SCIENCE FOR THE BENEFIT OF MANKIND

FAN VA TURMUSH

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690th ANNIVERSARY OF AMIR TEMUR

- Enlightenment in science
- Locusts are swarming insects
- Artificial Intelligence and Water Resources
- About the prominent scientist and archaeologist Edvard Rtveladze

Two grasshoppers with spikes along the tibia of their hind legs.
Author: Faunagalaxy

EDITORIAL

Dear readers of the journal "Fan va turmush"!

This issue is published following the large-scale celebration of the 690th anniversary of the birth of Sahibkiran Amir Timur, a great statesman, a brilliant military leader, and the greatest patron of science, culture, and art. He entered world history as a true architect of the Timurid Renaissance, which gave a powerful impetus to the development of the exact sciences and humanities. Today, as our country confidently enters a new stage of its national progress—the Third Renaissance—this tradition of tireless scientific enquiry has received a worthy continuation.

In this issue, we offer readers a broad overview of contemporary research in a wide range of fields of fundamental and applied sciences. Our researchers focus on fundamental questions of understanding the universe, the mysteries of nature and the microworld, as well as technological innovations of critical importance to the region, including the introduction of artificial intelligence in natural resource management and the development of high-speed information systems.

A significant portion of this issue of our journal is devoted to a profound understanding of national history, archaeology, and architectural heritage, which helps us better understand the cultural codes of the past. Additionally, the issue's authors address current issues of contemporary design, inclusive environments, and fashion, while the "Young Scientists' Tribune" traditionally gives voice to a new generation of researchers preserving the unique craft traditions of our region.

We hope this issue will inspire you and provide new insights, as it is through respect for our great past and bold scientific thought that our shared, successful future is forged.

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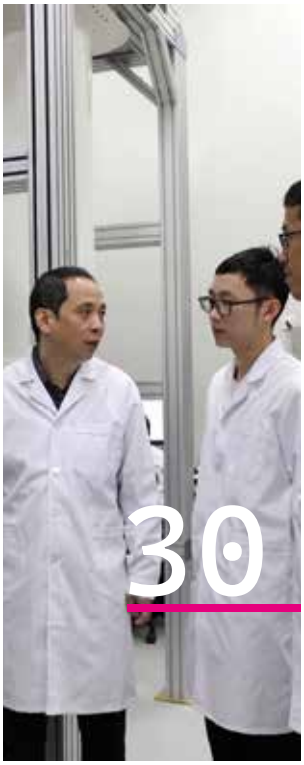

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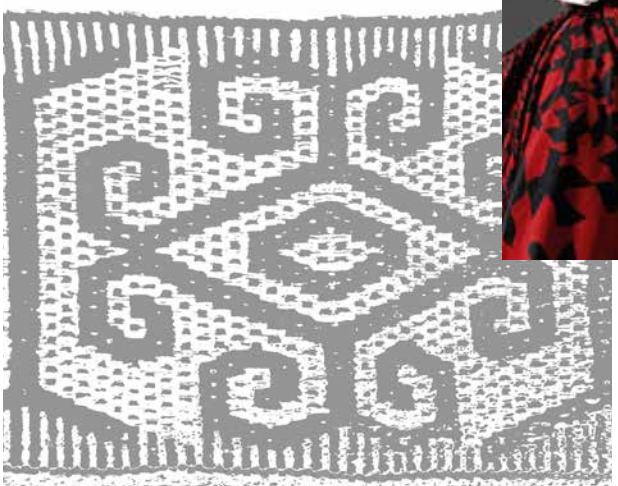


The greatness of sahibkiran through the eyes of scolars 690th anniversary of the birth of Amir Timur

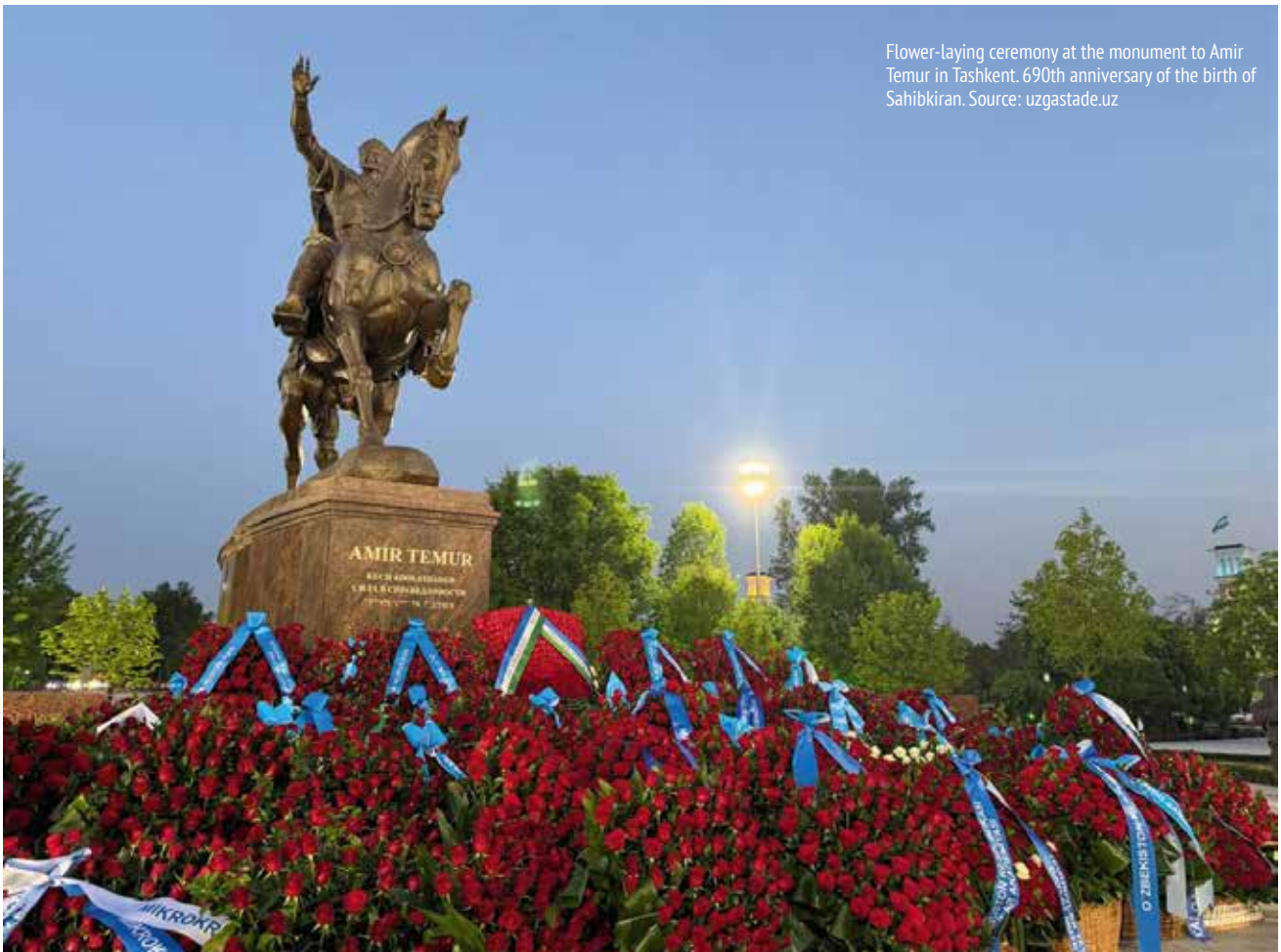
Masharip Abdullaev,
Doctor of Art History

Since the first years of independence, our country has been undertaking extensive work aimed at in-depth study of Amir Timur's rich scientific, spiritual, and cultural legacy and its widespread popularisation in Uzbekistan and abroad. A key step in this direction was the Resolution of the President of the Republic of Uzbekistan of February 5, 2026, "On the extensive celebration of the 690th anniversary of the birth of the great statesman and military leader, patron of science, culture, and art, Sahibkiran Amir Timur". Referring to his unique historical significance as the founder of the Second Timurid Renaissance, the Resolution emphasises the need for an in-depth study of "...the national and universal essence of the Second Renaissance, its enormous role and influence in educating the younger generation as the builders of the New Uzbekistan..."

In accordance with the decree, the State Museum of Timurid History underwent major renovations, large-scale landscaping of the square surrounding the monument to Amir Timur was undertaken, postage stamps and commemorative coins were issued, and feature films and documentaries were produced to reveal the historical figure's image. For the anniversary, the text of the "Codices of Timur" was published with scholarly commentary in Persian, Arabic, Chinese, English, French, Spanish, and Russian.

Dozens of works have been published on Amir Timur and the Timurids. Work continues on creating book-albums, "100 Rare Manuscripts of the Timurid Era" and "100 Rare Masterpieces of the Timurid Era", dedicated to the history of Amir Timur and the Timurid era. Copies of original written sources on the Timurid era held abroad are also being brought to Uzbekistan.

In the New Uzbekistan, Amir Timur is revered not only as a historical figure but also as a symbol of strong statehood, fair governance, and national pride. His rich legacy occupies a significant place in the spiritual life of our people, in the system of public admin-



Flower-laying ceremony at the monument to Amir Temur in Tashkent. 690th anniversary of the birth of Sahibkiran. Source: uzgastade.uz

The President of our country visited the renovated State Museum of the History of the Timurids

istration, and in the education of the younger generation. Now, the month of April is declared "The Month of Amir Timur" each year, and during this observance, meetings and educational events featuring scholars, writers, and artists are organised in comprehensive schools, specialised secondary, vocational, and higher education institutions, military units and military training institutions, businesses, and mahallas.

One of the main events in the celebration of Sahibkiran's anniversary was the International Scientific Conference on "The Role and Significance of Amir Timur and the Temurid Civilization in World History and Culture". The conference took place on April 9-10, 2026, at the Centre of Islamic Civilisation in Uzbekistan. Before the opening of the conference, a congratulatory message from the President of Uzbekistan, Shavkat Mirziyoyev, was read to the participants. In particular, it noted the following: "In New Uzbekistan, extensive work is being carried out to study the role and significance of the legacy of Amir Timur and the Timurids in the history of world civilization, to widely popularize it in the country and abroad, and to educate young people in the spirit of love for the Motherland... We will consistently continue our cooperation with you, true friends of Uzbekistan – tireless scholars and researchers who deeply study the Timurid Renaissance and our entire rich historical heritage, to further widely familiarise the world community with the reforms being carried out in the country in the socio-spiritual sphere".

The conference was attended by over 300 leading scholars, experts, diplomats, and members of the public from over 25 countries. Representatives of international organizations and academic centres, including ICESCO, the Oxford Centre for Islamic Studies, IRCICA, and the Al-Furqan Foundation, also participated.

The conference was organised by the Centre of Islamic Civilisation, the Uzbekistan Academy of Sciences, and the Ministry of Foreign Affairs in collaboration with the World Society for the Study, Preservation, and Popularization of the Cultural Heritage of Uzbekistan (WOSCU). Speakers discussed key aspects of the Timurid era, including public administration and diplomacy, military art and strategy, architecture and urban planning, as well as the development of science, education, and culture. Particular attention

The exposition of the State Museum of the History of the Timurids after reconstruction

was paid to the influence of Amir Timur's legacy on the formation of world civilisation, politics, and economics.

The international conference included a visit to the Centre of Islamic Civilisation, thematic exhibitions, a screening of the feature film "Amir Timur and Donna Maria," a mapping show, and a theatrical performance of "Wedding in Konigild". The film "Amir Timur and Donna Maria," shown during the conference, was also warmly received by participants. Particular attention was paid to the contemporary artistic interpretation of Sahibkiran's human qualities and his place as a historical figure.

Following the conference, scientific recommendations were developed, a plan for further study and popularisation of the legacy of the great Timurids was adopted, and an address from the conference participants was sent to the President of the Republic of Uzbekistan. The fact that Uzbekistan has become a global centre for the study of Amir Timur's legacy was once again confirmed by the results of this international conference.

During the closing ceremony, memoranda of understanding were signed between the Centre of Islamic Civilisation and several leading international scientific and cultural organizations. This conference marked an important step in strengthening international scientific dialogue and promoting Uzbekistan's rich historical and cultural heritage globally.

International interest in Amir Timur and his legacy in statecraft is growing. Academic conferences, exhibitions, and cultural events have been organized in a number of foreign countries. This demonstrates that Amir Timur's place and influence in global civilisation are increasingly recognised.

International Scientific Conference "The Role of Amir Timur and the Timurids' Civilisation in World History and Culture." Centre of Islamic Civilisation in Uzbekistan, 2026

Film "The Great Amir and Donna Maria." 2025

Insight in science

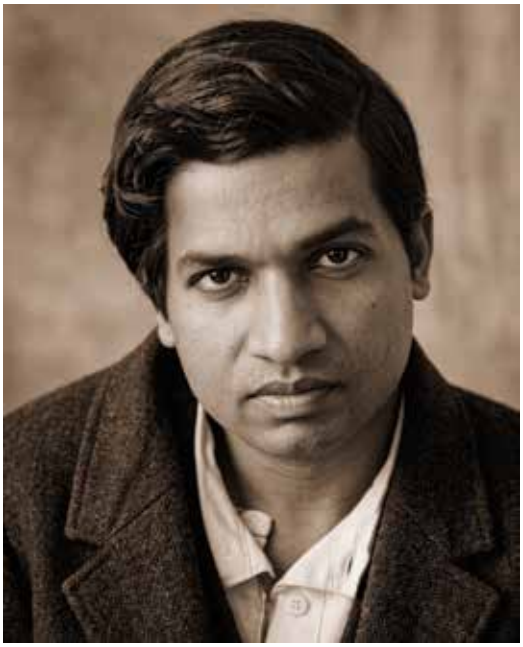
Abdulla Azamov,
Academician

Prologue. "A difficult task? Yes..."

Among all branches of scientific knowledge, mathematics stands out for its precision. This is due to several factors. First, mathematical truths are expressed by symbols with a precise, fixed meaning (any mathematical text can be rewritten symbolically). Second, every "acquired" scientific knowledge must be rigorously proven deductively, and third, what is proven is an immutable truth. Everything is unambiguous and indisputable. Only the process of "acquiring" mathematical knowledge remains mysterious. This process occurs in the mind, and it is difficult to determine whether mathematical thinking has any distinctive features. Nevertheless, there is certainly something about mathematical thinking that fundamentally distinguishes it from other sciences, including its closest relatives, physics and linguistics. At first glance, this is due to the abstract nature of mathematics. But we would like to emphasize, there is more to it than that.

First, a few words about abstraction. This quality is not a monopoly of mathematics—it is inherent in any form of scientific inquiry. However, it should be noted that abstraction in modern mathematics has been taken to extremes—many concepts are so removed from objective reality that the connection between, for example, algebraic geometry and nature is virtually impossible to discern. (Contrary to the meaning of the word "geometry"—the measurement of the Earth.) For comparison, consider the branch of physics known as quantum mechanics. Despite its high degree of abstraction, the objects it studies are nevertheless derived from objective reality, and this reality serves as a "guiding star" for the researcher. In mathematics, however, the situation is fundamentally different. For example, Fermat's Last Theorem has no connection to reality (pure mental arithmetic). To avoid misconstruing these words, let's give the opposite example: Galois's theorem in group theory is no less abstract, yet it finds application in physics and crystallography.

Some eminent mathematicians, such as Henri Poincaré, Jacques Hadamard, and György Pólya, have attempted to shed light on the process of mathematical discovery, but it remains shrouded in mystery. A striking example of this mystery of mathematical thinking is Srinavasa Ramanujan.



Srinavasa Ramanujan (1887 – 1920). "The Genius of Indian Mathematics"

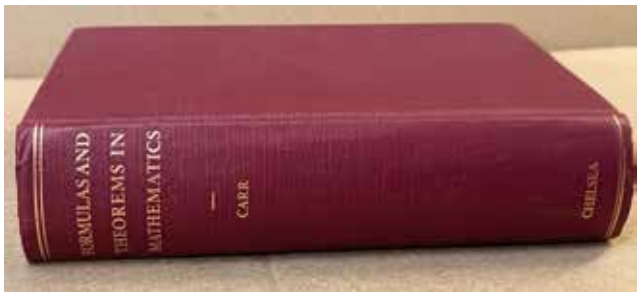
S. Ramanujan was born in 1887 in a small village in Tamil Nadu, far from any major cities. His family belonged to the exclusive Brahmin caste. His parents raised him in the spirit of religious tradition, particularly rejecting everything European, personified by the British colonialists who openly plundered India's wealth. It could be said that all circumstances were against Srinavasa becoming a mathematician. And to some extent, this was the case. But only to some extent. He was gifted with mathematical talent to such a degree that he was able to overcome all obstacles, like grass against asphalt.

Even in elementary school, Ramanujan demonstrated an aptitude for mathematics, which earned him admission to a junior high school with a discount—half-tuition. Apparently, geometry wasn't taught at this school, only algebra, and even then, only in the form of ready-made formulas, since by the time he graduated, Ramanujan had no idea what proof was. (Let's remember this circumstance as the first factor in the formation of the future mathematician). It so happened that a visiting university student lent him a trigonometry textbook, which contained quite detailed material, including trigonometric functions of a complex (!) argument. This subject primarily deals

with various formulas, which became the second factor.

When Ramanujan was in his final year of school, he came across a two-volume mathematics textbook by J. Carr, and this became the third factor. Carr's book was unique – it contained formulations of theorems of analysis (without proofs, of course), but mainly consisted of over 6,000 formulas from mathematical analysis and number theory. It ultimately shaped the future mathematician's thinking – Ramanujan began to live in a world of formulas. Moreover, with only a fragmentary knowledge of school mathematics and no university education at all, he began to independently discover new formulas! Naturally, without any proofs, since he had no idea what they were.

Naturally arises a question: if there's no proof, then the formula is likely to be incorrect. But not a single one of Ramanujan's formulas was incorrect! True, he could perform long sequences of arithmetic operations in his head. This skill allowed him to verify the correctness of formulas in specific cases, and that's all he did. Of course, not all of his formulas were new—some had already been discovered by other mathematicians, but Ramanujan didn't know that.



J. S. Carr. "A Collection of Formulas and Theorems in Pure Mathematics" (Edited/analyzed by J. Dutka)

After finishing school, the future mathematician entered college but was unable to continue his studies due to poverty. His father's friends helped him find a low-level job at the postal service. One day, a colleague saw his notebook of formulas and recommended he show them to mathematicians at the University of Madras—at the time, a provincial institution, despite its grandiose name. They failed to appreciate the significance of Ramanujan's formulas, but they did the right thing by recommending that he contact Hardy. This was very good advice. If another mathematician had been in Hardy's place, everything could have ended tragically.

Godfrey Harold Hardy (1877-1947) was a member of the Royal Society (i.e., the British Academy of Sciences), one of the renowned scientists of his era, nicknamed "the last representative of classical mathematics". Here, "classical mathematics" refers to the discipline that primarily operates with formulas. It would be no exaggeration to call the great Leonhard Euler (1707-1783) the "father of classical mathematics." He solved the Basel problem in a highly original way—calculating the sum of numbers of the form:

$$: 1, \frac{1}{2^2}, \frac{1}{3^2}, \frac{1}{4^2}$$

and so on ad infinitum. Euler found the answer $\frac{\pi^2}{6}$, i.e., derived the formula:

$$1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots = \frac{\pi^2}{6}.$$

(The expression on the left is an infinite sum.)

Let's return to the 20th century. One day, G.H. Hardy received a letter from a clerk in distant India that read as follows:

Dear Sir,

Let me introduce myself, I am an accounts clerk in the Madras Post Office with a salary of only 20 pounds sterling per annum. I am now about 23 years old. I do not have a university education, but I have graduated school.

After school, I spent all my free time studying mathematics. I didn't follow the regular curriculum that universities teach, but I forged my own path. I've been particularly diligent in studying divergent series, and the results I've obtained are considered astounding by local mathematicians. I encourage you to review the attached materials.

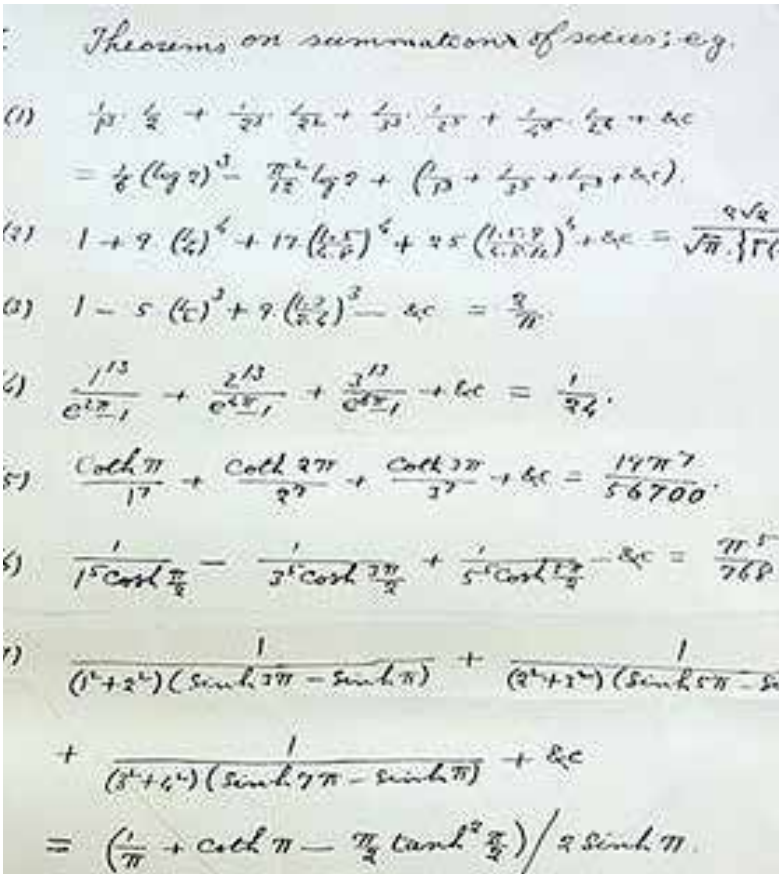
I am poor and cannot publish them, but if you find anything valuable among them, I ask you to publish it. I am not sharing my calculations or the final results I have obtained, but only outlining the paths I have taken. Since I am very inexperienced, I would highly value any advice you would deign to give me.

With begging your pardon for the trouble I have caused you, I remain, dear sir, yours sincerely

Srinavasa Ramanujan ".

Attached to the letter was a voluminous notebook containing more than two hundred formulas.

