SCIENCE FOR THE BENEFIT OF MANKIND

FAN VA TURMUSH

«Science and Life» popular science journal

Centre for Promotion of Science Uzbekistan Academy of Sciences

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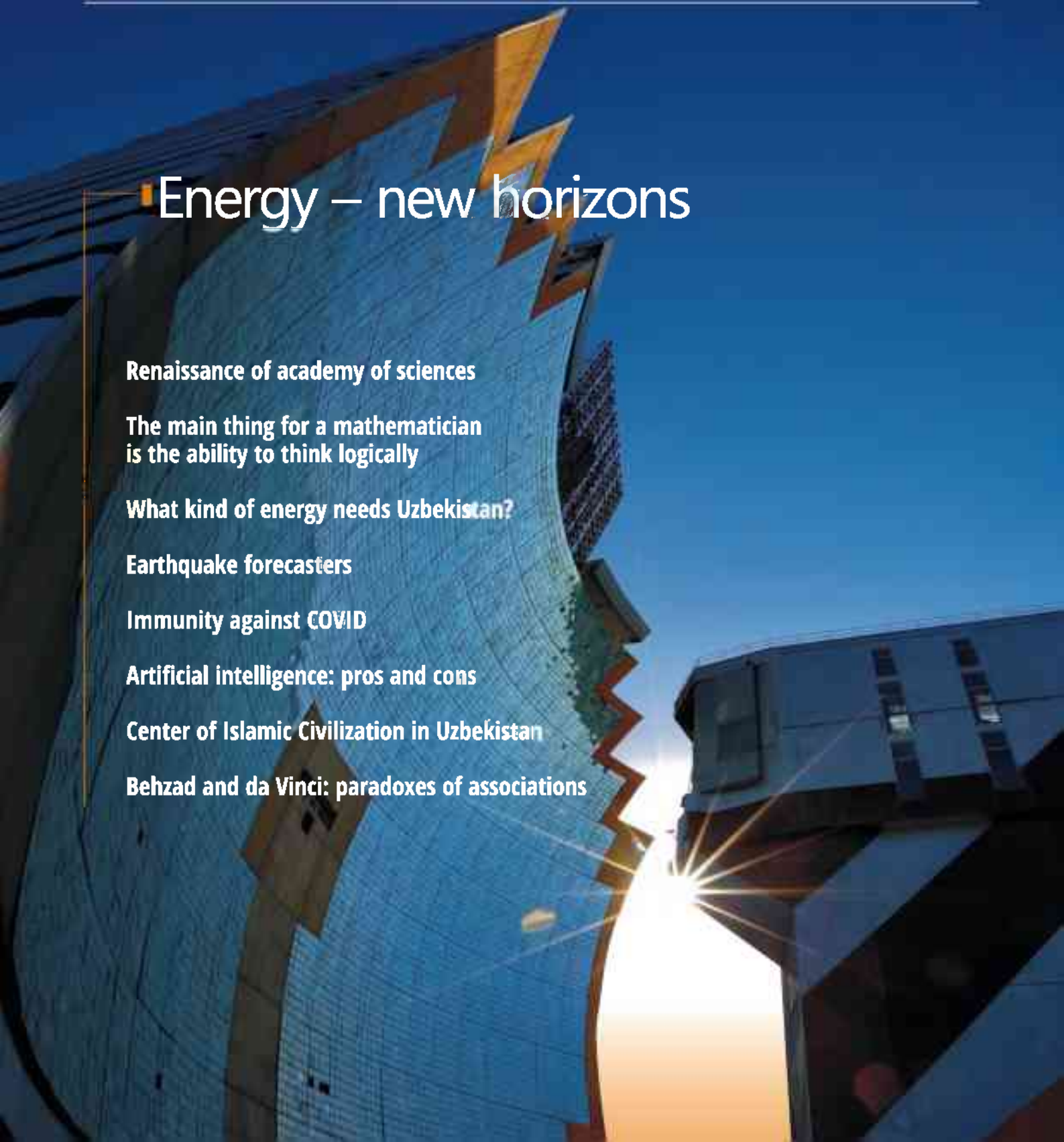

