

Science for the benefit of mankind

FANVA TURMUSH

«Science and Life» popular science journal

Centre for Promotion of Science Uzbekistan Academy of Sciences

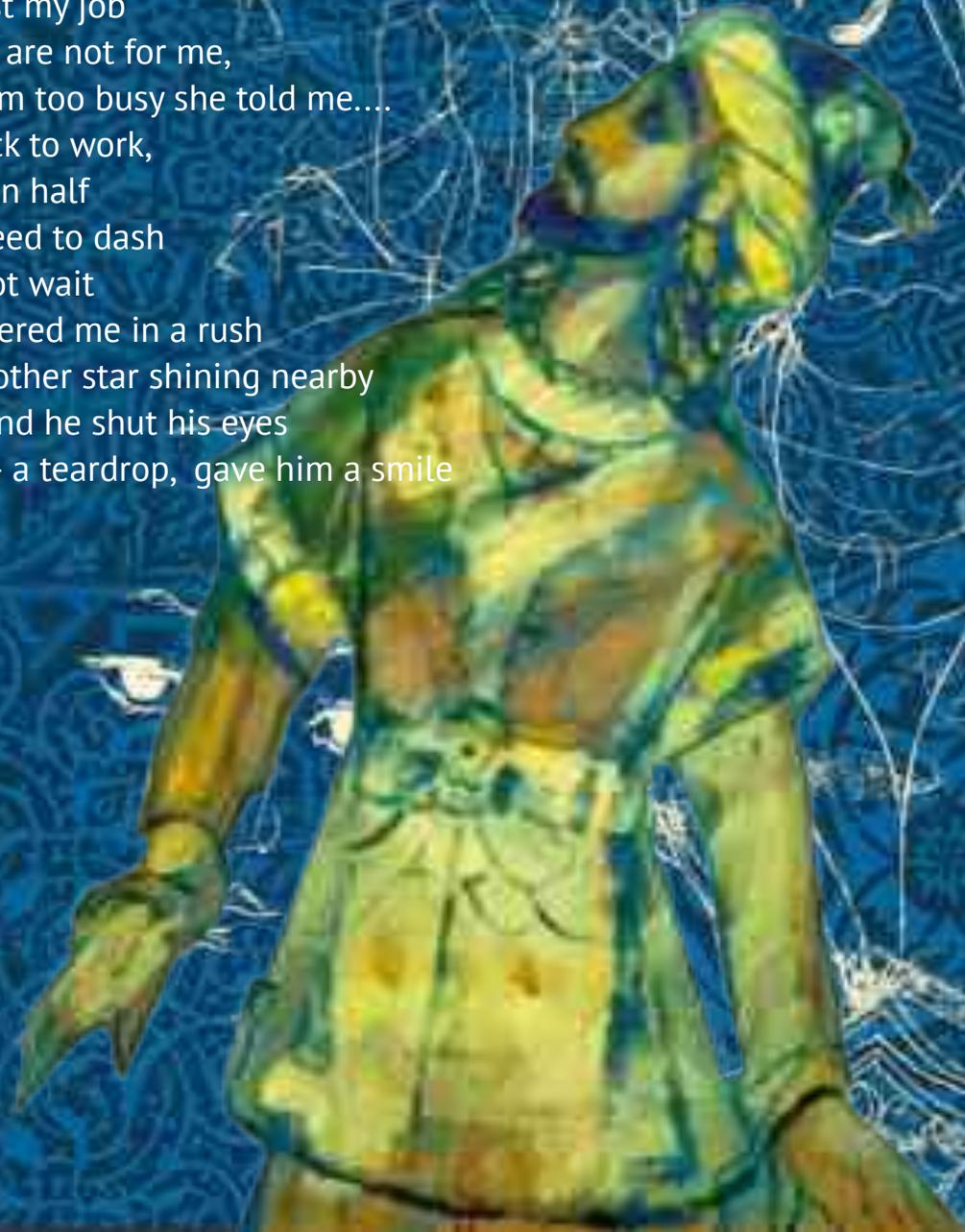
2/2023

THE SUN IS THE STAR OF THE GOD HELIOS

- The Phenomenon of the Cultural Heritage of Uzbekistan is Presented in Germany
- Discovery of Uzbek physicists
- Do We Need AEA?
- Pain and hope of the Aral Sea
- Once Again about Cotton
- Miraikan - Japanese Museum of the Future
- The Jadids are a Ray of Enlightenment!
- Chaos of color in Temur Shardemetov's painting

Star of Ulugbek

Do you know me, do you remember me, do you?
The stargazer asked the bright star.
I once found you on the Milky Way
And all the stars flickered except for you.
Those days I was young and raven-haired,
Time have passed as years whizzed by,
But every evening I forfeit all my time
Just to catch a silent smile in the sky,
I sent you an unanswerable question,
Woven by the heart and tenderness of roses.
The star smirked and replied coldly:
To radiate light is just my job
Love and tenderness are not for me,
Time is short and I am too busy she told me....
Go, stargazer, get back to work,
Don't rip your heart in half
The sun is rising, I need to dash
The starry sky will not wait
Work, work... she ordered me in a rush
And as there was another star shining nearby
Stargazer got tired and he shut his eyes
When his girlfriend – a teardrop, gave him a smile



Science for the benefit of mankind

The acceleration of time for society is a sign of striving forward, towards freedom and prosperity. In 1991, Uzbekistan switched the speed of time. The stage of Uzbek time has come. However, over time, sensations began to arise, if not of a stop, then of a sensitive slowdown in speed.

After 2016, an important breakthrough took place in the Uzbek time, we feel the power of the engine and move forward, picking up new speed. Changes are taking place in all areas of society. These changes have been implemented. Today, thanks to state support, the social status of science and scientific knowledge has become very high. One such example of renewal is the creation of the Centre of Promotion of Science at the Uzbekistan Academy of Sciences, which included the journal *Fan va Turmush* (Science and Life). The magazine has almost a century of history. The first issue of the journal was published in 1933 and was called “Socialistik ilm va texnika” (“Socialist Science and Technology”). Its circulation did not exceed two thousand, but it won the love and respect of readers, as its pages told about the latest achievements of the world and domestic science and technology.

Since 2023, the *Fan va Turmush* journal has been published in an updated format - unlike the previous issues with Uzbek-Russian texts in one issue, it has become trilingual. At the same time, the journal in Uzbek is published in Latin alphabet. Given the contingent of the republic and the desire of Uzbekistan to intensify international contacts, the journal is published in Uzbek, English, and Russian in the form of separate publications. The structure of the journal has also changed. The first block “Numbers rule the world” publishes materials from leading scientists in the field of physics, mathematics, energy, and astronomy.

The second block - “Nature and Man” - is devoted to publications in the field of medicine, biology, chemistry, zoology, seismology and other fields related to natural sciences. The third block reflects the most relevant discoveries and achievements in the field of IT technologies - artificial intelligence, nanotechnology, robotics, etc. The fourth block - “Society, history, culture” - includes scientific articles on history, archeology, art history, oriental studies, philology, jurisprudence, political science, and other branches of humanities and social sciences. Special sections are devoted to the latest discoveries in the field of domestic and world science.

90 years have passed since the first edition in Uzbek. In the history of its existence, the journal has undergone many changes, from the name to the temporary suspension of the publishing house. Of course, today it is difficult for printed publications to compete with the ubiquitous Internet. We hope that the journal “*Fan va Turmush*” will bring new important knowledge to the life of readers and will connect the concepts of Science and Life even more closely. We often say “how fast time flies”, but time is a relative concept. When you fly alone in an airplane for a long distance, time stretches ominously monotonously, but if there is an interesting interlocutor nearby, then time flows imperceptibly and comfortably quickly. You don't even notice how you reached the destination airport... Our journal “*Fan va Turmush*” could become this pleasant and helpful interlocutor.

CONTENTS



Science for the benefit of mankind
Editorial.....1

The phenomenon of the cultural heritage of Uzbekistan is presented in Germany
Masharib Abdullayev4

I. NUMBERS RULE THE WORLD

A new elementary particle found
Bekhzod Yuldashev, Kosim Olimov,
Khusniddin Olimov.....6

On the way to creating a nuclear power plant in Uzbekistan
Shavkat Abdukamilov.....12

The sun is the star of the god Helios
Igor Ibragimov.....18

II . NATURE AND MAN

Actual problems of waste management
Tatyana Pospelova, Mikhail Kremkov.....28

Environmental problems of the Aral Sea region - the impact of salt removal from the dried bottom of the Aral Sea
Bibigul Tleumuratova, Zhalgasbai Kublanov.....22

A new approach to cotton growing
Zabardast Buriev.....26

III. THE WORLD OF ENGINEERING AND INFORMATION TECHNOLOGY

IT Park is the basis for business
Bahromjan Jalilov.....30
Miraikan, a Japanese Museum of the Future
Zarina Nuridinova.....33

IV. SOCIETY, HISTORY, CULTURE

A scholar and a ruler
Surayyo Karimova.....36

Jadids: "Enlightenment is a matter of life and death"
Dilorom Alimova.....40



Gates of old Tashkent
Abdumannop Ziyaev,.....44

Two princes: Farkhad and Hamlet
Suvon MELI.....48

He adored the theater
Omina Azizova52

HEADINGS:

Golden Age of Beruni
Beruni on "Historical India"
Umida Kuranbaeva.....56

Tribune for young researchers
Chaos of color in Temur Shardemetov's painting
Khalida
Yusupova.....58

IN THE WORLD OF SCIENCE

Discoveries of scientists of Uzbekistan 60
Interesting facts of the world sciences 61
Miracles are just around62



The phenomenon of the cultural heritage of Uzbekistan is presented in Germany

**Masharib Abdullayev,
PhD (Art History)**

On May 3, 2023, President of the Republic of Uzbekistan Shavkat Mirziyoyev and Federal President of Germany Frank-Walter Steinmeier opened an exhibition entitled “Treasures of the Archeology of Uzbekistan from Alexander the Great to the Era of the Kushan Empire”. The exhibition was organized on the famous Museum Island in Berlin - in the James Simon Gallery and the New Museum (Neues Museum). At the opening ceremony, the head of our state noted with satisfaction that both in Uzbekistan and in Germany there is a growing interest in the rich cultural heritage and today’s achievements of our peoples.

The Fund for the Development of Culture and Art of Uzbekistan is doing a lot of work to popularize the rich and unique cultural heritage of our country. The sensations from the exhibition “Treasures of the oases of Uzbekistan - At the Crossroads of Caravan Routes” in the Louvre had not yet cooled down when Berlin invited lovers of history and art from all over the world. More than 260 thousand people visited the exposition in the Louvre.

Serious preparations were made for the organization of the exhibition. An agreement to hold it was reached in May 2019 during a state visit to Uzbekistan by German Federal President Frank-Walter Steinmeier. For almost four years, archaeologists, historians, art critics and employees of the museums of the two countries have been working on organizing the exhibition. In preparation for the exhibition, 43 museum exhibits from the funds of museums in Uzbekistan were restored by the restorers of the Louvre and the Museum of the History of the Primitive Period (Berlin State Museums). Among them, it is necessary to note the clay statue of a horseman found during the excavations of the Khalchayan Palace, the statue of a nobleman from the settlement of Dalverzintepe, the sculptural composition of the god Mithra on a chariot, and much more.

The exhibition “Treasures of Archeology of Uzbekistan from Alexander the Great to the era of the Kushan Empire” presents 285 exhibits from the collections of 9 museums of Uzbekistan (most of them are exhibited for the first time outside the Republic), as well as 65 exhibits from the collections of state museums in Berlin. The curator of the exhibition is Manfred Navroth, a specialist in the archeology of the Middle Ages, and chief curator of scientific projects of the state museums in Berlin. The scientific expert of the



Head of a warrior. 1st century CE. Halchayan



Carved frieze. 3rd-4th centuries. Yerkurgan



Head of a devata. 1st century CE. Dalverzintepe



The President of the Republic of Uzbekistan Sh. Mirziyoyev and the Federal President of Germany Franz Walter Steinmeier at the opening of the exhibition in the Berlin Museum

exhibition is a senior researcher at the Institute of Art History of the Uzbekistan Academy of Sciences, an art critic-archaeologist Jangar Ilyasov.

The exhibition tells about the ancient and rich culture of Uzbekistan, the history of the first states located on the territory of modern Uzbekistan and Central Asia, and covers the period from the 6th century BCE to the 4th century CE. Among the artifacts are statues of nobles, warriors, and women belonging to the upper strata of society of the Kushan kingdom, found during excavations of the palaces of Dalverzin-Tepe and Khalchayan.

The exposition exhibited at the Neues Museum, has incorporated exhibits from the Berlin State Museums. The first part of the exposition tells about the campaigns of Alexander the Great in Central Asia.

Museum exhibits are supplemented with a media component using video recordings of archaeological excavations. The second section of the exhibition was presented at the James Simon Gallery. This section is dedicated to the Kushan Empire and reflects the growth of urban culture with the predominant influence of Zoroastrianism and Buddhism, and narrates about artistic creation, which has risen to a higher level. As part of this exhibition project, a catalog was published in German and Uzbek, containing scientific articles by leading Uzbek and foreign scientists.

Over the centuries, the Great Silk Road has made an invaluable contribution to the development of trade, science, culture and art, serving intercultural dialogue, the exchange of spiritual values, the formation of progressive ideas, integration and cooperation, peace and creativity, tolerance and harmony. This

unique exposition allows visitors to get acquainted with the history of Uzbekistan, get a complete picture of the heritage of our people. The event will serve to further rapprochement and mutual understanding of the peoples of Uzbekistan and Germany, the development of a broad dialogue and multilateral cooperation between our countries. The exhibition will run until January 14, 2024.

The James Simon Gallery presents contemporary art and is located in the center of Berlin on Museum Island. Being one of the most famous galleries in the region, it presents the entire spectrum of contemporary fine art - from the work of young and promising artists to the works of famous masters. The museum regularly hosts exhibitions and events, including exhibition projects, lectures and educational programs.

The New Museum (Neues Museum) opened its doors to visitors in 2009. The museum is an exhibition platform for a wide variety of exhibits, allowing viewers to observe the development of ancient civilizations in the space from the Middle East to the Atlantic, and from North Africa to Scandinavia.

Golden treasure from Dalverzintepe. 1st century CE



A new elementary particle found

Bekhzod Yuldashev,

Academician

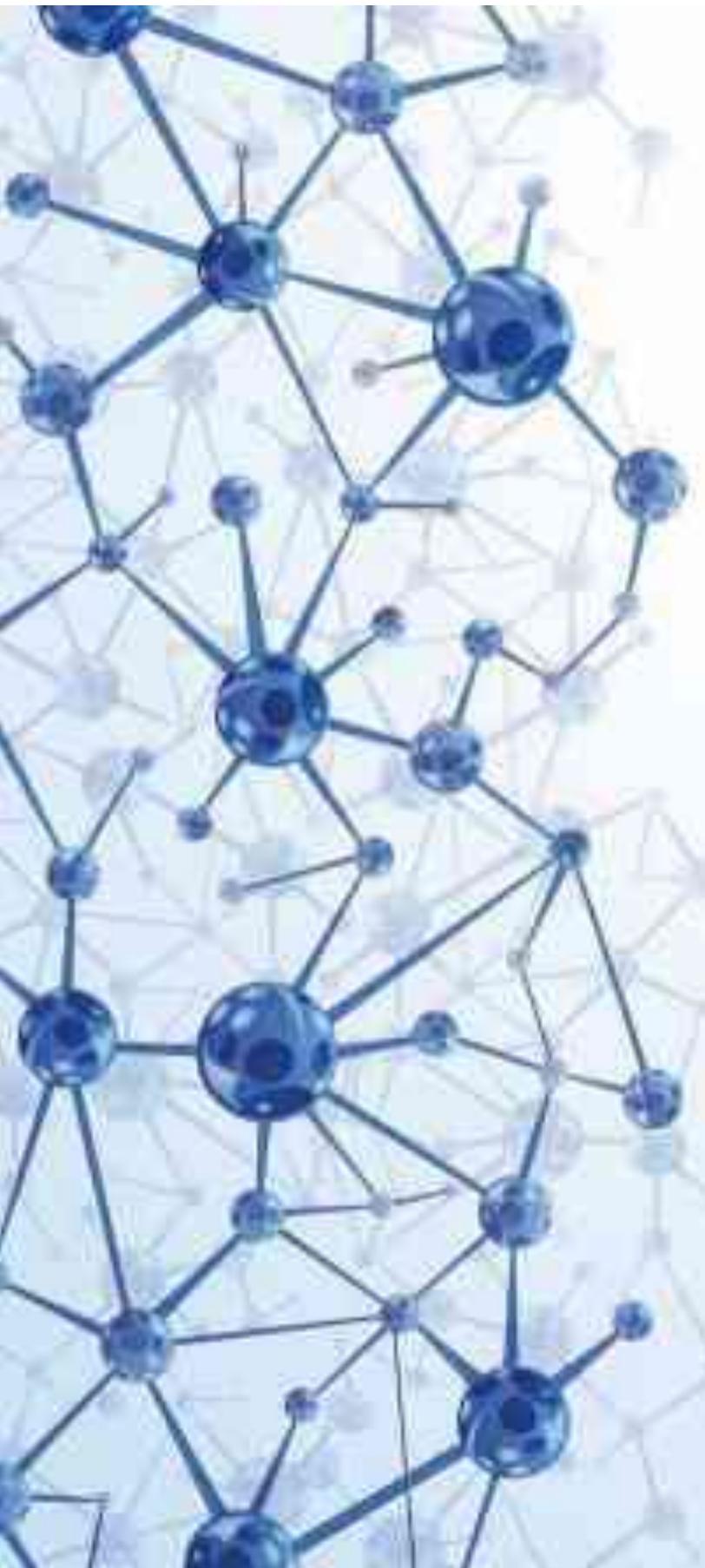
Kosim Olimov,

Prof., D.Sc. (in Physics and Mathematical Sciences)

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As you know, all substances in nature are composed of atoms. . Pure water molecule is made up of two atoms of hydrogen and one atom of oxygen. The air we breathe is made up primarily of atoms of nitrogen and oxygen, with a minimal number of atoms of carbon and argon. The Earth's crust contains most of the 90 easily found natural elements: mostly oxygen, silicon, iron, carbon, phosphorus, and many other lesser-known elements. Back in the 19th century, atoms were considered elementary particles that do not have an internal structure and are indivisible into smaller ones. In 1897, the English physicist Joseph Thomson discovered the electron. In 1899 another British physicist Ernest Rutherford first discovered alpha particles emitted by radioactive uranium, and in 1911, he first discovered the existence of a very small (ca. 10^{-15} meters in size) positively charged nucleus in the center of the atom, in which almost all the mass of the atom is concentrated. After the discovery of the proton by the same Rutherford in 1919, as well as the discovery of the neutron by James Chadwick in 1932, the structure of the atom was finally established as consisting of a very small but massive positively charged nucleus of ca. 10^{-15} meters located in the center, around which negatively charged electrons rotate at a distance of about 10^{-10} meters. The nucleus itself



consists of positively charged protons and uncharged neutrons. Protons and neutrons are called nucleons. The number of protons in the nucleus of an atom is equal to the number of electrons in the atom. Since the charges of the proton and electron are equal in magnitude and opposite in sign, the atoms are electrically neutral. The mass of a proton is approximately equal to the mass of a neutron, exceeding 1836 times the mass of an electron. Therefore, the mass of an atom is almost entirely (more than 99.9%) concentrated in its nucleus.

It should be noted that the term “elementary particle” is a collective one, referring to micro-objects on a sub-nuclear scale, which do not have an internal structure and cannot be split into constituent parts. However, in modern physics, the term “elementary particles” is used in a broader sense: this is the name given to the smallest particles of matter subject to the condition that they are not atomic nuclei or atoms, and they are also called subnuclear particles. Numerous studies of various elementary particles and their interactions have shown that the world of these particles is extremely diverse and has not yet been fully studied.