A page from Ramanujan's letter to Hardy



To give the reader an idea of what we are talking about, we will give a few examples:

$$e^{\pi\sqrt{58}} = 396^4 - 104.000000177\ldots.$$

$$1-5\left(\frac{1}{2}\right)^3+9\left(\frac{1\cdot3}{2\cdot4}\right)^3-13\left(\frac{1\cdot3\cdot5}{2\cdot4\cdot6}\right)^3+\ldots=\frac{2}{\pi}$$

$$e = 3+\cfrac{-1}{4+\cfrac{-2}{5+\cfrac{-3}{6+\cfrac{-4}{7+\ldots}}}}$$

$$\sqrt{1+2\sqrt{1+3\sqrt{1+4\sqrt{1+\ldots}}}}=3.$$

This formula involves infinitely repeated operations of summation, division, and root extraction. It also involves a familiar number (the universal constant — the ratio of a circle's circumference to its diameter) and the number (another important constant, designated by the first letter of Euler's last name). And the next equation involves yet another mathematical constant— $\gamma = \frac{\sqrt{5}-1}{2}$ the "golden ratio":

$$1+\cfrac{1}{1-\cfrac{e^{-\pi}}{1+\cfrac{e^{-2\pi}}{1-\cfrac{e^{-3\pi}}{1+\cfrac{e^{-4\pi}}{1-\ldots}}}}}=\left(\sqrt{\gamma}\sqrt{5}-\gamma\right)\sqrt[5]{e^{\pi}}.$$

Among the formulas were some that involved elements of higher analysis – the Euler gamma function, Bessel functions, and others. For example, the following formula

$$2\int_0^{+\infty}\frac{dx}{(1+x^2)(1+r^2x^2)(1+4x^2)(1+r^8x^2)\cdots}=\frac{\pi}{1+r+r^3+r^5+r^7+\cdots}$$

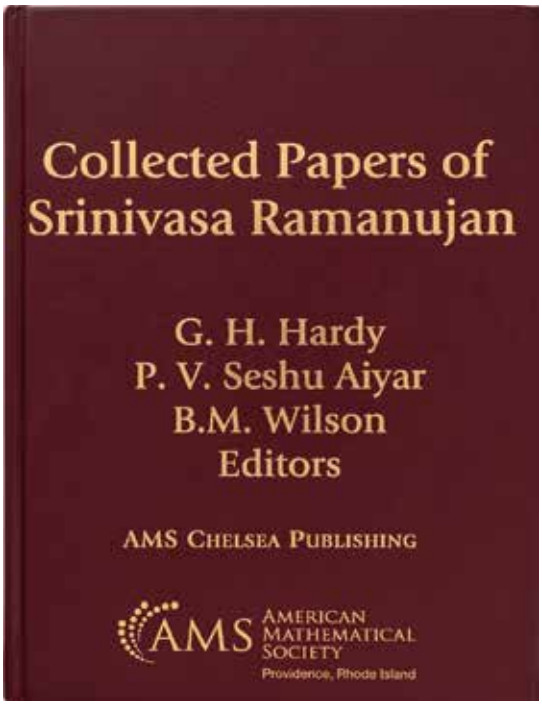
contains an improper integral, which is studied at the end of the second year of university!

Hardy was particularly struck by the identity:

$$1+\frac{1}{1\cdot3}+\frac{1}{1\cdot3\cdot5}+\frac{1}{1\cdot3\cdot5\cdot7}+\frac{1}{1\cdot3\cdot5\cdot7\cdot9}+\ldots+\cfrac{1}{1+\cfrac{1}{1+\cfrac{2}{1+\cfrac{3}{1+\cfrac{4}{1+\cfrac{5}{1+\ldots}}}}}}=\sqrt{\frac{e\cdot\pi}{2}}$$

(here the infinite sum and the infinite fraction are associated with the main constants of mathematics, and in an equal position, although by definition they are completely different).

The entire notebook was filled with these and even more astonishing formulas. (Those interested



A collection of Ramanujan's works published after his death

can view them on the website https :// archive . org / details / pli . kerala . rare .28155/ page / n 39/ mode /2 up :)

It was clear that the author of the letter was a gifted mathematician. Hardy thought that Ramanujan had learned from somewhere, or most likely discovered, a special method for deriving such formulas. And so, he wrote back to Ramanujan, asking him to share the method by which the formulas had been discovered. The young man was probably happy to receive a letter from the famous mathematician, but he didn't understand what the venerable scientist was asking – a method? He had no method. He thought and thought and... wrote down a formula. What method could there be here? And why were they correct? Why would he write down incorrect formulas? Did he need proof? What proof? Wasn't it enough that the formulas were correct? Yes, these two mathematicians were completely different – in education, in their thinking style, and in their understanding of mathematics.

Ramanujan sent Hardy a second letter, stating that he had no method, that he had nothing to hide, and that he wanted everyone to know about his discoveries. He also enclosed an even thicker notebook with new formulas. The wise Hardy realized he was dealing with a truly extraordinary case – Ramanujan was a unique discoverer, unlike any other mathematician, past or present. He invited him to Cambridge, one of the world's leading centers of the exact sciences at the time. Furthermore, he wrote to the Viceroy of Madras to help organize Ramanujan's trip.

After lengthy family discussions, Ramanujan departed for England. When he arrived in Cambridge, Hardy faced a dilemma: What should he do? Recommend him to university and further his knowledge? The scientist realized that this could ruin Ramanu-

jan's talent. Hardy then decided to work with him, combining his classical style with Ramanujan's mystical one. And so, began the collaboration between the British mathematician and the self-taught Indian mathematician.

Hardy's associate J.I. Littlewood is said to have said, "Every number was Ramanujan's friend." When Ramanujan was hospitalized, Hardy visited him and said, "I arrived in a taxi with the number 1729—a very boring number, it turns out, that can be factored into two prime factors: $1729 = 7 \cdot 247$, and that's all". Upon hearing this, Ramanujan perked up, raised his head, and said, "No, Hardy, no. It's a very interesting number. It is the smallest of all the numbers that can be represented as the sum of two cubes in two ways" ($1729 = 1^3 + 12^3 = 9^3 + 10^3$).

Hardy's collaboration with Ramanujan yielded many valuable results for science. One of these results is impossible not to mention: the solution to the problem of enumerating partitions of natural numbers. Euler had also studied this problem, but it remained open. The problem is stated simply: given a natural number n. In how many ways can it be factored into a sum of natural numbers? For example, 1 has only one way, 2 has two ways: 2 and 1 + 1, and 4 has five ways: 4, 3 + 1, 2 + 2, 2 + 1 + 1, and 1 + 1 + 1 + 1. The number of possible such factorizations of a number is denoted by $p(n)$. This sequence grows rapidly. Thus, by hand one can calculate that $p(10) = 42$, and with a computer: $p(50) = 204\,226$, $p(100) = 190\,569\,292$

Euler established the formula:

$$1 + p(1)x + p(2)x^2 + p(3)x^3 + p(4)x^4 + \cdots = \frac{1}{1-x} \cdot \frac{1}{1-x^2} \cdot \frac{1}{1-x^3} \cdot \frac{1}{1-x^4} \cdot \ldots$$

(On the right side is an infinite product.) But $p(n)$ there was no formula for finding the number itself. Not even an approximate one. After much research, combining Hardy's powerful arsenal of classical methods and Ramanujan's mysterious insights, the formula was constructed:

$$p(n) \approx \frac{1}{\pi\sqrt{2}} \sum_{k=1}^{\infty} A_k(n)\sqrt{k} \cdot \frac{d}{dn}\left(\frac{sh\left(\frac{\pi}{k}\sqrt{\frac{2}{3}n}\right)}{\sqrt{\frac{2}{3}n}} \right)$$

(The function $A_k(n)$that existed before is defined by an even longer expression). Dear reader, do not be afraid of this colossus, look at it as a picture.

The formula he had constructed was approximate, but it yielded close values of $p(n)$, which in itself was a significant achievement. However, Ramanujan insisted that an exact formula existed. Neither Hardy nor his other colleagues believed this—who knows what this strange Indian might dream up? But Ramanujan continued to insist. Naturally, he couldn't explain the basis for his certainty. "I think so, I'm sure of it," he insisted. And then one day, Ramanujan suggested replacing the expression in the formula

$$\sqrt{\frac{2}{3}n} \text{ with } \sqrt{\frac{2}{3}\left(n - \frac{1}{24}\right)}$$

They tried it. And... lo and behold, an exact formula emerged!

The English are known to be reserved. But that day, Hardy and his colleagues made no secret of their overwhelming emotions. At the same time, everyone was deeply puzzled: How could this be? How did Ra-

G.H. Hardy and S. Ramanujan

A snapshot from the film "The Man Who Knew Infinity". Left to right: Ramanujan, Hardy, and his colleague Littlewood

manujan know there was an exact formula? There are plenty of approximately solvable problems for which there are no exact formulas. Why subtract $\frac{1}{24}$? How did Ramanujan arrive at this? When pressed, Ramanujan himself responded, "An angel whispers in my ear". In the sciences, this is called by a more mundane, but no less mysterious, word: INSIGHT.

Unfortunately, the damp climate of England and his vegetarian diet undermined Ramanujan's health. In 1918, he was forced to return to his homeland and died two years later. Srinavasa Ramanujan became the first Indian elected to the Royal Society of London, forever cementing his place in the history of mathematics, becoming the embodiment of a mathematical miracle.

Epilogue
The Spirit of Mathematics

History is replete with examples of mathematical "eureka moments." Archimedes experienced this when he discovered a way to find the volume of a sphere. Before him, formulas for the volumes of prisms, pyramids, cylinders, and cones were known, but finding the volume of a sphere remained a tough nut to crack. Archimedes managed to calculate it by applying mechanics, specifically the lever rule. It turned out that the volume of a sphere is two-thirds the volume of the circumscribed cylinder. That this was the result of an epiphany is evidenced by the following historical fact: Archimedes bequeathed a drawing of the formula to be carved on his tombstone.

Two more examples. Seventeen-year-old Carl Friedrich Gauss (1777–1855) managed to solve the two-thousand-year-old problem of constructing regular polygons with a ruler and compass, using complex numbers, which other mathematicians at the time shied away from, calling them "imaginary." But Gauss had a stroke of inspiration!

Sixteen-year-old Évariste Galois (1811-1832) cracked the nut of the problem of solving algebraic equations. He himself recounted how it dawned on him—the solvability turned out to be related to the group of permutations of the equation's roots. The idea was completely new. Even such a venerable scholar as C.D. Poisson (1781-1840), who was appointed to review Galois's work, understood nothing and gave a negative review.

The great mathematician Henri Poincaré (1854-1912), who arguably experienced the most insights when solving complex problems, specifically studied this process at the request of the Paris Society of Psychologists. He established the reality of insight. He listed the conditions for such an event to occur: persistent search for a solution, intense, ever-deeper reflection, and an impartial approach (without self-interest: not for fame, money, or status). He even explained: if one tirelessly and focusedly thinks about

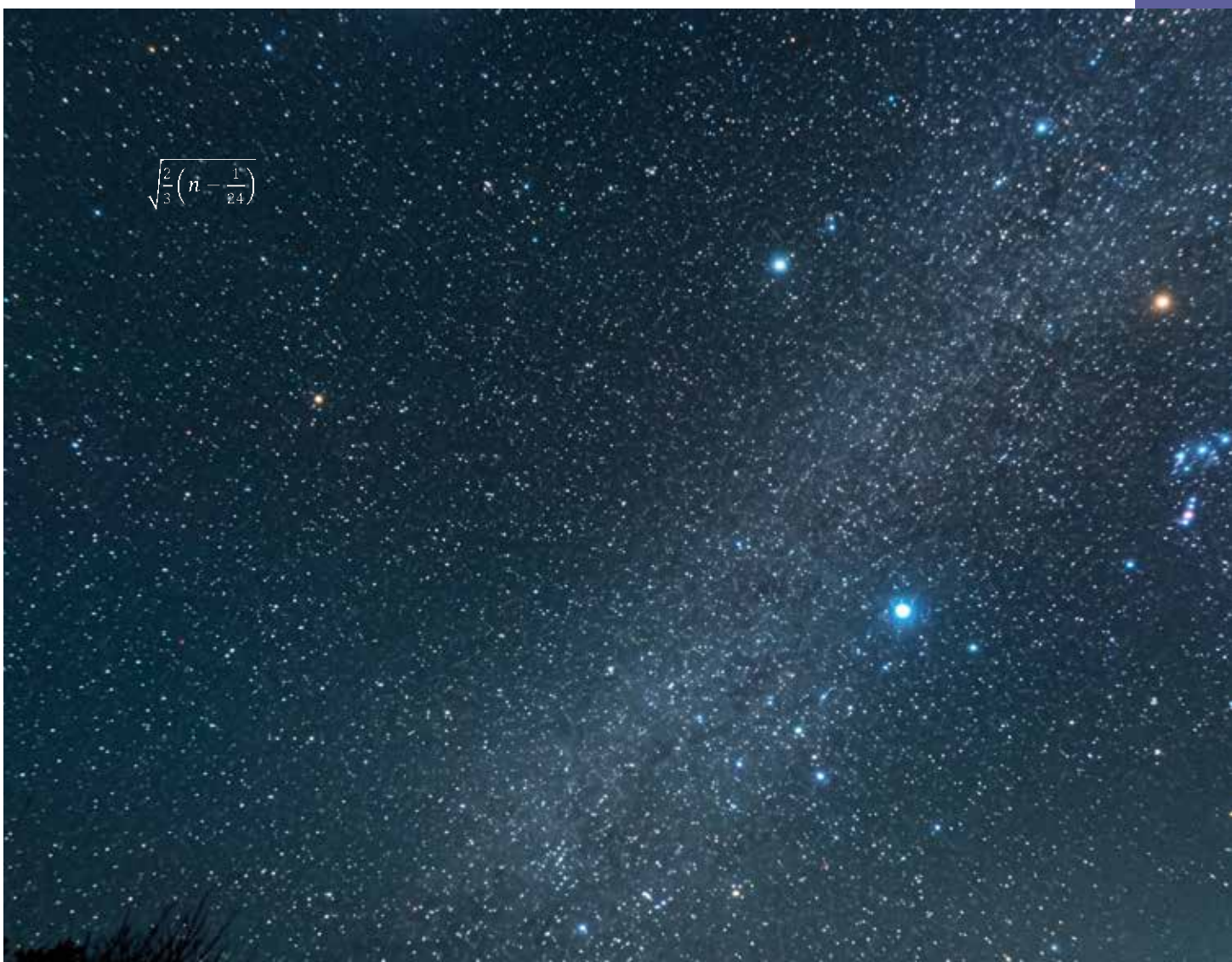
solving a problem, first or during the process assimilating all the relevant concepts and methods, then at one point the problem can sink from the conscious mind into the subconscious, where the search can continue and an idea — the key to the solution—can be found. This idea, rising back to the level of consciousness, is experienced as insight, like the appearance of rays of sunlight in a sky covered with dense clouds.

Poincaré is right, but only partially, in my opinion. The fact is that the question "What is the subconscious?" is no less complex and murky than the question "What is insight?" After all, the scientist didn't explain how the subconscious finds an idea. And the very concept of the subconscious is controversial. The author of these lines prefers Ramanujan's words: a researcher is struck by inspiration at the moment when an angel induces an idea into consciousness, giving impetus to thought. The angel of mathematics. And he doesn't come to everyone, only to those who are purposeful, prepared, and honest. Mysticism, you say? But isn't it mysticism to believe that gray matter weighing less than two kilograms is capable of inventing Ramanujan's astonishing formulas, overcoming numerous obstacles on the path to proving Fermat's Last Theorem, breaching the 2,500-year-old twin problem, and laying the foundations of modern algebra at the age of 16? If only this substance had billions of neurons with billions upon billions of interneural connections!

Today, science has become not a calling, but primarily a profession, a means of career advancement. Research plans are drawn up at the request of funding bodies, then articles are written in accordance with them, monographs are published, reports are compiled, and dissertations are defended. The volume of all this is growing exponentially. There's a race for the h-index and other scientometric indicators. If the research outcome can be planned, if the outcome is known in advance, then it's not science. Well, let's say it's cottage industry science. Where there's no room for insight. Such science can hardly be called fundamental.

Fundamental science is always a journey into the unknown. True achievement is the unknown, achieved through months and years of dedicated work. The great Alisher Navoi, in his "Appeal to the Creator," writes about enlightenment: "O Almighty! The state of the soul, illuminated by the sparkle of the 'pearl' drawn from the 'river of Your knowledge,' is like the starry sky on a clear night."

And happy is the scientist who has at least once experienced such an epiphany!



The moon - known to us and mysterious

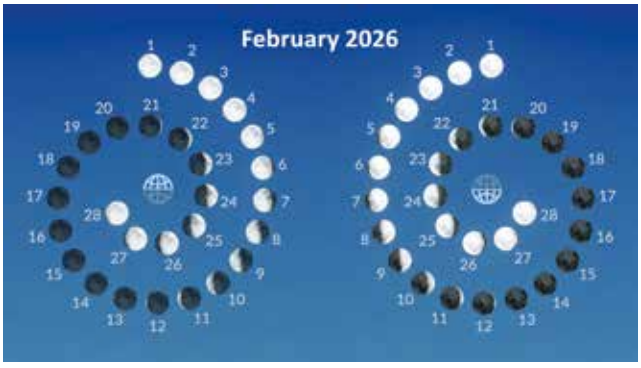
Chori Sherdanov,
Candidate of Physical and Mathematical Sciences

The Moon, which is clearly visible to the inhabitants of Earth in the sky, especially at night and in clear weather, has attracted the attention of humanity, and especially astronomers, since ancient times. Therefore, it is no coincidence that many folk beliefs, stories, and tales are associated with the Moon. This is entirely justified, since the Moon is our closest cosmic neighbor, a natural satellite of planet Earth. Thus, the average distance between the Moon and Earth is 384,403 kilometers, and the Moon's diameter is 3,476 kilometers. The Moon completes a full orbit around the Earth in 29.5 days. In one hour, the Moon moves relative to the stars by approximately 0.5°, or one of its apparent diameters. The gravitational attraction that the Moon exerts on the Earth causes ocean tides, which are synchronised with the position of the Moon relative to the Earth. In 1609, Galileo Galilei took one of the first photographs of the Moon using a telescope for his book Sidereus Nuncius also noted that it is not smooth but has numerous craters. Later, in the 17th century, astronomers Giovanni Battista Riccioli and Francesco Maria Grimaldi drew the first map of the

The Far Side of the Moon: A Mosaic of Images from the Lunar Reconnaissance

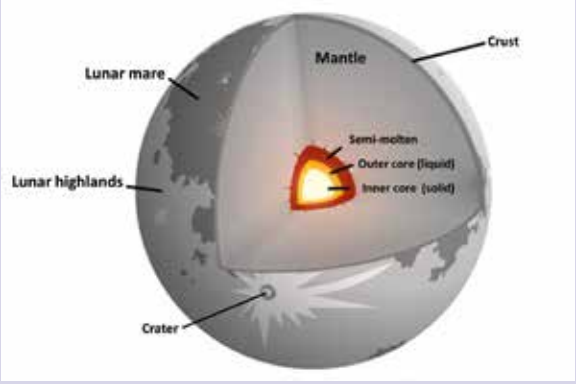
Moon and named some of the craters, many of which are still named today.

Modern science puts forward a number of hypotheses for the formation of the Moon. It is believed that the Moon formed approximately 4.5 billion years ago, that is, approximately 30-50 million years after the

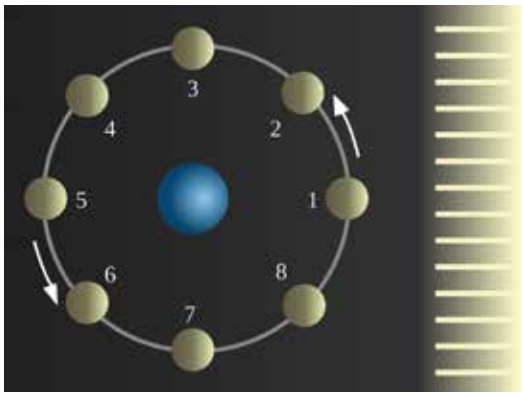


Daily visibility of the Moon in the Northern and Southern Hemispheres of the Earth in February 2026

formation of the Solar System. The geological age of the Moon is determined by dating various significant events and collisions in its history. One hypothesis



Schematic representation of the structure of the Moon from the outer crust to the inner core



The Earth-Moon system - Solar illumination, allowing us to observe the phases of the Moon: 1 - New Moon; 2 - Waxing Moon; 3 - First Quarter; 4 - Waxing Moon; 5 - Full Moon; 6 - Waning Moon; 7 - Last Quarter; 8 - Old Moon

for the Moon's origin is that its matter was torn from the Earth's crust by centrifugal forces generated by the Earth's rotation, leaving a deep ocean basin on the Earth's surface. Another hypothesis suggests that the Moon, along with the Earth, originated from the primary disk of the Solar System. However, the inclination of the lunar orbit is closer to the obliquity of the ecliptic than to the inclination of the Earth's equatorial plane. Therefore, such an inclination of the Moon's orbit to the ecliptic almost excludes the possibility that the Moon formed contemporaneously with the Earth or was later drawn into Earth's orbit. Furthermore, this hypothesis cannot explain the disproportionately small amount of the chemical element iron on the Moon compared to Earth. The most widely accepted theory currently is the giant impact theory, which posits that the Moon was formed by the collision of a young, semi-molten Earth with another primordial planet roughly the size of Mars, known as Theia. This hypothesis also explains why the Moon is poor in iron and many volatile chemical elements. The Moon's elemental composition and surface are known to have formed when its surface was covered by an ocean of molten magma. Scientists believe that

Photo of the "parselenium" phenomenon associated with the "four moons" observation on the night of February 1, 2026r.

A photograph of the first national flag planted by humans on the Moon (Apollo 11 mission, 1969). Since the issue of space colonisation was actively discussed from the very beginning of the space age and led to the adoption of the Outer Space Treaty (1967), this flag was not intended to symbolise any territorial claims

the combination of potassium, rare earth elements, and phosphorus is evidence of this molten ocean. Earth's tidal gravitational forces deformed the Moon, while it was still molten, into an ellipsoid shape, with its major axis directed toward Earth. The lunar crust is composed of many chemical elements, including uranium, thorium, potassium, oxygen, silicon, magnesium, iron, titanium, calcium, aluminum, hydrogen, and others. The overall chemical composition of the Moon is believed to be very similar to that of the Earth, with the exception of the iron content and highly volatile substances.

The surface of the Moon contains tens of thousands of craters over 100,000 in diameter, formed by impacts with celestial objects more than 1 kilometre. Most of these are hundreds of millions of years old and preserved due to the absence of a lunar atmosphere and the geological activity on the lunar surface. The dark lunar plains are called lunar maria because ancient astronomers believed they were actual bodies of water. The brightest areas on the Moon's surface are called lands or continents. It should be noted that the lunar maria are located almost entirely on the visible side of the Moon, while there are very few of them on the far side. Scientists believe that this asymmetry is the reason why the Moon's centre of mass is offset from its geometric centre. The small size of the lunar core is a possible explanation for why a virtually airless celestial body like our satellite, the Moon, could have an unstable magnetic field as a result of major collisions with various celestial objects. It should be noted that the Moon's magnetic field is very weak compared to Earth's. The lunar surface itself contains a layer of dust called regolith, which, like the lunar crust, is unevenly distributed across the surface. The crust has a thickness 60 km on the near and 100 km far

sides of the Moon. The regolith thickness ranges from 3 to 5 metres in the maria and from 10 to 20 metres on land. One hypothesis suggests that the lunar crust contains some water. According to measurements by the Clementine instrument, some lunar craters, which are permanently in shadow, contain frozen water. The total amount of water on the Moon is believed to be approximately 1 cubic km^3.

The Moon's atmosphere is very thin and insignificant compared to Earth's. One source of the lunar atmosphere is the emission of gases such as radon, which results from the radioactive decay of chemical elements found in the Moon's crust and mantle. Another source of the Moon's atmosphere is the bombardment of its surface by micrometeorites, solar wind plasma ions and electrons, and exposure to sunlight. Gases formed as a result of these processes can accumulate in the regolith due to lunar gravity, or they can be ejected into space by solar radiation pressure or carried away by the solar wind.