Energy – new horizons

In the coming year, 1.7 trillion soums have been allocated for preferential educational loans for university students, doubling the resources. This year, 1.5 trillion soums were allocated for the development of science and innovation. This is almost 6 times more than in 2017. At the same time, the salaries of scientists increased by 4.5 times. Thanks to all this, 18 new scientific areas were organized, such as nano- and biotechnologies, and digital geology.
Next year, 1.8 trillion soums will be allocated for science and innovation. Now we are waiting for concrete results from scientists in such important areas as saving water and energy resources, soil fertility, geology, industry, and construction.

We all know what complex tasks are set before us in today's intense times. In order to solve them and achieve our noble goals, to be globally competitive, we need to arm our people, first of all, our youth with science, enlightenment and spirituality, and the achievements of development.

It's no secret that today the world has become an arena of fierce competition. We all see how fierce the struggle is going on in all spheres. We all know very well that science, knowledge, and potential are as essential as water and air in modern times in every aspect, to put it simply, it is possible to gain more income and prestige with the power of science than with the power of human wrists and that any country can achieve progress only on this basis.

SHAVKAT MIRZIYOYEV
President of Republic of Uzbekistan

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IN THE WORLD OF SCIENCE

Renaissance of academic Science

Bekhzod Yuldashev,
President Uzbekistan Academy of Sciences

Science is the foundation of human progressive development. It has always been closely linked to the needs of man and society. As nature was mastered, spontaneous forms of ideas about its laws and features emerged. At the origins of knowledge about animals, birds, and fish - zoology - lay hunting and fishing. The transition to agriculture gave rise to the basics of biology, crop production, irrigation, which also required knowledge of mathematical calculations. The need to take into account weather transformations and climate changes, gave birth to astrology, the first astronomical calendars, star charts and the rudiments of knowledge of physics. This is how the great civilizations of Ancient Egypt, China, India, Mesopotamia originated. This series of world phenomena should also include our civilization, which originated in the floodplains of the Amu Darya and Syr Darya rivers.

It is no accident that since the first centuries of Islam a unique system of fundamental sciences has been forming on the fertile land of Uzbekistan. The extraordinary rise of the sciences, consecrated by the names of such titans as Al-Khwarizmi, Beruni, Ibn Sina, Al-Ferghani and many other scholars of Maverannahr was called the Muslim Renaissance or the First Eastern Renaissance. This era gave the world completely new, exciting scientific ideas and revolutionary discoveries.

This successful development of scientific knowledge, the growth of cities, the flowering of trade and economy were interrupted by the catastrophic devastation, which was caused by the Mongol conquest. Only thanks to Great Amir Temur managed not only to restore the cities of Maverannahr, but also to lay the foundations of a new Temurid Renaissance. Under them the authority and importance of scientific knowledge again increases, the status of scientist rises - as a wise man, leading the society to prosperity.

This tremendous historical stratum of our ancestors' achievements made it possible to create a true multi-vector scientific school in Uzbekistan in the mid-20th century. By the early 1940s our Republic had matured a scientific base and human resources of scientists needed for creating the system of the Uzbekistan Academy of Sciences, which this year celebrates its 80th anniversary. Over these years new directions in science and excellent scientific schools in different branches of sciences, headed by the prominent scientists of Uzbekistan, have formed.

The attainment of independence gave a new impetus to the development of the country's academic science. However, there have been unfortunate omissions in the management of science in understanding the place of academic, fundamental science in the development of society. Ill-conceived reforms of the system of the Academy of Sciences led to a decrease in the social status of a scientist and the outflow of young scientific personnel from academic science.

At the end of 2016, a new stage of democratization of life began in Uzbekistan, associated with the election of President Mirziyoyev. One of the important markers of the new policy was the course to support academic science. The stage of its true Renaissance has begun. For the first time in many years, in 2017, elections were held for new members of the Uzbekistan Academy of Sciences, and forms of material incentives for scientists were noticeably increased. In recent years, the material and technical base of the Academy of Sciences of the Republic has

been strengthened, and a strategically important transition of research institutions to budget financing has been carried out. In all scientific divisions of the academic system, the salaries of scientists of various categories were increased. All these measures contributed to the influx of a new wave of talented young scientists into academic science.