To date, four (4) types of fundamental interactions are known: gravitational, electromagnetic, strong, and weak. Gravitational interactions, which play a large role for objects with large masses, such as planets and stars, are usually neglected in the case of elementary particles due to the extremely small mass of elementary particles. Electromagnetic interactions are less intense compared to strong ones, therefore the bond of elementary particles generated by them is noticeably weaker. Electromagnetic interactions, in particular, ensure the bonding of atomic electrons with nuclei and the bonding of atoms in molecules. Strong interactions proceeding with the greatest intensity lead to the strongest bonding of elementary particles. These short-range (at distances of the order of 10^{-15} meters) strong interactions ensure the bonding of protons and neutrons in nuclei and determine their exceptional strength, which underlies the stability of matter in terrestrial conditions. Weak interactions are the least intense and cause slow processes with elementary particles. An illustration of their low intensity can be the fact that particles with an extremely small mass, neutrinos, subject only to weak interaction, freely penetrate, for example, the thickness of the Earth and the Sun.

It is known that electrons have no internal struc-

ture and are indivisible elementary particles. Protons and neutrons have also long been considered indivisible particles. However, in the second half of the 20th century, it was found that protons, like neutrons, have an internal structure and consist of the three most elementary (indivisible particles) - quarks. The proton is made up of two *u* and one *d* quark, while the neutron is made up of two *d* and one *u* quark. All matter in nature is made up of atoms, and all matter can be built using just three kinds of particles: protons, neutrons, and electrons. If we take into account the internal structure of protons and neutrons, then the building ‘bricks’ of matter in nature will be indivisible elementary particles: *u* and *d* quarks together with electrons.

Particles made up of three quarks are called baryons. Note that in addition to baryons, there are so-called mesons - particles consisting of a quark and an

Atomium one of the main attractions of Brussels, was designed for the opening of the World Exhibition in 1958 by the Belgian engineer Andre Waterkeyn as a symbol of the atomic age and the peaceful use of nuclear energy. The Polak brothers led the construction of the building.





antiquark. The antiquark has the same mass as the corresponding quark, but has the opposite charge. The antiparticle of an electron is a positively charged positron. Baryons and mesons are called hadrons. Hadron is a term for strongly interacting particles. The first known meson, the pi meson (or pion), was discovered by Powell's group in 1947 while studying the interactions of high-energy cosmic rays, most of which are high-energy protons, with emulsion nuclei. The existence of pi mesons was theoretically predicted by the Japanese physicist Hideki Yukawa in 1935. For their achievements, Yukawa (in 1949) and Powell (in 1950) were awarded the Nobel Prize in Physics.

In nature, there are only a few stable elementary particles that have an infinitely long lifetime in the free state. These are the proton, electron, photon and neutrino, which is the product of the decay of unstable particles as a result of the weak interaction. All other known elementary particles are unstable and eventually decay into the above-mentioned stable elementary particles. The neutron is stable only in the state bound by the strong interaction inside the nucleus. In the free state, the mass of the neutron exceeds that of the proton by a very small amount, approximately $1.29 \text{ MeV}/c^2$. Therefore, a free neutron, on average, over a lifetime of about 15 minutes, decays into a proton, an electron and an antineutrino as a result of a weak interaction. Most of the unstable elementary particles known in the world are resonances.

Resonances are called short-lived particles with a lifetime of the order of 10^{-22} – 10^{-24} seconds, the characteristic time of strong interaction, which are formed in nuclear or nucleon collisions at high energies in experiments on particle accelerators. Resonances are detected by analyzing the characteristics of particles - the decay products of these short-lived particles. Resonances formed in collisions of nuclei or nucleons

at high energies are studied by constructing experimental distributions of the invariant masses of particles into which these resonances can decay. Moreover, particles related to each individual act of interaction are combined. To construct the background distribution of invariant masses of particles, unrelated particles are combined, which are selected randomly from different acts of nucleon or nuclear interactions. The number of combinations in the background distribution is normalized to the number of combinations in the experimental distribution of invariant masses. The resonance reveals itself as a peak (maximum) in the experimental distribution of invariant masses, which lies much higher than the background spectrum in the mass region of the studied resonance.

In 2022, a group of physicists from the Physical-Technical Institute of the Uzbekistan Academy of Sciences, under the scientific supervision of Academician Bekhzod Yuldashev, for the first time in the world, obtained experimental confirmation of the existence of a new multiquark resonant particle. This new resonant particle, which is an eight-quark system consisting of two protons and a pi-meson, was first discovered in an experiment when analyzing collisions of carbon nuclei with a kinetic energy of 3.4 GeV per nucleon with target carbon nuclei.

It should be noted that until now, experimental indications of the existence of resonant particles consisting of four, five, and a maximum of six quarks have been obtained in the world. The study of the properties of the formed multiquark resonances is extremely important for determining and refining the intensity and magnitude of the strong interaction between different quarks of these resonant particles, leading to the formation of a specific multiquark configuration, and constructing a refined theory of the strong interaction that can fully and consistently explain all the observed processes occurring through the strong interaction in high energy physics.

Thus, Uzbek scientists were the first to discover a resonant particle with a record number of quarks equal to eight. The mass of the discovered new short-lived particle is about $2118 \text{ MeV}/c^2$ (see figure). The width (Γ) of the mass distribution of the new resonance does not exceed $4 \text{ MeV}/c^2$, which corresponds to the lifetime of this particle about $1.6 \cdot 10^{-22}$ seconds. The experimental excess of the observed resonance structure over the background distribution turned out to be 122 ± 20 events. The experimental excess of the detected structure over the background in the region

of the peak was 4.5 standard deviations (σ).

Information about the discovery of this new particle is published in a prestigious international scientific journal: K. Olimov, ..., B.S. Yuldashev, "Possible observation of $pp\pi^+$ resonance state in $^{12}\text{C}^{12}\text{C}$ collisions at 3.37 A GeV", *International Journal of Modern Physics E*, Vol. 31, no. 3, 2250024 (2022). (Web of Science & Scopus) <https://doi.org/10.1142/S0218301322500240>.

It is interesting to note that more than 40 years ago, also Uzbek scientists under the leadership of Academician B.S. Yuldashev, received one of the world's first experimental indications of the existence of diprotons - six-quark resonances, which was later confirmed by scientists from other countries.



Pic. 1. Screenshot of the publication

Synchrophasotron of the Laboratory for High Energy Physics of the Joint Institute for Nuclear Research (JINR, Dubna, Russia), in which carbon-12 (^{12}C) nuclei were accelerated to a kinetic energy of 3.4 GeV per nucleon. Then the accelerated ^{12}C nuclei irradiated a 2-meter propane

(C_3H_8) bubble chamber at JINR. A new eight-quark resonant particle was discovered by Uzbek physicists from the analysis of experimental data on collisions of carbon nuclei with a kinetic energy of 3.4 GeV per nucleon with target carbon nuclei in the JINR propane bubble chamber.



On the way to creating a nuclear power plant in Uzbekistan

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Energy is essential for sustainable economic growth and improved human well-being. That is why one of the 17 UN Sustainable Development Goals is “Ensure universal access to affordable, reliable, sustainable and modern energy for all”. In this sense, nuclear power provides access to clean, reliable, and affordable energy while mitigating the negative effects of climate change. It makes up a significant part of the global energy mix and its use is expected to grow in the coming decades.

According to the database of the International Atomic Energy Agency (IAEA), there are 422 nuclear reactors operating in the world today with a total installed capacity of 377,800 MW. These reactors generate approximately 10% of the electricity (generated) in the world. However, 57 nuclear reactors with a total design capacity of 59,580 MW are currently under construction.

Uzbekistan, having large reserves of natural uranium (6th in the world in terms of production and 10th in terms of reserves) and scientific and technical potential in the field of nuclear physics, plans to build the first nuclear power plant on its territory. It should be noted that Uzbekistan is not new to the use of nuclear energy for peaceful purposes. Since 1959, the research nuclear reactor VVR-SM of the Institute of Nuclear Physics of the Uzbekistan Academy of Sciences has been operating in the country. Scientists of Uzbekistan have significant experience in the operation and decommissioning of nuclear facilities, storage of fresh (?) and spent fuel, radioactive waste management, and ap-

I. NUMBERS RULE THE WORLD

plication of nuclear technologies in medical, pharmaceutical, agricultural, technical, jewelry, mining, and many other fields.

The country’s own nuclear power plant will allow Uzbekistan to:

- add an additional 2.4 GW of stable generating capacity in the overall energy mix;



Photo 1. Research Nuclear Reactor VVR-SM of the Institute of Nuclear Physics of the Uzbekistan Academy of Sciences

- save 3.5 billion cubic meters of natural gas annually;
- reduce emissions of greenhouse gases into the atmosphere, in particular, to 14 million tons of carbon dioxide and 36 thousand tons of nitrogen dioxide;
- contribute to the economic and social development of the region where the nuclear power plant will be built;

It should also be noted that more than 8,000 people will be involved during the construction of the nuclear power plant, and 2,500 people during its operation.

According to experts, due to the multiplier effect, every dollar spent on the construction of a nuclear power plant will return an average of 5-6 dollars to the country’s economy in the future. In addition, nuclear energy will diversify the energy balance of Uzbekistan, since 86% of the country’s electricity is generated at thermal power plants, which depend on natural gas supplies.

On July 19, 2018, by the Decree of the President of the Republic of Uzbekistan, the Uzatom Agency was established under the Ministry of Energy of the Republic of Uzbekistan. The Directorate for the Construction of nuclear power plants was formed, which in the future will be transformed into an organization for the operation of nuclear power facilities in the country. Over the past period, the Uzatom Agency has done a lot of work toward the

development of nuclear energy and launched a project to build the first nuclear power plant in Uzbekistan.

On September 7, 2018, an Agreement was signed between the Government of the Republic of Uzbekistan and the Government of the Russian Federation on cooperation in the construction of a nuclear power plant. The document provides for the construction in Uzbekistan of a nuclear power plant with a capacity of 2400 MW of a generation "3+" with two power units based on water-cooled power reactors VVER-1200; The Novovoronezh NPP-2 project was chosen as the reference plant. This project:

- focused on countries with high seismicity and hot climate;
- implemented in Bangladesh, Turkey, Saudi Arabia (tender underway);
- Unit 1 of Novovoronezh NPP-2 was commissioned in 2017, Unit 2 – in 2019;
- has a twofold 100% active security system with 100% redundancy within each channel;
- has a system of passive heat removal based on air (the system works with natural circulation in closed loops, condensing steam in the coolers. There is no need for water make-up and thus there is no limitation on the autonomy of the system);
- has a two-stage emergency cooling system for the reactor core;
- the area of the project is 76.4 ha;
- the project is designed for maximum accelerations in seismic conditions according to the maximum design earthquake (MCE) 0.44g and design earthquake (DE) 0.22g, which corresponds to a 9-magnitude earthquake.
- Today, NPPs of this type are designed to operate in the air temperature range from -37°C to $+47^{\circ}\text{C}$.

Photo 2. The Novovoronezh NPP-2 project was chosen as the reference plant



Modern nuclear power plants with VVER-1200 reactors of the 3+ generation are completely safe. First, the reactor has defense in depth:

- 1-barrier: firmly manufactured fuel pellets;
- 2-barrier: tightness of zirconium cladding of fuel rods;
- 3-barrier: tightness of the reactor pressure vessel and the primary circuit;
- 4-barrier: hermetic protective shell (containment).

- a) Fuel pellets
- b) Fuel elements
- c) Fuel assemblies
- c) Power generating unit

NPP power units have a double containment:

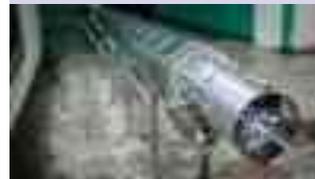
- internal containment - prestressed reinforced concrete 1.2 m thick in the cylindrical part (1.1 m in the dome) with an internal lining of 6 mm stainless steel;
- outer containment - reinforced concrete 2.2 m thick in the cylindrical part (0.8 m in the dome).



a) Fuel tablets



b) Fuel elements (TVEL)



c) Fuel assemblies (FA)-



d) Power unit housing

Internal containment

Outer containment

Photo 3. Defense in depth of the VVER-1200 reactor

A working group specially formed by the Government of Uzbekistan, based on archival data and real geographical, geological, and socio-economic data, identified 10 proposed locations for nuclear power plants. A decision was made to conduct all types of engineering surveys (geological, hydrological, meteorological, environmental, seismological, radiological, etc.) at four potential sites at the Tudakul point in the Navoi region and three potential sites at the Aydarkul point in the Jizzakh region. On May

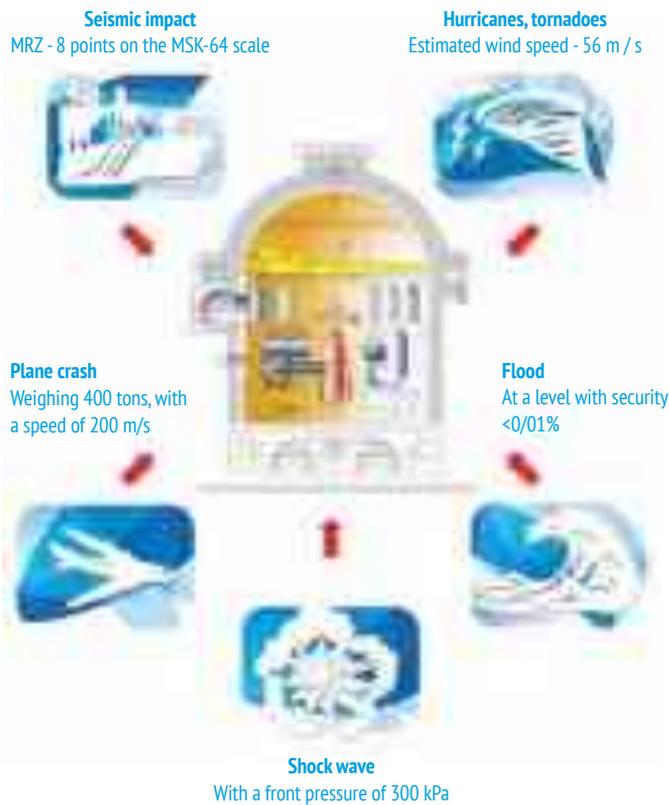


Photo. 4. Stability of the NPP power unit to external influences

7, 2019, the Republican Working Commission, headed by the Prime Minister of the Republic of Uzbekistan, together with the Scientific and Technical Expert Council of the Uzatom Agency, heard reports from the administration of the State Committee for Geology and the State Unitary Enterprise UzGASHKLITI, who conducted the above engineering surveys. It was decided to choose a site near Lake Tuzkan of the Aidar-Arnasay system of lakes as a priority since this site does not have prohibitive and unfavorable factors for the location of a nuclear power plant and it fully

complies with international requirements and IAEA recommendations.

To date, the Uzatom Agency has prepared over 20 draft decisions, on the basis of which the strategy for the construction of nuclear power plants and the development of nuclear energy in the country has been built. The Concept for the Development of Nuclear Energy in the Republic of Uzbekistan for 2019-2029 and the Roadmap for its implementation were approved. In order to create a regulatory framework for the use of atomic energy, the Law of the Republic of Uzbekistan “On the Use of Atomic Energy for Peaceful Purposes” No. ZRU-565 dated September 9, 2019 was adopted taking into consideration the recommendations of IAEA, Rosatom Russian State Corporation, Rostekhnadzor and WorleyParsons and other international experts.

The systematic work carried out in Uzbekistan on the construction of a nuclear power plant * will ensure the implementation of this project on time in compliance with all norms and requirements for safety and quality of work. Thanks to the efforts of the Government of the Republic, specialists from the Uzatom Agency and all organizations involved in the design and construction of nuclear power plants, a cheap source of electricity will appear in Uzbekistan, which will contribute to a reliable energy supply and energy security of the country, sustainable growth of its economy and the well-being of the people.

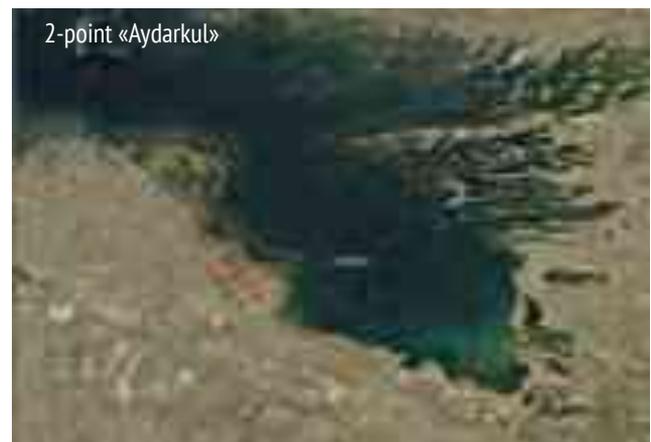


Photo 5. Considered sites at NPP locations



The sun is the star of the god Helios

Igor Ibragimov,
Candidate of Physical and Mathematical
Sciences

The sun is the only source of heat and light, without which the emergence and existence of life on our planet would be impossible. Therefore, it is very important to study the Sun comprehensively in order to understand how it works, why changes occur with it, and how they can affect life on Earth. For us, the Sun

seems to be a unique object, but from the point of view of astrophysics, it is an ordinary star, very average in its characteristics among hundreds of billions of stars in our galaxy, which has the poetic name of the Milky Way.

The relative proximity of the Sun to the Earth makes it possible to study it in detail, which is of decisive importance in understanding the structure and evolution of all other stars in the Universe. We know the radius, mass, and luminosity of the Sun, and estimated its age, in principle we understand the processes that occur in its depths. Based on this information, fairly correct models of stellar evolution were built, which are successfully applied to other objects in our Universe. But for justice's sake, it should be noted that many physical processes and phenomena on the Sun are still far from being fully understood.

The most important property of the Sun is the high constancy of its luminosity for at least 3 or even 4 billion years from the beginning of the origin of life on Earth. On the other hand, periodic changes in its activity occur on the Sun in different time intervals. The most famous of them and the most well-studied are the 11-year cycles of solar activity. Such changes (both fast and long-term) undoubtedly have a great impact on the Earth's climate and the state of the Earth's biosphere.



Helios on an antique
fresco from Pompeii

But all these variations in the activity of the Sun are natural and normal conditions for all living beings, including humans. The reason for optimism is the very existence of life in all its diversity, which over billions of years has not only adapted to these changes, but also, apparently, needs them.

Characteristics of the Sun

The radius of the Sun is 696 thousand km, which is 109 times the radius of the Earth, and the polar and equatorial diameters differ by no more than 10 km. The mass of the Sun is $1.989 \cdot 10^{30}$ kg, which is 330,000 times more than the mass of the Earth and 1000 times more than the total mass of all the planets of the solar system. The average density of the Sun is low - only 1.4 g / cm^3 , although in the center it reaches 150 g / cm^3 - 7 times more than that of osmium, the densest metal. Every second, the Sun radiates $3,84 \cdot 10^{26}$ J of

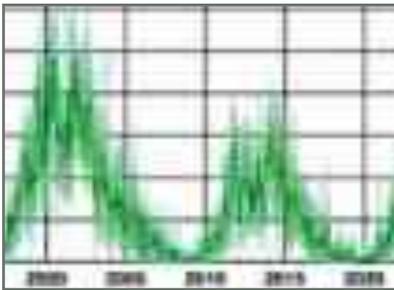


Photo 2. Variations in solar activity in the last two 11-year cycles

energy, which in mass-energy equivalent (mc^2) corresponds to a mass loss of 4.26 million tons per second. The distance from the Earth to the Sun is 149.6 million km. Light flies this way in 500 seconds. The angular size of the Sun in the earth's sky is 0.5 degrees, almost the same as the Moon. The temperature of the photosphere (the radiating layer of the Sun) is about 5770 Kelvin (or 5500°C), and in the center - 15.6 million K. The Sun on the surface consists mainly of hydrogen (70%), helium (28%) and 2% more heavy elements: C, N, O, Ne, etc. In the center of the Sun, part of the hydrogen turned into helium due to thermonuclear reactions, so the relative content is different there: 35% hydrogen, 63% helium, 2% of the remaining elements. The Sun, being a gas-plasma sphere, rotates around its axis non-uniformly: at the equator, it makes one revolution in 25 Earth days, and at the poles - in 35 days.