As they move through the solar system, the Earth and the Moon orbit their common barycentre (or common centre of mass), which is located approximately 4,700 km from the Earth's centre (at a depth of approximately 1,650 km) in the direction of the Moon. As a result, the Earth's orbital motion is eccentric. The Moon is characterised by synchronous rotation, due to which only one side (the "near side") is visible from Earth, and the time it takes the Moon to orbit the Earth is equal to the time it takes it to rotate its own axis. The other side of the Moon (the "far side") always remains hidden from observers on Earth, except for small areas, which is why the far side of the Moon was completely unknown to humanity until the beginning of the space age.

The Moon's synchronous rotation is a result of Earth's tidal forces. The far side of the Moon is sometimes mistakenly called the "dark side". A distinctive feature of the far side of the Moon is the almost complete absence of lunar "seas", or low-albedo basaltic plains. In fact, it receives exactly the same amount of light as the visible side, and precisely when the Moon is not visible due to the relative positions of the Earth, Moon, and Sun.

Different areas of the lunar surface are illuminated by sunlight in different ways depending on the relative positions of the Earth and Moon relative to the Sun. This results in the observation of various lunar phases (full moon, half moon, waxing and waning moon, crescent, etc.) reflected from the visible surface of the Moon in the Northern and Southern Hemispheres. Lunar phases are the periodic changes in the appearance of the sunlit portion of the Moon as we observe it in the sky. In Western culture, the four main phases of the Moon are new moon, first quarter moon, full moon, and third quarter, also called "last quarter".

The variety of lunar phases visible from Earth's surface on different days of the month, and the frequency of their alternations throughout the months of the year, puzzled ancient peoples. It was a great mystery to them, and they therefore considered the Moon an enigmatic object. Only with the advent of the first primitive, ground-based, non-optical astronomical instruments and the discovery that the Moon does not itself generate light, but merely reflects the sun's rays, did many of the enigmatic phenomena associated with the Moon become understood and explained.

According to the customs of the peoples of North America and Europe, the full moon observed in February is called the Snow Moon. Unlike some other names for the moon (such as the Worm Moon, and depending on the observed color of the lunar disk—the Pink Moon, the Red Moon, and others), the February full moon, as its name suggests, is the month when the most snow falls in North America. This is why Native American tribes called the February full moon the Snow Moon. Some tribes call it the Hunger Moon because the severe frosts during this month make hunting difficult. The last Snow Moon was on February 12, 2025, and the next one will be on February 21, 2027.

Let's take a look at another phenomenon that has seemed mysterious to people, related to the quadruple luminous disk of the Moon observed from Earth

A device with a lunar drill on the lunar surface and a capsule, returned on September 21, 1970, to the interplanetary station "Luna-16" with a sample of lunar soil

China's Chang'e-6 unmanned space probe on the far side of the Moon

on frosty winter nights. On the night of February 1, 2026, residents of several cities from St. Petersburg to Odessa observed "four moons" in the sky above the Northern Hemisphere. This unusual optical phenomenon allowed "four moons" to be seen in the sky—that is, four lunar disks, each differing in brightness. This phenomenon is called a "parselena", and it occurs during severe frosts due to the refraction of moonlight by ice crystals in the air. Thus, so-called "doubles" of the Moon appear in the sky. The real Moon can be easily distinguished by its rich yellow color, while its phantoms are virtually colorless (see photo).

Currently, due to the development of powerful rocket and space technology, the Moon has essentially become the first celestial astronomical object closest to Earth to be explored in detail by humans. Here, it's worth noting the key stages in human exploration of the Moon. The first spacecraft to soft-land on the Moon was the Soviet Luna-2 station in 1959, and the first photographs of the side invisible from Earth were taken by Luna-3 that same year. The first spacecraft to successfully soft-land on the visible surface of the Moon was Luna-9, and the first to successfully enter orbit around the Moon was Luna-10. Subsequently, several landers and orbiters were sent to the Moon for research purposes by a number of countries.

The Moon is the only extraterrestrial body visited by humans. On July 20, 1969, American astronaut Neil Armstrong became the first person to set foot on the Moon (photo).

In National Air and Space Museum, In Washington, the Apollo 11 spacecraft module, which landed Neil Armstrong on the lunar surface, is on display. Also on display is a recording of his conversations with the astronauts remaining on the spacecraft in lunar orbit, which, after the module's liftoff from the lunar surface, returned the entire crew to Earth.

It should be especially noted that Uzbek scientists and engineers took an active part in the scientific and technical support of the lunar exploration programme using automated mechanical devices. So, the world's first lunar self-propelled remote-controlled laboratories The Lunokhod and Lunar Drill, a lunar soil sampling vehicle, were manufactured with the participation of the Lavochkin Machine-Building Plant, the Central Research Institute of Machine Building, the Tashkent Machine-Building Design Bureau, and several other enterprises. These ground-controlled Lunokhod and Lunar Drill vehicles were successfully tested at the Nevich test site in the Tashkent region and at an experimental site in Kamchatka, where conditions and terrain were similar to those on the Moon. These vehicles were then sent aboard spacecraft to the Moon and made a soft landing on its surface.

Thus, the interplanetary space station Luna-16, which on September 20, 1970, carried out the first landing of a module with the propulsion system of the Lunar Drill on the surface of the Moon, was equipped with a return rocket, a device with a capsule in which lunar soil was placed, and its own control system. The landing stage with the lunar drill remained on the lunar surface for 26 hours and 25 minutes. The drilling lasted 6 minutes and 14 seconds, was monitored from Earth, and the drilling tool drilled to a depth of 35 cen-

timeters. In addition to collecting a 105-gram sample of lunar soil, the station also measured temperature and radiation. Moreover, it turned out that the composition of the extracted lunar soil, delivered to Earth by the descent module and capsule on September 24, 1970, for further study, was almost identical to the composition of the surface soils of our planet Earth. This also confirmed the astrophysical theory of the Moon's formation from material of terrestrial origin.

A series of automated technical launches to the lunar surface followed. The self-propelled Lunokhod-1 rover successfully operated on the lunar surface for 11 lunar days (10.5 Earth months, from November 17, 1970 to September 14, 1971, or 302 days), traveling 10,540 meters at an average speed of 0.14 km/h and transmitting numerous images of the lunar surface to Earth.

In 2024, China's unmanned space probe Chang'e-6 achieved the world's first soft landing and collected soil samples from the far side of the Moon, invisible from Earth. The spacecraft consisted of an orbiter, a landing module, an ascent module, and a return module. On June 2, 2024, Chang'e-6 landed on the far side of the Moon and spent two days collecting soil samples using a robotic arm and a special drill. On June 3, the Chang'e-6 ascent module, carrying 2 kg of regolith, was launched from the lunar surface into lunar orbit and landed on June 25, 2024. The Chang'e-6 lunar mission lasted 53 days, and the amount of lunar soil collected from the far side of the Moon was found to be consistent with the soil samples obtained from the visible side of the Moon.

Lunar exploration by scientists from the United States, China, Russia, and other countries continues. It's worth noting that China plans to send a manned mission to the Moon. China, in partnership with Russia, also plans to build a lunar research station by 2035. NASA plans to launch a 100-kW nuclear reactor on the Moon in 2030 to power a future research settlement. Roscosmos plans to build a nuclear power plant on the Moon by 2036 to power rovers, an observatory, and a lunar research station.

It will therefore come as no surprise that with the continued advancement of cutting-edge scientific and technological thought and the emerging opportunities for lunar exploration, linked to future projects based on the use of cutting-edge technologies, astronomy and cosmonautics will experience rapid development. And we will be able to learn much more about our closest cosmic neighbor, the Moon, as well as about other celestial bodies in the Solar System and the vast Universe.

(Based on Internet materials)

The microworld inside the termite: invisible helpers that crush wood

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Republican Scientific and Production Centre for Termite Control

The article examines the importance of termites in the natural cycle of substances and their role in increasing soil fertility, as well as the damage they cause as a result of their spread in anthropogenic environments. It also provides information on the nutritional and digestive characteristics of termites and the important role of their intestinal microflora in the decomposition of difficult-to-digest substances such as cellulose:

Termites are among the oldest insects on Earth, having evolved approximately 200 million years ago, even before mammals and most flowering plants. Interestingly, their social lifestyle also evolved very early, and in this respect, they adopted a social lifestyle even before ants and bees. Nature itself bears witness to the termites' long evolutionary history: gnawing marks, particularly on conifers, indicate that they have been feeding on wood for millions of years.

Over the course of their long historical development, termites have not only increased in numbers but also significantly expanded their range. They have successfully adapted to new conditions, particularly penetrating urbanized biogeocenoses and agrocenoses formed as a result of human activity. The main reason for this is their high adaptability: they are able to live in a variety of conditions, utilize various food sources, and defend themselves by forming communities.

There's no other insect on Earth that causes such irreparable and long-term damage to the wooden

structures of man-made buildings and structures as termites. Although there are approximately 3,000 termite species worldwide, only about 120 of them cause serious damage to various structures and buildings.

Four termite species have been recorded in Central Asia. Two species of termites of the genus *Anacanthotermes* are common in Uzbekistan: the Turkestan termite and the Caspian termite (*A. turkestanicus* Jacobs., *A. ahngerianus* Jacobs.), which have caused significant damage to residential buildings, agricultural buildings, and even historical monuments in almost all regions of the Republic of Uzbekistan and the Republic of Karakalpakstan, especially in the past 20-30 years.

The benefits and harms of termites

Termites perform an important ecological function in nature: they grind up dry plant debris and transport it to the lower layers of the earth as a food reserve, thereby participating in the nutrient cycle and significantly contributing to soil formation. In this regard, they can be considered a kind of natural "cleaners". However, it's worth noting that most termite species feed on dry plant debris, primarily dry wood, meaning that any plant material containing cellulose can serve as food for them. This characteristic also poses a certain danger to humans. Termites are capable of gnawing through the wood of any building and structure, causing serious damage to residential buildings, administrative buildings, historical sites, and even strategically important sites. Biologists of various specialties are increasingly interested in studying the lives of termites, since, despite their beneficial role in the circulation of substances in nature and soil formation, they are very complex and interesting living organisms that simultaneously have a serious destructive impact on wooden parts of structures and various objects of the national economy, posing a certain danger to humans.

Termites, although at first glance they appear to be simple, tiny insects, are actually some of nature's most complex "social engineers". They are often popularly called "white ants" because their lifestyle is similar to that of ants. However, termites belong to a completely different group than ants and have a unique biology.

The collective is a small "state"

Termites are widespread in tropical and warm climates and live in vast colonies numbering thousands, even millions, of individuals. This community can be thought of as a perfectly functioning "state", in which each class of termite in the nest performs its own function: workers build the mound, search for and gather food, and care for the eggs and larvae; soldiers defend the colony from enemies; sexually active individuals reproduce; and the "king" and "queen" live in the centre of the nest, with the queen being particu-

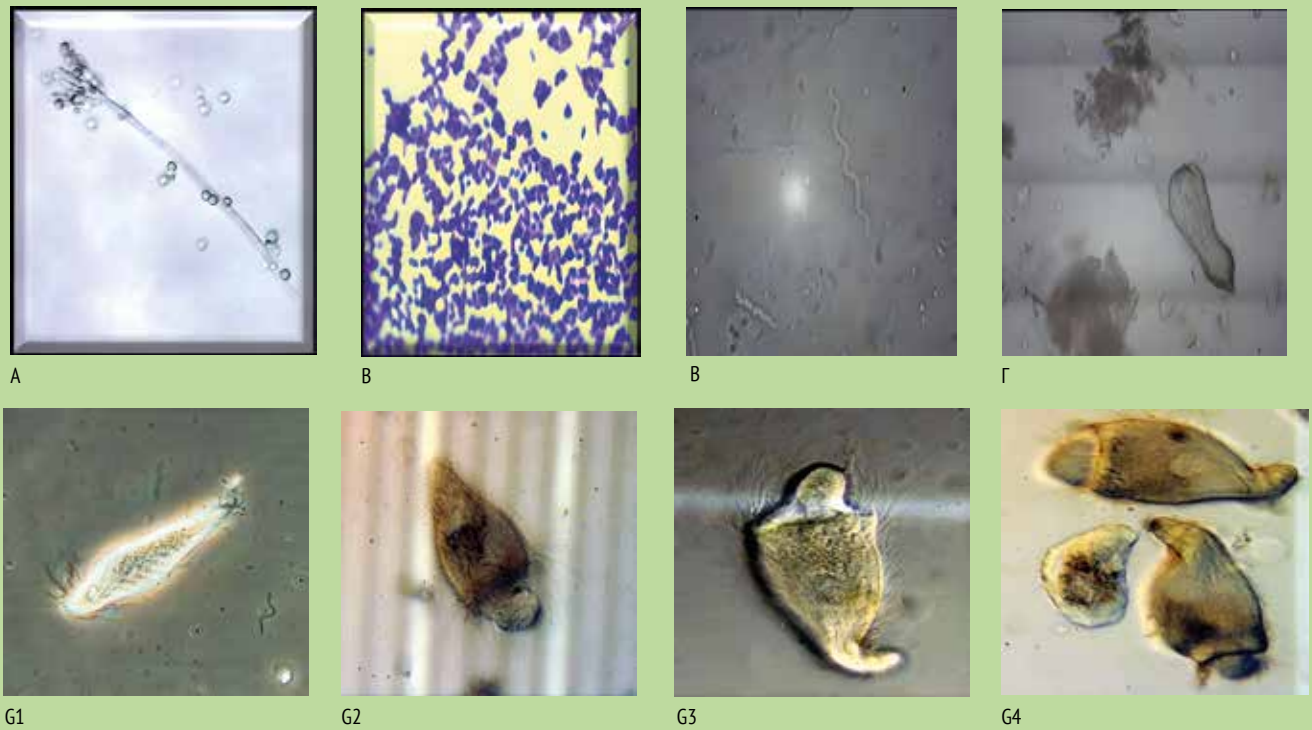

Figure: A - a colony of bacterial isolates found in the intestine of the termite Anacanthotermes turkestanicus; B - spirochete; C - amoeba (amebide); G - single-celled flagellate protozoa belonging to the Hypermastigina family:
G, No. 1 - Dinenympha sp., G, No. 2 - Spirotrichonympha sp., G, No. 3 - Holomastigotoides sp., G, No. 4 - a group of flagellates

larly impressive: she can lay thousands of eggs a day and is the lifeblood of the entire colony.

What do termites eat?

Termites feed primarily on cellulose, meaning they consume materials such as wood, plant stems, dry leaves, and even paper. This may seem simple at first glance, but cellulose is actually a complex substance, and most animals cannot digest it on their own. This is where termites' uniqueness comes in: they not only consume wood but are also able to convert it into energy with high efficiency.

"Hidden helpers" in the intestines

This process is carried out not by the termite itself, but by "secret helpers" living in its gut – symbiotic microorganisms. Scientists who have studied termite gut microbiota claim in their scientific papers that it is extremely diverse, that microorganisms make up two-thirds of the termite gut's mass, and that termites have lived in symbiosis with these microorganisms for millions of years thanks to coevolutionary adaptations. Termite guts are home to numerous bacteria and single-celled organisms (protozoa), and they have developed a mutually beneficial relationship. These symbionts break down cellulose, converting it into simple sugars and other digestible substances. As a result, termites obtain the energy and nutrients they need to survive. At the same time, some microorganisms synthesize vitamins and amino acids, providing the termite with additional nutrients.

Our scientific studies of termite gut microbiota yielded very interesting results (figure). Although termites are a stable part of any senosis, we have confirmed that they themselves, especially their gut, represent an ecosystem populated by a variety of protozoa, bacteria, and spirochetes. We discovered that termites cannot digest cellulose without these microorganisms. Studies of termite enterobionts have shown that the number of simple symbionts in the termite gut can reach several million. Their main representatives are flagellates belonging to the orders *Polymastigina* and *Hypermastigina*. The nature of their nutrition can divided into xylotrophs (*Polymastigida*), feeding remnants cellulose, and osmotrophs (*Hypermastigin* a), feeding on dissolved substrates. It is worth noting that the absence or increase in the number of protozoa in the intestines of termites during and after molting is associated with an increase in the motor activity and viability of termites, which indicates the important role of enterofauna in the survival of these insects.

It's important to note that without these microorganisms in the gut, the termite would be unable to feed on wood and would likely die within a short time. Thus, the relationship between the termite and its symbiont is not simply a partnership, but a matter of life and death. This situation is considered the most successful example of symbiosis in nature. There's another interesting aspect of termite life: newly hatched young termites initially lack these beneficial microorganisms. They acquire symbionts from larger termites through a special process of mutual feeding called trophallaxis, either through mouth-to-mouth (stomodial) or even anal fusion (proctodial). Thus, not only food is transferred within the community but also microorganisms that play a key role in termite digestion. In this way, each new generation of termites acquires the microflora necessary for life.

Interestingly, in some highly developed termite species, not only protozoa but also specialized groups of bacteria participate in the breakdown of cellulose. In some cases, these bacteria are even capable of partially breaking down more complex substances, such as lignin. This makes termites one of the most important organisms in nature involved in the processing of dead organic matter.

In conclusion, termites are more than just small wood-eating insects; they are a complex "biological system" that interacts with the microorganisms that inhabit their gut. Their ability to convert cellulose into energy is of interest not only to science but also to the study of biotechnology, ecology, and even renewable energy sources. From this perspective, it's entirely reasonable to call termites a unique and efficient "biochemical factory" of nature.

Locusts are swarming insects

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Certain inhabitants of the natural environment, particularly insects, pose a serious threat to agricultural sustainability. Locusts (*Orthoptera: Acrididae*), one such biological representative, are among the most dangerous pests in human history, causing mass famine, economic collapse, and social instability. Locust plagues are mentioned in ancient written, religious, and historical sources, and their mass proliferation is known to have disrupted agricultural activities in many regions.

Locusts are of great scientific interest not only as herbivorous insects but also as organisms with complex anatomical, ecological, and biological properties. In particular, some locust species undergo morphological, physiological, and behavioral changes as their population density increases, forming swarms, which fundamentally distinguishes them from other insects. This characteristic requires a special approach to studying locusts and allows them to be viewed not only as a pest but also as a unique model of evolutionary adaptation.

Thousands of locust species are currently known worldwide, and most play a vital role in maintaining ecological balance. Approximately 200 locust species have been identified in Uzbekistan, varying greatly in their ecological and biological significance and life-history. These species include unique and rare species, predators, and those that damage agricultural crops.

Locusts belong to the order Orthoptera and develop through metamorphosis. Their developmental cycle includes the stages of egg, nymph (larva), and adult insect. The body length of locusts ranges from 1 cm for meadow locusts to 10 cm for desert locusts. This biological characteristic is important when developing locust control strategies.

Although locusts are found in almost all regions of our country, the main distribution centres of swarming species are usually located in areas relatively remote from agricultural lands—in foothill pastures, saxaul forests, desert and semi-desert areas, tugai forests, and around water bodies. These areas provide favorable ecological conditions for the natural devel-

A - Kyzylkum Desert in the Bukhara region.

B - pastures of the Kashkadarya region.

C - deserts of Karakalpakstan.

D - mountainous areas of the Namangan region.

Figure 1. Distribution areas of the swarming locust in Uzbekistan:

Figure 2. Two morphologically distinct species of Asian locust (photo by F. Gapparov).

opment and reproduction of locusts, allowing them to reproduce unchecked over long periods.

For example, the main distribution areas of the Moroccan locust are in the foothill pastures of Uzbekistan at altitudes ranging from 600 to 2,000 metres above sea level. Although these areas are located far from agricultural lands, under favorable conditions, a sharp increase in locust populations can lead to migration into cultivated areas and cause significant damage (Figure 1d).

Not all locust species are considered dangerous to agriculture. Only a few species, under certain conditions, are capable of forming swarms and causing significant crop damage. The main species exhibiting this characteristic in our country and Central Asia include the Asian locust, the Moroccan locust, and the oasis (Italian) locust. These species often breed in pastures and areas remote from cultivated land, but in some years, as their range expands, they move closer to agricultural lands, posing a serious threat.

Swarming is a unique biological phenomenon characteristic of locusts, in which members of the species undergo dramatic changes depending on population density. Swarming locusts differ fundamentally from solitary forms in appearance, coloration, body proportions, behavior, and lifestyle. These changes indicate that locusts have adapted to ecological competition and the struggle for resources.

For example, the swarming form of the Asian locust is characterised by relatively long wings, short legs, flat shoulders, as well as high mobility and voracity. These characteristics allow it to migrate long distances and occupy vast territories in a short time.

The ability of locusts to swarm was first scientifically described by B.P. Uvarov in 1921. According to this theory, locusts are capable of changing their morphology, physiology, and behavior depending on population density. That is, members of the same species can switch from a solitary to a gregarious lifestyle under certain environmental conditions.

This viewpoint, advanced by B.P. Uvarov, was subsequently recognised by locust researchers worldwide as the “form variability theory”. Following this theory, locusts began to be studied, dividing them into two main groups: swarming and non-swarming locusts. This distinction served as an important methodological basis for developing locust control strategies.

The locust’s life cycle is strikingly dual. Most of the time, it lives in what’s known as a solitary phase. Outwardly, it’s a calm, secretive insect, green or brown in color, preferring to keep aloof from its fellow locusts. During this period, locusts pose no threat to agriculture. However, when environmental conditions change—for example, heavy rains followed by a period of drought, leading to overcrowding and food shortages—their behavior and even anatomy begin to change. Physical contact with other locusts triggers a hormonal surge, triggering a transition to the gregarious phase. The locusts change colour, develop

Figure 3. A - Three-year-old larva of the large humped saxaul locust B - A small bush of white saxaul that has been attacked by locusts

American bird katydid

longer wings, and become incredibly aggressive. Most importantly, they begin to gather in huge groups, forming nomadic swarms. Locusts have a number of key physical characteristics for their migrations and mass movements:

Powerful legs: Her hind legs allow her to leap up to 20 times her body length. This helps her move quickly across the ground when a swarm begins to form.

Compound wings: Locusts have two pairs of wings. The front, stiffer ones are used for gliding, while the hind wings, wide and transparent, provide thrust for long flights. This allows the swarm to travel vast distances.

Compound eyes: Compound eyes, composed of thousands of individual lenses, provide nearly 360-degree vision. This feature is critical for orientation and coordination within a dense flock. (Electronic resource https://www.ixbt.com/live/flora_and_fauna/zhivaya-stihiya-kak-bezobidnaya-sarancha-prevraschaetsya-v-bedstvie.html) [1].