The leadership of the country pays great attention to the integration of science with the urgent needs of society, which was reflected in the concept announced in January 2023 in the President's Address to the Parliament of the country. Substantial financial support of the national science sets the task for scientists to achieve concrete results both in the basic sciences and on the implementation of scientific discoveries in various sectors of the economy and the national economy.

Of particular importance in strengthening the role and authority of academic science is the work to promote the activities of scientists in Uzbekistan, to familiarize the general public with the latest achievements of world and domestic science. To this end, by the decision of the Government of Uzbekistan, the Science Center for Propaganda was established at the Uzbekistan Academy of Sciences, which includes the oldest national science journal "Fan va Turmush", which turns 90 this year. The updated issue of this journal, the reader holds in his hands. Taking this opportunity, I would like to wish success to the staff of the Center and at the same time to the journal «Fan va Turmush» in their important work to promote science, the purpose of which is to serve the benefit of mankind.

Panel in the building of the Uzbekistan Academy of Sciences

The main thing for a mathematician is the ability to think logically

Interview with the Hero of Uzbekistan, Academician
Sh.A. Ayupov

A. Khakimov: First of all, dear Shavkat Abdullayevich, let me congratulate you on behalf of the Center for Propagation of Science of the Uzbekistan Academy of Sciences and the "Fan va turmush" science journal on the high title of Hero of Uzbekistan, which you were awarded in 2021.

How did you feel about being awarded this highest award in the country?

Sh. Ayupov: Thank you for the congratulations. This award was completely unexpected for me. As a rule, on such occasions, interviews are conducted, and questionnaires are prepared on those who are promoted for awarding. This time I did not have such a nomination procedure. I was at my daughter's house, my wife and daughter were talking, and I was watching Akhborot news program on TV. Usually the honorees are introduced first, after the other major news. And then the announcer began announcing the names of those who had been awarded the honorary title of Hero of Uzbekistan. The picture of Muhammad Akhmedov, a farm manager in Bukhara Province, appears on the television screen. The announcer begins to talk about his merits... And then suddenly my picture pops up on the screen and they announce that I was awarded the high title of Hero of Uzbekistan .... I started calling everyone to the TV, at that moment I was overwhelmed with a feeling of joyful excitement and simultaneously gratitude to President of Uzbekistan Shavkat Mirziyoyev for high evaluation of my scientific activity. A few minutes later my family members, relatives, friends, colleagues started calling me and congratulating. This day will be remembered as one of the most exciting and joyous days of my life.

A. Khakimov: When we talk about the national mathematical school, we cannot avoid mentioning the achievements of great mathematicians of the past, such as Al-Khwarizmi. And what was Al-Khwarizmi's contribution to world science?

Sh. Ayupov: Indeed, when we were at school we heard about Al-Khwarizmi, but we were not very clear on the significance of his discoveries. We knew that he had something to do with solving quadratic equations, which are also studied at school now. But in fact, that's not the case at all. First, Al-Khwarizmi's world-famous book, Al-Kitab al-mukhtasar fi hisab al-jabr wa-al-mukabala (The Short Book of Replenishment and Contraposition), which means that the words «numbers,» «mathematics,» and «equations» are not in the title of this book. In this book, the words «replenishment and contrast» refer to operations on numbers or symbols when solving quadratic equations, i.e., Al-Khwarizmi for the first time put the concept of operations on objects at the forefront of his mind. Secondly, it is proved