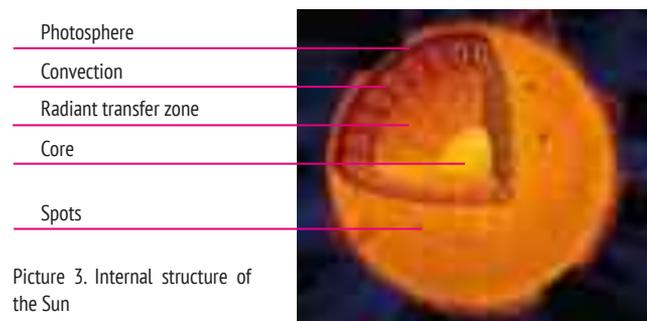
The Sun is a second generation star, its age is 4.57 billion years, which is much less than the age of the observable Universe - 13.8 billion years. According to modern concepts, in the early Universe there were only hydrogen and helium. And the Sun, as well as the planets, other bodies of the solar system and ev-

erything that is on them, arose from a substance enriched with elements heavier than hydrogen and helium. These elements were synthesized in the center of hot and massive stars and were ejected into interstellar space after the bright end of their life path in the form of supernova explosions. This stellar substance is also contained in us, so we are all descendants of supernovae.

Structure of the Sun

According to the internal structure, the Sun can be divided into four zones in which various physical processes take place. The central region is its core, where thermonuclear reactions occur, converting hydrogen into helium with the release of energy, which ensures the luminosity of the Sun. In order for two hydrogen nuclei (protons) to react, their energy must be sufficient to overcome the electrical repulsive forces acting between them, so the reaction of converting hydrogen into helium can only proceed at a very high temperature - about 15 million degrees and high density. In stars like the Sun, nuclear reactions occur in a three-step process called the proton-proton or pp cycle. In the first stage, 2 protons collide and form a deuterium, a positron, and a neutrino. On the second, a proton, interacting with deuterium, forms the nucleus of the helium-3 isotope and a gamma quantum. Finally, in the third step, the helium-3 nuclei fuse and produce a regular helium-4 nucleus and two free protons. Other reactions leading to the formation of helium from hydrogen are also less likely to occur.

As you move away from the center of the Sun, the density and temperature of matter decrease and nuclear reactions almost completely stop outside the core (about 1/4 of the solar radius). The energy of the Sun, arising in the solar core, is transmitted to the outside first by radiation in the radiative transfer zone at depths from 0.25 to 0.7 solar radii, mainly in the gamma and x-ray ranges. The temperature of this zone is so high that the solar matter in it is completely ionized and transparent to radiation. Radiation quan-



Picture 3. Internal structure of the Sun

ta move in the radiant zone, colliding with plasma particles. Due to multiple scattering and re-emission, these quanta take about a million years to reach the upper boundary of the radiative zone.

From a depth of 0.7 solar radius to its surface, convective plasma flows begin to participate in heat transfer. This is due to the fact that the temperature at this level, although high (about 2 million K), is already insufficient for the complete ionization of heavy atoms, such as carbon, nitrogen, oxygen, calcium, and iron. These ions effectively absorb the radiation coming from the depths of the Sun, the matter at the bottom of the convective zone heats up, and the process of its “boiling” (or convection) begins. The layer in which this happens is called the convective zone. Between the convective and radiation zones there is a very thin interface called a tachocline. It is assumed that it is here that the solar magnetic fields are formed, which, rising together with the plasma into the outer layers of the Sun, play the most important role in its activity.

The convective motions of the plasma very quickly transfer heat from the depths of the Sun to its surface. In this case, the rising substance expands and cools. When approaching the visible surface of the Sun, the plasma temperature drops to 5700° K. The last zone is the atmosphere of the Sun, which itself consists of 4 levels that differ sharply in their characteristics and properties. The lowest layer, about 300 km thick - the visible surface of the Sun, the photosphere, has many interesting details that are best studied. These include sunspots, bright torches, and pellets.

Thanks to studies carried out with the help of ground-based and space telescopes, giant turbulent motions of plasma, called supergranulation, as well as oscillations by acoustic and internal gravitational waves, have been discovered in the photosphere. The study of these oscillations on the surface of the Sun makes it possible to obtain information about its internal structure, which gave rise to new areas of science - helioseismology, and later - astroseismology, which studies the internal structure of other stars. The solar corona is one of the most beautiful astronomical phenomena observed from Earth. It only becomes visible during full solar eclipses.

Directly above the photosphere is the chromosphere - this is a heterogeneous layer with a thickness of about 10 thousand kilometers. The temperature of the chromosphere increases with height from 6000 ° C to about 20,000 ° C. At this temperature, hydrogen atoms are excited and intense radiation is formed in its lines, in particular in the H-alpha line (transition



Picture 4. Photosphere of the Sun with spots and pellets

from the 3rd excited level to the 2nd) with a wavelength of 656.3 nanometers, corresponding to the red region of the visible spectrum. Therefore, the chromosphere is observed during total solar eclipses in the form of a red-pink ring surrounding the dark disk of the Moon. The chromosphere can also be observed in telescopes using narrow-band optical filters or spectrographs. One of the most interesting features in the H-alpha line images are prominences - regions of dense cold plasma in the form of tongues or arches that penetrate from the chromosphere high into the corona and, for this reason, are visible above the solar edge.

Above the chromosphere is a very thin (about 100 km) transitional atmospheric layer that separates the hot corona of the Sun from the much colder chromosphere. Its temperature below is only about 20,000 K and grows extremely rapidly with height, reaching about 1,000,000 K at the upper limit. Finally, the topmost, rarefied and hot layer of the Sun's atmosphere is the solar corona, which has a temperature of over 1 million degrees consists of fully ionized plasma.

Like other layers of the atmosphere, the corona is highly heterogeneous and contains many features such as streamers, coronal holes, rays, and loops. The shape of the corona itself and the size of its structures change depending on the phase of the solar activity cycle. Due to the high temperature, the corona is unstable and continuously evaporates into outer space, forming the solar wind - a stream of very hot ionized gas. It continuously expires at a speed of more than 500 km / s and could be a mortal danger to life on Earth if it reached its surface. Fortunately, we are protected by the Earth's atmosphere and magnetic field. However, during strong solar flares, powerful plasma ejections occur, their speed and density are much greater than those of the solar wind during quiet periods. A solar flare is an explosive process of release of

kinetic, light and thermal energy in the atmosphere of the Sun. In the most powerful solar flares, which last tens of minutes, the energy release can reach 10²⁶ Joules, which is about 25% of the energy released by the Sun in one second, or 1 million tons (!) in mc² mass-energy equivalent.

Space weather

Solar flares cover all layers of the solar atmosphere and often lead to coronal mass ejections. Such emissions, reaching the Earth, interact with the Earth's magnetosphere, disturbing and rocking it, which causes magnetic storms. The strength of such a magnetic storm depends not only on the power of the flash, but also on the place on the Sun where it occurs. Charged particles ejected from the Sun move along the lines of the interplanetary magnetic field, and the Earth crosses the field lines emerging from the middle of the western (right) hemisphere of the Sun. The time of movement of plasma flows from the Sun to the Earth is about 2 days, and this makes it possible to predict magnetic storms in advance. At least, if a powerful flare occurred in the west of the Sun, then in a day or two we should expect a magnetic storm and fairly accurately estimate its strength. What is the danger of flares and magnetic storms?

It is known that 5-7% of people are weather dependent. Their well-being and health can be affected by sudden changes in the weather and magnetic storms, although the mechanism of this effect has not yet been fully elucidated. As a rule, these are people of increased excitability, having various diseases of the cardiovascular, nervous or endocrine systems. Usually they are well aware of their problems and have the necessary medicines and medical recommendations to relieve exacerbations during disturbances in the Earth's magnetic field. Numerous studies have shown that healthy people do not notice any special changes

in their state during magnetic storms.

The tasks of studying solar activity, the near-Earth space environment and predicting magnetic storms are vital for human health and various areas of their activity. Therefore, in recent decades, continuous monitoring of the Sun outside the Earth's atmosphere has been established using specialized satellites (the GOES, SOHO, HINODA series and the latest SDO - solar dynamics observatory). The equipment installed on the satellites makes it possible to continuously measure the solar magnetic field and obtain very high quality images of the Sun in the optical, ultraviolet and X-ray ranges.

The processing of these data is carried out in real time, information about changes in solar activity is received by the relevant services a few minutes after the start of the events.

At the same time, short-term (for three days) and long-term (for 27 days) forecasts of the geomagnetic situation and the probability of occurrence of magnetic storms are prepared and uploaded to the Internet for the general public. An example of such a forecast is shown in Figure 7, which shows that the holiday of the beautiful half of humanity on March 8, 2023 will not be overshadowed by magnetic storms. – Бу сана аллақачон ўтиб кетди!

In conclusion, we can say that the solar monitoring service, modern means of processing and transmitting information, as well as many years of experience and scientific knowledge already gained, make it possible to quite reliably predict dangerous events associated with solar activity and take effective measures to protect against them or mitigate their consequences.



Picture 5. The solar corona

Actual problems of waste management

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Mikhail Kremkov

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Currently, the problems of rational use of waste as a consequence of production processes and the life of the population are becoming more and more relevant for all countries of the world. As you know, human activity inevitably leads to the formation of various types of waste. The growth of the population of modern megacities and cities, the increase in the volume of production and consumption of goods and services, the increase in the needs of the population and the technological capabilities to meet them are accompanied by an avalanche-like increase and accumulation of solid industrial (SW) and municipal (MSW) waste. For example, the countries of the European Union (EU) alone produce 25 million tons of plastic waste

annually, of which less than 30% is collected for recycling. It is predicted that by 2050 the amount of waste on the planet will increase by 70% compared to its already high level today.

According to the generally accepted definition, waste is the by-products of human life, which are formed both in the processes of production and consumption. Accordingly, a distinction is made between production waste and consumer waste. Consumption waste includes solid waste generated in the process of human life, not related to the implementation of its economic / industrial activity, that is, waste generated in public areas, as well as household / municipal waste in residential areas of cities and towns. Consumer waste makes up the bulk of MSW, including industrial waste, similar to solid household waste.

At the turn of the 19th–20th centuries, the countries of the world were gradually realizing the need to develop and apply methods for the disposal and processing of waste. The beginning of the formation of modern understanding and approaches to the management and use of waste dates back to the 1980–1990s. Currently, the waste management system is defined as a set of activities for the separate collection, transportation, sorting, processing, recycling, or disposal of waste and control over these processes.

Based on world experience in this area, a classification of countries has been developed by the level of waste management, depending on the share of waste sent for processing or incineration compared to the percentage of landfill. Countries that recycle or incinerate from 0% to 40% of waste are considered “beginners”, from 41% to 80% - “catching up”, and from 81% to 100% - “advanced”. According to this classification, the most “advanced” countries are Germany and South Korea, “catching up” - Great Britain and



the USA. The CIS countries, including Russia, Belarus, Ukraine, Uzbekistan, Kazakhstan, and others, are included in the category of “beginners”.

For example, in Belarus, the level of use of municipal solid waste (MSW) from their total volume has increased by about 2 times since 2012 and amounted to about 25–27% at the end of 2021. The National Strategy for the Management of Municipal Solid Waste and Secondary Material Resources (SMR) in the Republic of Belarus for the period up to 2035 provides for bringing the level of MSW use in the total volume of their generation to 64% by 2025, to 70% by 2030, and by 2035 - up to 90%. To achieve this indicator, it is planned to develop further the existing MSW management system, namely: accounting for the volume of burials and the morphological composition of MSW and SMR, the development of logistics for the separate collection of MSW, the optimization of legislation and the management system, the infrastructure of the MSW management system, as well as the energy use of MSW.

The main ways of waste management for the world community were identified at the International Conference on Sustainable Development in Johannesburg (South Africa) in 2002, they include: - prevention of waste generation; - their maximum reuse and recycling; - use of alternative environmentally friendly materials. Currently, in the countries of the European Union, the Waste Directive has legally approved a hierarchy of ways to handle waste, including: - prevention of waste generation; - their reuse; - recycling (processing) of waste; - energy use; - and final disposal (storage, burial). This Waste Management Concept can be visualized as an inverted pyramid of the “waste management hierarchy”, reflecting all 5 named methods. This will provide the following indicators:

- minimizing the harmful effects of MSW on human health and the environment;

- rational use of natural resources by: - prevention of waste generation, - maximum possible extraction of components contained in waste (organic matter, scrap metal, paper and cardboard, glass, polymers, textiles, used tires, etc.);

- involvement of these components in the economic turnover as additional sources of raw materials, materials, semi-finished products, etc.

The main objectives of the implementation of this Directive are: - responsible consumption and production; - safe ecology, preservation of ecosystems; - resistance to climate change; - partnership for sustainable development; - introduction of modern technologies for the collection and composting of biological waste; - energy use of MSW in the form of fuel and sources of thermal and electrical energy. Achieving these goals, based on the National Strategies for MSW and SMR, will contribute to economic recovery, welfare growth and improvement of the quality of life of the population, environmental conservation and climate change mitigation.

The most important condition for the implementation of these National Programs is measures to organize comprehensive interaction between state bodies, municipalities, legal entities, and infrastructure industries in the field of MSW and SMR management.

The main principles in choosing measures for the treatment of MSW are environmental safety and economic efficiency. The program-targeted approach to regulating the methods of waste management with the arrangement of appropriate priorities has been recognized as progressive. The highest priority in terms of environmental safety has a way to prevent the generation of waste, that is, a set of measures to





reduce the amount of garbage/waste produced, both in production processes and consumption. The next most important way is the reuse of products, that is, the secondary use of objects without their additional processing (for example, the reuse of glass containers). These two methods correspond to the principle of “zero waste”, waste-free production, and a high “culture” of consumption.

An intermediate position in this hierarchy is occupied by waste recycling (processing into secondary and tertiary materials for their reuse), composting (processing of the organic fraction of MSW based on thermal disinfection), waste incineration with energy generation, biogas collection at landfills, etc. The least efficient way to handle waste is to bury it and burn it without generating energy.

The waste management infrastructure is an environment with service structures and regulatory influences that ensures the functioning of the entire waste management system. The components of this environment are as follows: - legal (legislative), - institutional and organizational, - financial and economic, - technological support, including digitalization, - information and communication, - provision of human resources.

An integrated system for ensuring non-waste production and consumption is optimal. The European Union has adopted a number of Regulations governing the handling of various types of waste: - packaging, - plastic bags, - used oils, - waste from sewage treatment plants, - obsolete vehicles, - waste electrical and electronic equipment, etc. The requirements of the EU Directives are fulfilled through national legal systems of the participating countries. The Waste

II . NATURE AND MAN

Framework Directive 2008/98/EC12 established a common regulatory framework for the EU countries and regulates the collection, processing and disposal of waste in the EU, as well as measures to protect the environment and human health.

EU countries are developing national waste management plans. Particular attention is paid to the organization of separate collection of waste (paper, metal, plastic, glass, textiles, biowaste, hazardous waste, etc.), as a condition for the use of effective technologies for processing, recovery and disposal of waste. In highly developed countries, goals are set for the transition to a “circular” economy, to low- and zero-waste industries and “zero” waste. Naturally, the creation of a modern efficient system for the treatment of MSW requires significant financial resources.

The required amount of funding and the rate of its growth should be determined taking into account the entire life cycle of all types of MSW and SMR and the strategy for developing the waste management system: - prevention of their formation, - accumulation and collection, transportation, sorting, reuse, processing, methods of disposal and neutralization, burial. The transition to the group of advanced countries with modern waste management technologies requires large amounts of funding and the use of effective financial mechanisms within the framework of a unified state waste management policy.

The considered world experience in waste management can also be applied in Uzbekistan, in connection with the implementation, in accordance with the decision of the Leadership of the Republic, of a cluster model for the collection, transportation, processing, use, and disposal of municipal solid waste in most regions of the country.





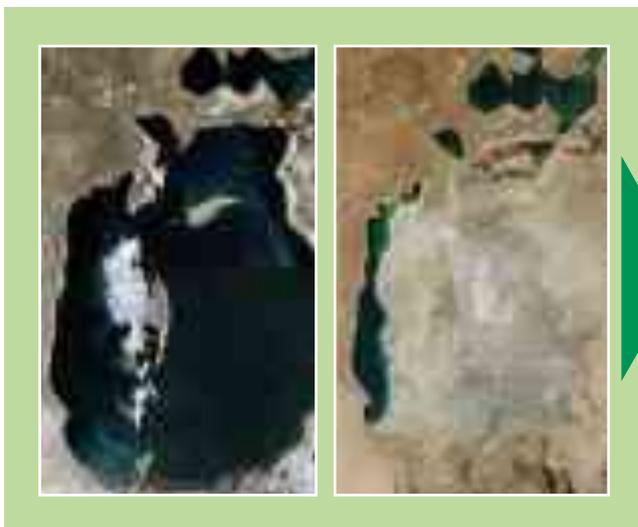
Environmental problems of the Aral Sea region - the impact of salt removal from the dried bottom of the Aral Sea

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As is known, the Aral Sea region is a zone of global anthropogenic and natural ecological catastrophes. This was manifested in a significant decrease in the water level and a decrease in the area of the water surface, the retreat of the sea coast, and the loss of over 90% of the water volume of the Aral Sea and, as a result, the formation of the Aralkum desert on its former bottom. According to the calculations of scientists, the influence of anthropogenic factors on the decrease in the level of the Aral Sea exceeded 70%. As a result, within a radius of up to 100 km from the former borders of the Aral Sea, the climate changed to sharply continental, the amount of precipitation decreased several times, *tugai* forests died, more than 130 species of animals and 30 species of fish disappeared, and the number of diseases among the population became more frequent.

One of the significant environmental problems of the modern Aral Sea region, associated with the drying up of the Aral Sea and the desertification of its former seabed, is the formation of salt marshes and the removal of their salts from the surface of the dried seabed along with dust drifts during strong winds or

the so-called salt-dust storms. These storms carry sand and dust deposits from the dry bottom and the salts and chemical pollutants accumulated in it over a very long distance. The dust-salt transfer that has been going on for many years and at the present time also provoked not only a significant climate change but also led to a significant increase in respiratory, eye, oncological, and other associated diseases among



Picture 1. In the period 1960-2009 the area of the Aral Sea decreased by 10 times from 67,499 to 6,700 km²

the population of the Aral Sea region.

The removal of salts from the dried bottom of the Aral Sea is a progressive process, due to the still ongoing increase in the area of salt marshes and, accordingly, increasing salt formation on the dried bottom of the former Aral Sea basin. The strengthening of this process is also facilitated by global warming, which activates atmospheric circulation in the territory of the Aral Sea region. In some cases, emerging salt-dust storms are the cause of a significant increase in the content of salt-dust substances in the atmospheric air in the Aral Sea region.

Picture 2 shows a salt-dust storm of unprecedented scale, which rose on May 27-28, 2018 as a result of a powerful invasion of cold Arctic air masses. The wind speed on the dried bottom of the Aral Sea during this salt-dust storm reached 100 km/h. According to the results of chemical analysis, scientists found that toxic sulfate salts prevailed in this salt-dust flow, the concentration of which at the level of 2 m was 1500 µg/m³ (Pic. 3), while the MPC (maximum allowable concentration) of sulfate in the air is equal to 20 µg/m³. That is, there was an excess of the MPC for the



Picture 2. Synthesized image of the salt-dust storm on May 27, 2018, obtained by shooting from the artificial Earth satellite NOAA-18



Picture 3. Photos taken during salt and dust storms: a) Nukus, October 2022 b) Urgench, May 2018

content of salts in the air by 75 times (!), which has a significant impact on flora and fauna.