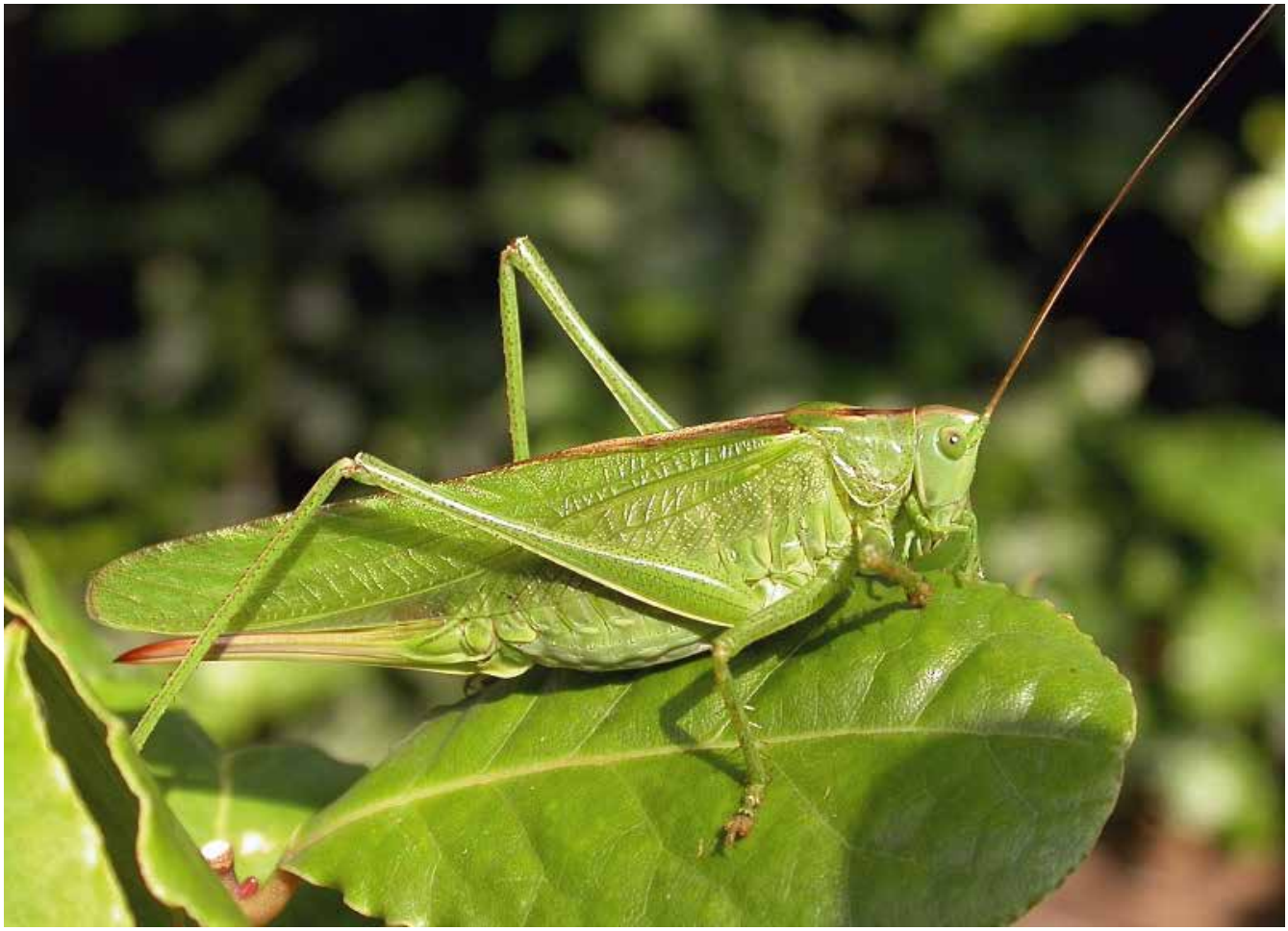
The bulk of damage to agriculture is caused by swarming locusts. Research shows that this group accounts for more than 90 percent of the economic damage caused by locusts.

Locusts are considered omnivorous by nature. However, some swarming species have been observed to specialize in specific plants. Their primary diet is virtually any vegetation. Swarms can consume not only field crops like wheat, barley, and corn, as well as pasture vegetation, but also rice, sorghum, and even sugarcane and saxaul. For example, the large humped saxaul locust feeds exclusively on saxaul and does not harm agricultural crops. Therefore, caution should be exercised when classifying such species as common pests.

Scientists have observed a significant increase in the numbers of the Greater Humped Locust in saxaul thickets in several Central Asian countries in recent years. This situation poses new environmental challenges and highlights the need to monitor the locust's distribution and conduct a more in-depth study of its biology.

Locust control has been carried out using various methods throughout human history. Initially, mechanical methods—digging trenches and burying locusts—were widely used, but later chemicals were introduced. Currently, locust control is carried out using an integrated approach.

In the global locust control campaign, only two countries have successfully eliminated the locust threat: Australia and the United States. This was made possible by the collaboration of specialists from various locust control agencies, as well as the fact that the locust infestation is confined to a single country. No other country has succeeded in completely eradicating the locust threat. In Uzbekistan, the goal of



Green katydid

locust control efforts is not to completely eradicate these pests, but to ensure that locust numbers do not exceed economically sustainable levels. Control measures will only be taken if the number of swarming locusts exceeds 5 individuals per square metre (the number of non-swarming species exceeds 10 individuals). Conversely, if the number of swarming locusts is less than 5 individuals per square metre, no control measures will be taken.

Despite their reputation as agricultural pests, some locust species, particularly the migratory locust (*Locusta migratoria*) and the desert locust (*Schistocerca gregaria*), have gained significant economic importance in recent years. They are primarily used as highly nutritious food for exotic pets—reptiles, birds, and spiders. This industry is gaining popularity, and now in Europe, the price of 100 locust nymphs in pet stores can be comparable to the harvest from one hectare of land. Furthermore, locusts are considered a leading candidate for an alternative source of protein for human consumption. Specialized locust farms have already been established and are successfully developing around the world on an industrial scale. Given the potential, scientists are even developing mobile units for rapid sublimation and freezing, designed to efficiently harvest insects directly at the site of their aggregations. [1].

Thus, the locust order is one of the twofold characterised insect species: on the one hand, it is an interesting natural species for study and possible practical use, and on the other hand, it is a formidable plant pest, causing great damage to agricultural crops.

Artificial intelligence in water resources management

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As is well known, water resource management has accompanied human civilisation since the advent of sedentary life. As early as 3000-2000 BCE in Ancient Egypt, Mesopotamia, and the Indus Valley, and later in the Amu Darya-Syr Darya region, people built quite complex irrigation systems, as well as flood control methods and even early hydrometeorological monitoring.

Thus, in the vast expanses of present-day Central Asia, just as thousands of years ago, one can still hear the prayer: "May the sacred waters help me...". And this is far from accidental, as human life in this region, including the cultivation of crops and livestock grazing, is unimaginable without water supply and artificial irrigation of the former desert and steppe lands. The most ancient irrigation systems in this region, with canals and ditches, primitive by today's standards, are recorded in the lower reaches of the Murghab, Amu Darya, Zerafshan, and Kashkadarya rivers, dating back to the mid-1st millennium BCE.

The scientific approach to water resources management developed gradually, going through several stages:

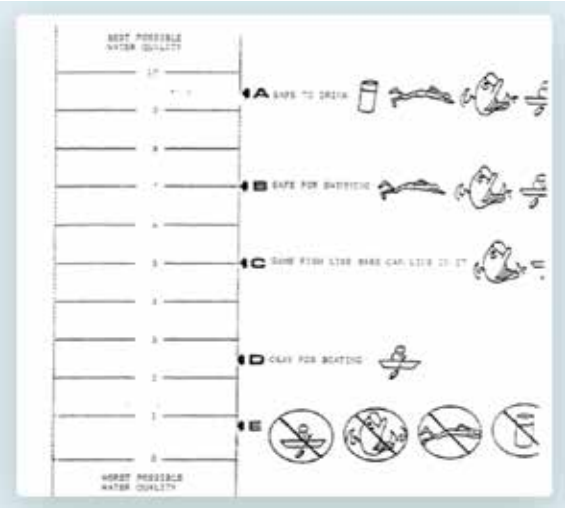
1) Before the 18th century: Knowledge about water was accumulated through practical experience and observation. The construction of aqueducts, dams, and irrigation canals was based on trial and error.

2) 18th-19th centuries: During this period, the physical foundations of hydraulics and hydrology were laid. Scientists such as Daniel Bernoulli, Henri Darcy, and Barré de Saint-Venant described the fundamental laws of water movement. Industrialisation and urbanisation necessitated the creation of modern sanitation systems, shipping canals, and flood protection.

3) 20th century: The development of numerical methods and the advent of computers made it possible to create complex hydrological and hydraulic models. Tools for optimizing hydraulic structures, managing reservoirs, and planning water resources emerged. Hydrometeorological observation networks were established, and water cycle theories were developed, including processes of infiltration, evaporation, and pollutant transport.

4) 21st century: Humanity is entering an era where vast amounts of big data are analysed by «smart machines.» When people talk about artificial intelligence (AI) in water resource management, many imagine the stuff of science fiction: drones over canals and robots at dams. In reality, things are simpler and more practical. Today, AI is, above all, a way to quickly transform large data streams (pressure, flow, and water level sensors, satellite images, and weather maps) into understandable signals for dispatchers, indicating flood risk, leaks, changes in inflow, and deterioration in runoff quality. Artificial intelligence can identify patterns that elude traditional methods, make accurate forecasts, and make decisions in real time. Therefore, it is no coincidence that the water sector is actively embracing this new paradigm. According to Stanford University's 2024 AI Index, artificial intelligence already outperforms humans in a number of tasks, including image recognition, visual reasoning, and English language comprehension, although it still lags behind in mathematical reasoning and planning. The application of AI in water resource

Transforming the Water Treatment Industry and Technologies with Artificial Intelligence



One of the early formulations of the "water quality scale" that still exerts a significant influence on water evaluation research

management is becoming possible thanks to a confluence of factors:

Computing power. The advent of graphics processing units (GPUs), specialised tensor processing units (TPUs), and cloud platforms has made training complex neural networks practically feasible. Today, even very deep neural networks can be trained in a relatively short time.

Deep learning architectures. Convolutional neural networks (CNNs) for image processing, recurrent neural networks (RNNs) and LSTMs for time series, and transformers and large language models (LLMs) for text have demonstrated impressive results in a wide range of fields.

Standardised datasets and open-source tools. The ImageNet and MNIST databases, as well as the TensorFlow, PyTorch, and Keras platforms, have simplified the development and testing of AI models, making them accessible to researchers worldwide.

Big Data. Satellite remote sensing (Sentinel, Landsat, MODIS), Internet of Things (IoT) sensor networks, and automated weather stations generate petabytes of big data on water systems. This data is essential for training AI models. The water sector uses a variety of information sources: hydrometeorological observations (precipitation, temperature, evaporation, river levels, soil moisture) ; - with satellite data and remote sensing Earth probing (assessment of water body area, snow cover, glaciers, floods, water quality); - sensors and the Internet of Things (IoT) (water pressure and flow in pipelines, wastewater treatment parameters, tank levels); - models and simulations **(**results of numerical hydrodynamic and hydrological calculations). AI combines this data, revealing hidden relationships between atmospheric, surface, and groundwater processes.

John Crutilla applied the insights of welfare economics to proposed federal water projects, including the construction of dams on the Hells Canyon section of the Snake River in Idaho.
Source: Photo: Danita Delmont/Shutterstock.

Summarising global experience in implementing AI in the water sector, we can identify several groups of technologies that provide the greatest practical effect in addressing the following water resource management challenges.

1) Regression, classification and forecasting of time series.

This is the most practical layer of AI in water management, as a significant portion of water processes are observed as time series: water levels and discharges, reservoir inflows, precipitation, soil moisture, pipeline pressure, water consumption by region, etc. Forecasting these time series is key to operational management. Both classical statistical models and neural networks (e.g., LSTM/ Transformer approaches) are used here. Importantly, AI is better at identifying existing nonlinearities: for example, when the same rainfall results in different water runoff due to soil moisture, temperature, channel conditions, etc.

2) Emulation of physical models.

Classic hydrodynamic and hydrological models are good at calculating physical parameters (water flows, flood levels, pollutant transport, etc.) and often produce high-quality results, but they come at a cost: a single scenario can take hours or days to calculate. Operational management often requires an answer right here and now, across multiple scenarios. This is where emulators or surrogate models come into play. Here, AI is trained using the results of a physical model (or observations) and then reproduces its output quickly, in near-real time: this is critical for optimising water distribution, risk assessment, flood management, and for management of complex systems (channels, nodes, reservoirs).

3) Computer vision: satellites, drones, cameras.

Modern neural network models (primarily CNN and their derivatives) solve the following types of key problems: - classification (what is visible in images - water/land, type of reservoir); - object detection (identifying washouts, garbage jams, violations at hydraulic structures); - semantic segmentation (precise water boundary by pixels - the basis of flood maps); - instance segmentation (when it is necessary to separate objects of the same type into instances). Computer vision turns images into management indicators: - flood area; - reservoir dynamics; - infrastructure condition; - drought/wetting indicators. This is especially

valuable where ground-based measurements are few or difficult to access and scattered.

4) Natural language processing and large language models (LLM).

Technical support for the water sector involves more than just sensors and gauging stations. It also requires a vast array of text documents: regulations, hydraulic structure passports, reports, operation logs, applications and requests, measurement protocols, projects, standards, correspondence between organisations, and much more. Here, LLM methods are extremely useful for quickly finding relevant points in documents, comparing requirements, and extracting parameters (for example, from pumping station passports or inspection reports). Furthermore, LLM methods enable the automatic generation of summary reports on the situation, such as «what has changed,» «where potential risks exist,» «what actions have been taken according to regulations,» and others. LLM accelerates access to knowledge and makes digital systems user-friendly for specialists. However, there is a fundamental caveat: LLMs can also provide incorrect answers. Therefore, in management tasks, the decisions and recommendations provided by LLMs should be applied, simultaneously cross-checking them against verifiable sources.

Thus, these four groups of AI-based management technologies address the basic needs of water management: - understanding the dynamics of ongoing changes over time (forecasts and time series); - quickly calculating complex process physics (emulation); - seeing the situation in space (computer vision); - working with knowledge and documents (NLP/LLM).

Smart Farm in Asia: AI-Based Data Infographics and Digital Rice Irrigation Monitoring

Together, they form the «skeleton» of a modern intelligent water management system, namely: input data → models → forecasts/maps → decisions → execution control.

AI methods help make decisions that conserve water, save the biosphere, and protect ecosystems. In the UNESCO and Deltares «Applications" of AI for water management» report (2025) provides the following practical examples of the application of AI in water resources management:

•The AWARE platform (developed by the International Water Management Institute, IWMI) integrates real-time data: - satellite measurements of precipitation (IMERG); - soil moisture; - river levels; - drought indices. Machine learning processes all these input parameters and produces a forecast, for example: In N days a flood is possible, or a drought begins, or the

Aqueduct of Segovia

water level will drop. Particularly interesting is the WetIn component (Weather and Impact Indicator) is a mobile app for local residents. Instead of complex graphs, this app displays simple thresholds, such as: if more than X mm of rain falls in Y hours, there is a high risk of future flooding. Based on this forecast, local communities, farmers, and civil defense agencies receive clear and actionable signals, rather than simple numbers.

•Project COALA (Copernicus for Sustainable Agriculture (Australia) uses AI to analyse satellite images and weather data from irrigated fields. The system provides farmers with an accurate map of plant water stress across the field. As a result, instead of irrigating the entire field, only the dry areas can be irrigated, resulting in water savings of over 20%.

•The NEXOGENESIS project (EU-funded; 20 partners from Europe and South Africa) uses AI to assess the potential negative impacts of water scarcity and identify more coordinated actions in the context of WEFE (water-energy-food-ecosystems). A key tool is Self-Learning Nexus Assessment Engine (SLNAE), also known as NEPAT, considers possible scenarios and helps find optimal solutions by taking into account the relationships and tradeoffs between components.

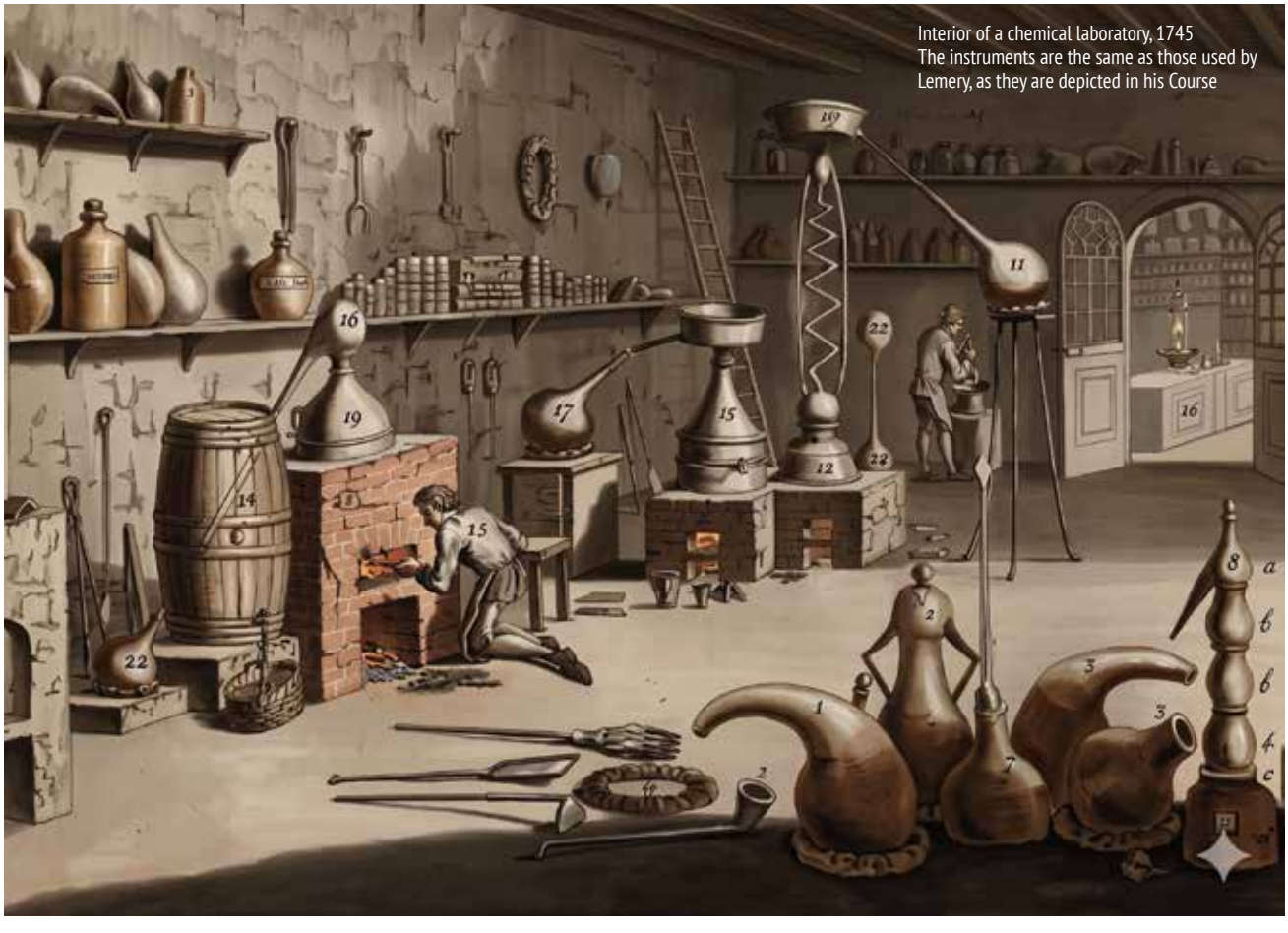
•The XFLEX HYDRO project (funded by the EU) is implementing AI-driven hydropower technologies at existing hydropower plants to improve grid stabilisation. Similarly, in China, hydropower giant SPIC is using drones with image and sound recognition, as well as thermal imaging, to monitor the condition of equipment at the Wuqiangxi hydropower plant in real time.

•The RainGuRU operational platform (TU Delft and HKV) uses weather radar data and an AI model to update the precipitation forecast every 5 minutes for a horizon of up to 1.5 hours, for example for the Netherlands.

It's becoming clear that AI in water resources management isn't just an abstract «technology of the future,» but a tool that can solve a number of pressing problems. Based on international experience, priority areas for AI application in Uzbekistan's water sector could include:

1. Irrigation and agriculture. Using machine learning models to forecast irrigation water requirements based on weather data, soil moisture, crop growth stage, and crop types will optimise water application schedules, reduce overwatering, and minimise losses. This, along with drip and discrete irrigation systems already being implemented in Uzbekistan, could result in significant water savings per hectare.

2. Pumping station management. Deep learning algorithms and AI optimization methods can re-



Interior of a chemical laboratory, 1745
The instruments are the same as those used by Lemery, as they are depicted in his Course

View of the Chelsea Waterworks Fire Station with the Boulton and Watt Pumping Engine. Aquatint, [1810–27]. Sheet: 37 x 56 cm

duce pump energy consumption and select optimal operating modes based on the current tariff, load, and water balance.

3. Flood and drought forecasting. A combination of satellite data, gauging information, and AI models similar to the international AWARE platform could form the basis of a national early warning system for the Amu Darya and Syr Darya river basins, as well as Uzbekistan's reservoirs.

4. Detection of leaks and unauthorised water intakes. Methods for detecting anomalies using flow and water level sensor data, as well as computer vision (drones, satellites), can detect potential leaks, canal bed erosion, and illegal irrigation ditches at an early stage – before water losses become critical.

5. Decision support. Large language models (LLMs), trained using national regulatory documents, technical regulations, and design documentation, will help specialists quickly find relevant materials, compare standards, and automate the preparation of analytical reports on water bodies.

Since all of these promising water resource management areas listed above have global prototypes and successful practices, this is not just a matter of theoretical possibilities, but rather the application of these new, effective technologies, ready to be adapted to Uzbekistan's conditions. The use of AI methods in water resource management opens up new, practically significant opportunities for various stakeholder groups and the public.

For Uzbekistan's scientific community, the application of AI in water management opens a broad research front: from developing local datasets and adapting neural network architectures to arid climate conditions to creating hybrid intelligent models for transboundary river basins. This will enable the development of indigenous approaches to water resource management in conditions of severe water shortages.

For practitioners – hydraulic engineers, agronomists, and water managers – AI is a path to more efficient water management, where every decision is based on robust data and models, rather than intuition or outdated instructions.

For civil society as a whole, this is a real opportunity to create a foundation for further sustainable development in the current context of a rapidly changing climate and limited water resources.

High-speed information technologies

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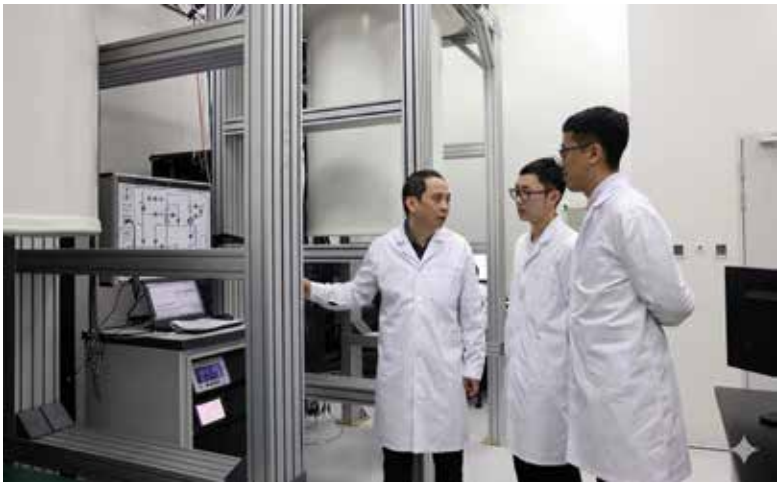
Currently, due to the development of big data information technologies and artificial intelligence models, there is a rapid increase in the number of organisations, companies, and universities, as well as individual users of information services and data. The use of such information systems by consumers is determined by the balance of two main factors: their speed and the cost of receiving information from its sources. Therefore, the topic of increasing the speed of information technologies is of interest to everyone – from businessmen, managers, students and schoolchildren to reputable scientists and academicians. The need to develop such information systems requires the creation of a class of high-speed technologies. However, as an analysis of the work of global centres for communications and computing research shows, this goal cannot be achieved using so-called "conventional" (or classical) technologies widely used today. This is due to the fact that the flow or speed of information transmission and processing based on microtechnology is limited to 10 million bits per second (the term "bit" means one unit of information), which is usually called a byte. However, these are fundamentally different concepts.