that it was Al-Khwarizmi who systematized Indian numbers and introduced the notation for the sign of zero in the book «The Book of Indian Numeracy». And on the basis of his works the decimal system with nine digits and the sign of zero appeared, which is used now all over the world. In fact, we know that the ancient Romans used Roman numerals, but try to do arithmetic on Roman numerals and you will get nothing. And here already positional calculus allows you to carry out any arithmetic operations - addition, subtraction, multiplication, and division. But the most important thing is that he showed the method of how to solve quadratic equations. Al-Khwarizmi explained how to describe the actions step by step in order to solve these equations. When his works were translated into Latin in Europe, out of respect for copyright, they made a direct reference to the author's name in Latin «Algorithmi dixit ...» - «Al-Khwarizmi says ...». Later this link was understood as a method of action. Further, his method of algorithmization of the sequence of actions was used to solve a variety of problems, ranging from mathematics to new information technologies. And, thanks to the title of Al-Khwarizmi's book, algebra was created and exists as a branch of mathematics and as a mathematical object - an abstract set endowed with operations on its elements.

Al-Khwarizmi is the property of all mankind, but it is equally important to emphasize that the true homeland of such a brilliant scientist is the land of Uzbekistan.

A. Khakimov: You are one of the most titled scientists of Uzbekistan - an Academician of the Uzbekistan Academy of Sciences, a laureate of the State Prize in the field of science and technology, director of the Institute of Mathematics named after V.I.Romanovski. The younger generation of scientists is proud of you. They are interested to know - how and when did you get the idea to become a mathematician?

Sh. Ayupov: In general, I believe that the attitude to mathematics is formed primarily by the teacher. After all, mathematics is a complex science, and if the teacher cannot explain this subject to students, then there is a rejection. And when the teacher explains all this in a very interesting, enthusiastic way, with examples, the subject begins to captivate and attract students with special magic. My interest in mathematics emerged in grades 6-7. Then I was interested in the exact sciences and participated in Olympiads in physics, mathematics, and chemistry. The turning point was the event when I successfully performed at the Republican Mathematics Olympiad. Then there were all-Union Olympiads, scientists from Novosibirsk came to us. At that time, Akademgorodok was founded in Novosibirsk and we were selected for the summer physics and mathematics school (LF-MSh 1968). I studied there and finally decided to become a mathematician. From the tenth grade, I attended a circle at another school - No. 111 on Chigatai Darvoza. On the walls of the school, there were portraits of three national academicians-mathematicians - T.N. Kary-Niyazov, T.A. Sarymsakov, and S.Kh. Sirojiddinov. Looking at their portraits, I firmly decided to become a student of one of these academicians. Not even a year passed, and I became a student of the Faculty of Mechanics and Mathematics of Tashkent State University, and in the third year I entered the Department of Functional Analysis, headed by Tashmukhamed Alievich Sarymsakov. I went to his seminars and, in fact, under his guidance, I went through my scientific path from a student to an academician, becoming an academician in 1995 - during the lifetime of my scientific mentor. At the age of 24, I defended my Ph.D., and at the age of 30 - my DSc dissertation.

A. Khakimov: What were the topics of your Ph.D. and D.Sc. dissertations?

Sh.Ayupov: The candidate's thesis (now is equal to Ph.D.) was closer to algebra - Tikhonov rings, their homomorphism and modules, and the doctor's thesis (D.Sc.) - on ordered Jordan algebras and their applications to quantum probability theory. It was at the intersection of probability theory and functional analysis. Quantum probability proper is a noncommutative probability theory, and one such algebraic model of quantum mechanics was created by the German physicist and mathematician Pascual Jordan.

A. Khakimov: I recently read an interview with Jean-Michel Bismuth, a well-known mathematician and editor of a French mathematics journal, in which he says that recently mathematics has been developing under the influence of physics. What is the current trend in the development of sciences - physics, chemistry, astronomy, and mathematics? It used to be said that mathematics is the queen of sciences. Don't you feel today like a mathematician in the background of these kindred sciences?