It should be especially noted that during the emerging salt-dust storms, which occur quite regularly in the drained Aral Sea basin, there is a detrimental effect of salt removal on the ecology, environment, flora and fauna of the Aral Sea region.



Picture 4. Salt and dust storm damaged plants in May 2018. 400 km from the salt extraction site.

So, for example, immediately after these storms, significant damage to crops was observed over large areas and distances from the source of storms (Pic. 4), as well as an increase in diseases and death of livestock grazing during these storms.

In the studies of scientists, the lifetime (ie, the time spent in the atmosphere) of small salt particles with a diameter of 0.1-20 microns was determined, which ranges from several weeks to several months. This circumstance causes a long-term impact of salt particles carried out from the dried surface of the bottom of the Aral Sea on the environment. The most important negative consequences of the impact of salt-dust storms on the ecology and sanitary situation in the surrounding areas are as follows.

Firstly, it is, of course, the impact on the health of people and especially children. Thus, a comprehensive examination of the respiratory organs of the children of the Aral Sea region, subject to the influence of salt-dust storms, conducted by scientists from Kazakhstan made it possible to identify new diseases associated with the peculiarities of the course of chronic diseases of the upper and lower respiratory tract. Also, for

the first time, it was possible to diagnose interstitial lung damage, leading to deep functional and cytomorphological changes in the lung tissue in the examined patients. Researches of scientists of Uzbekistan also allowed to establish correlation dependences ($R=0.65$) of primary morbidity of the population of Karakalpakstan with diseases of the respiratory tract with the observed dynamics of a significant change in the concentration of sulfates in the air.

It should be especially noted that, given the scale of salt removal from the post-water land of the Aral Sea, the study of the identified relationship between primary morbidity and the dynamics of changes in the concentration of sulfates in the air is relevant not only for the South Aral Sea region (Republic of Karakalpakstan, Khorezm region, western parts of Navoi and Bukhara regions) but also for the nearby territories of Kazakhstan and Turkmenistan. This problem is of concern to medical professionals and scientists also in Russia, who study the growth dynamics of certain types of diseases in the Southern Urals and the Volga region, observed in recent years compared to 1980, and depending on the indicators of the deterioration of data on diseases directly in those days, when air and territory are polluted with harmful salts brought by salt-dust storms from the Aral Sea.

The effect of salt removal on the climate, according to the results of our long-term studies in the period 1966-2005, was manifested both in a decrease in air temperature ($0.08\text{ }^{\circ}\text{C} / \text{year}$), and in an increase in the amount ($+0.2\text{ mm} / \text{year}$) and mineralization ($10\text{ mg} / \text{dm}^3 / \text{year}$) of precipitation falling in the Aral Sea region.

In addition, the salinization of soils by salt aerosol from the dried bottom of the Aral Sea occurs during the infiltration of dry salt precipitation along with precipitation. Such mineralized sediments increase the concentration of salts in the studied pore solution by 3.2 g/l .

The governments of the countries that are most interested in reducing the removal of salts from the dried bottom of the Aral Sea, Uzbekistan and Kazakhstan, have carried out a number of large-scale measures to reduce the removal of salts. This, first of all, was associated with the carrying out of forest plantations of the corresponding types of vegetation, the maintenance of artificial reservoirs - Muynaksky, Rybatsky, and Zhylytyrbas, as well as the outlets of the Kokaral dam and water collectors KS-4. We have developed and are implementing a method for assessing the effectiveness of these positive anthropogenic impacts (PAI) in relation to the weakening of the re-



removal of salts from the dried bottom of the Aral Sea. Based on the modeling results, it was found that these positive anthropogenic impacts, for example, in 2019, reduced the removal of salts by 24.98 million tons per year. At the same time, without these preventive measures taken, the removal of salts in the Aral Sea region at the present time would have amounted to 117.48 million tons per year.

Thus, it can be argued that as a result of the implementation of these measures and the comprehensive work carried out, significant results were achieved in solving the problem of reducing the removal of salts from the dried bottom of the Aral Sea.

Nevertheless, despite the half-century existence of this topical problem - reducing the impact of salt-dust storms on the ecology, many aspects of their influence still remain unexplored. For example, methods for predicting and modeling the processes of occurrence, intensity, and negative consequences of dust storms are still far from perfect. Detailed medical and biological studies of the mechanism of the influ-

ence of sulfate aerosol on the body and the growth of diseases among the population, as well as the study of its effect on farm animals, have not been carried out. Also, the effect of salt aerosol on the physiology of various agricultural plants and, accordingly, on their development and productivity has not been studied in detail.

Scientists of the Karakalpak branch, as well as the Khorezm Academy of Mamun of the Uzbekistan Academy of Sciences, are currently actively working on solving these and other pressing environmental problems.

A new approach to cotton growing

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Uzbekistan is one of the largest suppliers of cotton fiber, which is one of the leading countries in the world in cotton growing. Such achievements are based on a 100-year history of cotton breeding, an existing large genetic collection, and a large number of highly qualified specialists in the field. Cotton is the main industrial crop of Uzbekistan; its fiber is mainly in demand on the world market. It is the largest renewable source of natural fiber in the global textile industry. Cotton fiber has a number of advantages over synthetic fibers due to its elegance (?) and air permeability features, and also because it is an environmentally friendly product.

One of the urgent and necessary for solving problems today is the creation of cotton varieties with a unique genome, high fiber quality, and yield, early maturing, and resistance to various adverse natural influences, diseases, and harmful insects. In recent years, it has been repeatedly noted that the creation of new varieties of cotton based on traditional breeding methods required a long period of time and cost. In the early 1990s, the use of modern biotechnological tools in crop breeding, such as DNA marker technology, and in the 2000s, RNA interference, made it possible to achieve high results in agriculture. For the first time in Uzbekistan, scientists of the Center for Genomics and Bioinformatics, Uzbekistan Academy of Sciences, under the leadership of Academician Ibragim Abdurakhmanov, introduced the technology

of “gene-knockout” of cotton (RNA interference) into production and, in a short time, cotton varieties of the Porloq series with high-quality fiber, 38-40 mm and a density of 36 g/tex, as long and soft as a variety of fine staple cotton, resistant to water deficiency, salt, and disease, with an average yield of 20% more than conventional varieties of cotton. These achievements of the scientists of the Center have received international recognition, and the technology of gene knockout, that is, “turning off the activity of genes”, has been patented in the USA, Russia, Egypt, and China.

Since 2013, these biotech cotton varieties have been cultivated in almost all regions of the country. At present, varieties “Porloq” are grown on farms on a total area of more than 380 thousand hectares. The cotton fiber of this cotton variety is estimated at 12 percent more expensive than other varieties grown in our country and is in great demand on the world market.

As part of an international project, in collaboration with colleagues from the United States, the Center’s scientists brought to Uzbekistan sets of more than 3,000 microsatellite DNA markers specific to the cotton genome for further research on the cotton



Porlok-1



Kashkadarya region, Nishan district, farm «Nishon Kuzgusi», cotton variety Portlok-4

genome. In subsequent years, with the help of these DNA markers, the origin of the Uzbekistan cotton germplasm collection was molecularly genotyped, each of more than 1000 accessions belonging to different geographical regions and ecotypes of the world, and their genetic diversity was assessed.

By 2007, for the first time in the world, associative mapping of medium staple cotton was carried out and dozens of genes were identified that are responsible for the quality and yield of fiber. The results of research on the cotton genome began to be published in 2008 in a number of prestigious world scientific journals.

Thus, the first practical application of the “marker-associated selection” (MAS) technology was started in 2009 by the Center’s scientists using DNA markers associated with the quality of cotton fiber. The launch of the MAS technology platform allowed scientists to quickly create cotton varieties Ravnaq-1, Ravnaq-2 and Baraka, which have high fiber quality, high yield, and early maturity, and also begin to use them in production. In addition, MAS technology has served as an impetus for the creation of new early maturing varieties Taffakur and Sakhovat, responsible for the quality and high fiber yield. At a later stage of research, using gene pyramid technology, significant progress was made in creating new varieties of cotton by combining several fiber quality markers into one genotype using DNA markers.

To perform high-precision mapping of cotton genes, the scientists of the Center created the world’s first special cell association population mapping, consisting of more than 3000 recombinant inbred lines from multiple parental genotypes. A special population of cotton was also created with a chromosome that changed the recombination of inbred lines. These cotton populations are a means of taking cotton gene mapping to a new level.

It’s no secret that global climate change causes an increase in temperature on Earth from year to year,





Portlok-4

which leads to droughts and a reduction in water resources. Drought, in turn, leads to a sharp decline in crop yields around the world. Uzbekistan is a region with limited water resources, and drought is one of the most acute and painful problems. Therefore, the creation of new varieties of agricultural crops resistant to water deficiency is one of the most important tasks facing science. And in this area, our scientists have achieved a number of successes and achievements. With the help of modern “gene-knockout” technology, as a result of weakening the activity of genes, new lines of Eskimo cotton were created in a short time, at the same time resistant to drought, salinity, and frost, the moment they are on the eve of transfer to the state for approbation.

Another factor negatively affecting the sustainability of cotton cultivation is Fusarium wilt disease. This disease annually leads to large losses of cotton crops in the fields. In this regard, the Center carried out large-scale research work and achieved a number of results. Armored cotton varieties resistant to Fusarium wilt disease, created with the help of new technologies, will appear in the fields of Uzbekistan in

II . NATURE AND MAN

the coming years, and they will alleviate the situation of farmers suffering from wilt disease, which is widespread in Bukhara and Navoi regions.

Recently, global climate change, the reduction of water resources, and the deterioration of land melioration have led to a reduction in cotton fields. In this regard, it is necessary to apply new approaches to growing cotton. In recent years, advances in modern Omix technology have led to the development of a completely new, personalized agricultural direction. Research on this issue, one of the first, was carried out by scientists from the Center for Genomics and Bioinformatics of the Uzbekistan Academy of Sciences. According to the concept of personalized agriculture, when growing crops, especially cotton, it is necessary to take into account soil and climatic conditions, temperature and water regimes, the need for fertilizers, response to various biological and chemical influences, as well as the genetic potential of the variety. As a result, each variety will develop its own individual fertilizers, irrigation volume, and regime, as well as cultivation and monitoring technologies in general. As a result of the research, data were obtained on which genes of biostimulants affect cotton and what processes change in the cell.

In addition, genes associated with various biotic and abiotic stresses have been identified. As a result, new agrotechnological recommendations will be developed based on the achievements of modern genomics in the cultivation of cotton varieties.

Currently, the scientists of the Center are working on the creation of crop varieties adapted to negative environmental changes, as well as the development of technologies that improve the environment using modern methods of genomics and molecular biotechnology. In general, research conducted by the Center for Genomics and Bioinformatics of the Uzbekistan Academy of Sciences on the genome and selection of cotton is not inferior to the research of the world’s leading research centers.



IT Park is the basis for business

Bahromjan Jalilov,
Director of the Fergana regional branch

IT Park is a complex of facilities, buildings and structures designed to ensure the commissioning and entry into the market of promising start-up projects for IT companies, projects of the foreign economic zone, including in integration with scientific and educational organizations. This is a platform where active and talented people in the field of IT will have a real opportunity to translate their ideas into real business projects through accounting, law, marketing and education.

On July 24, 2019, the first IT Park in the Republic of Uzbekistan opened in Tashkent. In this short period of time, IT Park brought its first fruits in the form of 28 new startups, created dozens of projects in the field of information technology, and also implemented trainings,

“master classes” and “meetups” to stimulate young people, increase interest in this area and develop computer literacy among the population.

The Fergana branch of IT Park was established in June 2020 and, thanks to the attention to the industry and reforms, in terms of its results and performance, it occupies a high position among the IT parks in the country. The building of the technopark is designed to simultaneously accommodate more than 120 jobs; currently, about 30 employees of the center, more than 50 freelancers, as well as 50 IT specialists from various districts of the region operate in it as a single team. IT Park provides businesses with the infrastructure they need, including state-of-the-art labs, co-working spaces and office space, digital technology, marketing, digitalization, and other consulting services.

Among the training courses organized in IT Park and IT centers in cities and regions are the courses “one million Uzbek programmers”, “Robotics”, “Digital technological literacy”, “Cybersports”, “Programming languages”, “web programming”, SMM, “Graphics and video editing”, “Creating applications for Android”. Currently, 750 boys and girls are enrolled in the courses. By the end of 2022, more than 3,500 young people became graduates of the center, of which more than 300 continue their activities in the IT park and in partner organizations.

On the basis of IT Park, several new industry enterprises have been created in the region. As an example of projects implemented in the Fergana region by our graduates, we can cite such training centers for modern professions as Codial, Edu Master, Ali Design, Zed Academy, Westen, Hashtag, Hachathon, IT Community, Muhandison, as well as SoftLab and Muhandisona enterprises.

Currently, together with state bodies and organizations of the region, about 300 employees of state organizations have undergone advanced training in the courses “Programming”, and at the end of 2022, another 400 employees have completed advanced training.

In addition, the presentation of the Minister for the Development of Information Technologies and Communications Sh. Shermatov to the Head of State was attended by freelancers: 14-year-old Mustafa Mukhamedov, 11-year-old Nurullo Egamberdiev, 17-year-old Muhammad Kadyr Abdullayev and 15-year-old designer with disabilities Muhammad Ayub Alimov who conduct master classes to transfer their knowledge and skills throughout the country.





At the initiative of the Khokimiyat of the region and the territorial department of the Ministry of Digital Technologies in the Fergana region, an IT grant for youth was organized, 250 participants were registered, 100 talented young people were trained in foundation courses for a month; as a result, 25 young people received free training in programming, design, modeling, and SMM courses. As part of mastering the future profession, and in cooperation with the Agency for Youth Affairs, more than 300 young people receive education at the expense of the Youth Fund. One of the largest events in the country, IT-week, was also held from December 19 to 23 in the center of digital technologies. During the event, about 700 young people took part in the nominations “ideaton”, “hacking”, cybersports, and the winners were awarded.

Voice chats were organized with Sardor Sadykov, who works as a product analyst at the British company OWLEE LDT Meet Up Lab, as well as with a Java and JavaScript expert working in GeoCue, Alabama, USA, with 20 years of experience. During the year, together with more than 15 local companies, there were organized job fairs at the Workshop.

In addition, it was the Ferghana branch of IT Park in the region that organized: the formation of a single team for the export of remote services (BPO), the creation of the 1st branch of the single integrator

UzInfoCom, the start of the activities of Unicon Soft companies, the opening ceremony and the admission process to the considered first-class IT Park University (ITPU). About 30 talented young people and freelancers of the region participate in international projects and, with the help of their intellectual potential, implement outsourcing services at an average cost of about \$5,000 per month. In addition, the young people of the center participate in the 5th stage of the “youth start-up initiatives support program” and are currently developing their own start-up projects, participating in the incubation program at the regional stage.

In 2022, a conversation was held with freelancer Jahangirmirza Ibragimov, who maintains his blog on the YouTube platform and makes money on it, which is one of the achievements of the Center. The Engineericy video blog currently has over 195,000 subscribers and publishes mostly English-language content about 3D printing and making useful items with 3D printers, and the total number of video views on the blog has exceeded 93,000,000.

From among the “chicks” of the center, several more graduates and young professionals began freelance activities in various cities and districts of the region, for example, Izzatulla Rasuljanov, Abdulla Sattoraliev, Muhammadmubin Bakhodirov, despite

their youth, they receive orders, using the Kwork.ru exchange website, from Russia, Ukraine, Belarus, and some other countries and carry out freelance activities at the Center.

Using the conditions created at the Center, more than 10 local and national events for young people, about 10 IT master classes, and meetups are held monthly. In December 2021, for the first time for programmers of the country, the IT Week within ICT Week was held in the Fergana region, and the process of preparing the launch of a mini-satellite into space was launched. More than 300 young people took part in this competition.

A lot of work is being done in the Ferghana region to take first place among the regions in the IT field, as well as to support talented youth, freelancers, and start-up projects.

In 2021-2022 alone, the number of residents of the Fergana branch of IT Park increased 10 times from 6 to 62. The volume of services provided by enterprises in the first quarter of this year amounted to

8.9 billion soums, while for the entire 2022 this figure amounted to 20.5 billion soums. Separately, it can be noted that the results of the 1st quarter of the current year amounted to 50% of the results of 2022.

Exporters and resident enterprises in BPO in the 1st quarter carried out export operations in the amount of \$229,900. This indicator was 71.5% of the results for the whole of 2022 (\$322,000). That is, in one quarter, we managed to achieve results that are more than 70% of the annual indicator.

In the first quarter of 2023 alone, a cybersecurity exhibition, an ICT week, and IT fairs were held. At the republican stage in cybersports in the direction of PUBG Mobile, the Fergana region took 1st place. For the first time, the Fergana team took part in the international project Axelerator Plug and Play. In the startup competition of the CIS countries, the team of the Fergana region shared 1-3 places with rivals.

In 2023, the number of employees of resident enterprises in the region reached 600 people, in 2022 this result was 280 people, and in 2021 - only 50. These achievements can be called the result of assistance provided by the khokimiyat of the region, the territorial department of the Ministry of Digital Technologies in the Fergana region, as well as the interaction established between the Fergana regional department of the Agency for Youth Affairs and the territorial department for the Fergana region of the Ministry of Science and Innovation.

The work of the self-improvement team and in collective harmony over the course of 3 years contributed to an increase in digital indicators by several times.

The main goals and objectives by the end of this year are to achieve an internal turnover of 50 billion soums, exports of \$3 million, the creation of about 100 resident enterprises, and more than 1,000 jobs. Taking this opportunity, I advise the youth of our region to try themselves in modern professions and improve their knowledge and skills at courses that are organized in summer in district and city IT centers.



Miraikan, a Japanese Museum of the Future

Zarina Nuridinova
doctoral student



Today, the notion of “modern museum” is relative, because already tomorrow existing museums can easily become museums of the past. The transformation into “modern museums” takes on a different form. However, the most striking and relevant trend is the introduction of interactive audiovisual technologies.

In the museum space there is a transfer of centuries-old spiritual and cultural experience. The museum began to be perceived not as a “contemplative space”, but as a “living”, emerging space with an important resource of informational and emotional impact. The question that is relevant today is: why does a modern person go to a museum? Definitely, “a person goes to a museum to see the future through a skillfully recreated past.” In this sense, of particular interest is the concept of the Miraikan Museum, which introduces visitors to the wonderful world of modern technology. Miraikan is one of Tokyo’s modern museums dedicated to innovation and the advancement of science. Getting into this museum, it seems to visitors that the future has already come - this is the main showcase of the futuristic achievements of the talented Japanese people. The National Museum of Science and Innovation (officially Nippon Kagaku Miraikan), was established in 2001 and is a leader in modern technology in Japan.

The museum is housed in a purpose-built modern building in the Odaiba district of Tokyo. The building has six floors filled with interactive exhibits. Here visitors can learn everything about robots, how the Internet works and find out the answers to a thousand very simple but important questions.

On average, a visit to the museum takes two to three hours. A fascinating journey into the “future” sometimes fascinates and surprises even today’s youth. A fascinating, original and at the same time information-rich form of pastime draws attention to the museum, thereby increasing the number of its visitors.

In a “game” form, you can learn such fundamental sciences as physics, biology, computer science, astronautics and robotics. Moreover, museum visitors are given the opportunity to touch, twist, scratch, feel, turn on robotics so that there is as much tactile communication between modern technologies and humans as possible. Foreign visitors can easily get acquainted with the activities of the museum with the help of audio guides in English.

The main exhibit of the Miraikan Museum is the ASIMO humanoid robot from Honda. The speed of his movement around the museum - 6 km / h - is comparable to the speed of movement of an ordinary person. He can go up and down stairs, play football, see





everything that is happening around him, and react very quickly to what is happening. He moves around the museum for a reason, he likes to have real-time conversations with visitors, recognizing the speech of several people. At the museum, the visitor can witness robots becoming more and more human-like. Someone is afraid of it, someone admires it.