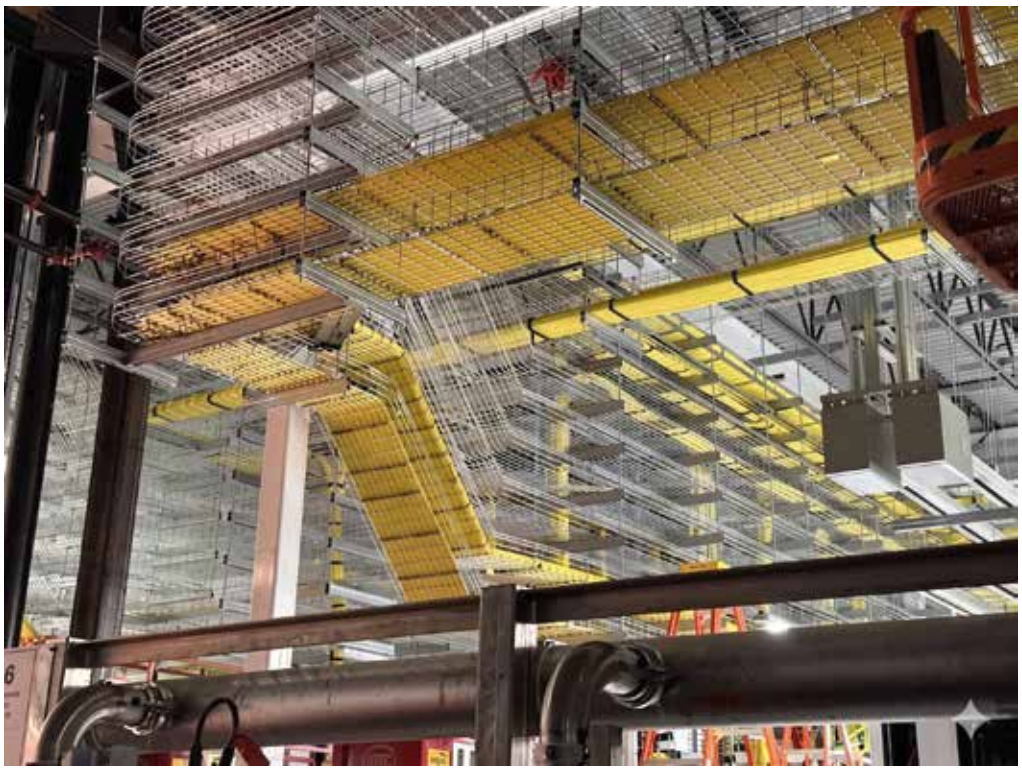
The whole problem is that this requires the creation of ultra-fast devices operating in the frequency range above 100 million Hertz. In other words, we need to develop devices that perform 100 million operations per second. From a physical perspective, this means that the duration of such changes is a fantastically short time – 10 nanoseconds. Let's clarify that one nanosecond, as we know, is equal to one billionth of a second. Recently, scientists at the Centre for Quantum Computers and Communications Systems at the University of California developed a unique new wireless communication system based on nanoscale integrated structures that can achieve data transfer rates of up to 120 million bits per second. For comparison, the theoretical transmission speed limit of current WiFi systems is about 30 million bits per second, and so-called 5G systems mm Wave – no more than 5 million bits per second. Therefore, the use of new high-speed technologies based on the properties of nanoscale structures makes it possible to exceed both the transmission speed and the volume of transmitted data and information by 10 times compared to conventional communication systems widely used today.

As can be seen, the increased speed of communication systems and quantum computers has necessitated the creation of devices operating on a completely different scale, both in time and size. Simply put, this requires the creation and application of quantum nanotechnologies and ultra-fast devices based on the phenomenon of optical magnetism (or, more briefly, optomagnetism).

On the other hand, any communication system can be characterised by its efficiency or "performance," which is typically expressed in terms of the amount of electrical energy consumed by the system. From this perspective, a new information transmission system operating in the frequency range above 100 million Hertz consumes an estimated power of approximately 200 milliwatts. Meanwhile, "classical" communication systems require several watts of power, which is unacceptably high for the widely used and beloved smartphones and other mobile devices. Thus, the transition to nano-integrated circuits, as opposed to micro-integrated circuits, allows for a radical increase in the energy efficiency of information and communication systems. Furthermore, such communication systems can become an alternative to "classical" communication systems—those that use kilometer-long cables in so-called data centres (i.e., centres for processing and storing large volumes of information)—reducing the costs of creating and maintaining such infrastructures. Obviously, we are talking here about very expensive fiber-optic communication cables.



Scientists in China have used a quantum computer to fine-tune an artificial intelligence model



Colossus, a powerful "quantum refrigerator," is getting ready for launch.

We can also estimate the power consumed by a new high-speed communications relay in a single day. Considering that a day is equal to 86,400 seconds, it's easy to calculate the power consumption—approximately 20 kW. If we assume that several million such data centres are used to operate the global information system, and for simplicity, assuming a total of 1 million centres, we find that the total power consumed in just one day is... 20 billion watts, or 20 GW. This calculation clearly demonstrates that accessibility to global information requires a huge expenditure of energy, i.e., the comfort of the global information civilisation requires a huge financial investment. If we now calculate the required power for such information systems over a single year, we arrive at a massive power consumption of 7.3 trillion watts, which clearly exceeds the technical capabilities of these systems. A typical example is the cryptocurrency mining farms created in the banking and financial sector at the beginning of the 21st century, based on microelectronic circuits of multi-computer systems that consume previously unimaginable amounts of electricity.

It's worth noting a key difference between information and communication systems based on nano-integrated circuits (or nanotechnology) and traditional micro-integrated circuits (or microtechnology). The former utilises a fundamentally new device—a so-called optical nanoprocessor— that operates under the influence of an ultrashort laser beam. Meanwhile, the latter, a traditional technology, utilises the direct action of electric current. Since the passage of electric current through the elements of such a circuit generates heat, this significantly reduces the energy efficiency and service life of such "classic" communication systems.

An analysis of the work of global information and communication centres shows that the ongoing transition from microelectronics to nanoelectronics and optical processors—i.e., the miniaturisation of processors—will lead to 10,000 times greater performance than existing processors (!). According to estimates from these research centres, such an optical processor consumes only 1 watt of power for 300 trillion operations per second, which is 100 times higher than that of traditional processors or graphics processors.

At the same time, it's impossible not to mention the creation and application of so-called "artificial intelligence". As demonstrated by specialists at the research lab of the world-renowned company Apple, which develops "artificial intelligence" models, colossal efforts are still required for them to achieve human-level thinking and analysis. Therefore, billionaire Elon Musk's claim that by 2030, "artificial intelligence" will be "smarter" than all of humanity is far from reality. Tests of so-called "artificial intelligence capabilities" have yielded disappointing results, demonstrating that, without human involvement and supervision, artificial intelligence models cannot operate independently or autonomously. This means that a long way remains to be seen before the creation of so-called autonomous general intelligence. Furthermore, these tests revealed another "depressing" picture: the inability of artificial intelligence to think creatively, as its actions are based solely on and within the framework of embedded training information and specific human-created examples.

In this regard, we cite the famous Italian mathematician Bazzardi: "No supercomputer has ever

shown us what we don't know". Therefore, we believe that the conclusion about the unlimited capabilities of artificial intelligence, including high-speed quantum computing, is either "far-fetched" or "wishful thinking" on the part of its developers. And the models and ideology of human-created artificial intelligence methods can never be smarter than their human creator.

However, artificial intelligence models and platforms are truly necessary and even indispensable in many cases. Naturally, this applies to the analysis and processing of unprecedented volumes of data for statistical research, satellite imagery analysis, natural phenomenon forecasting, and sophisticated scientific experiments.

Let's support this last conclusion with two examples. The first concerns the analysis of archival data from the Hubble Space Telescope using artificial intelligence. In just two and a half days, it managed to analyse nearly 100 million images accumulated over 20 years of observations. What's remarkable here is that the "artificial intelligence" discovered over 1,000 rare cosmic objects previously unnoticed by specialists (some of which defy existing classifications altogether). The second example is the compilation and identification of nearly 700 million galaxies discovered by the Webb Space Telescope (which represents one-eighth of the visible universe, i.e., just one octant of the "cosmic" sky). Obviously, this work could not have been accomplished without the help of artificial intelligence, since conventional analysis would require several decades. Here, of course, artificial intelligence is essential.

In conclusion, we'd like to say a few words about the theoretical research being conducted at the Nanotechnology Engineering Research Centre at Bukhara State Technical University on the so-called ultrafast dynamics of electron spins in magnetic systems. This is because it is impossible to develop high-speed optical processors and quantum computers without controlling the motion of an individual spin or a system of electron spins.

As our latest theoretical studies have shown, it is possible to achieve a response speed of 1 femtosecond for these devices, or an operating frequency , i.e. 1,000 trillion Hertz, taking into account the effect of the magnetic field of ultrashort femtosecond laser radiation on the electron spins in the systems under study. Consequently, this will enable the creation of high-speed communication systems and quantum computers capable of processing or transmitting information at speeds 1,000 times faster than existing devices.

Russian physicists set a world record for quantum computing

The Contribution of the Turkestan Circle of Amateur Archaeologists to the Study of Samarkand's Archaeological Heritage

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Samarkand, as one of the most ancient centres with a rich historical and cultural tradition in Central Asia, has attracted the attention of scholars, tourists, and researchers for many years. The numerous archaeological sites, architectural examples, and material culture preserved in the region are an important source for studying the region's history. The Turkestan Circle of Amateur Archaeologists played a special role in shaping archaeological research in Turkestan in the late 19th and early 20th centuries. This circle also contributed to increased scholarly interest in historical centers such as Samarkand. In particular, important stages in the development of archaeological thought in the region included attempts to establish a branch of the circle in Samarkand, the development of a programme for cataloguing ancient monuments, and the promotion of initiatives for monitoring and excavating individual archaeological sites. This article analyses the activities of the Turkestan Circle of Amateur Archaeologists in Samarkand, its scientific initiatives, and its contribution to the study of Samarkand's archaeological heritage.

The Turkestan Circle of Amateur Archaeologists, founded in 1895, was an important factor in the study of Samarkand's archaeological heritage. The circle's charter was approved by the Minister of Public Education on October 31, 1895. From then until 1917, information about the TCAA's meetings and its activities was regularly published in the local press, primarily in the newspaper Turkestanskie Vedomosti. Information about the circle's meetings was also published in supplements to the Archaeological Commission's news. With the establishment of the Turkestan Circle of Amateur Archaeologists, efforts began to establish a branch in Samarkand. At the general meeting of the Samarkand Regional Statistical Committee on December 29, 1895, the "Draft Work Programme of the Historical Department of the Statistical Committee for the Cataloguing of Ancient Monuments in the City of Samarkand and Its Environs" and the "Explanatory Note" to this programme were adopted. The program consisted of eleven points and covered virtually all issues related to the history of Samarkand and the cataloguing as well as restoration of its architectural monuments:

1. Creating a systematic catalogue of all works and other materials on the history of Samarkand and the region, as well as organising the translation of "important works" into Russian;
2. Using written sources and information to compile a list of all monuments and indicating historical sites and their locations;
3. Developing a master plan for the city of Samarkand and its environs, with a complete listing of monuments;
4. Defining plans, directions, monuments, and their relative significance;
5. Restoration of monuments;
6. Studying monuments from a construction and architectural perspective;
7. Protecting and restoring ancient monuments;
8. Creating and publishing a plan of the city of Samarkand and a construction and architectural atlas with accompanying text;
9. Providing a historical classification of each monument or site based on factual and historical materials, and analysing inscriptions on monuments through a critical assessment;
10. Creation of plans and classifications of Samarkand in different historical periods (the period of the Iranian invasion, the Greek period, the Judeo-Christian period, the Islamic period, especially the Timurid period);
11. Compilation and publication of a publicly accessible guide to the city of Samarkand.

M. Masson writes that the Samarkand branch was not particularly effective and was disbanded shortly after its creation, without ever beginning

The first topographic plan of the Afrasiab settlement, compiled during the research of N. I. Veselovsky. 1885 (Vyatkin V. L. Afrasiab – the settlement of the former Samarkand. Archaeological essay. Tashkent, 1927. P. 5)

The Church of St. George, built by Priest Voznesensky. 1930. On July 21, 1896, the first official museum in Samarkand was opened in this building. (Photograph and Document Collection of the Museum-Reserve, Inv. No. 21314/43)

any practical work. Despite this, the creation of the Turkestan Circle of Amateur Archaeologists had a positive impact on the work of researchers of ancient monuments in Samarkand.

The circle's members regularly inspected and catalogued archaeological burial mounds. For example, N.F. Sitnyakovsky noted that excavations on the "archaeologically interesting Talibarzu hill, located 6 versts from Samarkand," were important for archaeology. A.F. Korchagin emphasised the need for excavations in Samarkand and Merv to discover material traces of Nestorianism. In this regard, N.F. Sitnyakovsky stated that in 1899, while conducting a topographic survey in the Samarkand region, he investigated a *kariz* known as "Kyafir-muri" on the Dargom Canal and that traces of Nestorianism may have been discovered in this area. In Urgut, near the Dargom Canal, a hill known as "Kyafir-muri" was photographed by A.L. Kun in 1872 and included in the second volume of the Turkestan Album.

While in the early years of the circle's activities, articles were published that did not offer comprehensive and accurate scientific views on the archaeology of Turkestan, including the archaeology of Samarkand. In subsequent years, relatively significant research findings were published. Among these, a few works were directly related to Samarkand. Of the 21 publications the circle published, only 16 articles were directly related to Samarkand.

It would not be an exaggeration to say that among these articles, an article on ostadons (ossuaries) was enthusiastically received by the circle's members. Articles on ostadons, a phenomenon alien to Russian culture, were published in a number of the circle's publications. The first report on ostadons discovered in the Eastern Quarter of Samarkand in 1899 was made by P.A. Kamarov at a circle meeting in 1901. In an article by I. T. Poslavsky devoted to ostadons found in Samarkand and its environs, he erroneously asserted that Samarkand ostadons lacked lids. In response, N. I. Veselovsky noted that the Samarkand ostadons known at that time had not been found in their original form, so they should be carefully evaluated; the lids could easily have been lost, and denying their existence would be wrong. In 1906, K. A. Inostrantsev published an article on this topic. In his article, he noted that the issue of ostadons had been widely discussed, but it was too early to draw conclusions and that many finds remained to be identified and

L. S. Barshchevsky with his collection in his own house in Samarkand

studied. N. P. Ostroumov also addressed this topic and compared specimens discovered in the Samarkand and Tashkent regions. B. Kastal'sky, who joined the circle in 1907, discovered approximately 700 fragments of ostadons in the village of Biyanaiman in the Kattakurgan district in the spring of 1908. Consequently, an initial report on these findings was presented to the circle by I. T. Poslavsky on May 26, 1908, and an article on the findings, prepared by B. N. Kastal'sky himself, was subsequently published in the circle's 1909 publication. A. D. Kalmykov also reports on the findings of B. N. Kastal'sky in one of the circle's publications. B. N. Kastal'sky has very few articles on archaeology. However, over the course of several years, he assembled a large archaeological and numismatic collection. The same can be said of I. T. Poslavsky. B. N. Kastal'sky's extensive collection, assembled in the late 19th and early 20th centuries, is housed in the Samarkand State Museum-Reserve. The establishment of the Turkestan Circle of Amateur Archaeologists and the efforts to organise its Samarkand branch are considered an important milestone in the development of sustained scholarly interest in Samarkand's cultural heritage in the late 19th and early 20th centuries. Although the Samarkand branch of the circle failed to fully develop practical activities and soon ceased operations, its creation had a significant impact on the development of archaeological research and attitudes toward ancient monuments in the region. The "Programme for Cataloguing Ancient Monuments in the City of Samarkand and Its Environs" represented a shift from simple observations to a systematic and comprehensive study of historical and cultural heritage. This programme covered a wide range of issues, from compiling a catalogue of written sources and translating key works into Russian, to architectural research, reconstruction, protection, and restoration of monuments, and the creation of historical and architectural maps and atlases.

The activities of the circle's members contributed to the intensification of field observations of archaeological sites in Samarkand and its environs. Interest in sites such as Talibarzu, Kafir-muri, and Dabusiya, as well as attempts to identify material traces of Christianity, indicate an expansion of archaeological research and the beginning of a deeper understanding of the region's multilayered history.

V. Vyatkin in the exhibition of the Samarkand Museum. 1915 (Photograph and Document Collection of the Museum-Reserve, inv. no. 7110a)

Kuyun is an archaeological site at the junction of the Bronze Age and Early Iron Age cultures

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In her monograph, Bronze Age specialist N. A. Avanesova emphasised the significance of the Andronovo cultural -and historical community, noting it as one of the key issues in the study of Bronze Age archaeology, requiring further clarification and analysis (Avanesova, 1991, p. 5). Indeed, the Andronovo community represents a vast archaeological phenomenon of the Late Bronze Age, encompassing vast territories from the Urals to Central Asia. Its study is important for understanding the socio -cultural processes of this era, including the spread of metallurgy, economic practices, and migratory connections between ancient communities.

Modern research notes that the term “Andronovo culture” is a subject of scholarly debate. There are multiple approaches to its use, as this concept encompasses a variety of local cultural traditions of the Bronze Age with varying chronologies and material attributes, complicating a unified classification and chronological framework for their development.

At the same time, the problem of the genesis and interactions of the painted ceramic cultures of the Bronze Age and Early Iron Age remains a key issue in modern archaeological research in Central Asia. Analysis of Bronze Age sites shows that only comprehensive studies of each local group of sites allow us to establish the cultural connections, technological features, and mutual influence of the various cultural traditions of the region, which is important for understanding the dynamics of ancient social processes.

The relationship between the Yaz 1 monuments and the cultures of Tashkent, Fergana, and Xinjiang also requires detailed study, as only through the comparison of ceramic forms, economic remains, and technological features can we identify the routes of cultural contacts, migrations, and the exchange of ideas between ancient communities. To address these issues, it is important to carefully examine each monument individually and within a broader cultural and historical context.

In this regard, the Kuyun settlement, discovered during recent archaeological research, is considered a significant site for deepening our understanding of the cultural processes of the Bronze Age in Central Asia (Fig. 1). The Kuyun archaeological site is located on the border of the Pskent and Akhangaran districts of the Tashkent region; its territory is partially occupied by the modern cemetery of the city of Almalyk. It is dilapidated; three mounds currently remain, provisionally named the Eastern Remnant (currently not preserved), the Central Remnant (CO 1 and CO 2), and the Western Remnant. These mounds are a*dyrs*, over which cultural layers up to 1.5-2 meters thick or more, belonging to the Burgulyuk culture, have been preserved. (Ilyasova, Maksudov, Wulfert, Normuradov , 2018. pp. 60-64; Ilyasova, Murodaliev, 2025. pp. 136-142). As a result of the excavations, a settlement of the Burgulyuk culture was discovered, and material traces of the Andronovo culture were found in some areas.

The ancient monument of Kuyun is a historical location between the Almalyk-Telau road and Ziyarat Parpiata

It should be noted that the main structures are associated with the Burgulyuk culture. Research has revealed that the Kuyun settlement consists of several construction layers (Ilyasova, Maksudov, Khamidov, Lingmey Lin, Wulfert, Normuradov , 2020. pp. 97-110). The uppermost layer is associated with above-ground frame structures with postholes and isolated hearths. Layer 2 is characterized by structures, of which low walls made of mud brick and *pakhsa* remain, and a surface level, sometimes lined with pebbles, on which postholes from possible roofs are also noted. The lower, third layer is occupied by small pits—semi -dugouts—arranged in terraces, in keeping with the terrain. All three types of similar dwellings were identified at the Chust culture sites (Zadneprovsky, Matbabaev , 1984. p. 57: Matbabaev , 2002. pp. 48, 53; Matbabaev , Ivanov, 2004. pp. 102-104). Three types of dwellings were also identified for the Burgulyuk settlements in Tuyabuguz (Buryakov, Koshelenko, 1985. pp. 198-199).

The dimensions of the semi-dugouts of the lower horizon are: P-3: 3×2 m; P-4: 1.70×2.40 m; P-5: 1.40×3 m; P-6: 2×2 m; P-8: 2.30×1.70 m. In two of them, *sufas* (elevated seats) were found in the corner. They could have served as steps during the descent. Small fireplaces were also cleared here. In dugout 4, in the southeastern corner, the descent is formed by large stones. Similar small dugouts were previously excavated in Tuyubuguz (Abdullaev, Duke, 1987. p. 16).

In 2018, fragments of Andronovo-type pottery were discovered in layers 2b, 3a, and 3b at the heavily degraded eastern edge of the excavation site located on the Central Outlier. The boundary between the layers containing Andronovo and Burgulyuk material was established. Unfortunately, due to the destruction of the site in this area and up to the eastern outlier, where Andronovo material was also discovered, it can currently only be assumed that the later Burgulyuk people intruded into the older layers. On the eastern outlier, Andronovo material was discovered in the third, lowest layer. A fragment of Chust-type pottery with triangular painting was found in the upper layer. Another small fragment, painted with a mesh pattern, was found on the Central Outlier.

The Andronovo-type ceramics found at Kuyun are decorated with comb and smooth stamps in the form of stripes, triangles, and depressions of various shapes. A vessel fragment decorated with a large smooth stamp is noted. The ceramics are primarily greyish-black in color, due to reduction firing, but the interior of some fragments is brown. The finds include fragments of reddish-brown and light brown colours. Several fragments of brownish-red rims have an admixture of shell rock in the dough. Flat-bottomed ceramics were also found. Similar ceramic ornamentation was noted at Kairakkum (Litvinsky, Okladnikov, Ranov, 1962. p. 250, pl. 92, 94, 100). In Kazakhstan it belongs to the final bronze (Zdanovich, 1990. Pp. 151-152, Fig. 2, Fig. 3; Maksimova, 1959. Pp. 114, Table XVI: 6,15, XVII: 4, 35; Goryachev, 2006. Pp. 57, Fig. 14; Baitanaev , 2010. Pp. 33-34; Chernikov, 1960. Pp. 212, Fig. XVII (16).

Finds: a whole khum, ancient grains of wheat and barley, as well as traces of local metallurgy (copper and bronze)

Burgulyuk ceramics are represented by several types: *khums*, cauldrons with cylindrical spouts and handles, pots, lids, and bowls. Two of our fragments with scratched ornamentation have analogies with material from Kavardan, which, according to researchers, dates to the final phase of Burgulyuk II (6th-4th centuries BCE) (Alimov, Bogomolov, 1996. p. 86).

