of the founders, Ronald Wayne. And we can immediately highlight another significant fact.

The Apple founder sold his shares to Steve Jobs and Steve Wozniak for just \$800, but today they could bring him more than \$20 billion. After leaving the company, Ronald had no success in his professional activities. And until 2011, he did not use a single gadget released by Apple.

The Newton logo was not used for long. The thing is that in a small form it did not look as good as in the drawing due to the fact that there were quite a lot of small details.

In 1976, it was replaced by a rainbow apple, which was practically a picture that every user can see on gadgets today. The official change of the logo to a modern design occurred only in 1998.



The book Little Prince and its popularity

The children's book that was never a children's book that the lucky ones encountered in childhood and those who got acquainted too late, like the one who wrote this article, admire it. This is Saint-Exupéry's masterpiece, which should be re-read every year, at any age, with the exposition of philosophy it contains, and which creates a new path for a person and a new perception every time it is read.

Perhaps the most important reason why the book has become an icon of popular culture is the image of the Little Prince created by the author himself. The illustrations in the book are painted in watercolors by the author himself. Necklaces, figurines, notebooks of the Little Prince... When we go to souvenir shops, we come across a figurine of the Little Prince. I must say, the figure of popular culture is the Little Prince.

The author of the book, Antoine de Saint-Exupéry, as we have already said, was a pilot. He was involved in a plane crash in the 1930s and spent several days struggling to survive in the desert. The author, who miraculously survived, added the "desert" detail to The Little Prince, which he wrote about later about the event. The fact that the Little Prince suddenly finds himself in the middle of the desert is completely autobiographical.





Interesting facts about volcanoes and eruptions

Volcanic eruptions are phenomena as beautiful as they are destructive. Mentions of monstrous eruptions and the devastation they caused are preserved in legends. Fortunately, nowadays people have learned to predict in advance when the next volcano will once again want to emit streams of hot magma.

1. The word “volcano” comes from the name of the ancient Roman god Vulcan, the lord of underground fire.

2. The most dangerous active volcano these days is considered to be the Popocatepetl volcano, located thirty kilometers off the capital of Mexico.

3. There is not a single active volcano in Australia.

4. Many inhabited islands are of volcanic origin, for example, Grenada (see interesting facts about Grenada).

5. The lands adjacent to volcanoes are considered one of the most fertile.

6. The speed of lava flowing from the mouth of an erupting volcano can reach 70-90 kilometers per hour.

7. Suritsey Island, located near Iceland, is the youngest island on Earth. It appeared in 1963 as a result of the eruption of an underwater volcano.

8. At the beginning of the 20th century, the eruption of the Mont Pelee volcano on the island of Martinique caused the death of the entire population of the island, killing more than thirty thousand people. By a happy coincidence, only two islanders managed to escape.

9. There are about one and a half thousand active volcanoes on the Earth’s surface.

10. Archaeologists have found that a supervolcano eruption that occurred about 75 thousand years ago caused a “volcanic winter” effect, blocking the sun for many years, and even caused rains of sulfuric acid



What are the Northern Lights

The Northern Lights are also called the aurora. It is provoked by the solar wind - a stream of ionized particles emanating from the Sun at a speed of 300-1200 km/s. When these particles reach the Earth’s magnetic field, they merge with the atmosphere and paint it with colorful stripes. In this case, the color depends on the type of gas particles.

The palette of the northern lights is dominated by pale green. It comes from oxygen molecules floating at an altitude of about 100 kilometers from the Earth’s surface. This is the type of glow that occurs most often. It is much less common to see the northern lights in red hues. These oxygen particles flare up at an altitude of up to 300 kilometers. Aurora also comes in blue and violet-red. Nitrogen molecules glow in these colors.

The area where the northern lights can be seen is called the auroral oval. When the Sun is calm, its diameter can be up to 3000 km - the same as the distance between Kaliningrad and Yekaterinburg, Russia. It would seem that a celestial glow of such a scale should be visible under any conditions. But it’s not that simple.

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