Near each exhibit, you can find a monitor that displays any information of interest to the visitor. The museum has all the conditions for interactivity: if a visitor wants to perform a surgical operation on his own, the lack of skill will not hurt him, you can take a scalpel and dare. Also, you can assemble a person from parts - life-size body parts.

At one of the stands of the “Miraikan” National Museum of Science and Innovation, they explain the physical properties of the smallest elementary particles of neutrinos. Designed by the Japan Science and Technology Agency, this ultra-modern and unique facility includes many hands-on interactive exhibits.

They are devoted to various aspects of human life: from earthquakes to the vagaries of the weather, from renewable energy sources to robotics, from microparticles to space.

Impressing Visitors Dome Theater - Miraikan DomeTheater, which made an amazing viewing experience possible by projecting bright ultra-high definition images onto a domed screen using two high-intensity 4K RGB laser projectors. Thanks to audiovisual effects, visitors get an unforgettable experience.

A very large exposition is devoted to space topics, visitors can visit a spaceship and find out how astronauts eat and spend time away from Earth. And also for the 10th anniversary of Miraikan, an unusual exhibit was installed - the Geo-Cosmos globe, which is about 6 meters in diameter and covered with many OLED screens. This unique spherical display is a kind of interactive globe. It is sometimes referred to as a “globe display”. In almost real-time, an image of the Earth is displayed on its surface, formed on the basis



of real data received from many research laboratories and measurement stations located in different parts of the planet. It is in this way that one can observe the movement of air masses, changes in the acidity of the oceans, surface temperatures and other scientific information, as if a museum visitor is actually looking at our planet from space in real time (though with a slight natural delay). From time to time, videos are shown on the screen, for example, on the COVID 19 pandemic, or global warming issues. The exhibit was created on the initiative of the head of the museum, one of the first Japanese astronauts Mamoru Mori.

One of the interesting things about the museum is the real-time earthquake monitoring system. In a special room, data is collected from a huge number of seismometers throughout Japan, which show the state of the country as a whole. Museum visitors can optionally search the online database for information on recent earthquakes.

Every year, the Miraikan Museum hosts 3 to 6 specially selected exhibitions in which science and art often intersect. The exhibitions cover a wide range of human problems. This is the growth of pollution on the planet, and the impact of robots on humans, and even questions about the end of the world and other problems.

Special experiments and seminars are held in the "Museum of the Future" "Miraikan", in which every-

one can participate. The museum also offers programs for children from other countries (experiments and seminars are held in English).

In conclusion, I would like to emphasize that the role of digital technologies in the museums of the future is becoming more significant year by year since museums will be aimed at designing a culture that did not exist before. Of course, a system object cannot be the work of one person, and a team of specialists will work within the museum, who will unite to create the concept of a "unique modern museum of the future".

A SCHOLAR AND A RULER



**Prof. Dr. Surayyo Karimova,
D.Sc. (Historical sciences)**

During the reign of Amir Temur (1360-1405), Samarkand acquired the status of the capital of a vast empire in the Muslim East and turned into the most prosperous city of Maverannahr in all respects. We can see confirmation of this in written sources, architectural monuments, and works of art that have survived. In the field of science, the Samarkand astronomical school of the 15th century, like the “Bayt al-Hikma”

IV. SOCIETY, HISTORY, CULTURE

(“House of Wisdom”) of the 9th century in Baghdad, the Mamun Academy of the 11th century in Khorezm, took its place in the history of world science. In this, a considerable role belongs to Mirzo Ulugbek Timurid.

The grandson of Amir Temur, the son of Shahrukh Mirzo (1377-1447) Muhammad Taragay Mirzo was born on March 22, 1394, in the city of Sultania (Iranian Azerbaijan) in one of the military campaigns of Amir Temur. Since childhood, he was affectionately called Ulugbek (great bek), and this epithet stuck with him until the end of his life.

Amir Temur looked at the upbringing of children and grandchildren as a task of national importance, therefore, like most princes, Ulugbek was brought up in the palace, in the hands of prominent scientists and writers of his time. In particular, until the age of 11, Temur’s eldest wife, Saray Mulk Khanum, was engaged in his upbringing. Later, noticing his grandson’s great talent and phenomenal memory, grandfather pays great attention to his broad and deep education, entrusting Ulugbek’s education to one of the famous scientists, a prominent poet and great erudite Hamza ibn Ali Malik Tusi, known as Sheikh Arif Azari.

Ulugbek’s father, Shahrukh Mirzo, had a rich library, consisting of many rare books. Inquisitive from childhood, Ulugbek studied books from the palace library with great interest and attention, among which were the works of such ancient scholars as Plato, Aristotle, Hipparchus, Ptolemy, scholars of the Islamic period - al-Khwarizmi, al-Ferghani, al-Buzjani, al-Be-



Drawing engraving from the book of Jan Hevelius depicting Mirzo Ulugbek

runi, Ibn Sina, al-Chagmini and others. He participated in scientific debates of scientists and poetic competitions of poets, which were arranged in the palace by his father. All these factors contributed to the formation of his future as a major scientist.

Amir Temur took Ulugbek with him on military campaigns. In particular, in 1404, during a campaign in China, he was next to his grandfather. On February 18, 1404, Amir Temur dies, and from that moment on, the struggle between the Timurids for power begins, which, as a result, leads to a weakening of the central power in the empire. Ulugbek also takes part in this struggle and in 1409, with the support of his father Shahrukh Mirzo, he took over the power in Maverannahr, where he ruled for 40 years until his death at the hands of his own son Abdallatif in 1449.

Mirzo Ulugbek, along with state affairs, was actively involved in scientific activities. Realizing well that the prosperity of the country and the well-being of the people is largely associated with educated people and the development of science, he built a madrasah in 1417 in Bukhara, in 1417-1420 in Samarkand and in 1437 in Gijduvan. Of these, the Bukhara and Samarkand madrasahs functioned until the 19th century. One of the madrasahs of Samarkand adorns Registan Square to this day as a majestic and beautiful building of the 15th century. The first Mudarris (teacher) of this madrasah was a prominent scientist of his time, Muhammad Khavafi. According to sources, out of 90 listeners of his first lecture, only two - Ulugbek and Kazizada Rumi understood its content.

Exact and natural sciences, literature and linguistics were taught in the Samarkand madrasah along with Islamic sciences. Ulugbek personally took part in the lessons in mathematics and astronomy. Mathematics was taught according to the "Fundamentals" of the famous ancient Greek mathematician Euclid (3rd century BCE), as well as according to the work of the well-known author of the 12th century in Central



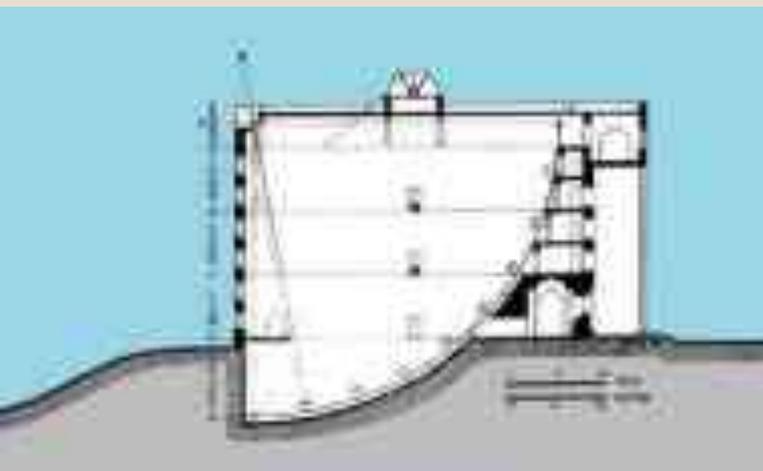
Model of the Ulugbek observatory in the Samarkand Museum named after Mirzo Ulugbek

Asia Sirajaddin Sijavandi "Tajnis al-hisab" ("On fractional numbers") and according to the treatise Sham-saddin al-Samarkandi, a polymath of the 13th century, "Ashkal at-tasis fi-l-khandasa" ("Substantiated Geometric Figures").

As for astronomy, basic knowledge in this subject was taught on the basis of the work of the Khorezmian scientist of the 13th century, Mahmud al-Chagmini "Mulakhhas fi-l-haya" ("Abbreviation on astronomy"), which is an edition of the "Almagest" by the ancient Greek astronomer and geographer Ptolemy (2nd century CE). Then they began to study the "Canon of Masud" by Abu Rayhan Beruni, "Zij-i Ilkhani" by Nasiraddin at-Tusi. According to Ulugbek's colleague and teacher of the madrasah Jamshid al-Kashi, the main textbooks on astronomy were the works of such scientists from the Maraga Observatory as Nizamaddin al-Naysaburi, Qutbaddin Shirazi and others. Mirzo Ulugbek himself lectured on these works.

In Samarkand madrasahs, together with Ulugbek, another 60 prominent and well-known scientists of that time conducted teaching and scientific activities. Of these, Kazizada Rumi, his son Hasan Chalabi, grandson Mirim Chalabi, Jamshid al-Kashi, and Ali Kushchi, father and son from Kashan Muinaddin and Mansur ibn Muinaddin al-Kashi are mentioned in the sources.

Serious scientific research required astronomical observations. In this regard, Ulugbek creates an observatory in Samarkand, equipped with precise measuring instruments.



According to some scholars, it was a three-storied cylindrical building. His main instrument was a quadrant - a 90° arcuate instrument with a radius of 41 m. It had two arcs, i.e. it was a double quadrant, so with its help, it was possible to observe not only the Sun but also the Moon, other planets, and fixed stars. In addition, the armillary sphere, the astrolabe were among the most modern instruments for that time, and an azimuthal circular instrument for measuring the height of the Sun was installed on the flat roof of the building. With the help of all these instruments, measurements were taken and new scientific data were obtained. The closeness of the obtained data to modern ones indicates the greater accuracy of astronomical observations and measurements that were made using these instruments.

At the observatory, work was underway to create the largest and most accurate catalog of stars, necessary and very important for the astronomy of that time. The results of these works are reflected in the work "Zij-i Jadid-i Guragani" ("New Guragan Tables"). It is also known as "Zij-i Ulugbek" ("Tables of Ulugbek"), "Zij-i Sultani" ("Sultan's Tables"). "Zij" is a product of thirty years (1414-1444) of observing the movement of the Sun, Moon, other planets and stars. It consists of an introduction and four articles.

The first article provides chronological information, i.e. calendars of various peoples, translation of dates from one calendar to another chronology, names of months for various peoples, their holidays.

The second article is the main one and it presents the entire mathematical apparatus, i.e. simple and complex trigonometric formulas of great accuracy are given, covering all elementary mathematics. Also outlined are methods for determining geographic longitudes and latitudes, a table of coordinates for 240 settlements in various regions, and a method for calculating the Qibla azimuth.

The third article is devoted to the issue of planetary motion and stellar astronomy. Tables of coordinates of 1018 stars are also given here.

The fourth article of "Zij" contains astrological calculations.

One of the important sections of the "Guragan tables" is a catalog containing the coordinates of 1018 stars. The first star catalog was compiled by Ptolemy in the 2nd century CE. Later scholars made corrections to Ptolemy's catalog without direct observation. By the beginning of the 15th century, the discrepancy between the actual location of the stars in the sky and their coordinates had grown so much that Mirzo Ulugbek decided to conduct observations himself to determine the coordinates of the stars. Thus, over the course of 13 centuries, his tables became the first catalog compiled on the basis of original astronomical measurements. It should be noted that among the astronomical and mathematical works Ulugbek's "Zij" as well as "Tahrir-i Uklidis" ("Corrections of Euclid") by Nasiraddin at-Tusi are widely distributed today in numerous manuscripts in many book depositories of the world (more than a hundred). This indicates the enormous popularity of this work in the Islamic world.

Initially, "Zij" attracted the attention of Samarkand scientists. The first commentaries on it were written in Samarkand, first by Ulugbek's student Ali Kushchi, then by Mirim Chalabi. In the 16th-17th centuries, this work was commented on by scientists from Iran, as well as from Iraq, Syria, and Egypt. Finally, the Indian scientist Sawai Jai Singh (1686-1743) built several observatories in India following the tradition of the Samarkand observatory, and for the Baburid sultan Muhammad Shah (1719-1748) wrote the book "Zij-i Muhammadshahi" ("Tables of Muhammad Shah"), where he included many tables of Ulugbek.

Among Ulugbek's comments on the Zij created in the Muslim East, the most complete is the comment by Nizamaddin Abu-l-Ali ibn Muhammad ibn Husayn



Chingiz Akhmarov. Ulugbek and his young colleague Ali Kushchi at the observatory. Samarkand. 1963.



Chingiz Akhmarov. Portrait of Ulugbek. 1974.

Birjandi (d. 1525), who was a student of Mansur ibn Muinaddin al-Kashi, one of the representatives of the Samarkand astronomical school. The work was written in 1523 and is called “Sharkh-i Zij-i Ulugbek” (“Commentary on Ulugbek’s Zij”), in it Birjandi solved many problems from Ulugbek’s Zij, provided proofs of each rule given by Ulugbek, providing them with numerical examples and drawings. He enriched his work with new astronomical and mathematical data accumulated from the time of Ulugbek to his day.

In Europe, astronomers first noticed Ulugbek’s “Zij” in the 17th century, since by that time in Europe there was an urgent need for accurate astronomical tables and star catalogs. In addition, thanks to the appearance (1582) of the “Diaries” by Louis Gonzalez de Clavijo on the activities of Amir Temur, as well as the book “The History of the Great Tamerlane” (1607), Europeans had a great interest in the personality of Amir Temur and his descendants. Most of all, this interest was shown by the British, since by this time the dominance of the British on the sea routes had begun

and for navigation, they needed Ulugbek’s tables.

The English astronomer John Greaves in 1648 was the first to publish part of the star catalog and geographical tables, and in 1650 - the chronological tables of the Zij. After that, English scientists continued their research in this direction, and in 1665 T. Hyde, in 1725 D. Flamstead, in 1767 G. Sharp, as well as the French orientalist L. A. Sedillo in 1847-1853, the American researcher E. B. Noble in 1917 published various parts, translations and a critical text of the Zij. In 1994, a scientifically commented translation of this work into Russian was published in Uzbekistan in connection with the celebration of the 600th anniversary of Mirzo Ulugbek. In 2022, Zij was published in Uzbek, Russian, English, and Chinese in connection with the regular meeting of the Shanghai Cooperation Organization in Samarkand, where it was presented to the heads of participating states.

The high appreciation of Ulugbek’s “Zij” by European scientists was reflected in the work by the Polish astronomer Jan Hevelius (1611-1687) “Prodromus Astronomiae” (“Bulletin of Astronomy”), published in 1690 in Gdansk. In it, the star catalog of Ulugbek was compared with the catalog of stars of Ptolemy, the famous European astronomers Tycho Brahe, Riccioli, and Wilhelm IV, as well as with the catalog of Hevelius himself and showed their high accuracy compared to the rest. “Catalogue of the Starry Sky” by Hevelius is decorated with two engravings depicting the most famous astronomers in the world. They depict astronomers with the goddess of astronomy Urania, where Mirzo Ulugbek is in the first place to the right of Urania. The inclusion of Ulugbek in the engraving and his position in the composition indicates the high recognition of the “Guragan tables” as a worthy contribution to the treasury of world astronomical science. The name of the scientist in the 17th century is also immortalized in the name of one of the craters on the Moon.

In Uzbekistan, in the homeland of Ulugbek, in various regions, educational institutions and streets are named after him, monuments are erected in various cities, museum expositions are organized, and literary, theatrical, and film works are created. Mirzo Ulugbek left an indelible mark on our national history as a learned ruler.

Jadids: “Enlightenment is a matter of life and death”

Prof. Dr. Dilorom Alimova
D.Sc. (Historical Sciences)

At the beginning of the 20th century, when political events were raging in Turkestan, affecting all social strata of the population, a movement of national progressives called Jadidism entered the public arena as a leader. It was a unique socio-political phenomenon that contributed to the growth of national self-consciousness and played a significant role in the cultural development of Turkestan, the formation and development of the Jadids: “Enlightenment is a matter of life and death” national liberation ideology.

The Turkestan region of that time was a colony of the Russian Empire, which became its raw materials appendage, gratuitously feeding the metropolis with its natural resources, in particular, cotton and silk. The penetration of Russian capital into Turkestan, of course, gave an impetus to the development of banks, the construction of railways, and so on. But the development of usurious capital greatly increased the number of bankrupt peasants. By November 1912, the debt of the population to credit institutions reached 157 million rubles, which led to an increase in the number of landless people. By 1917, in some districts of the Fergana region, the landless accounted for 30%, and in the Tashkent and Andijan regions - 40-50% of all farms.

On the other hand, it included a new European culture with a fairly rich experience and technological achievements, a developed educational system, connected in general with the European world. And this, of course, could not but affect the minds of the pro-



gressively thinking intelligentsia of the region. Under the circumstances, she saw the main reason for the social and colonial oppression, the backwardness of the country in the ignorance and lack of enlightenment of the people, supported by the ruling circles. Therefore, the solution of urgent problems was seen at first only through enlightenment. As they believed, “enlightenment is a matter of life and death.”

Why was the question asked that way? Because the Jadids, or as they called themselves - national progressives - *Milliy taraqqiyparvarlar* were highly educated people of their time. They studied, taught, and sought to master both Eastern and Western cultures. They visited both Russia and other countries of Europe and Asia, could see, and compare the levels of development of education, and cultures of different countries, and, being intellectuals, were ignited by the dream of spreading the achievements of world civilization in Turkestan.



Textbooks for students of new types of schools

After the conquest of Turkestan by the Russian Empire, opportunities opened up for the penetration of democratic ideas from both Europe and Asia, and communication with the outer world contributed to the development of liberation ideas in the region. These were the first steps in the formation of the philosophy of national freedom, the main postulate of which was enlightenment. Its supporters were far from leading, organizing, or supporting the popular uprisings that broke out in different parts of the region, but they were well aware of their causes, and their critical attitude toward the existing system, understanding the need for reforms was a great achievement of this time.

One of the passionate supporters of the reforms was the famous educator Ahmad Donish, as well as such poets as Muqimi, Furkat, Khamza, Berdakh, Zavki, Bayoni, and Avaz Utar, who in their poems called the people to knowledge and enlightenment. Democratic ideas also dominated the minds of such prominent figures as Abay and Chokan Valikhanov, who saw a way out of the impasse not only in enlightenment

but also in the unity of the Turkic peoples. On this basis, the Jadids grew up, who went far ahead of their predecessors from enlightenment to politics.

Along with enlightenment, the Jadids sought to change the old system of social and political statuses to progressive forms of development. But this was already the second political stage of the movement. In Turkestan, the most prominent representatives of Jadidism were Mahmudkhoja Behbudi, Ubaydulla Asadullakhodzhaev, Munavvar Qori Abdurashidkhanov, Abdulla Avlony, Tashpulatbek Norbutaev, Khoji Muin, Abduqadir Shakuri, Nasirkhantura Kamalhanuraev, Abidjon Makhmudov, Ashurali Zahiri, Ishankhoja Khonkhojaev, Iskhakhan Ibrat. In Bukhara - Sadridin Aini, Faizulla Khodzhaev, Abdurauf Fitrat, Musa Saidzhanov, Abdulvakhid Burkhanov, Usman Khojaev, Mirkomil Burkhanov, Mukhitdin Rafoat, Mukhitdin Mansurov, Mukhtor Saijanov, Abdukadir Mukhitdinov, and others; in Khiva - Bobookhun Salimov, Polvonniyaz Yusupov, Avaz Utar, Khusain Matmurodov, Nazar Sholikorov, Otajon Abdalov, Khudoybergan Divanov, Muhammad Rasul Mirzo, Matyakub Pozachi, Otajon Sadaev, Bekjon Rakhimov, Muhammad Devanzade, and others. All of them made a significant contribution not only to the enlightenment of the masses but also to the development of liberation ideas.

At the stage of enlightenment, the Progressives saw their main task in creating a new system of education, and they gave all their strength to the implementation of this reform.