At P-4 (TsO1), next to the hearth, a well-preserved single-edged bronze knife was found. It had a projection, straight blade and back parallel to each other, and a blunt end of the blade beveled towards the blade. The length was 16.5 cm, the blade width was 3 cm, and the diameter of the handle pommel was 2 cm. The handle had a figured rounded pommel. Researchers noted that among the single-edged knives of the Tashkent-Fergana region, there were examples of knives with round or semicircular handle ends (Litvinsky, Okladnikov, Ranov, 1962, p. 204, pl. 40/4; 47/5). An analysis of the single-edged knives of Eurasia allowed N. A. Avanesova to conclude that they were produced by Andronovo craftsmen (Avanesova, 1991. p. 28). A significant assemblage of stone tools was discovered at the Kuyun settlement: grain grinders, chimes, grinders, whetstones, burnishers, and sling stones. Unique artifacts include a pestle made of a translucent greenish rock covered with a whitish coating, which mineralogists have preliminarily determined to be calcite. The pestle was most likely made from a piece of stalactite[1].

Kuyun site we discovered is characterised by its diverse assemblage of artifacts, i.e., finds of Burgulyuk-era materials and Andronovo-type ceramics. Moreover, Burgulyuk belongs to the late variant, while Andronovo ceramics, by analogy, are also dated

[1] The authors thank Sunnat Tursunov, a research fellow at the Geological University, for his assistance in this determination.

to the late variant.

The Andronovo activity was fueled by the search for new ore sources due to the crisis in metallurgical resources (Avanesova, 2002. p. 18). Apparently, their appearance in the Akhangaran River valley, rich in mineral resources, is connected precisely with this trend. Some mines in the Fergana-Tashkent region were developed during the Bronze Age, in particular, the Aktashkan copper deposit , as well as the workings in Almalyk (Ruzanov, 2016. p. 63). The study of metal products from the early period of Burgulyuk I allowed us to shift the lower boundary of the culture to the 13th-12th centuries BCE (Ruzanov, 2016. p. 68). It has been suggested that in the second half of the 2nd millennium BCE, a group of tribes of the Sapalli culture advanced into the Tashkent oasis (Ruzanov, 2016. p. 84).

It should be noted that excavations in 2023 revealed the remains of a lower-level dwelling in the form of a large semi-dugout, approximately 6 meters in diameter. Furthermore, a large metallurgical production zone was discovered at the southern end of TsO-1. At TsO-2, revealed foundry form with remains copper (bronze). Also revealed find stone with iron inclusions (Ilyasova, Murodaliev, 2025. P. 136-142). J.F. Duque believed that part of metal products Burgulyuk people could acquire from the Andronovo-Tazabag'yab tribes that metallurgy was strongly developed (Duque, 1982. P. 79) .

According to S.R. Baratov, the Burgulyuk culture was a variant of the Chust culture, and its uniqueness was due to intensive contacts with the late Andronovo and Karasuk pastoral populations (Baratov, 2009. p. 31). Fragments of steppe bronze ceramics of the Dandybai-Begazin culture type were found in the lower layers of Shashtepa; a settlement of the Burgulyuk culture was also discovered here in the lower horizon [Filanovich , 2009. p. 63]. Steppe bronze ceramics and late Burgulyuk ceramics were also found in the vicinity of the Kavardan settlement (Alimov, Bogomolov, 1996. p. 87).

It should be noted that there were no previous radiocarbon dates for the Burgulyuk culture of Tashkent (Ilyasova, Maksudov, Khamidov, Lingmei Lin, Wulfert, Normuradov , 2020, p. 109). The updated data are provided below:

Thus, radiocarbon dating of the Kuyun settlement materials was conducted for the first time for

Calibrated radiocarbon dates for the Kuyun settlement

Table No. 1

Sample	Context / layer	Radiocarbon date (BP)	Calibrated range (95.4% HPD)	Notes
BA182333	Eastern remnant, layer 2	3300–3100 BP*	1068–918 cal BCE	Burgulyuk layer
BA182334	Eastern remnant, same layer	3300–3100 BP*	1042–910 cal BCE	Burgulyuk layer
BA182335	Central remnant, 3a, dugout P 2, tier depth 100–125 cm	3500–3350 BP*	1311–1194 cal BCE	Andronovo ceramics

* BP radiocarbon dates are approximate based on calibrated ranges provided by measurement results (2018).

Kuyun is a unique and, so far, the only monument in the Tashkent region where traces of the Andronovo and Burgulyuk cultures intersectкультур

Burgulyuk culture sites. The results of calibration using IntCal20 (OxCal 4.4) showed that the Burgulyuk layers (samples BA182333 and BA182334) date to the mid-11th to late 10th centuries BCE, while the layers containing Andronovo ceramics (BA182335) date to an earlier period, approximately the late 14th to early 12th centuries BCE. (We would like to express our sincere gratitude to researcher Lin Lingmei for the data from her research conducted at Peking University).

Problems of connections between the Burgulyuk culture and the Painted Pottery culture of Xinjiang, in particular with the Tarim sites, have also been noted by a number of researchers (cited in: Sverchkov, 2010. p. 183). L.M. Sverchkov suggests that the emergence of the Burgulyuk culture of the Tashkent oasis could be associated with the westward and southwestward movement of some part of the Tarim Basin population (Sverchkov, 2010. p. 189). Yu.F. Buryakov compares the Chauhougou complex (Xinjiang) with materials of the Burgulyuk culture (cited in Matbabaev , 2008. p. 135). In a recently published article, Lin Lingmei notes that round-bottomed pottery with cylindrical spouts, similar to the Burgulyuk, was discovered in the Ili Valley in northern Xinjiang. It dates back to the 12th-10th centuries BCE. And, although the painted ceramics of Fergana and Xinjiang arose in these two regions independently of each other, certain connections and interactions can be observed (Lin, 2020. Pp. 52-64). According to A.-P. Francfort and J. Lhuillier , despite the signs of an indirect connection between the "northern" cultures of painted ceramics (Fergana, Chach, Ustrushana and Sogd) with Xinjiang, this region is not the birthplace of the painted ceramics cultures (*Francfort H.-P,* 2005. Pp. 253-328 ; Lhuillier , 2013. P. 17).

Without claiming to resolve the complex and controversial issues surrounding the origins of the Burgulyuk culture and the migration routes of its bearers, we hope that the new data published about this pre-

viously unknown site and the new materials obtained during its excavations will contribute to the accumulation of our knowledge on the subject and will help in resolving several important issues.

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On the history of the study of the architecture of Bactria- Tokharistan
(based on the research by Academician E.V. Rtveladze)

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The name of Edward Vasilyevich Rtveladze is widely known not only in Uzbekistan but also far beyond its borders. His role in the development and popularization of Central Asian scholarship, including history, archaeology, numismatics, epigraphy, and architecture, is invaluable.

His life's work was archaeology, or more precisely, field archaeology. His entire career and his major scientific discoveries were connected to the Surkhandarya region and the study of the enigmatic Bactrian civilization. This region is rich in ancient architectural monuments, dating from the Bronze Age to the Kushan period, particularly the Sherabaddarya and Surkhandarya valleys, facilitated by such factors as favorable geographic conditions and a relatively stable political situation (during the Kushan period). It was here, beginning in 1967, that he began his many years of work as part of the Uzbekistan Art History Complex Expedition (UzAHCE, established in 1960) under the guidance of his teacher, G.A. Pugachenkova (Nurmukhamedova, 2012, p. 150).

Outstanding scientist and archaeologist Edward Rtveladze (1942-2022)

His first object was the excavation of the temple complex of the citadel of the Khatyn-Rabat settlement (a landmark monument for him), which began back in 1967. Route and continuous studies of ancient settlements of Northern Bactria, such as Khatyn-Rabad, Talashkan-tepa (in the Sherabad district), Bandykhan, Dalverzintepa, Shurobkurgan, Kampyrtepa (Gagarin district), as well as medieval monuments made it possible to study the monuments of the Surkhandarya region and create a more complete picture of them.

Ancient period

In 1968, a survey and long-term study of the Dalverzintepa settlement – its citadel, temple complex, and *naus* began. Based on stratigraphic observations, it was determined that structure Dt-7, located near the city wall and measuring 32x20 m, was a blind platform surrounded by narrow, U-shaped corridors. This structure was a temple to the Bactrian goddess Nana (Pugachenkova, Rtveladze, 1978, p. 89), as evidenced by the subject matter of a painted panel. No less interesting was the discovery of a *naus* – a burial structure (13x12.5 m) laid out as a central corridor with crypts located off it (four on each side). The study of this building allowed the archaeologist to identify a change in religious beliefs and a burial rite that existed in the late Kushan and Kushan periods only in the territory of Northern and Southern Bactria – ossuary-less burials of bones, close to Zoroastrian ones.

Edward V. Rtveladze paid special attention to the problems of the formation of ancient cities, as well as military architecture. Thus, three settlements examined by him in the village of Bandykhan in 1974 allowed us to identify three stages of cultural development in the 1st-half to the early 2nd half of the 1st millennium BCE. In 1972, the Talashkan-tepa settlement (round in plan, 130 m in diameter) with powerful monolithic walls and 14 semicircular towers, made it possible to uncover a Bactrian fortification of the 6th-4th centuries BCE (Rtveladze, 2020. P. 228). And the discovery of a powerful wall from the Kushan period of the 1st-2nd centuries CE in a mountain pass near the village of Derbent (united in antiquity and the Middle Ages under the general name Derbent or Iron Gate), rising 400 m above the Shurobsay valley, define the northwestern border of Bactria during the Kushan era (Rtveladze, 2003). Scholars proposed three types of defensive structures: border walls and fortresses, state fortresses for overseeing water distribution, and state fortresses that controlled crossings across the Amu Darya. The study of Bactrian fortifications allowed him to prepare an article and a report on the topic «Bactrian fortification genesis and evolution in their social and cultural aspect» to participate in the international conference in Valbonne (France) in 1982.

By the time Rtveladze discovered the Tokharistan Archaeological Expedition (TAE), which he organized

Three musicians (a drummer, a lutenist, and a harpist) surrounded by acanthus leaves, a fragment of the "Ayrtam" frieze, housed in the Hermitage Museum in St Petersburg, Russia. This piece originally formed part of the entrance to a Buddhist temple. Circa 1st century CE

in 1999, has under his belt numerous route studies, the defense of a doctoral dissertation (in 1989), scientific trips and lecturing in Japan, Italy and France (including participation in the work of the French archaeological expedition in Cyprus), and election as a full member of the Uzbekistan Academy of Sciences (in 1995, specializing in historical sciences).

The experience accumulated during numerous expeditions allowed the scholar to concentrate on a deep and comprehensive study of the Kampyrtepa settlement, discovered in 1972 during archaeological reconnaissance in the Amu Darya valley. These excavations, which Rtveladze called the Oxus Campaign, were large-scale, involving not only a comprehensive study of this settlement but also an in-depth exploration of the southwestern part of the Surkhandarya region. From an architectural perspective, it became possible to determine the urban planning principles of this settlement, «a unique opportunity to study not individual residential units..., but residential quarters as a whole» (Rtveladze, Alpatkina, 2009. p. 43), as the settlement was completely uncovered. The use of all three types of stratigraphic research made it possible to form a clear picture of all periods and stages of inhabiting the settlement (Hellenistic, Yuezhi, Parthian and Kushan), and the outstanding achievement of these studies, according to Edward V. Rtveladze , “the discovery of the earliest Greco-Macedonian frurion in Transoxiana, erected during the reign of Alexander the Great on the right bank of the Oxus (Amu Darya)” (Rtveladze, 2009. p. 4), and also the fact that Kampyrtepa was one of the main cult centers of Bactria during the Hellenistic era, as evidenced by the majestic temple, towering over the Oxus to a height of more than 20 m. A comprehensive, long-term study of the urban culture of this settlement, its powerful fortifications and architecture allowed the archaeologist to prove the fact that Kampyrtepa was once the site of Ptolemy’s legendary Alexandria

Kampirtepa is a fortress located in northern Bactria from the late 4th century BC to the mid-2nd century AD. Today's Surkhandarya region, Muzrabad district

of Oxus.

Originality of Edward V. Rtveladze's scientific thought allowed him to find new perspectives and insights into established definitions using archaeological data. Many of the problems examined in his works, from the perspective of the history and theory of architecture, are unique. His research is comprehensive, drawing on archaeological, topographic, and geographical studies, numismatic data, and ancient (for example, Bactrian) inscriptions to address specific issues. These include studies of the Kara-Kamar cave complex and its interpretation «as a Mithraeum, i.e., a sanctuary of Mithras» (Arshavskaya, 1992, p. 7); and the discovery of the habitation of so-called cuestas (hard-to-reach rocks) in Northern Bactria during the Kushan period and the construction of fortifications on them. Reading and translating ancient inscriptions (for example, a Bactrian monumental inscription) allowed the scholar to reinterpret the cult complex on Ayrtam (contrary to the prevailing opinion about its Buddhist character) (Masson, 1935) as a dynastic temple dedicated to the cult of the Kushan king Huvishka (Rtveladze, 2018). The functions of the monumental building in Khalchayan, defined by G.A. Pugachenkova as the palace of the Kushan Geraichi clan, were reconsidered. According to Edward V. Rtveladze, it was originally the palace of the supreme rulers of the Great Yuezhi, subsequently converted into a temple of deified ancestors (History of Statehood, 2009. P. 460) .

Medieval period

In addition to the monuments of the ancient period, his extensive research also includes a study of the architecture of the Surkhandarya region in the early and medieval periods. This includes the localization of the settlements and villages of Northern Tokharistan from the early medieval period mentioned in written sources – the capital of the region of the same name, Chaganian (on the site of the settlement Budrach), identification of the large village of Navanaktepa with the medieval village of Navanaktepa (Rtveladze , 1978. p. 115), the villages of Derzengi and Barangi.

Archaeologist Edward Vasilievich Rtveladze in 2015

Research into the rock burials of Bittepa (western Surkhandarya region) allowed the archaeologist to identify unusual types of burial structures from the 7th-8th centuries CE and their design, characteristic of the entire Northern Tokharistan (Rtveladze, 1986). In addition, certain planning features of the Bittepa crypts – the presence of a U-shaped entrance frame,

Archaeological excavations of Dalverzine-Tepe, near Denau - Surkhandarya region

The Dalvarzintepa monument, located in the Shurchi district of the Surkhandarya region. Photo: meros.org

Archaeologist Edward Vasilievich Rtveladze in 2002

the division of the chamber on four sides by deep arched niches, the presence of pendentives in the form of a semicircular vault in the corners of the chamber led Rtveladze to suggest that the architecture of the Bittepa crypt is «one of the links in the chain of genesis of Muslim mausoleums» (Rtveladze, 1982. p. 34). For the first time, thanks to archaeological excavations carried out during work on the Amu Darya island of Aral Paigambar (near Termez), fundamentally new facts were obtained not only on the history of the construction of monuments and the clarification of their dating, but also on the architectural planning, stylistic and decorative features of such little-studied monuments as the architectural ensemble of Zul-Kifl (Rtveladze, Arshavskaya, 1978), the oldest multi-column mosque in Central Asia on Sapoltepa (28 km from the settlement of Budrach), dating back to the 11th-12th centuries. The result of many years of work was the monograph «Medieval Monuments of Surkhandarya» (1982), prepared by Z.A. Arshavskaya, Edward V. Rtveladze and Z.A. Khakimov, which covered all the architectural and archaeological monuments of the region studied at that time.

The scholar's contribution to the preparation of the «Collection of Historical and Cultural Monuments of Uzbekistan,» the primary goal of which was the preservation of architectural heritage, is noteworthy. Thus, in 1967, the Academy of Sciences and the Ministry of Culture of the then USSR decided to compile a multi-volume Collection of Historical and Cultural Monuments located within the Soviet Union. Essentially, the goal was to create an encyclopedic reference work that would include both above-ground monuments and archaeological sites. Scholars from Uzbekistan, who joined the work in August 1973 by government decision, also actively participated in this work. A team of staff from the Art History Research Institute worked on the architectural and monumental art monuments. Edward V. Rtveladze edited the Surkhandarya Collection of Monuments and authored 198 reference articles and an introductory historical and geographical essay. The scholar's encyclopedic knowledge enabled the successful creation of a work «that reveals the cultural history of the region from the dawn of civilization to the present day» (Babajanova, 1992, p. 8). Such a work was a first, as it combined the work of archaeologists, historians, art historians, and architects.

Among the 500 archaeological sites discovered in the Surkhandarya region, the archaeologist had a direct relationship with many of them. Based on these, fundamentally important issues for the architectural science of Uzbekistan were revealed, such as the formation of the cities of Bactria-Tokharistan and their classification (dividing them into 4 groups: large cities, medium-sized cities, and small towns), the typology and genesis of urban settlements of the Kushan period in this area (Rtveladze, 1974). Edward V. Rtveladze also studied fortification architecture, the architecture of ancient religious and funerary structures – monuments of the Achaemenid, Greco-Bactrian, and Kushan periods. The culmination of many years of research was the defense of a doctoral dissertation on the topic "Ancient Bactria - Medieval Tokharistan. Dynamics of Historical and Cultural Development" (1989), as well as the publication of the monograph "Northern Bactria – Tokharistan. Essays on History and Culture. Antiquity and the Middle Ages» (1990) jointly with G.A. Pugachenkova.

Tokharistan studies were laid largely thanks to Edward V. Rtveladze's many years of archaeological and archaeological-topographical work. The scholar's research was always distinguished by the breadth of its scientific approach, its substantiation, and the inclusion of various artifacts obtained during numerous archaeological expeditions. His remarkable capacity for work, immense willpower, and ability to conduct in-depth analysis, as well as his absolute dedication to his profession, contributed to his becoming one of the world's foremost archaeologists.

Reinterpreting Furniture Adapted for People with Disabilities through Design

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The home environment is not merely an ordinary space that serves everyday life. Through form, scale, texture, light, circulation paths, and the arrangement of objects, it also shapes an artistic atmosphere. For this reason, comfort and openness are among the key aesthetic qualities of an interior. They define the structure of space, influence how people move through and perceive it, and help form the image of the home.

At the same time, an accessible environment is a major factor in the independence and quality of life of people with disabilities. According to the World Health Organization, nearly 15 percent of the world's population lives with various functional limitations [11]. Historically, standard planning solutions and mass-produced furniture often failed to take physical diversity into account. As a result, special adaptations were added only later, and this frequently had a negative effect on the overall aesthetic integrity of the interior.

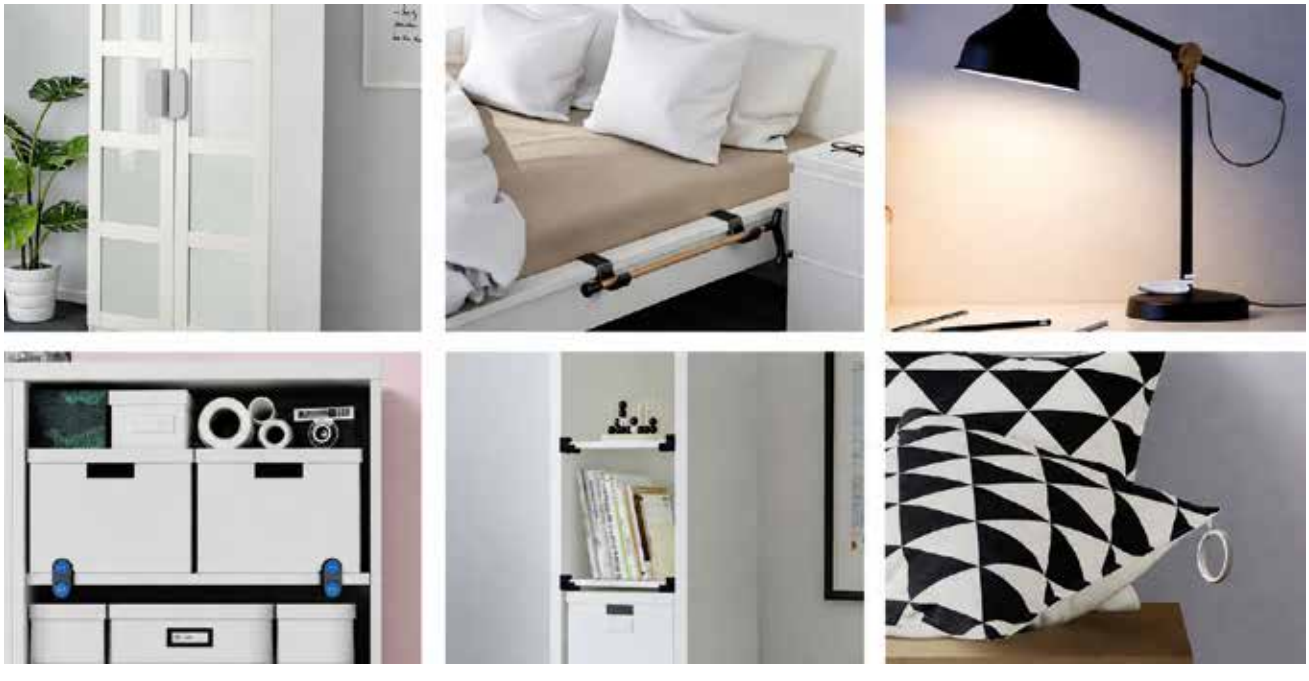
Today, an important shift can be observed in design culture. The idea of "design for all" is no longer understood simply as a set of regulatory requirements, but as an approach that combines comfort and beauty. From this perspective, the home environment can be viewed as an artistic medium that generates form and meaning while taking human physical characteristics into account. The central research question therefore becomes: can furniture designed for the needs of people with disabilities be both highly functional and aesthetically developed at the same time?

The aim of this study is to reinterpret home furniture from the perspective of human diversity and to substantiate the principles by which the residential environment can function as a medium of artistic expression. The theoretical significance of the research lies in clarifying art-historical concepts related to the object-spatial environment. Its practical significance lies in the possibility of applying the identified principles in the analysis and design of residential interiors.

Methods

The study combines analytical and practical approaches.

First, contemporary scholarly literature in interior design, ergonomics, and accessible design was reviewed. In particular, the analysis focused on scientific sources that reflect the evolution of attitudes toward disability in design, historical experience, and new technical solutions.



Second, examples of adaptive furniture and practical design projects were comparatively analyzed. This included commercial furniture designed for people with disabilities, products by major brands, and experimental concepts. In particular, IKEA's This-Ables initiative (2019) and the OMTÄNKSAM collection (2020) were examined [5].

Third, users' experience of organizing the home environment was taken into account on the basis of interviews, reports, and journalistic materials [2]. These sources made it possible to compare scientific and project-based approaches with real needs.

Thus, the research methodology was based on theoretical analysis, comparative evaluation, and the study of practical examples.

Discussion

The analysis shows that inclusive design in the home lies at the intersection of several disciplines. It is directly connected with architecture, industrial design, sociology, and art history. Early studies mainly focused on the functional side of accessibility. For example, Clarkson and Coleman examined the history of inclusive design in relation to ergonomics and the needs of older adults, while Hannah Meiklejohn-Kerr's historical overview demonstrates that furniture adapted to special needs is not a new phenomenon.