Sh. Ayupov: In fact, what is mathematics and where does it get its problems from? These tasks were always taken from practice. The same scientists of antiquity used mathematics to distribute the inheritance among the heirs. Mathematics basically took problems more from mechanics, as well as from engineering sciences. Now especially theoretical physics is actually the

Footage from the interview

From left to right: Academician Shavkat Ayupov, Fields medal prize winner, Professor of University of California San Diego Yefim Zelmanov and Academician Abdulla Azamov. Khiva

basis of modern trends in mathematics, the so-called quantum field theory, and quantum mechanics. In many meetings with schoolchildren and students, I often repeat that a good knowledge of mathematics is necessary in order to achieve high results in any field. Moreover, mathematicians by education achieve outstanding results when they move to other branches of science. For example, Otto Yulievich Schmidt graduated from the Physics and Mathematics Department of Kyiv University and began his scientific research in the field of abstract algebra. In 1916, he published the monograph Abstract Group Theory, which became a fundamental work in this field.

It should be noted that in mathematics the most ingenious results and ideas arise from young scientists. For a mathematician, the highest honor is the Fields Medal, which is awarded every 4 years to several deserving mathematicians under the age of 40. Experienced mathematicians can correctly set a problem and direct it to its solution, but the brightest ideas come from the young. There is Fermat's great theorem, which for 350 years great minds could not solve. And in 1994, the American mathematician Andrew John Wiles coped with this task by applying modern branches of mathematics, the so-called elliptic curves over the field of rational numbers. Also in 1994, a number of scientists found a gap in his proof. He wanted to state his position at the World Congress of Mathematicians in Zurich in 1994, but there were several hundred pages, and therefore they decided to postpone this issue until the next Congress. By the next congress in 1998 in Berlin, the correctness of his proof was confirmed. However, it was impossible to give him the Fields medal, as he was already over 40 years old. Then the Fields Prize committee presented this scientist with a silver plaque on which was written: «For outstanding services, but the size of the plate does not allow listing all his achievements.» Why was it written like that? Fermat himself, when studying this problem, wrote in the margins of the translation of his book Diophantus on arithmetic: "In fact, I proved that the equation $Xn + Yn = Zn$ has no solution in positive integers, for natural n greater than 2, but the fields of this book are too narrow to allow me to present this proof." I note that it is still not known whether there is an elementary solution to Fermat's theorem.

A. Khakimov: Can you point out the difference between fundamental and applied mathematics?

Sh. Ayupov: In fact, this division is conditional. Actually, fundamental mathematics takes a problem from other sciences and makes a mathematical model out of them, i.e. studies this problem already from the point of view of mathematics. Moreover, it is even possible that new mathematical theories arise in this process, but then these results are returned to practice already as applied mathematics. That is, mathematics takes a task from practice, and develops it in its models - this part is called fundamental. Our scientists are really more engaged in fundamental mathematics. This is how mathematical statistics describe production processes in fundamental mathematics, although statistics itself is the applied part of mathematics. Or, for example, economics. It creates its own models, and there is a direction in mathematics - differential equations, dynamic systems of optimal control, etc. However, the Nobel

Prize is not awarded for achievements in mathematics. Despite this, a number of mathematicians have won the Nobel Prize specifically in economics, because their models have found amazing applications in economics. For example, the first was V.V. Leontiev, an American scientist, mathematician, and economist of Russian origin. He is followed by the famous Russian mathematician and economics specialist L.V. Kantorovich, and one of the last Nobel Prize winners was the American mathematician, the founder of game theory, John Nash. As you can see, some results obtained today will not necessarily find application at the same moment. For example, when in ancient Greece one of the largest geometers Apollonius of Perga invented conic sections - a parabola, a hyperbola, and an ellipse, who devoted a treatise of eight books entitled "Conic Sections" to these wonderful curves, it was believed that this was a purely theoretical discovery. Then no one knew that after many centuries it would be discovered that all cosmic bodies move exactly along one of these curves.