The Jadids not only theoretically substantiated the need for its implementation, but also made great efforts to implement it in practice, opening new method schools, libraries, and reading rooms, publishing textbooks, and newspapers, and creating the first theater.

By 1911, the total number of new method schools in Turkestan was 63, in which 4106 children studied, 30 schools operated in the Fergana region, 12 in Semirechye, and 5 in Samarkand. The city of Tashkent, of course, was distinguished by the number of schools - there were 24 of them - and the quality of education.

Unlike the old *maktabs*, children here became literate in 40 days. Therefore, in a relatively short period of time, these schools gained confidence and popularity among the population. In addition, the teachers were mostly young people, whose ages did not exceed 25 years, there could be no talk of an obsolete teaching system based on a baculine argument here. Exemplary new method schools were: in Samarkand - the school of Jurabaev and A. Shakuri; in Ferghana - the schools of Abdul Vakhob and Mazitov - in the village of Beshkovak, Fergana region; in Tashkent - Ishank-

hoja Khankhojaev, Sabirjan Rakhimov, and Munavvar Qori Abdurashidkhanov. The authorities themselves marked Munavvar Qori's school as the best. At one time, its graduates were M. Uygun, Khamza, K. Ramazan, and Oybek.

Makhmudkhoja Behbudi and Munavvar Qori Abdurashidkhanov were the authors of about 15 manuals and textbooks. The tsarist administration of Turkestan was initially positive about the activities of the new method schools, realizing that they provide a certain level of general education compared to the old *maktabas*. However, over time there has been a tendency to discourage the organization and spread of new method schools and even close some of them. The authorities saw in them instilling in Muslim children the ability to "perceive any trends", referring to anti-government sentiment.

Nevertheless, the Jadids did not get tired of seeking the opening of new schools to replace the closed ones. As a result, by 1917 there were already about 100 schools in Turkestan.

Renewal processes in the education system also spread in the Emirate of Bukhara and the Khiva Khanate. In the Khiva Khanate, the problem of reforming the education system was much easier to solve. This was due to the fact that the Khan of Khiva Muhammad Rahim II (Feruz) was a well-known patron of culture, approving of technological innovations. In 1874, on his initiative, a lithographic machine was brought to Khiva from Russia.

Trying to create a new system of education and enlightenment, national progressives relied on the cultural heritage of the peoples of Central Asia. Often in their writings they reminded readers of it, citing as examples Ibn Sina, Farabi, and Ulugbek, as the actual founders of social and scientific reforms in Central Asia. According to the Jadids, the study of their works was to promote the progressive development of the region and raise the national consciousness of the people.

While promoting enlightenment, they often recalled the European medieval Renaissance, realizing that the reasons for the development of European powers are the education system and the development of new technologies. They tried to introduce everything that is acceptable for Turkestan into the field of educational reforms.

The process of uniting the progressive forces of the region and intensifying the educational activities of the Jadids was marked not only by the opening of new method schools, but also by the organization of the national press, in particular, the emergence of new

newspapers and magazines. So, in 1906, under the editorship of I. Obidov, the newspaper "Taraqqi" began to be published, in the same year, under the leadership of Munavvarkori - "Khurshid", in 1907-1908 under the editorship of A. Avloni - "Shukhrat", and A. Bektemirov headed the newspaper "Osiyo". However, soon the colonial government, relying on the report of its expert N.P. Ostroumov closed these newspapers. On the basis of a new wave of enlightenment in 1913-1915 such newspapers and magazines as "Samarkand", "Sadoi Turkiston", "Sadoi Fargona", "El Bayrogi", "Kengash", "Turon" and "Oyna" already appeared, and in 1917 printing organs such as "Hurriyat", "Najot", "Kengash", "Turon", "Ulug Turkiston" and others. Thanks to the entrepreneur Saidazimbai, the newspaper "Tujjor" was published. The newspaper, being a tribune of the Jadids, opened up even wider opportunities for them to propagate their reformist ideas than did the schools. In total, there were more than 15 of them, and it was already a great ideological force. The range of topics was very wide, from educational to political. The national press that began to form clearly demonstrated the presence in the region of a new type of person with progressive thinking, who cares about the welfare of the nation.

Jadids saw unnecessary and harmful traditions (excessive rituals, lavish weddings, and funerals) among the reasons hindering progress towards progress, common in the everyday life of the Turkestanis, but in fact alien to Muslim canons, burdening the already difficult life of people.

The Jadids understood that the colonial system of government of the Russian administration in Turkestan not only did not meet national needs but also caused enormous socio-economic damage to the country. Therefore, their struggle for a new method of secular education, the strengthening of the best aspects of national identity, and the intensive development of culture ultimately resulted in a struggle for political independence and democratic forms of government. This led to the creation in November 1917 of the Republic of Turkestan Mukhtoriyati (Turkestan Autonomy), centered in the city of Kokand, which was defeated by the Bolsheviks.

The Jadids were convinced that the Turkestan region, being part of the Muslim world, but representing an independent unique phenomenon in world history, must find its rightful place in the complex and controversial future that the 20th century opened. Their names were consigned to oblivion in Soviet times, but took their rightful place in the historical and cultural heritage of independent Uzbekistan.



F. I. Ruzanov. Portrait of Azimjan Yakubov. Early 20th century Bukhara



Dmitriev. Mirza Abduvohid Burkhonzoda. 1912, Bukhara



A new method school, opened by Haji Muin in Samarkand

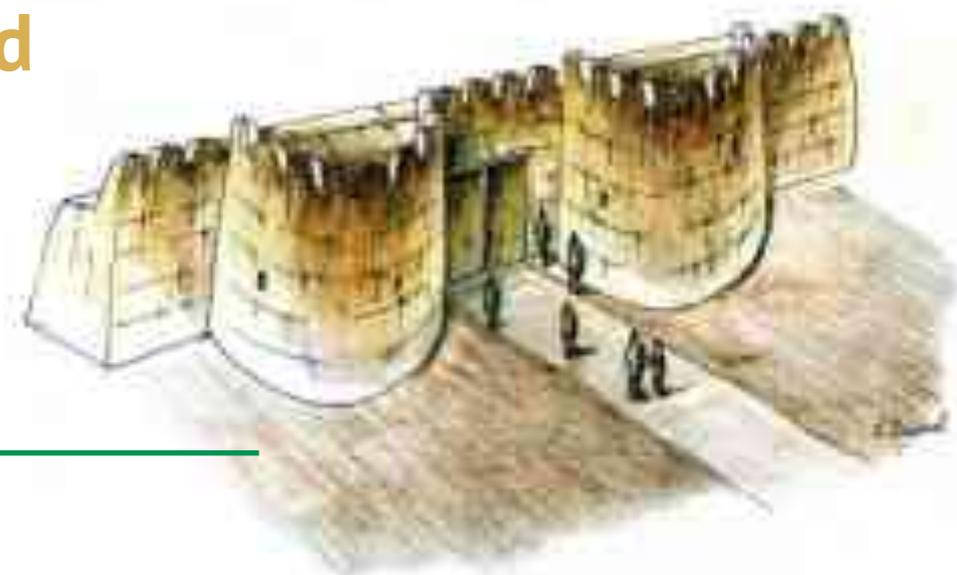


The play «Padarkush» by Mahmudhoja Behbudi. The play was written in 1911 and published in 1913



Troupe «Turon»

Gates of old Tashkent



Abdumannop Ziyaev,
D.Sc. (Architectural sciences)

The construction of a new outer fortress wall of Tashkent (the end of the 18th - the beginning of the 19th centuries) is one of the major urban development works of the period of Yunuskhoja's reign. Despite the haste of construction and weak defensive qualities, this construction allowed the city to determine the size of its territory and the placement of city gates along the perimeter of the fortress walls. If at the beginning of the 18th century there were eight gates in the defensive walls of Tashkent, then a hundred years later their number was reduced to six, despite a significant increase in the area of the city. Probably, these were the gates that functioned in those years, but in reality, the number of gates built under Yunuskhodzh could be 11, as in Bukhara. The reduction in the number of functioning gates is due to the unreliability of the city gate security system, which was often the object of assault and subsequent capture by the enemy (by setting them on fire).

Yunuskhoja, who had experience in leading the city when he was the head of the Shaikhontohur *daha* (district), attracted all the male population of Tashkent to build new city walls. Perhaps the construction of the city's fortress walls was carried out in the autumn-winter period when the population was free from agricultural work. At the same time, there was a decline in trade activity in the bazaars of the city, due to the cessation of caravan communication between the regions due to road slush. This made it possible to connect artisans and merchants to the work.

The new city gates of Tashkent were probably built under the supervision of craftsmen invited from the Emirate of Bukhara, which could be reflected in their appearance. The reason for this was the military confrontation between Yunuskhoja and the rulers of the Kokand Khanate that began in those years.

Due to the lack of photographic documents and measured drawings of the gates built under Yunuskhoja, it is possible to recreate them hypothetically using materials from the fortification of the cities of the Bukhara Emirate. Consequently, the gates of Samarkand, Kukcha, Chigatai, Sagban, Karasaray, Takhtapul, Labzak, Parkent, Koymas, Beshagach, Kamalon, had some similarities with the nature of the Bukhara fortification. This could be expressed in the fact that the walls and gates were adapted for firing with flanking semicircular towers. Here, locally produced cannons were located on the platforms of the semi-towers.

The height of the gates and walls of the city varied depending on their strategic location and ranged from 6 to 8 meters. At the base, the thickness of the walls reached 3-4 meters, but in some places it was thinner and was not designed to withstand artillery fire.

The 11 gates of Tashkent of the Yunuskhoja period listed above had an entrance part, which was an opening no more than 3-3.5 m high, double-leaf gate panels made of strong wood, reinforced with metal fasteners. On the sides of the doorway there were semicircular towers, crowned with battlements

in the upper part. In different parts of the semi-towers, loopholes for shooting were arranged, and arrows were located on the platforms from their inner part.

It can be assumed that one of the architectural elements above the doorway of the gate was a decorative arched opening, which, in most cases, was present in the gates of Bukhara. The upper part above the gate ended with a parapet with loopholes, and behind it, banquets were held, where the defending soldiers were placed.

Each gate had passages from the inside - premises for protection and other needs. The gates were timed to open at dawn and close before dusk.

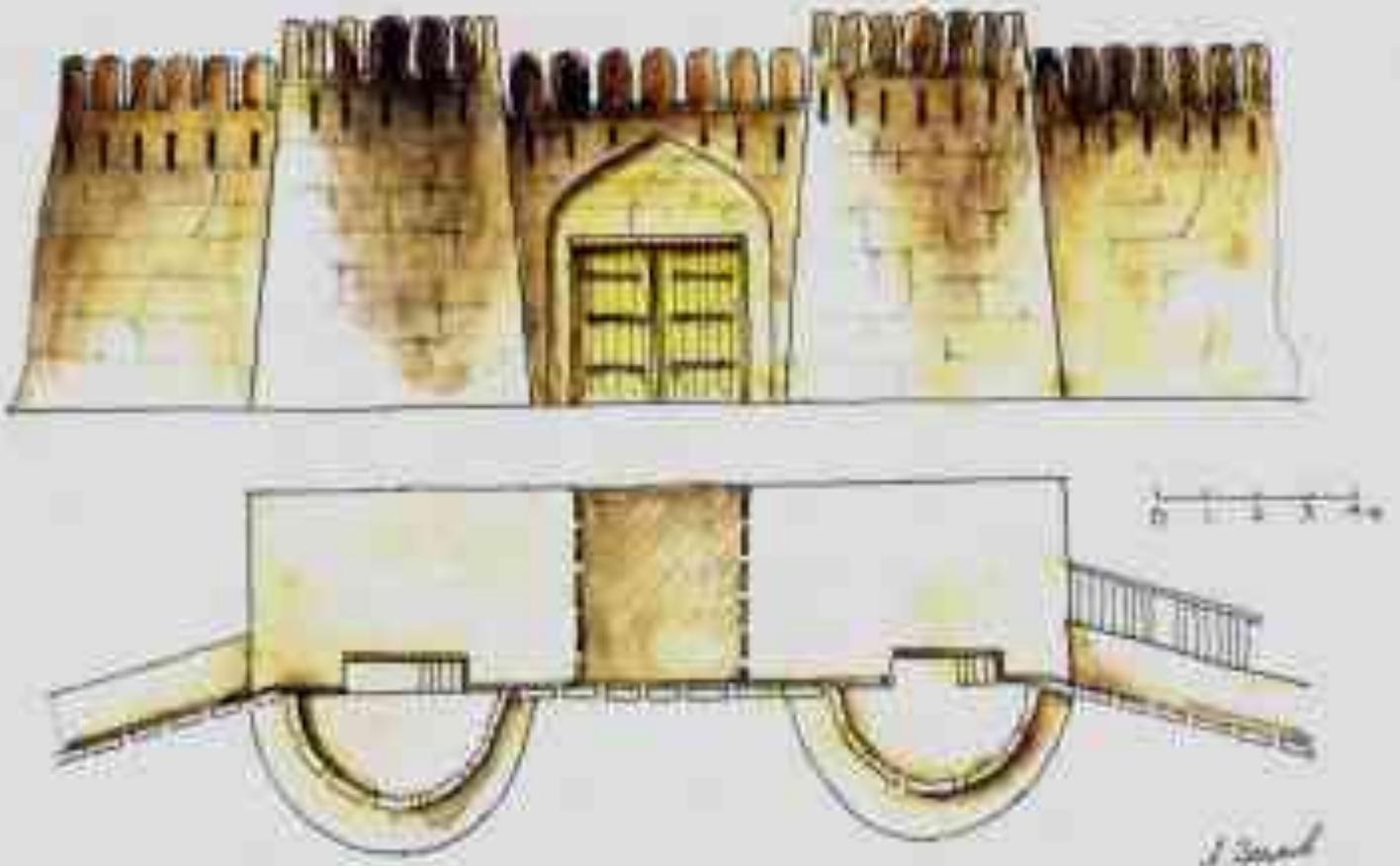
With such a long fortress wall, the possibility of strengthening it with half-towers was limited. As can be seen from the survey of the line of fortifications, the flanking half-towers were unevenly located on it, sometimes the distance between them varied from 30 to 150 m.

Soaked clay, mined from the bottom of temporarily blocked canals and ditches, served as the main building material for the fortress walls. In this way, the population achieved a double result. Firstly, the old canals were expanded, their carrying capacity increased, and thus water was supplied to the poor-

ly irrigated new sections of the city. Secondly, the improvement of the irrigation network made it possible to significantly expand the city in the eastern, southern, and western directions, adding to Tashkent the empty low-water lands of the former suburbs. In the construction of fortress gates, in the upper part of the semicircular towers and battlements above the entrance opening, brick, sometimes burnt, was often used. However, *pakhsa* (wet clay) remained the main building material of the walls.

From a military point of view, the southeastern walls of Tashkent were considered the most resistant. The abundance of irrigation canals provided enough clay for their construction. It is no coincidence that the eastern fortress gates of Tashkent were called "Koimas", which means "Impassable".

The southwestern section of the wall from the Beshagach gate to the ancient Bozsu canal was considered to be less well-endowed building material in the form of *pakhsa*. The reason probably lies in the unwillingness of the population of the Beshagach daha to include several old cemeteries in their territory - Khoja Alambardor, Charkh Kamalyan, and Samarkand *darbaza*, if the border of the city is moved south, to the Zakh canal.





Clay for this segment of the fortress walls was taken from three sources: from the bottom of the ravine, where the ancient Zakh canal flowed; from a quarry, the development of which was restored in connection with the construction of the city wall (now a lake at the National Park); from the canal diverted from Ankor towards the cemetery of Khoja Alambardor.

During the years of the war with the Kokand Khanate (1800-1810), the defensive wall of Tashkent could not resist the blows of the Kokand artillery, since it was erected in the time of Yunuskhaja, with a height of 6-8 m, it had an insignificant thickness.

As part of the Kokand Khanate, Tashkent, as one of the main strongholds, was re-fortified and its outer city wall was rebuilt. The old walls of the times of Yunuskhaja were increased in height and thickness, and ditches filled with water were made in the most strategically dangerous areas.

The height of the walls was brought in places to nine meters, and the thickness to four or five meters, which made them difficult to penetrate for artillery.

A feature of the defensive walls of Tashkent during this period was the arrangement of wide banquetts (upper platforms) in them, reaching in places

up to 3-3.5 m, which made it possible to drive laden *arbas* (a type of carts) with clay through them.

The last reconstruction of the defensive walls and gates of Tashkent was carried out from 1840 to 1865. These works were associated with two events: the first was the confrontation between the Kokand Khanate and the Emirate of Bukhara, and the second was the start of a large-scale offensive by tsarist Russia against Central Asia. In 1853, the Kokand fortress Ak-Mechet, located on the right bank of the Syr Darya, was captured, and the Perovsk fort was built in its place.

Tashkent, like other cities of the khanate - Turkestan, Chimkent, and Pishpek, rapidly strengthened the power of its fortifications. By the 1840s, the complete development of the lands of the eastern suburbs under the new urban territory was completed. Here, under the walls of Urda, the Sarbaz (military) contingent was stationed.

The configuration of the city plan after the annexation of the eastern territories (district) acquired a more complex form. The fortress walls along the entire perimeter of Tashkent were a closed continuous broken line. By 1865 their length was nineteen versts, and twelve gates were built in them. The same num-

ber of radial transport arteries, originating in the area of the Chorsu bazaar, ended at the gates of the outer wall.

Before the city was annexed to the Kokand Khanate, Tashkent had the following external gates: the western gate was called Kukcha, the northwestern gate was called Samarkand; northern - Sagban, Karasaray and Takhtapul; southern - Kamalyan and Beshagach. The eastern gate, before joining the lands of the left bank of the Ankhor canal to the city, was probably built at the junction of Labzak and Shaykhontokhur streets to the defensive wall and was called the same. The last gate to the east, "Koimas", was rebuilt later, as the area around it was the least populated in the city.

In the eastern part of Tashkent, after being conquered by Kokand, near the new Urda, two gates were rebuilt - Kashgar and Kokand. Through them, the Urda garrison communicated with the outside world. In the citadel itself, there were three gates, which were intended for communication with the city and the Sebzar court, where the main Kokand military contingent was located.

The external appearance of the new fortress gates (Kashgar, Kokand, and the rebuilt Koimas) could differ from those previously erected under Yunuskhaja. Craftsmen from the Kokand Khanate worked here, and they could be identical to the gates of Kokand or have similarities with the gates of Kokand.

The gates in the fortress wall were named depending on a number of factors: in the case of the gates of Samarkand, Kukcha, Kokand and Karasaray *darbaza* - from the direction of the roads that led to these cities and villages. The name of the Beshagach, Kamalyan, Kashgar, Labzak and Sagban *darbaza* gates came from the residential areas and streets located next to them. For example, people from East Turkestan, *Kashgarlyks*

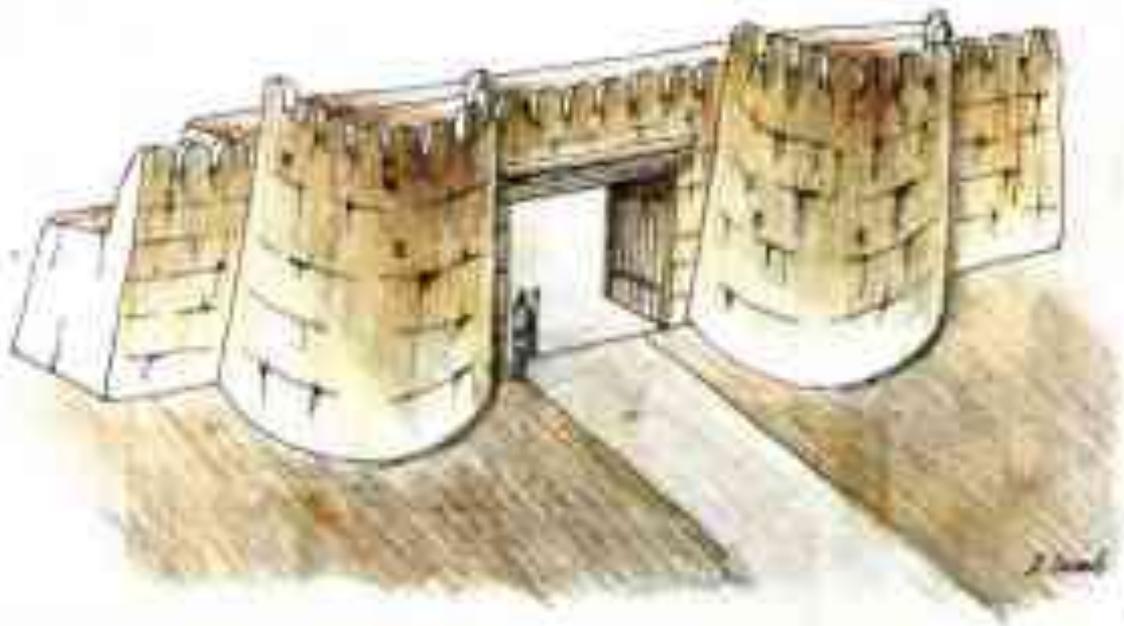
(those who are from Kashgar), settled near the gates of Kashgar, and formed the mahalla "Kashgar" here. The names of other gates were derived from their specific characteristics. For example, Takhtapul is a gate with a wooden ramp, Koimas is an impenetrable gate.