Research shows that throughout history, people with disabilities have adapted their living environments to their own needs. Yet the significance of such solutions for the wider consumer market has only begun to be recognized in industrial design over the last few decades [4]. In contemporary research, the aesthetic issue is also becoming increasingly important: specialized furniture is expected not only to be convenient, but also visually appealing [4].

For a long time, furniture designed for people with disabilities was primarily medical and utilitarian in character. Specialized chairs, beds, and lifting devices were developed more as medical equipment than as elements integrated into an interior. As a result, the mistaken idea emerged that ergonomic furniture cannot be beautiful.

In recent years, however, this approach has begun to change. Major companies are now developing products that combine accessibility with contemporary design. In 2023, for example, Pottery Barn launched the Accessible Home line, adapting well-known furniture models to the needs of users with disabilities while preserving the brand's visual identity [5]. IKEA projects likewise offer examples of interiors that are both accessible and aesthetically coherent for wheelchair users [6]. These cases show that inclusive design does not limit artistic possibilities; on the contrary, it opens the way to new compositional solutions.

At the same time, a number of challenges still hinder the widespread adoption of such furniture. The main difficulty is economic. The market for these products remains narrow, and the cost of technologi-

Affordable Home Project

cal solutions is high, so prices are often considerably higher than for conventional furniture [2]. In many cases, innovative products are imported, which makes them less accessible for a broad audience.

Another important problem is the lack of information. Many users simply do not know enough about the possibilities that already exist. Height-adjustable desks, for example, are often promoted as office or gaming furniture, although they can also be highly useful for people with disabilities [2]. As a result, some users are forced to make the necessary items themselves or order them individually.

International and Regional Context

At the international level, inclusive housing has become one of the important directions of contemporary design. Systems such as the ADA in the United States have established minimum standards of accessibility. At the current stage, however, the main focus is shifting toward the principle of Design for All. This approach implies not only compliance with regulations, but also the creation of an equal aesthetic experience for all users.

In Europe and North America, major companies are attempting to integrate universal elements into their core product lines. In developing regions such as Central Asia, inclusive residential design is still at an early stage. At the same time, interest in this field is growing: state programs, social innovations, and competitions for young designers all serve as examples. This suggests that public support and social awareness can significantly accelerate the development of this direction.

Results

Based on the analysis, the results can be summarized in five main directions.

The first direction is ergonomic adaptation. In the home environment, ergonomics matters not only for comfort, but also for the proportional balance of space. The size and height of objects, as well as the distance between them, determine the user's possibilities for movement. Research shows that adapting furniture to anthropometric indicators increases personal independence. For example, for wheelchair users, the recommended height of a kitchen work surface is around 80–85 cm [2].

The second direction is technological adaptability. Smart mechanisms, sensors, and voice-control tools create convenience for the user while also enriching the modern aesthetic character of the interior. Prototypes of smart desks, modular constructions, and robotized furniture blocks are clear examples of this [3], [7], [8].

IKEA's ThisAbles Project (3D-Printed Accessories)

Affordable Home Project

Affordable Home Project

The third direction is aesthetic integration. Comfort and beauty are not opposites. On the contrary, elements that serve accessibility can become a full-fledged part of the interior design. Color, contrast, material, compact form, and hidden assistive mechanisms are especially important in this respect [5], [6].

The fourth direction is user participation. A project becomes more effective when it is created not merely for the user, but together with the user. Interviews, online initiatives, and experience-based approaches bring space closer to real needs.

The fifth direction is systemic support. For inclusive design to be implemented broadly, industry, the state, and society must act together. Grants, tax incentives, rehabilitation programs, and information campaigns play an important role in this process [2].

Overall, the study shows that it is possible to combine functionality, technological convenience, and aesthetic expressiveness in the design of home furniture. Ergonomics, technology, aesthetics, and collaboration together form an integrated design approach.

Conclusion

The results of the study show that the home environment is not only a living space, but also a medium of artistic expression. Furniture and interiors created with the needs of people with disabilities in mind generate aesthetic value alongside comfort. For this reason, the idea of "design for all" acquires particular importance precisely within the residential environment.

This approach reveals three main outcomes. First, a home environment that takes physical capabilities into account increases a person's independence and safety. Second, the means used to ensure accessibility become a source of technological and artistic innovation. Third, traditional ideas about the interior are transformed, and accessibility becomes an inseparable part of the image of the contemporary home.

From the perspective of art history and design criticism, ergonomics, technology, and accessibility can be evaluated not only as practical tools, but also as components of the artistic language of the interior. In future research, it will remain important to study more deeply the relationship between utilitarian and aesthetic aspects, expand interdisciplinary connections, and compare different cultural experiences.

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Rebellious fashion as a form of expression of feelings and social manifestos

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In contemporary culture, fashion is no longer a purely aesthetic or utilitarian practice, but rather a powerful means of artistic and social expression. This trend is particularly noticeable in rebellious fashion, where clothing is viewed not only as a means of self-expression but also as a form of critical perception of reality. In contemporary provocative fashion, designers such as McQueen, Westwood, Kawakbo, and Margiela often employ the «aesthetics of ugliness» to push the boundaries of elegance and demonstrate that beauty can emerge from suffering and deformation. Therefore, it is crucial to analyze fashion as a language capable of reflecting complex emotional states, collective traumas, and ideological conflicts. Of particular interest in this regard are the collections of Alexander McQueen and Vivienne Westwood, whose works demonstrate a shift from decorativeness to conceptualism. In their work, fashion is presented as a complex form of artistic communication in which personal experience is transformed into universal cultural codes. Their collections demonstrate that clothing can serve not only as an aesthetic object but also as a means of expressing historical trauma, social conflict, and identity. The goal here is not rebellion per se, but rather to encourage the viewer to rethink accepted norms and values. Through shock, deformation, and symbolism, the designers create a new visual language where beauty emerges from the brink of destruction.

Alexander McQueen. Angels and Demons. 2010. Final Collection

Vivienne Westwood wasn't about beautiful clothes; she was the leading figure who brought a spirit of anarchy and conscious subversion of tradition to high fashion. Together with Malcolm McLaren, she turned clothing into a political tool and a form of protest against bourgeois norms[1]. Vivienne says, "I don't consider myself a designer who predated the punk era. I simply used fashion as a form of rebellion and resistance". The tears on her T-shirts, her anti-royalist slogans—all of this evokes mixed feelings: emotion, anger, and hope for freedom. The holes and rents on her T-shirts, slogans against royal power - it all sounds as an emotion + anger + hope for freedom. Westwood didn't strive for "peace and love" like most people—she wanted her clothes to provoke, provoke thought, and make people think. The key is that rebellion is presented as catharsis.

In her most controversial collection, "La Mode Destroy" (The Style of Destruction), Westwood pioneered the use of "damaged" materials, torn fabrics, and recycled materials. This movement (also known as "deconstruction") rejected classical rules of quality and form, emphasising imperfections and disproportions. Her famous T-shirt featured a red swastika, an inverted cross, and the inscription "DESTROY". "DESTROY" is the belief that in order to build something new, one must destroy the old. It was all about shocking the older generation, breaking taboos, and saying, "We are not afraid of your past". It was about the pain caused by fascism, war, and hypocrisy—and at the same time, about the hope of youth for awakening. According to Westwood, "clothes should be uncomfortable for a person to feel alive". In her work, fashion became more than just "decoration" but a way of self-definition through rebellion, using elements such as English knots, chains, and counterculture symbols.

Vivienne Westwood's work views clothing as an "irrational coded message" aimed directly at the subconscious, symbolically expressing the emotions of the designer and the wearer. This gives new meaning

[1] The End of Fashion: Clothing and Dress in the Age of Globalization. Collective authors. Moscow: NLO. Series "Library of the journal "Fashion Theory". ISBN: 978-5-44-481404-8. Among the authors: Hazel Clark, Adam Geczy, Valerie Steele, Vicky Karaminas and others.

Vivienne Westwood, Mini-Crini Collection, 1985. 1985

to the historical corset. Boucher's corsets, with their erotic carinae, no longer constrain or restrict the female body, but become a means of pride and erectile appeal: Sensation "Look at me, but on mine conditions" gives force femininity. As a result, fashion simultaneously serves as both defense and offense, becoming a "shield and sword". In this context, provocation is the designer's attempt to force society to look at a "hidden wound" (race, sexuality, or class).

Her "Mini Krini " collection offers a playful and sophisticated freedom, contrasting with the broad shoulders and rigid shapes of 1980s women's fashion, through a combination of a smaller version of the crinoline, prints from children's dresses and ballet motifs. Vivienne Westwood showed that fashion can be a driving force not only through its aggressiveness, but also through its charm.

T-shirt with the words "God Save the Queen". 1977
Metropolitan Museum of Art, New York

Alexander McQueen, who survived abuse as a youth, combines spiritual suffering and beauty in his work. His collections are a cry from the heart. McQueen says, "I want people to feel what I feel". Sources describe McQueen's work as more than just fashion design, but as a profound exploration of human fear, history, and cultural suffering[2].

His clothes are a kind of trauma therapy. He explored themes such as romanticism, lust, and death, incorporating autobiographical elements into many of his collections. His shows often resembled art performances or performances, evoking anxiety and discomfort in viewers.

The «Highland Rape» collection (1995) was long remembered by fashion experts as one of his most provocative shows, featuring models in tattered clothing, covered in mud and fake blood. In it, the designer used images of women in utterly pathetic outfits as a reference to the 18th-century genocide of Scots by the English, as well as contemporary tragedies in Rwanda and Bosnia. McQueen challenged conventional notions of beauty and created grotesque forms, such as his famous "armored boots," which distorted the normal silhouette of the human body [3].

The theme of violence continues in his 1999 collection, but this time it is perpetrated by machines. At the end of the performance, two industrial robots "suddenly awaken" and begin aggressively spraying Shalom Harlow (a former ballerina) performing in a

[2] End mods. Clothes And costume in e pohu globalization (The End of Fashion : Clothing and Dress in the Age of Globalization). Collective authors. Moscow: New Literary Review (NLO). (Series "Library of the journal "Fashion Theory"). ISBN: 978-5-44-481404-8. Among the authors: Hazel Clark, Adam Geczy , Valerie Steele, Vicky Karaminas and others.

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A set from the "It's a Jungle Out There" collection, presented as part of the autumn-winter season 1997/1998 by Alexander McQueen

simple white muslin and tulle dress with black, yellow, and green paint. Harlow initially defends herself with her hands, then gives in and collapses before the audience's eyes, completely helpless and defenseless. In this performance, McQueen juxtaposes beauty and violence / man and machine. The innocent woman in the white dress (a symbol of purity and vulnerability) becomes a symbolic metaphor for the contagion of cold technology, the threat it poses to humanity, and the birth of art through destruction and chaos.

His collection, "The Widows of Culloden" (2006), marks a shift from Alexander McQueen's provocative approach to a more complex, almost tragic, figurative poetry. If "Highland Rape" is a scream, "Culloden" rises to the level of a requiem. The collection is dedicated to the widows of those who fought in the Battle of Culloden, the tragic story of Scotland's defeat by the English in 1746. The designer explores themes of sadness, dignity, melancholy, Scottish identity, and historical trauma. The main accents are romantic tweed, tartan, antlers, Gothic dresses, and elegant mourning beauty. This is a majestic, poetic expression dedicated to the memory and resilience of Scottish widows. McQueen transformed historical trauma into luxurious, romantic, and gothic mourning. Here, pain is transformed into beauty, and sadness into virtue. At the end show a holographic image of a woman in an elegant airy dress, as if ghost, gives the event a requiem feel.

If McQueen's 'Widows of Culloden' collection delved into the quiet melancholy of Scottish grief, his 'Skanners' collection (2003) transports us to an atmosphere of long exile, from the icy tundra of Siberia to rainy Japan. Here, there is not only pain but also curiosity, a yearning to find warmth in the cold. He transformed the results of his brain scans into an invitation: peer inside the designer and journey together, as if in modern armor. A personal gesture, the designer literally "scans" his mind and soul, inviting the viewer to peer within. The contrasts of cold and heat, darkness and light, destruction and luxury evoke a sense of security and survival in a harsh world. This collection awakens a profound interest in the cultures of Eurasia, cultural exchange (such as along the Silk

Alexander McQueen. From the 2009 autumn-winter collection. Victoria and Albert Museum, London

"Fashion in Motion": Alexander McQueen, 1999. Photo: Victoria and Albert Museum, London

Road), and how human identity transcends borders and challenges. This is considered the emotional core of the collection. The collection traces the evolution of the designer's emotions: from personal pain and anger to a broader, philosophical view of the world, culture, and human resilience.

Summarising the designers' approaches, we can identify the main characteristics of rebellious fashion. First, it functions as a subconscious language, conveying encrypted emotional and cultural meanings. Second, clothing acts as a boundary between the individual and society, simultaneously protecting and provoking. Third, the aesthetics of deformation and "ugliness" are actively used as a way to expand notions of beauty. Finally, provocative fashion resists commercialisation, reclaiming fashion's status as an intellectual and artistic expression. It can be concluded that fashion is not just fabrics or dresses. It is a language of feelings and emotions. Designers infuse their pain, joy, anger, melancholy, or pride into clothing—and when they wear it, they begin to feel alive, strong, free, and heard. Thus, provocative fashion occupies a special place in contemporary culture, acting as a mediator between individual experience and collective consciousness and confirming that fashion can be a full-fledged form of artistic and social analysis.

Alexander McQueen. Angels & Demons. 2010. Final Collection

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Different paths, one city: national leaders of the 20th century in Tashkent

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The second half of the 20th century marked a special historical period for Tashkent. During this period, the city became not only a political and cultural centre but also a platform for international diplomacy and cultural dialogue. World leaders representing various ideologies and political views visited Tashkent and praised its development, the hospitality of the Uzbek people, and its cultural potential.

The visits of the Shahanshah of Iran Mohammed Reza Pahlavi, the President of Indonesia Sukarno, the Prime Minister of India Jawaharlal Nehru, the President of the Republic of Ghana Kwame Nkrumah, the leader of the Cuban Revolution Fidel Castro and the President of Pakistan Mohammed Ayub Khan left a significant mark on the history of Tashkent.

On June 30, 1956, the Shah of Iran, Mohammad Reza Pahlavi, and Queen Soraya Pahlavi arrived in Tashkent on an official visit. They were accompanied by Iranian Minister of Commerce Ibrahim Kashani, Senator Mohammad Said, the Shah's Adjutant General Yazdan Panah, and a delegation of Iranian journalists. Banners reading «Welcome» in Uzbek, Russian, and Persian were displayed at the Tashkent airport.

During their visit, the Shah and Queen visited industrial enterprises , scientific and cultural institutions in Tashkent, and collective farms. They visited the Academy of Sciences of the country and met with scientists. Academy's President T. Zahidov spoke about the prospects for scientific cooperation between scientists from Uzbekistan and Iran and presented the Shah with a Russian and Uzbek edition of Abu Ali ibn Sina's «Canon of Medicine,» as well as a three-volume catalogue of oriental manuscripts.

In the evening, the guests attended a gala concert at the Navoi Uzbek State Academic Opera and Ballet Theater. On July 2, 1956, the Iranian delegation left Tashkent.

On September 4, 1956, a ceremonial welcome was held in Tashkent for Dr. Sukarno, President of the Republic of Indonesia and a prominent statesman and political figure. During his visit, Sukarno toured Tashkent's historical and cultural monuments, including the Tillashaykh Mosque, and met with Mufti Eshon Babakhan ibn Abdulmajidkhan. He also visited the chemical plant in Chirchik, learned about the production process, and signed the enterprise's book of honored guests. At the collective farm, he was presented with a Karabair horse. That evening, September 5, a public event dedicated to welcoming President Sukarno was held at Pakhtakor Stadium. Approximately 75,000 people attended the event. Addressing the crowd, President Sukarno began his speech by thanking those who had spoken before him for their greetings and thanking all the participants for coming to the meeting.

In his speech, Sukarno compared Tashkent to many cities in Indonesia, noting the similarities in the climate and natural conditions of the two regions. Despite Tashkent being located thousands of kilometers from Indonesia, separated by endless seas, vast

Shahenshah of Iran, Mohammed Reza Pahlavi and the Queen Soraya in Tashkent, Sharof Rashidov and Abdullah Khakimov in front of a microphone. 1956

Kwame Nkrumah, President of Ghana, during an official visit to Tashkent, 1961

Visit of Indian Prime Minister Jawaharlal Nehru to the Uzbek SSR. 1955.

plains, and high mountains, the Indonesian guests nonetheless felt as if they were in their own country, surrounded by beloved family. The Indonesian leader wrote the following words to the Uzbek people: «*There is a saying in Indonesia: 'The road is long, but the hearts are close.' Today I leave Tashkent. But you and your hospitality will forever remain in my heart...*»

The outstanding statesman and politician, Prime Minister of the Republic of India Jawaharlal Nehru, was solemnly welcomed in Tashkent on September 9, 1961. At the welcoming ceremony, Nafisa Fakhriddinova , an 8th grade student at School No. 24, addressed the guest of honor in Hindi and warmly congratulated him on his visit to Uzbekistan.

In his speech, Jawaharlal Nehru recalled his trip to Uzbekistan six years earlier. He noted that during this trip, he made many friends and encountered expressions of sincere love and deep respect for the Indian people at every turn. During his tour of the city, Nehru visited the new Chilanzar district of Tashkent, which was under construction, and inspected the activities of School No. 163.

Indonesian President Sukarno with a doira at the Kyzyl Uzbekistan collective farm during a visit to the USSR. 1956

During his trip, Jawaharlal Nehru visited the Institute of Oriental Studies of the national Academy of Sciences and met with prominent scholars of the country. The Institute's director, S. Azimjanova, provided detailed information on the comprehensive and fruitful research conducted by the Republic's orientalists.

On September 10, 1961, a gala banquet was held in honor of Jawaharlal Nehru. Speaking at the event, Jawaharlal Nehru noted that the friendly relations between the Indian and Uzbek peoples had deep historical roots and expressed his profound gratitude for the sincere hospitality extended to him in Uzbekistan.

In July 1961, a number of senior officials of the country gathered at the Tashkent airport for the ceremonial welcome of President Kwame Nkrumah of the Republic of Ghana. The President of the Republic of Ghana began his acquaintance with the life and work of the people of Uzbekistan with a visit to the «Qizil Uzbekiston» collective farm, located in the Ordzhonikidze district. He inquired about cotton yields, cotton plant care methods, and fieldwork mechanisation processes. Students from the boarding school, built with funds from the collective farm, welcomed the guests from Ghana. Fifth-grade student Bakhtiyor Turakhanov asked the President of Ghana to convey his greetings to the children of Ghana. Afterward, Kwame Nkrumah spent over two hours touring the Tashkent Textile Mill. There, he was introduced to new equipment, advanced technological processes, and production methods. Workers and specialists from the plant presented the President of Ghana and his entourage with samples of fabrics produced at the plant.

Relations between Cuba and Uzbekistan began after the victory of the Cuban Revolution in 1959. In May 1963, Fidel Castro visited our country. According to eyewitnesses of that visit, tens of thousands of people took to the streets of Tashkent to greet him. In addition to Tashkent, Fidel Castro also visited Samarkand, where he toured several of the ancient city's architectural landmarks. During his trip, Castro also visited the Tuyabuguz Reservoir in the Tashkent region, opened a year before the Cuban leader's arrival, listened to stories about the construction of the Great Fergana Canal, and praised the courage of the Uzbek people. Upon leaving Uzbekistan, Castro emphasised the hospitality, sincerity, and beauty of the people of the country and said that the visit had left a deep impression on him.

Pakistani President Mohammed Ayub Khan visited Uzbekistan on April 9, 1965. The Pakistani President expressed gratitude to the country's leadership for the warm welcome extended to him and his accompanying persons in Uzbekistan.

Fidel Castro (left) and First Secretary of the Central Committee of the Communist Party of Uzbekistan Sharaf Rashidov (second from right) talk with M. Muminov, a shepherd from the Sverdlov collective farmNovosti Archive. Author: Vasily Malyshev

First Secretary of the Central Committee of the Communist Party of Cuba, Chairman of the Council of Ministers Fidel Castro, and First Secretary of the Central Committee of the Communist Party of the Uzbek SSR Sharaf Rashidov greet residents of Tashkent. 1963.
Photo by Vasily Malyshev

President of the Islamic Republic of Pakistan, Field Marshal Muhammad Ayub Khan, at a meeting with imams of Tashkent mosques. Tashkent. Khast-Imam. April 1965

The famous photo of Fidel Castro with a tractor driver at the Uzbek collective farm "Kyzyl Uzbekistan." 1963, Tashkent region. Photo: RIA Novosti Archive. Author: Vasily Malyshev

Indonesian President Sukarno on his way to the Imam al-Bukhari Mausoleum. Uzbekistan, 1961. Archive: Nuri C Bin Sulaiman

A number of important agreements were signed aimed at developing mutually beneficial trade, expanding economic and technical cooperation, and strengthening scientific and cultural ties. On the evening of April 9, the President and official guests from Pakistan departed Tashkent for Samarkand on a special train. In Samarkand, the Pakistani guests toured the city and viewed its architectural and historical monuments, embodying the centuries-old rich cultural heritage of the peoples of Uzbekistan, as well as the historical ties between the peoples of Uzbekistan and Pakistan.

After a tour of the city, the guests visited the All-Union Scientific Research Institute of Karakul Sheep Breeding. Here they learned about the scientific work being done in the field of Karakul sheep breeding and advanced livestock farming methods. The delegation then traveled to the Jizzakh combine. During a tour of the Hungry Steppe (Mirzachul), the guests learned about the rich experience accumulated by the region's residents. Pakistani President Mohammed Ayub Khan visited several state farms located on virgin lands and personally inspected the tray irrigation system and the seeding process in such areas.

Thus, the visits to Tashkent by Mohammad Reza Pahlavi, Sukarno, Mohammad Ayub Khan, Kwame Nkrumah , Fidel Castro, and Jawaharlal Nehru became important political and cultural events in the city's history, further strengthening Tashkent's importance on the international stage. These visits went down in history as a shining example of friendship, cooperation, and cultural dialogue between peoples.

Artistic traditions of the Andijan school of carpet weaving

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The art of carpet weaving is one of the most ancient layers of human culture, embodying life, spirituality, worldview, and aesthetic perception. In the lives of the peoples of Uzbekistan, carpet weaving occupied a place not only as an applied craft but also as a spiritual symbol. Through carpets, people artistically expressed their inner world, dreams, and relationship with nature.

The geographic environment, lifestyle, and social needs played a significant role in the development of Uzbek carpet weaving. Each region developed its own unique weaving techniques, pattern structures, and color combinations. Carpets were generally divided into two types: piled (knotted) and pileless (smooth). Knotted carpets were thick and retained heat in cold climates, while pileless carpets were lightweight and comfortable for nomadic life. Dyes were obtained from natural sources: pomegranate peel, indigo, onion peel, grape skin, and saffron, ensuring the natural beauty of the color palette.

a) b)

a) Carpet. Kyrgyz. Fergana Valley, early 20th century. Wool, knotted fabric.
b) Chowadon. Uzbeks or Kyrgyz. Fergana Valley, 1940s. Wool, knotted fabric.

The Fergana Valley is one of the centers of Uzbek applied arts, where carpet weaving developed in close connection with sericulture, embroidery, and wood carving. Fergana carpets are characterized by artistic simplicity, color balance, and an elegant pattern system. Along with a central medallion composition, Fergana Valley carpets also feature a symmetrical pattern system. The combination of colors—red, brown, blue, and white—expresses warmth and harmony with nature.