Urda was connected with the old city through the western gate. Near these gates, inside the fortress, a small bazaar functioned, where they traded on certain days of the week.

The defensive walls of Urda were more powerful than the city ones. The most fortified was the southwestern part, which was the highest in the city and in the suburbs (now the Mustaqillik monument is located here). This section of the citadel was a bastion with three towers, designed to monitor the city and bombard residential areas if necessary. The height of the outer walls of Urda reached 14 m, with a base width of 6 m, and a banquet - up to 4 m. Three gates flanked by towers were built in the defensive walls of Urda - from the western, southern, and eastern facades. The western gate led to the old city; the eastern ones - to the Sarbaz court, where the main contingent of ordinary soldiers lived with their families; southern (reserve) - to the suburbs.

* * *

Today, the silhouette of Tashkent is defined by new high-rise buildings of residential complexes, hotels, and banks. The "old" city has also changed, where wide highways and multistorey buildings began to appear on the sites of historical arrays. But, unfortunately, the historical topography of the city with its unique irrigation network and original fortification began to disappear. Therefore, today it is important, on the basis of scientific research, to try to recreate the picture of the famous fortress gates of Tashkent that once existed.



TWO PRINCES: FARKHAD AND HAMLET

Suvon MELI,
D.Sc. (Philology)

The idea of comparing these two tragic images created by Alisher Navoi and William Shakespeare came to me about twenty years ago. At the time, I didn't quite realize the depth of the problem. Now I understand that it is impossible to cover this topic in one article since the works that tell about these two heroes are extremely large.

"Farhad and Shirin" is one of the epic works of the great "Khamsa", each poem of which is a masterpiece in itself. In this respect, the Khamsa resembles a ball, which is considered the most perfect geometric shape. If you place a dot anywhere on the ball, that spot will be the center. In the same way, whichever work of "Khamsa" you take as an object of study, it remains the central, most important work for both the researcher and the reader. It is known that the great images that have taken a firm place in the treasury of world literature have one unique quality. They live and can live independently of the author who created them. Not every image is capable of such an independent life. To do this, the image must have a life-giving power and impressive attraction, which can be called divine.

Farhad and Hamlet are great images that have such a full-fledged essence. But there is a second aspect of the issue. Naturally, living beings receive images from their creator. But this does not interfere with their independent life, since their fundamental principle is the greatness of the spirit. This is a simple, but nevertheless useful truth.

So, what is the necessity and scientific expediency of comparing two great images? It is known that the tragedy "Hamlet" and its main character are the pearl of world literature and theater.

Can we say the same about our great epic and the image of its main character Farhad? Of course no. We still have not tried to penetrate the essence of this stunning image.

At the same time, we must definitely note the valuable thoughts regarding the image of Farhad in the articles and studies of prominent Russian scholars E.E. Bertels, I.S. Braginsky, Uzbek scholars Academician A. Kayumov, Doctors of philological sciences A. Khayitmetov and S. Erkinov. A new interpretation of the poem "Farhad and Shirin" and its main character was demonstrated by literary critics N. Kamilov and B. Erali.

The image of Farhad, whose essence is not sufficiently disclosed, and Hamlet, whose many hidden sides are revealed, and many aspects of the character, continue to cause controversy and discussion among specialists. Not surprisingly, this ongoing controversy prompted us to compare the two characters. In addition, it is an effective scientific method for compar-



Chingiz Akhmarov. Farhad and Shirin.
A panel in the theater of Navoi. 1944.

ison, which allows you to penetrate deeper into the essence of the works... “Comparing the two stories allows us to see the previously invisible facets of both works and shed light on aspects that were not so obvious before. That is, they are compared with each other in such a way that one of them is reflected in the second, and the other in the first.

The difference between images created in different parts of the world is huge, it seems that it would be preferable not to compare them. But there is one indisputable aspect that connects them - they are both princes, children of rulers. We believe that this predetermination of fate in itself gives the right to comparison. The theoretical psychologist L.S. Vygotsky begins the chapter about Hamlet in the book “Psychology of Art” with the words “the tragedy about Hamlet is considered mysterious for everyone.”

If we talk about the secrets and mysteries of Farhad and Shirin, and Farhad himself, they are more mysterious than Hamlet (both the work and the hero). In Hamlet, the mystery begins with a ghost entering the scene (Chulpan translates this word as “shadow”). This radically changes the situation, all further events

in the tragedy unfold against the backdrop of a story told by a ghost. Ghost says:

So listen, Hamlet.
Announced to be sleeping in the garden
The snake stung me. Danes
Shameless lies introduced into deceit.
You should know my noble boy
The snake is your father’s killer
In his crown.

The great poet Boris Pasternak, who translated the tragedy into Russian with great skill, writes about this: “Starting from the moment the ghost appears, Hamlet “forgives himself” in order to fulfill the desire of the one who sent him” (3, 797). Interestingly, Pasternak’s sentence enclosed in quotation marks, that is, the sentence “do the will of the one who sent him,” is borrowed from the Bible and is a statement about Jesus. From this moment, Hamlet’s soul acquires mystery and insight. As soon as he hears the bitter truth, Hamlet exclaims: O my prophetic Soul! Chulpan translated this one as “Oh, my heart, which owns



Chingiz Akhmarov. Farhad and Shirin. A panel in the theater of Navoi. 1944.

insight!”, And Sheikhzade - briefly “Oh, insight!”. (Pasternak says: “Oh, my insights!”). Chulpan’s translation is accurate and close to the original. But in both versions of the translation, the word “insight” is stable. Insight - with the intervention of a deity, supernatural forces, with the help of which extraordinary phenomena occur, a miracle.

If after meeting with a ghost in the soul of Hamlet there was an insight, then in the epic of Navoi, the insight begins with the birth of Farhad. He is a child begged from God. This is not only a great saga, but also one of the predestinations in the entire Universe. Many mythical heroes, including the hero of our great epic Alpamysh, were begged from God. Farhad is one of them.

In the name of Farhad, insight also appears. As it says in the work: “Al-Asmu Tanzilu Minassamo” (names fall from heaven), this name was given to him not by his father, but by love. And the true essence of love is the Almighty.

So the name of the son was given by the khakan:
Farhad

No, not a kagan, some say
Love itself named him so,
His souls comprehended the nature.
She didn’t need two words,
Five words served here as the basis for her ...
(translated by L. Penkovsky)

These five parts - firaq (separation), jealousy, suffering, and pain were taken from the letters of the name. (Farhad - separation. “Ah-groaning sound”, “Rashk” - jealousy, the root of the most bitter torment, “Hajr” - parting, “Dard” - sadness is poison.

Defeated in a verbal battle by him, Khosrow sends him to the fortress of Diva. As stated at the beginning of chapter 42, “the fact that the guards, knowing that

he comes from a royal and divine lineage, released him from roam the steppes and mountains,” reached such an extent that the guards bowed before this man and said:

While you’re still strong, leave
Get out of Selasil!
We were not worth your hair, -
We will not open your escape.
Let Khosrow cut off our heads,
But be free and be healthy.
(P. 275-276)

Such self-sacrifice can only be shown in relation to the owners of holiness and virtue. And Farhad is just such a person. Firstly, the murder of Khosrow by his own son Shery is associated with the death of the great poet Farhad.

The law of love is such that again and again
For spilled blood, blood will answer!
Farhad was killed by Khosrow - and now
Retribution accelerated the firmament.
(P.363)

Secondly, at the end of the story, the commander of the Chinese emperor, the hero Bahram, invades Armenia with an army, where, after putting things in order, he disbands the troops from China and the Maghreb, and, as it is said in chapter 52, “he himself leaves the mortal kingdom and ascends to the spiritual kingdom.” This means that the brave hero “Farhad remained until his death with his Shapur, and was later buried in the same place.

He shook off the hem from the ashes of the world, -
He went to Farhad’s tomb.
And with him - Shapur. Close to her in those days



Innokenty Smoktunovsky as Hamlet. 1964.



Eugene Delacroix. Hamlet and Horatio in the graveyard in front of the gravedigger holding Yorick's skull. 1839

They lived as hermits.
(p.382)

Here, in the Russian translation, there is an inaccuracy, not “in those days”, but forever. Until death. That’s what friendship is!

This was such a great deed that only such great god-like beings as Farhad could do it. This is tantamount to immortality, which the great poet himself aspires to:

Die, Navoi, if you want to achieve perfection,
Like Farhod and Bahram!

Alisher Navoi used the image of Khosraw, which is often found in Persian-Tajik literature (the historical prototype is the famous Sasanian king Khosraw

Anushirvan), as a prototype of the image of Farhad, while William Shakespeare took the image of the hero of medieval Scandinavian legends Amled as the prototype of Hamlet. In both works, the tragedy, which showed the crisis of humanistic ideas, is a turning point in the philosophical understanding of reality. In other words, an immoral act, deceit, a desire to take revenge in response to a crime lead to terrible consequences that become an indirect or direct cause of the death of the heroes of the tragedy.

The ideas of the Temurid Renaissance (Alisher Navoi) and the moral philosophy of the European Renaissance (William Shakespeare), being personified in these two tragic characters, seem to enter into an invisible dialogue between themselves, the meaning and content of which have yet to be revealed to new generations of scholars.

HE ADORED THE THEATER

Omina Azizova
PhD (Art History)

The name of Abror Khidoyatov, a significant figure in stage art, a mature figure in the Uzbek theater, a legendary actor who completed his service at thirty-three and received the title of People's Artist at forty-five, will be inscribed with a capital letter in the history of our national stage art. He got acquainted with the theater at the age of twelve, and at fourteen he began his unofficial career on the stage with the play "Layli and Majnun". At the age of nineteen, he became the official actor in the theater, playing the role of Nemat in G. Zafari's play Halima. At the age of twenty, he studied at the Uzbek Drama Studio in



A. Abdullaev. Portrait of A. Hidoyatov in the role of Othello. 1946

Moscow (1920-1924). During these years, he played the roles of Harpagon (Miser, Moliere), Bob (Echo, Bill-Belotserkovskiy), Nasriddin (I'm getting married again, Cholpon), the city mayor (The Government Inspector, Gogol) which played an important role in the creative development of the actor.

He gave all his energy, heart, and attention to each performance. He loved the theater so much that he even came to rehearsals before anyone else. Every time he went on stage, he felt a strong emotional excitement, as if he was performing for the first time, as if he was testing the audience.

Abror Khidoyatov "... pay attention to the meaning of what you say on stage, what you do, and your actions! Let the role you play first mature in your heart! Do not cry in lies, do not laugh in lies, if everything does not come from the heart, you cannot convince the public!" He made these same words his motto for life and devoted himself to the stage. He idolized the theater...

Abror Khidoyatov, not the son of a rich man or a scientist, but simply the son of a doctor, entered the history of the Uzbek theater as an accomplished stage master, actor, People's Artist of Uzbekistan, laureate of the State Prize. As a child, Abror Khidoyatov learned to play the *dutor* from a neighbor musician nicknamed "eshan". Mannon Uyghur also saw his student Abror Hidayatov while he was playing *dutor* and singing in a teahouse and invited him to his "Turon" troupe.

Abror Hidoyatov's father, Hidoyathoja Rahmatulla, took his son to the Coliseum Theater in Tashkent for the first time when he was twelve years old. Here, both watched the play "Layli and Majnun". It was this spectacle that made him fall in love with the theatre. He got attached to performing arts, and gradually he became a theater goer. Gradually, he began to participate in the mob scenes of the play "Layli and Majnun". Thus, Abror Hidoyatov became attached to theater art for life. For Abror Hidoyatov, the theater had already become his home, workplace, homeland, and his closest person. The actor, who didn't even have a bed to sleep on, used to cover stage equipment on cold days. Mannon Uighur lives in one room of the theater. There was nothing but love for art in their hearts. They did not enter art for money or fame. They loved the theater so much...

Abror Hidoyatov played complex, conflicting characters full of emotions. For example, the Governor ("The Government Inspector", Gogol's work, staged by the studio), Hamlet ("Hamlet", M. Uygur, B. Khojaev), Gofur ("The Master and his Servant", Ye. Bobojonov), Othello ("Othello", N. Ladygin, M. Uygur), Muqanna ("Muqanna", S. Mikhoels, M. Uygur), Navoiy ("Alisher Navoiy", M. Uygur, N. Alieva) and others.

The play "Hamlet", which appeared on the stage in 1934, quickly became a sensation. Abror Hidoya-



Othello - People's Artist of Uzbekistan Abror Hidoyatov.

to's interpretation of Hamlet, who appeared on the stage, was embodied by a smart, philosopher, and wise character. On the stage, Hamlet, a tall, handsome, captivated the entire audience with his pitiful point and sonorous voice. As Julius Fuczyk said, this is a truly Shakespearean "Hamlet", a beautiful drama, whose tragedy you immediately feel as if you were in his shoes. Even if you don't know the language, you can hear every word of Shakespeare.

The Danish prince Hamlet is deeply saddened when he learns that his father's murderer was his uncle, Claudius. He realizes that he has taken it upon himself to take revenge on Claudius, the murderer, by exposing his hideous image and hypocrisy. When you watch Hamlet in an actor's interpretation, personal suffering loses its meaning in front of the grief of mankind. Abror Khidoyatov's Hamlet is in no hurry to take revenge on Claudius. He thinks a lot before taking revenge, trying to get to the bottom of the situation. In the actor's interpretation, Hamlet appears as an observant, heartbroken, and lonely prince. From the language of the actor's character, the singer pronounces the words "the world is a dungeon for me" throughout the performance. These words summarize the complexities and spiritual contradictions of his



People's Artist of the USSR Abror Hidoyatov

hero's story. Hamlet in the interpretation of Abror Hidoyatov is portrayed as a young man who completely lost faith in people. He even doubts and turns away from his beloved Ophelia. Hamlet, made with great pain, a huge heart, spectacular pathos, restraint in speech, temperament, and strength in the actor, was another school in creating the next major image of the actor - Othello.

The bright personality of Abror Hidoyatov, the amazing richness of his work as a creator and theater personality, the richness of the spiritual heritage left by the actor, set difficult tasks for anyone who wants to speak about him. After all, A. Hidoyatov was a wonderful person, possessing extraordinary intelligence and talent. Today, Uzbek theater is developing based on the acting school created by Abror Hidoyatov. He lived only fifty-eight years. He spent thirty-nine years with the theater and performed fifty-two plays.

Until the last years of his life, he never took a break from the theater. On April 26, 1958, the 500th performance of the play "Othello" took place. Abror Hidoyatov performed this role continuously for seventeen years. On October 10, 1958, he died prematurely due to heart disease. After all, the colorful images created by the actor are of incomparable importance in raising the morale of the nation. Abror Hidoyatov's creative path and fate are unique and honorable, and behind this fame, there are many hardships, sleepless nights, lost nerves, lost health, and lost precious time. After all, Abror Hidoyatov loved the theater from his heart... and his memory will live on for centuries.

Beruni on “Historical India”

Umida Kuranbaeva
Institute of Oriental Studies,
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researcher

A thinker and polymath - Abu Rayhan Beruni (973-1048) has a scientific heritage of about two hundred works, of which only 33 have reached us. The scientist's works contain valuable information about many countries and peoples. For this reason, they are used as primary sources in many researches

In the works by Beruni, we often come across information about Indians. In Central Asia, there was a great interest in the country of India and the life of the peoples living there. Because, until the middle of the 19th century, Turan and India were neighbors for a thousand years.



As a result of political events in the Khorezm palace, in 1017 Mahmud Ghaznavi conquered this land. After that, Sultan Mahmud attacked India many times. And Beruni, who was taken from Khorezm to Ghazna, had been to these regions with him. Beruni visited India due to the military expeditions of the Ghaznavid dynasty to this country, so the scientist gave very important information about these expeditions

According to the information in Beruni's works, Mahmud Ghaznavi's invasion to India did not happen by coincidence. Before him Mahmud ibn al-Qasim ibn al-Munabbih, the Arab commander, had entered this country. The conqueror occupied Sindh in 708 and founded the cities of al-Mansura and al-Ma'mura in the acquired territories. He went as far as the Indian city of Kanauj, occupied the lands of Kandahar and the borders of Kashmir.

As-Saqafi ruled these regions until 714. It was these cities that served as a base for Sultan Mahmud's invasion to India and created the ground for more than thirty years of military campaigns. Beruni expressed his opinion on this situation and wrote that Yamin al-Dawla (a title given to Mahmud of Ghaznavis on the side of the Caliphs of Baghdad) destroyed many cities during his march to India. Even so, Beruni recognized Ghaznavi's creative works.

Beruni mainly visited the northern regions of India and had the opportunity to get to know the geographical location, regions and cities of this area. The thinker visited several cities in India and explored the places. He said: *"I myself found the width of the fort of Lavhor (Lahore) to be 300 and 10'. It is 56 miles from it to the capital of Kashmir. Half of it consists of hills and half of flat fields"* - Ghazna 30° 35'; Lamghon 34° 43'; Kabul 33° 47'; Purshovar 34° 44'; Kande-Amir 33° 55'; Weihand 34° 30'; Danpur 34° 20'; Jaylam 33° 20'; Nandna Fort 32° 0'; Sialkot 32° 58'; He determined that the distance between Nandna fort and Multan is about 200 miles and cited in his work. The mention of these historical-geographical names in the work "Boburnoma" written by Zahiriddin Muhammad Babur four centuries later shows the high scientific value of Beruni's information. According to Beruni's writing, *"We have not been to other places of the Indians than these places"*, it seems that he was in a part of the north-western lands of India, that is, in some cities in the oasis of Punjab, in the lands up to Peshawar and Sialkot, and in the south to Multan, and in the western borders of Kashmir.

The "India" written by Beruni is located on the southern and southeastern border of Central Asia. Due to its geographical location and proximity, this region has attracted dozens of Central Asian ethnic groups from ancient times to the Middle Ages. The Hindukush mountains system and its ridges - most of

the large historical regions such as Kubi-Baba, Pagan and South Tokharistan, Bamiyan, Kabulistan, Zabulistan, Gandhara region and the Kashmir valley at the foot of the Himalayas were established by the Kushan kingdom, the Hephthalite state and the Central Asian ethnic groups, which later was part of the Turkic Khanate, and this area was a mixed area of Persian, Indian, Turkic and other ethnic groups as early as the first centuries AD.

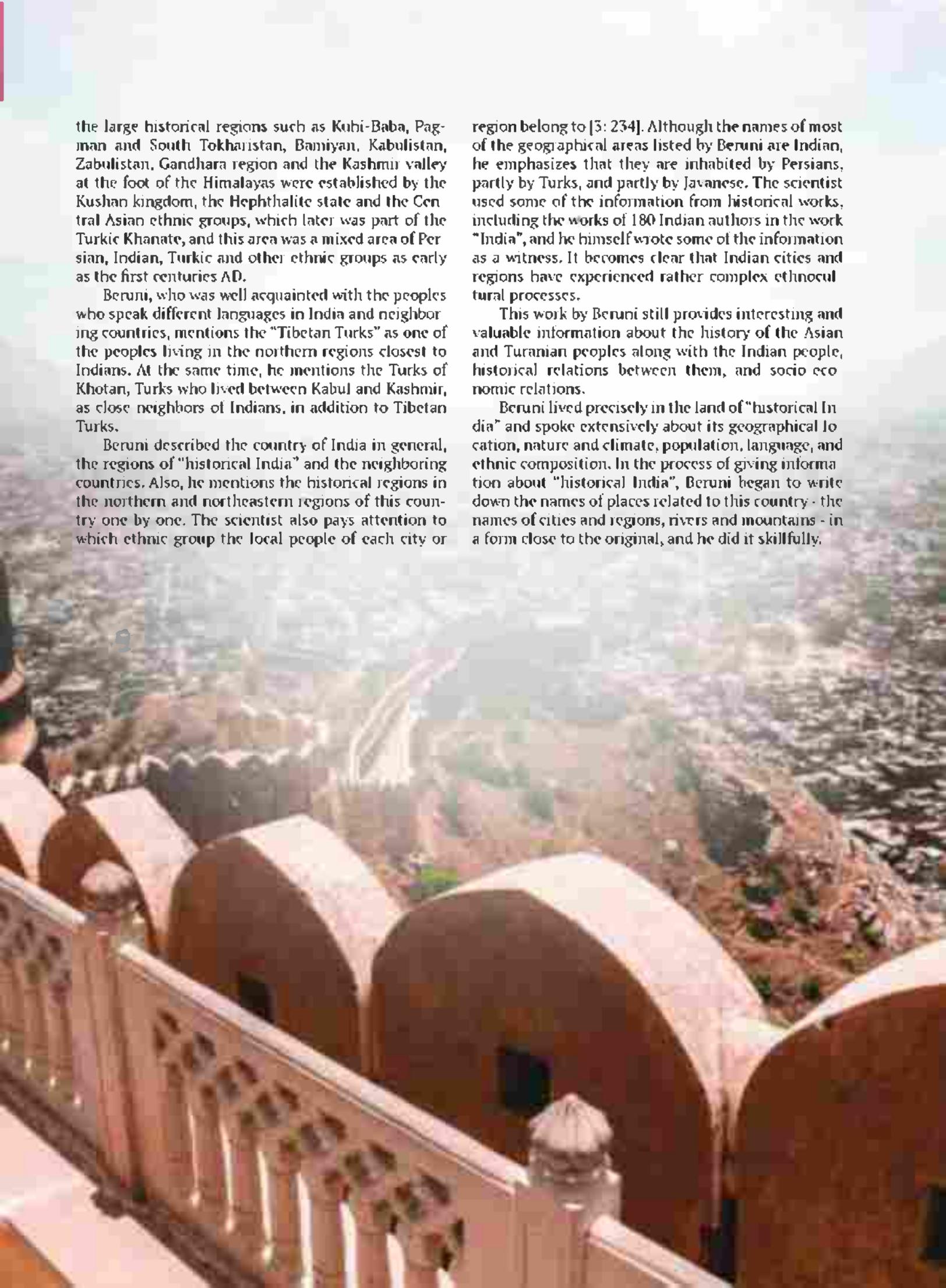
Beruni, who was well acquainted with the peoples who speak different languages in India and neighboring countries, mentions the "Tibetan Turks" as one of the peoples living in the northern regions closest to Indians. At the same time, he mentions the Turks of Khotan, Turks who lived between Kabul and Kashmir, as close neighbors of Indians, in addition to Tibetan Turks.

Beruni described the country of India in general, the regions of "historical India" and the neighboring countries. Also, he mentions the historical regions in the northern and northeastern regions of this country one by one. The scientist also pays attention to which ethnic group the local people of each city or

region belong to [5: 234]. Although the names of most of the geographical areas listed by Beruni are Indian, he emphasizes that they are inhabited by Persians, partly by Turks, and partly by Javanese. The scientist used some of the information from historical works, including the works of 180 Indian authors in the work "India", and he himself wrote some of the information as a witness. It becomes clear that Indian cities and regions have experienced rather complex ethnocultural processes.

This work by Beruni still provides interesting and valuable information about the history of the Asian and Turanian peoples along with the Indian people, historical relations between them, and socio economic relations.

Beruni lived precisely in the land of "historical India" and spoke extensively about its geographical location, nature and climate, population, language, and ethnic composition. In the process of giving information about "historical India", Beruni began to write down the names of places related to this country - the names of cities and regions, rivers and mountains - in a form close to the original, and he did it skillfully.



Chaos of color in Temur Shardemetov's painting

Khalida Yusupova
Art critic

Temur Shardemetov - a young artist from Karakalpakstan - was educated at the Kamoliddin Behzod National Institute of Arts and Design with a degree in Theater Decoration. He began his first steps in creativity at the Mukimi Music and Drama Theater. Subsequently, the artist participated in many national exhibitions and organized several solo exhibitions in various cities of Uzbekistan. His work is a reflection of his inner world and in many ways expresses the artist's vision of the surrounding reality. From the point of view of stylistic commitment, the works of Temur Shardemetov can be attributed to a variety of abstract expressionism. Abstract Expressionism is



a movement in American painting that originated in New York City in the 1940s after World War II. It was the first specifically American movement in painting, placing New York at the center of the Western art world, a role previously performed by Paris. Although the term "abstract expressionism" was first applied to American art in 1946 by the art critic Robert Coates, it was first used in Germany in 1919 in the magazine *Der Sturm* in reference to German expressionism. In the US, Alfred Barr first used the term in 1929 in reference to the work of Wassily Kandinsky. In general, abstract expressionism can be grouped around two main trends: action painting and color field painting. Action painting, often showing the vigorous application of paint - sweeping gestural strokes or drops and splashes with no brushes at all - is both an impromptu revelation of the artist's individual psyche and an exercise in balancing chaos and control. In contrast, the more intellectual discipline of color field painting is characterized by large strokes of color in simplistic compositions. In the work of Temur Shardemetov, one can see the merging of these two trends into a single alloy, in which color and the method of its application played an important role in creating the work.

The quick strokes of the master determine the dynamism of his painting. The paintings painted by the artist are non-objective, multi-layered, colorful compositions, often with a pronounced texture. His painting is freedom in its absolute, as far as painting can be free at all. The painter managed to find an accurate associative art form that conveys important existential problems of our time.

Using the term "chaos" in relation to the painting of T. Shardemetov, it should be noted that usually, this word means a complete lack of order and a random accumulation of heterogeneous elements. And if in everyday vocabulary this word has a somewhat negative meaning, then in art it stands for expression, dynamic rhythm, and a high intensity of emotions. The concepts of chaos and order, movement, and static linearity are also extremely widespread in the art of the 20th century, especially in the art of the avant-garde. Thus, chaos and absolute order were two ways to escape from a painful and difficult reality. On the one hand, we see the Dadaists, who responded to violence and chaos by creating even more meaningless forms. On the other hand, there is an attempt to achieve absolute abstractionism, which is also an extreme rejection of reality. Malevich's black and Suprematist square, an absolutely simple, geometric

«Portrait of a Seated» 2022



«Portrait of a Seated»-1, 2022





"Portrait" 2022



Composition-1. 2022.

form, represented the zero degree of painting, which can be seen as the most extreme escape from the chaos of everyday life.

In Temur's painting, chaos is represented through color. Color is as a determinant of its inner essence, its relationship with the world. With the help of color, he expresses himself, and his attitude to the world. In addition to color, the nature of strokes with uneven high relief plays a huge role in his paintings. As a result of this, the canvas turns out to be "textured" and very dynamic. Each color has its own spiritual and expressive value, and human emotions can be conveyed only in color, without resorting to the image of real objects.

In the paintings of Temur in 2016, the formation of his own style is clearly traced. In the works of these years, we still do not see such bright and unbridled, wild colors - this happens gradually. The master's works begin to take on a completely new format starting in 2020. Various types of abstract portraits, images of a seated figure are the basis of his work. Portrait resemblance is not important for the artist, since the figurative image is only a tool for conveying

associative ideas. To some extent, all these portraits are the personifications of modern man, sometimes devastated, but in a state of internal and external struggle. The "Portrait" of 2022 is a vivid reflection of this psychological tension - all emotions are conveyed through color spots. The picture is conditionally divided into two parts, the upper one with a predominance of white and the lower one with a bright pink color. The very image of the person being portrayed is indicated by a dense black line. In the works of Temur Shardemetov, one can note an addiction to black as an important means of expression. Black color, from the point of view of physics, is the fusion of all colors together, the opposite of white. It is a mysterious color, keeps a lot of secrets, and suggests understatement. At different times, for some people, it was a symbol of despondency and mourning, for others - luxury. Black combines death, evil, and chaos, but at the same time refinement, temptation, and greatness. Often, artists use this color in its purest form when they want to evoke negative emotions. However, black, combined with brighter and warmer colors for contrast, balances the picture, and it is no longer perceived as gloomy.



Composition-2. 2022.

In any case, it is the author's emotional state that is transmitted to the canvas through painting. It is also worth noting that most of Temur's paintings are untitled, which gives the viewer power and freedom to think.

In the painting "Portrait of a Seated" in 2022, the artist actively uses blue. The blue color is often associated with calmness, reliability, and tranquility. It symbolizes eternal values, height, and depth, wisdom, severity, and seriousness. But it is in the psychology of painting that it is commonly believed that this color symbolizes depression since in English there is an expression "to feel blue", which means "to be upset", "to be sad, to mope".

Orange color releases emotions and is an excellent antidepressant. Helps to induce a surge of vitality, gives an optimistic tone, and is considered the personification of creative inspiration. Orange color adds activity, but at the same time gives a feeling of

inner balance and spiritual harmony. In this picture, the orange color in combination with black becomes even more expressive and exciting.

Temur Shardemetov allegorically, associatively, with the help of complex and dynamic color combinations and forms, tries to express the pressing problems of a contemporary and what worries him in this seething stream of time.

“GLOSSARY OF THE UZBEK LANGUAGE” PUBLISHED

On June 1, 2023, the National Academy of Sciences hosted a presentation of the “Glossary of the Uzbek Language”, published at the expense of the Uzbek Language Development Fund jointly with the Department for the Development of the State Language of the Republic of Uzbekistan and the Institute of the Uzbek Language, Literature and Folklore.

The presentation was opened by the vice president of the Uzbekistan Academy of Sciences Bahrom Abdukhalimov. Then the documentary film “The World of the Alphabet” about the creation of the “Glossary of the Uzbek Language” was demonstrated. After the demonstration of the film, the director of the Institute of Uzbek Language, Literature and Folklore Nizomiddin Makhmudov, Deputy Head of the Department for the Development of the State Language Bekzod Shukurov, Deputy Chairman of the Union of Writers of the Republic of Uzbekistan Nadir Januzak, Advisor to the Minister of Higher Education, Science, and Innovation, People’s Writer of Uzbekistan Isajan Sultan made speeches. Then the compilers of the glossary Prof. Dr. Yorkinjon Odilov, and Prof. Dr. Durдона Khudaiberganova spoke, who expressed their opinion on the meaning of the published dictionary.

The six-volume “Glossary of the Uzbek Language” in Latin alphabet contains more than 80 thousand words and phrases widely used in the modern Uzbek literary language, terms related to science, technology, art, and culture, words used in several dialects, some historical and obsolete terms.

The new edition of the glossary has been replenished with more than 3,000 new vocabulary items drawn from dialects of the Uzbek language, words, idioms, and locutions of the popular spoken language and words that came to Uzbek from other languages as a result of mutual economic, political, cultural ties with other states. Also, the glossary was enriched with a large number of illustrations, and the interpretation of the meaning of words was improved. The dictionary shows the semantic changes that have occurred in the lexical composition of the Uzbek language in the previous period.



DALVARZINTEPA IS REVEALING ITS SECRETS AGAIN

In the autumn of 2021, excavation work was resumed at the Dalvarzintepa monument (Shorchi district, Surkhandarya region). It was the excavations at Dalvarzintepa that made it possible for the whole world to learn about the palaces and temples of the Kushan period, the magnificent Buddhist sculptures and colorful murals, peat terracotta figurines and the master potters who provided the city with high-quality tableware. Even jewelry and gold bars decorated with mysterious Indian inscriptions have been identified. In addition, the phrase “know the whole world” is not a mere combination of words, but a fact: the excavations in the settlement first became known to world science thanks to the publications of scholars G.A. Pugachenkova, B.A. Turgunov, E.V. Rtveladze, T.V. Belyayeva and others. Then the findings from Dalvarzintepa were exhibited at exhibitions in Japan, South Korea, Germany, the Netherlands, France, and Switzerland.

In 2021-2023, the members of the Dalvarzintepa group of the Uzbekistan History of Art Expedition set themselves the goal of a systematic study of the northern defense center of the city and the buildings adjacent to it. A number of new excavations in the fortress wall and the area adjacent to it showed that this area was occupied during the Kushan-Sasanian period (3rd – 4th CE). An interesting find in the study of the city’s fortifications was the Sagana of the 7th-8th centuries CE, carved on the fortress wall. It contained a double grave with simple burial goods - an iron ring, a pair of beads, bronze bells, and a seal. In the mouth of the deceased was a bronze ring - apparently a substitute for the “Obol of Charon”, a coin used in Greek mythology to pay a boatman in the afterlife. Such graves in Sagana correspond to the last stage of the life of people in the ruins of the Kushan urban area.





“NEVER SEEN BEFORE”

– Scientists Discover an Extraordinary New Species of Pterosaur With Over 400 Teeth

Paleontologists from England, Germany, and Mexico have uncovered an extraordinary new species of pterosaur, characterized by an astonishing 400 teeth that resemble the prongs of a nit comb. The remarkable fossil was discovered in a German quarry. The jaws of this pterosaur are really long and lined with small fine, hooked teeth, with tiny spaces between them like a nit comb. The long jaw is curved upwards like an avocet and at the end it flares out like a spoonbill. There are no teeth at the end of its mouth, but there are teeth all the way along both jaws right to the back of its smile.

“And what’s even more remarkable is some of the teeth have a hook on the end, which we’ve never seen before in a pterosaur ever. These small hooks would have been used to catch the tiny shrimp the pterosaur likely fed on – making sure they went down its throat and weren’t squeezed between the teeth.”

The discovery was made accidentally while scientists were excavating a large block of limestone containing crocodile bones.



“GOLDEN BOY”

– Researchers Digitally Unwrap 2,300-Year-Old Undisturbed Mummy

A digital unwrapping has revealed that a 2,300-year-old unopened mummy serves as a showcase of ancient Egyptian beliefs.

Scientists from Egypt used computerized tomography (CT) to ‘digitally unwrap’ the intact, never-opened mummy of a 2,300-year-old teenage boy of high socioeconomic status. They found that this ‘Golden boy’ is an undisturbed showcase of ancient Egyptian beliefs about life after death. For example, he was sent on his way with no fewer than 49 amulets of 21 types to promote his bodily resurrection. He wore sandals and was garlanded with ferns, rich in ritual meaning. These results provide a unique insight into mummification procedures and beliefs about the importance of grave ornaments during the Ptolemaic period. They are published in *Frontiers in Medicine*.

<https://scitechdaily.com/golden-boy-researchers-digitally-unwrap-2300-year-old-undisturbed-mummy/>





PLANETARY SYSTEMS

What are planetary systems ?

As of June 30, 2022, there are 5108 exoplanets in 3779 systems discovered, with 826 systems having more than one planet. There are still 2.724 candidates awaiting confirmation. The planetary system to which planet Earth belongs is called the Solar System.

A planetary system is the set of non-stellar celestial bodies gravitationally bound to a star or a system of stars. Our planetary system, the Solar System, is made up of eight planets, asteroids, natural satellites and comets.

Of the 2.034 star systems, which are at most 326 light-years away, 1.715 are or have passed through the region where we can see us, and another 319 systems will be added to the group in the next XNUMX years.

The solar system consists of eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune and it is located in the Milky Way. According to NASA, more than 5,000 planets discovered today include small rocky worlds, such as the Earth, gas giants many times higher than Jupiter, and the so-called "hot Jupiters", located on very close orbits around their stars.

What is the difference between the world and the Universe?

The word universe is of Latin origin "universum" and means "whole whole" or "all in one". Mundo is a noun and designates the physical space of the entire planet. From the Latin mundu and the ancient Greek κόσμος, kósmos, it has the meaning of order, organization, beauty, harmony. The most abundant chemical element in the Universe is hydrogen (H). It is estimated that it constitutes 75% of the mass of all matter and that it represents 93% of the atoms in the cosmos. It is also the simplest and lightest chemical element, with just one proton in the nucleus and one electron in its electron. Since we already know that there are at least another 200 billion galaxies in the universe, we can therefore estimate that there are 10^{25} exoplanets orbiting stars



SCIENTISTS TUSSELED OVER TYRANNOSAURS

For over a century, Tyrannosaurus rex has stood alone. Despite occasional suggestions to the contrary, paleontologists have recognized only one species of Tyrannosaurus. This year, however, one study came to a different conclusion. Citing features of the skull, the paper proposed that paleontologists have actually discovered two other Tyrannosaurus species in addition to rex—named T. regina and T. imperator. Outside experts quickly nixed the idea, however, saying the evidence cited is very variable between individuals and that such minor differences are better understood as variations in a single species, T. rex itself. If other Tyrannosaurus species await discovery, they will have to pass a high bar for recognition by experts.





SCIENTISTS UNEARTHED A SWIMMING, DIVING DINOSAUR

Dinosaurs walked the earth, and some flew in the air, but paleontologists have long wondered why no non-avian dinosaurs seemed to have bodies well-suited for swimming. The answer, it turns out, is that paleontologists just hadn't found them yet. Less than a month ago, paleontologists announced the discovery of *Natovenator*, a small and almost duck-like dinosaur that lived in the Cretaceous of what's now Mongolia. Among other telltale features, the ribs of this raptor relative are swept back much like those of diving birds such as auks and penguins that carry on the dinosaur legacy today. *Natovenator*, the researchers propose, was a semi-aquatic hunter that swam after fish and other slippery prey. Some dinosaurs really were built for the water, after all.

ROBOT DOGS ARE HIKING THE ALPS AND PREPARING FOR SPACE

Four-legged robots could be our best friends in research and work. A robot dog could be your new hiking buddy — if you can keep up with it. Back in 2016, scientists at Swiss research university ETH Zurich introduced the world to their autonomous four-legged robot, ANYmal. The robot dog has now been upgraded with a new controller that helps it traverse difficult terrain without any prior training.

To demonstrate it, ANYmal was tasked with hiking an unfamiliar trail in the Alps — and it reached the summit four minutes faster than the average human hiker, without falling or making any missteps. Why it matters: As fun as a hike with an autonomous robot dog might be, these bots aren't meant to replace family pets — they're working dogs, built to help with dull, dirty or dangerous jobs. While some robot dogs can actually do things — Boston Dynamics' famous Spot has an attachable arm that lets it move objects and turn levers — most are primarily designed to walk around and collect data using cameras and sensors. This can save human workers from having to conduct routine inspections of dangerous environments, such as chemical plants, or assess damage in disaster zones, such as the site of a nuclear meltdown. For now, the researchers will continue developing their robot dog, preparing it for future deployment at worksites, in disaster zones, and, maybe one day, on other worlds.



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The Maidanak Observatory of the Astronomical Institute of the Uzbekistan Academy of Sciences is located in the Kashkadarya region of Uzbekistan at an altitude of 2700 meters above sea level. The main telescope of the Maidanak Observatory with a primary mirror diameter of 1.5 meters is the largest astronomical instrument in Central Asia