The Andijan school occupies a special place in the carpet weaving art of the Fergana Valley. In the late 19th and early 20th centuries, women in the city of Andijan and surrounding villages were engaged in carpet weaving. Thanks to the creativity, taste, and patience of these women, Andijan carpets are distinguished by their elegance, naturalness, and spirituality.

The main characteristics of Andijan carpets include a short pile, a combination of red and blue colors, the use of diamond-shaped and branch-shaped patterns in the central composition, the predominance of natural dyes, and the presence of symbolic elements such as the “ram’s horn,” “wave,” and “tree of life” in the patterns.

“Khidirsha” carpets of the Kyrgyz people of the Andijan region deserve special attention. They are distinguished by a combination of red and blue colors, decorated with a pattern of ram’s horns, and a unique combination of diamond-shaped medallions creates compositional harmony. What makes these carpets unique is that each pattern reflects folk beliefs, ideas of harmony with nature, and stability.

In the mid-20th century, the Ministry of Light Industry established a specialized carpet weaving workshop in Andijan. Local artisans, such as Dardokdon Gimsan-opa, Oyimkhon and Mekhriniso Tepayevs began working in this workshop. They revived ancient carpet weaving traditions and breathed new life into this art. In the area where the workshop was located, silk, wool, and other fiber-containing materials were processed on looms, and the weaving industry developed. Thus, the art of carpet weaving was revived in the city. In particular, a group of female weavers, led by M. Teshabaeva, founded a school to train young masters with the help of mentors. Among them were experienced masters such as Nariman Rasulov, Klavdiya Tarasova, and Nadezhda Karlova, who taught the secrets of carpet weaving to a new generation of weavers. In 1961, the Andijan carpet “Khidirsha” was awarded a first-degree diploma at the All-Union Exhibition of Folk Crafts in Moscow. This achievement testifies to the high skill and dedication of local artisans to their art.

The Andijan Regional Museum houses numerous carpets woven from yarn, among which the so-

Rug . Andijan, 20th century. This example was made at the Andijan Art Products Factory.

called “terma” carpets occupy a special place. These carpets are usually woven on special looms, 20, 40, or 60 centimeters wide. During the weaving process, the threads are laid in layers, creating a strong structure. Such “terma” carpets have been widely used in everyday life since ancient times. Later, they began to be used to make various household items, such as bags, pillows, and blanket covers. The use of natural dyes gave the carpets an even more elegant appearance.

In the late 19th and early 20th centuries, under the influence of Kyrgyz artisans, Andijan carpet weaving reached a new level. Masters such as Ugiloy Khakimova and Mukhabbat Mirzakarimova became famous for their “terma” carpets, created in the 1980s. The museum’s exhibition also included the “Khidirsha” and “Gulcha” carpets, woven at the “Sufikullol” weaving factory in the Jalalkuduk district, in those years. K.F. Tarasova’s “Khidirsha” and “Gulcha” carpets are distinguished by their colorful patterns and traditional decorative style. In particular, the “Khidirsha” carpet, created in 1976, combines red and gold tones, reminiscent of sunbeams. The floral motifs in the central part of the “Gulcha” carpet are elegant and well-proportioned.

These carpets are valued not only as household items but also as artistic relics of their era. All these examples of carpet weaving from Andijan and the Fergana Valley, continuing the rich traditions of folk applied art, represent the harmony of national craftsmanship and aesthetic taste. The Andijan school of carpet weaving, rooted in the artistic traditions of the past, has not lost its value even in the modern era. Unfortunately, during the Soviet period, carpets were produced primarily for export, and their national characteristics were sometimes simplified or obscured. Craftswomen were forced to secretly pass on traditional patterns and techniques to their apprentices.

In the years following independence, the art of carpet weaving in Andijan has experienced a revival. Young artisans are taught the secrets of carpet weaving at training centers in the Andijan region. This is an important factor not only in preserving cultural heritage but also in educating the younger generation in the spirit of national values. The art of carpet weaving is an integral part of the people’s lives, representing not only a practical necessity but also a spiritual value. Today, the traditions of the Andijan carpet weaving school are evolving, adapting to modern design and international markets. This allows Uzbek carpet weaving to be represented with dignity on the international stage.

Terma gilam. Author Mirzaeva Zeinabkhon. Andijan region, Bulakbashi district, Shirmonbulak village. 1980.

Per aspera ad astra! On the anniversary of academician Shomansur Sagdullaev

The editorial board of the journal "Fan va turmush" warmly and sincerely congratulates the outstanding scientist and talented scientific organiser, Academician, First Vice President and Chief Academic Secretary of the Uzbekistan Academy of Sciences, Sagdullaev Shomansur Shokhsaidovich, on his 75th birthday. We are publishing an article about his scientific and organisational activities, prepared by his students and colleagues.

The renowned Uzbek scientist Shomansur Sh. Sagdullaev, born in 1951, defended his dissertation for the degree of candidate of technical sciences in 1984 and his doctoral dissertation in 2007. In 2016, the Higher Attestation Commission awarded him the title of professor in bioorganic chemistry, and he has been a full member of the Uzbekistan Academy of Sciences since 2023. Total work experience is 53 years, including 51 years of fruitful activity in the system of the Uzbekistan Academy of Sciences. From 1974 to 1985, he worked his way up from a laboratory assistant to a senior researcher at the Institute of Chemistry of Plant Substances of the Uzbekistan Academy of Sciences; from 1985 to 1996, he was the head of the Experimental Production Enterprise of the Institute; from 1996 to 2006, he was deputy director of the Institute for production and economic issues; since 2006, he has been director of the Institute of Chemistry of Plant Substances named after Academician S.Yu. Yunusov and, simultaneously, since 2025, first Vice President and Chief Academic Secretary of the Uzbekistan Academy of Sciences.

Academician Shomansur Sh. Sagdullaev is a renowned technologist and scientist who founded a major scientific school in the field of isolating biologically active substances from plant materials, their advanced processing, and their introduction into pharmaceutical practice. His research focuses on the structure, physicochemical properties, and relationships of primary and secondary metabolites in medicinal plants. Based on this scientific approach, technologies for isolating biologically active substances using environmentally friendly and cost-effective methods were developed. In particular, modern and highly effective extraction methods using CO_2 under ultrasonic and highly critical conditions were developed and implemented. Based on established scientific principles, advanced technological solutions for the integrated processing of plant materials were proposed.

Under his scientific supervision, technologies were developed for producing new compounds with high antiarrhythmic activity and low toxicity through chemical modification of diterpene alkaloids and the introduction of pharmacophoric groups into their composition. He directly supervised the organisation and implementation of preclinical studies of these developments. At his suggestion to the head of our state, an NMR spectrometer from the Japanese company JEOL was purchased and commissioned, and to date, the structures of over 5,000 chemical compounds have been determined. As a result, the frequency of publication of scientific research results by republican chemists in international journals with a high impact factor has increased significantly. At the same time, thanks to his efforts, the institute's material and technical infrastructure has been strengthened, and its equipment with modern scientific equipment has been upgraded to a new level.

Under his leadership, the Institute annually accepts and successfully implements dozens of national and international scientific, practical, and innovative projects. This has led to a steady increase in the number of scientific articles published in highly ranked journals and has created the foundation for strengthening the Institute's reputation not only within the country but also in the international scientific arena.

Under his direct leadership, more than 20 medicinal products have completed clinical trials and received approval for use in medical practice. Currently, approximately 10 medicinal products are in clinical trials, and more than 15 promising substances are undergoing preclinical studies.

Academician Shomansur Sagdullaev and the staff of the Media Centre for the Promotion of Science of the Uzbekistan Academy of Sciences

Academician Shomansur Sagdullaev - First Vice President - Chief Academic Secretary of the Uzbekistan Academy of Sciences

Shomansur Sh. Sagdullaev is the Editor-in-Chief of the international scientific journal "Khimia prirodnykh soieinenii (Chemistry of Natural Compounds)", which is included in the Scopus and Web of Science databases. Scientists from approximately 50 countries publish their research results in this journal. The journal's 2024 impact factor was 0.9.

The scientist has published over 500 scientific papers, over 100 of which are indexed in reputable international databases. He is also the author of over 80 domestic and three foreign patents, five monographs, and a foreign monograph published by Springer. He has presented papers at nearly 30 prestigious international conferences worldwide and established fruitful scientific collaborations with scientists from countries such as Russia, Turkey, France, Germany, China, and Kazakhstan.

As part of his scientific school, 20 researchers have defended their dissertations, 10 of whom have earned PhD degrees, and 10 have earned DSc degrees. The presence of representatives from the People's Republic of China among his students further confirms the scientist's international reputation.

Based on his research, the first scientific and technical centre for the production and testing of pharmaceutical substances in accordance with GMP requirements was established in the country, specialising in the isolation of biologically active substances from medicinal plant materials. Currently, this centre processes over 150 tons of raw materials annually and produces over 1,000 kg of active substances of 20 different types, registered with the Ministry of Health of the Republic of Uzbekistan. The substances produced are supplied under contract and exported to many domestic manufacturers, including Radix LLC, Nika Pharm LLC, and Nobel Pharm LLC, as well as to foreign manufacturers, such as VILLAR Pharmcenter JSC and VIFITEKS JSC.

The scientist's many years of fruitful work have been duly recognised by the state. He has received such prestigious awards as the Shukhrat Medal, the First Class State Prize of the Republic of Uzbekistan in Science and Technology, the Order "For Selfless Service," and the honorary title of "Honoured Scientist of the Republic of Uzbekistan." He has also been awarded gold medals from the International Scientific Partnership Foundation of the Russian Federation, the Order of Friendship of the People's Republic of China, and awards from the Republic of Kazakhstan and the Xinjiang Uyghur Autonomous Region. In 2017, he was awarded the title of Honorary Member of the National Academy of Sciences of the Republic of Kazakhstan.

He is known not only as a leading scientist but also as a statesman and public figure, actively involved in public life. He was a member of the Senate of the Oliy Majlis of the Republic of Uzbekistan from 2020 to 2024 and was also elected as a deputy of the Tashkent City Council of People's Deputies for the 2020-2024 and 2025-2029 terms. This clearly demonstrates his multifaceted personality, highly trusted, broad-minded, and active participation in important decisions concerning the country's development.

Academician, Professor, Doctor of Technical Sciences, Honoured Scientist of Uzbekistan, Shomansur Sh. Sagdullaev is an outstanding technologist and scientist who founded and established a nationally recognised school in the development and implementation of technologies for producing medicinal products from plant materials.

Kh. U. Khalbekova . "Halophytes of Uzbekistan (biotechnological approaches and chemical efficiency of plants)"

This monograph presents the results of comprehensive research aimed at cultivating promising halophyte species on saline irrigated lands in order to increase the productivity of contaminated soils on the bottom of the Aral Sea.

Particular attention is also given to the use of biotechnological methods in the propagation and cultivation of halophytes. Scientific research is presented data about the use methods microclonal reproduction allows to obtain micro plants that are resistant to high temperatures concentrations salts V conditions in in vitro And capable fast develop at early stages stages Ontogenesis. It has been established that the addition of microclones to vegetative experiments has a positive effect on seedling survival, biomass production, and physiological stability in saline substrates. Biotechnological methods have been scientifically proven to be highly effective in producing planting material for restoring degraded lands and stabilizing agroecosystems in arid regions. This monograph is a scientifically sound and methodologically well-developed study that will serve as a useful guide for young specialists, researchers in botany, ecology, and biotechnology, as well as for practitioners involved in the restoration and sustainable use of degraded lands.

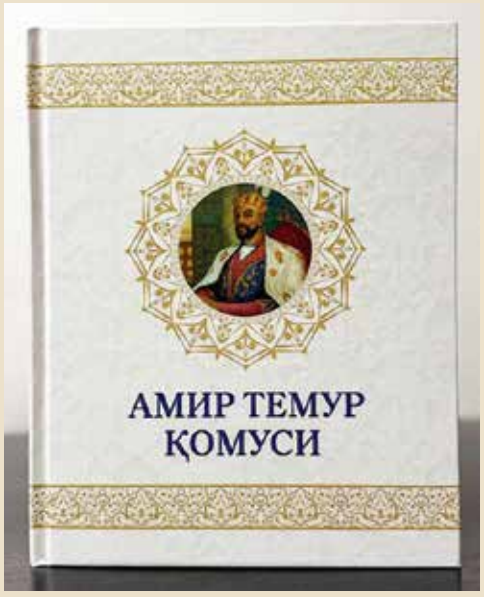
Mirsaidov M.M., Abdikarimov R.A., Eshmatov B.Kh. "Models and methods for solving problems of mechanics of composite shells".

This monograph presents mathematical models and methods for solving problems in the mechanics of composite reinforced shells subjected to various loads. The mathematical models are constructed using the classical Kirchhoff- Love theory and the refined Timoshenko theory. Systems of nonlinear integro-differential partial differential equations are derived using the Bohlmann-Volterra model. Using the Bubnov-Galerkin method, based on a polynomial approximation of deflections, in combination with a numerical method based on quadrature formulas, efficient computational algorithms for solving problems in the dynamics of a viscoelastic anisotropic reinforced shell are developed. A software tool developed in the Delphi algorithmic language allows one to study the shell's dynamic behavior over a wide range of changes in its physical and geometric parameters. A number of problems in the statics and dynamics of anisotropic reinforced plates are solved under various boundary conditions and external loads. This monograph is intended for designers, master's degree students, basic doctoral students, doctoral students, independent researchers and research associates conducting scientific research in the field of mechanics of deformable solids, structural mechanics and seismic resistance of buildings and structures, specialists in the field of mathematical modeling, as well as for senior undergraduate and graduate students in the relevant areas of education and specialties.

The monograph covers issues of mechanics of deformable solids, structural mechanics, and seismic resistance of buildings and structures.

This publication serves as a valuable theoretical and practical resource for industry professionals, researchers, and undergraduate and graduate students.

Tashkent: “Shark” Publishing House, 2026. 301 p.
The book is published in Russian.



Fan Publishing House. Amir Timur’s Dictionary .

Fan Publishing House of the Academy of Sciences of the Republic of Uzbekistan has published the first volume of “Amir Timur’s Dictionary,” dedicated to the life and work of the great military leader Amir Timur. This encyclopedic dictionary presents events from the birth of Sahibkiran Amir Timur to his death (1336–1405) in alphabetical order. This publication is an important source of information not only for historians but also for the general public.

Editor-in-Chief: Tulkun Hayit
Creative team: Khabib Abdiev , Aziz Sharipov, Hakim Satorii , Shohista Oljaeva , Dilafruz Kurbanova, Ozoda Rakhmatullaeva, Mukhayo Khamroeva , Fakhriddin Khasanov, Abdulla Ulugov , Tulkun Eshbek , Bakhtiyor Khaidarov, Komiljon Sultanov, Lobar Mardonova , Muhabbat Shoyusupova , Khaitova Saodat Tulkun kizi , Sokhiba Abdullaeva.

V.V. Paramonov, “Relations of Central Asian Countries with Russia and China: Leading Experts and Institutions, Key Scientific Publications and Research”

The monograph “Relations of the Central Asian countries with Russia and China: leading experts and institutes, main scientific publications and research” by V.V. Paramonov, head of the department of the Coordination Methodological Center for Contemporary History of Uzbekistan of the Academy of Sciences of the Republic of Uzbekistan, Doctor of Art History, has been published in Chinese .

This monograph presents an in-depth scholarly analysis of the relations between the Central Asian states and Russia and China. It examines the works of over 500 leading experts from more than 20 countries . main scientific publications And research , systematized level international scientific development and contribution leading scholars. The studies are also examined by country (Central Asia, Russia, China, and the global context) and categorized by their most significant scientific works. This publication serves as an important resource for the study of regional cooperation and international relations.

An educational story for children about sharks, in which you can learn the most interesting, little-known, and rare facts about these toothy predators

Much has been said and written about the dangerous predators that roam the deep seas. Since ancient times, as soon as humans learned to build boats and began crossing the oceans, they recognized the dangerous creatures that swim in the depths. However, you might be surprised to learn that sharks aren't even among the top ten most dangerous fish in the world!

For example, there are porcupine fish, piranha, tigerfish, electric eels, stonefish, and others. But sharks are not among them!

First, it's important to know that giant, bloodthirsty, toothy creatures that swallow people are a myth inspired by movies. In fact, there are about four hundred species of sharks, and many of them are completely harmless to humans!

Just imagine, sharks appeared before dinosaurs! Almost four hundred million years ago. The Earth looked completely different back then. But even then, sharks were different: some were tiny, no more than 30 centimeters long. And others were true giants, with jaws large enough to fit a full-sized person!

However, sharks have certainly evolved. For example, the first representatives of their species had a bony skeleton. Today, however, modern sharks don't have a single bone! Because their skeletons are now entirely composed of cartilage. Furthermore, sharks, unlike other fish, don't lay eggs; they give birth to live young. Just like mammals.

Although sharks thrive in the ocean, their gills aren't as efficient as those of other fish. Because of their structure, they extract only half the oxygen from the water. To keep their gills clean and hydrated, they must constantly move. Therefore, if a shark is captured and kept in captivity, it becomes lethargic due to a lack of oxygen and room to move. Sharks are also color-blind, seeing everything in shades of gray, and have poor hearing.

At the same time, sharks certainly have their advantages! And what advantages! For example, these ancient fish have an excellent sense of smell and can actually detect blood in the water from a great distance. Furthermore, these predatory fish can detect the slightest vibrations in the water.

But the most interesting thing, of course, is the shark's teeth! These deadly triangular spines can be

arranged in five, ten, and sometimes even fifteen rows in the mouth! Imagine several rows of neat, knife-sharp teeth. But that's not all! A shark's teeth, like the fish itself, are in constant motion. The back rows, as they wear down, replace the front ones. Thus, in ten years, a shark goes through nearly thirty thousand teeth!

Finally, this educational story for children about sharks brings together little-known information about these fish that you're sure to love!

- Sharks don't feel pain at all.
- Fish never sleep because they can only "breathe" in water by constantly swimming.
- Marine predators don't blink, even though they have eyelids.
- Any shark can sense just one tiny drop of blood in a huge pool of water.
- Toothy fish are very sensitive to the Earth's magnetic field, which allows them to navigate like a compass.
- In terms of danger to humans, sharks are at the bottom of the list. However, this certainly doesn't mean you can tease them.
- A great white shark can easily bite through a thick steel rod.
- One of the largest and most dangerous species of white sharks, killer whales (orcas) enjoy hunting.
- The great white shark does not tolerate confinement and would rather die without food.
- The skin of a tiger shark is several times stronger than the skin of a bull.
- The largest of the shark species is called the whale shark. But it also has tiny teeth, only 6 millimeters long.
- Typically, when hunting, sharks attack a weaker opponent. Therefore, they first circle around their prey, studying it.
- Some predators communicate with their relatives by grinding their teeth.
- Finally, there are fish that can live for two hundred years. These sharks inhabit the waters of Antarctica and are called «polar sharks.»

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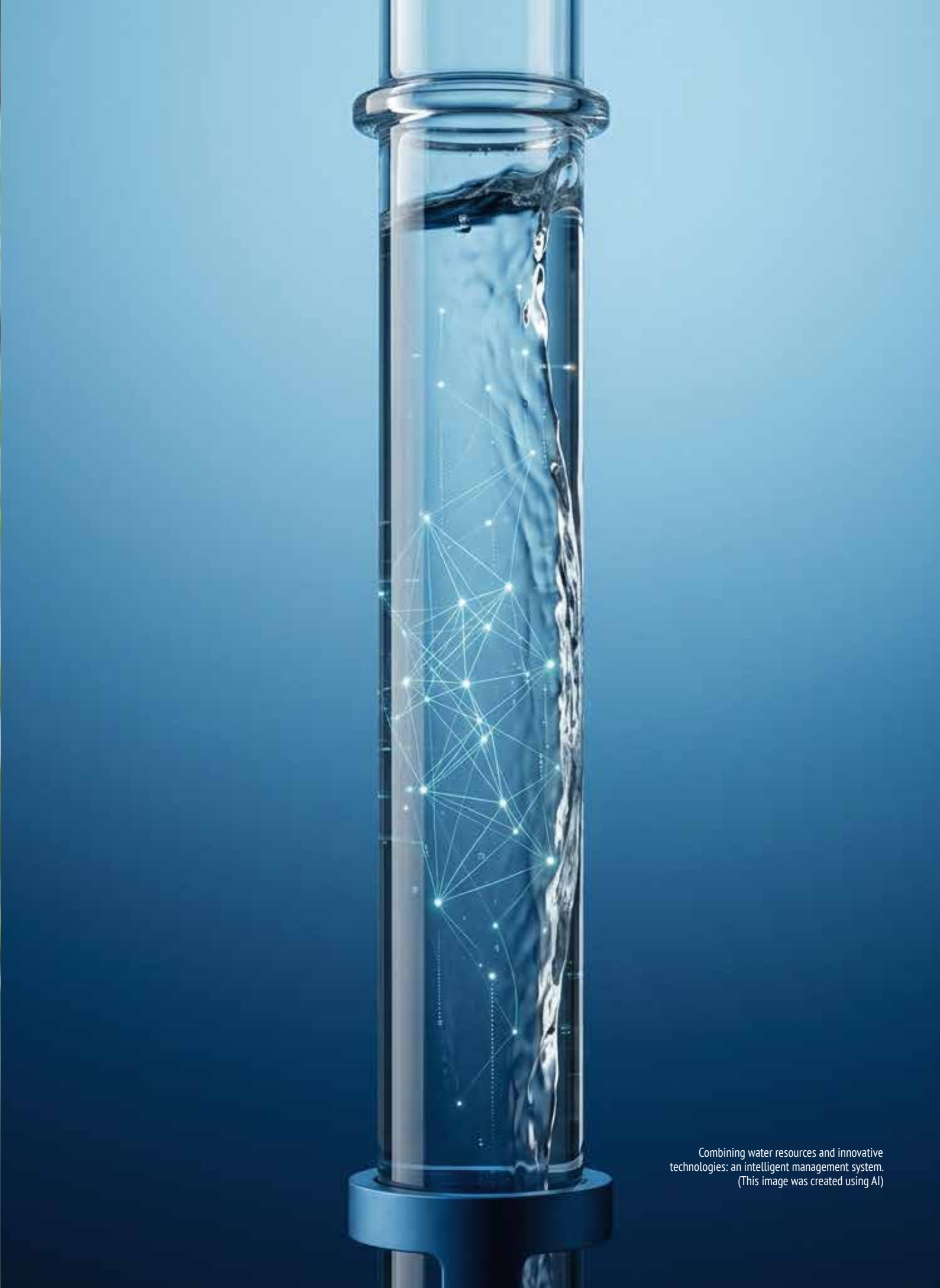
On the cover: Battle between Amir Timur and Tokhtamysh Khan (right panel). 1420–1440, possibly Herat. 15th century. Topkapi Palace Museum Library (Istanbul), manuscript H.2153 (fragment). Source: Turks: A Journey of a Thousand Years, 600–1600



Combining water resources and innovative technologies: an intelligent management system. (This image was created using AI)

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The installation with the Lunar drill on the surface of the Moon and the apparatus with the capsule, returned on September 21, 1970 to the interplanetary station «Luna-16» with a sample of lunar soil