A. Khakimov: What can you say about the national mathematical school, what are its main achievements?

Sh. Ayupov: First of all, the very first mathematical school that was recognized worldwide is the school of probability theory and mathematical statistics, which is associated with the name of V. I. Romanovsky, whose name our Institute of Mathematics bears. He is the teacher of T.N. Kary-Niyazov, T.A. Sarymsakov, and S.Kh. Sirajdinov, and he was a graduate of St. Petersburg University, where he received a degree in mathematical statistics, published his papers in leading French journals. It was a recognized school in the field of mathematics, and recognition of its achievements was that in 1986 the First World Congress of the International Bernoulli Society on Mathematical Statistics was held in Tashkent, and 200 scientists came from abroad, and there were over 1200 participants in total! This was indeed a recognition of the international level of the Uzbek mathematical school. Academician Tashmukhamed Alievich Sarymsakov came from this school, but then he initiated a new direction - functional analysis, in which an internationally recognized scientific school was also created. In addition, there are recognized schools in Uzbekistan on the theory of differential equations

Our scientists are also invited to work in international mathematical centers. In 1994, when I worked at the Louis Pasteur Institute in Strasbourg (France), there was a mathematical center, from there I brought a new direction in algebra, which is called the theory of non-associative algebras. This section of algebra has already been included as an independent section in the classifier of mathematical sciences. This is also a recognition of the merits of our algebraic school.

A. Khakimov: Do you think we have such a level of social status and authority in mathematical science in the country that can be attractive to young people?

Sh. Ayupov: Well, I'll tell you that until 2016, the attitude towards science, and in particular towards mathematics remained poor. Many academic institutions were transferred to other departments or closed altogether. And our Institute of Mathematics, although it retained its legal status, was transferred to the National University of Uzbekistan. In many universities the hours of teaching mathematics were reduced, we worked on grants with very small salaries. But after the adoption in 2019 of the Decree of the President of Uzbekistan "On the development of mathematical science and education in Uzbekistan and the improvement of the activities of the V.I. Romanovsky Institute of Mathematics, Uzbekistan Academy of Sciences" and with subsequent significant state support, we were the first to switch to basic state budget financing. For our Institute, a new modern building was built on the university campus, next to the National University of Uzbekistan and the Ministry of Innovative Development. The sign of special attention of the head of state to mathematics was already shown in 2017. For a long time, mathematicians were not awarded the State Prize, and in 2017, the President of the Republic Shavkat Miromonovich Mirziyoyev presented me, together with my students, with the

Shavkat Ayupov with colleagues and the Nobel Prize prizewinner John Nash at the International Congress of Mathematicians in Beijing. 2002

Institute of Mathematics named after V.I. Romanovsky of the Uzbekistan Aacademy of Sciences

State Prize of the 1st degree in the field of science and technology. In 2020, another decree of the President of Uzbekistan on the development of mathematical education was adopted. This Decree organized 5 branches of our Institute in the capital of the Republic of Karakalpakstan - Nukus and in 4 regional centers - Urgench, Samarkand, Bukhara, and Namangan. And each department received 10 employees, which doubled the number of employees of the Institute as a whole. Now we have 8 laboratories and 5 regional departments at the Institute, and they are located directly in the leading universities of the country.

A. Khakimov: Can you say that you are optimistic about the development of mathematics in Uzbekistan?

Sh. Ayupov: By the Decrees of the President of Uzbekistan, we were given the responsibility to supervise both school and university mathematics, in addition, we hold Republican Olympiads and prepare the national team of Uzbekistan for the International Mathematics Olympiad, in other words, our Institute has become the central headquarters of mathematics in the republic. Communication with the younger generation of young talented scientists allows us to look with optimism at the future of mathematical science in Uzbekistan.

A. Khakimov: Do you think there is a connection between mathematics and creative human activities, such as painting or music?

Sh. Ayupov: In fact, as I have already noted above, if a person knows mathematics, it does not matter what he does - biology or medicine, but he gets better results than someone who does not know mathematics at all. There is one foreign journal called «Notices of the American mathematical society», which analyzed the dynamics of the use of mathematics in other sciences. It turned out that over the past 10 years there have been more articles in the field of mathematical medicine. And here is how they explain

it. Firstly, when they say "mathematical medicine", it is easier to get funds from officials for research than for pure mathematics, and secondly, medicine now has the tools and database that are required to create a mathematical model of the problem under consideration. And if earlier medicine was considered a science, the basis of which is an experiment, now, when mathematics enters into it, it also becomes a fundamental science. Music is also prone to solutions in the field of rhythms and harmony of sounds, which is proved by the creative heritage of the great scientist Al-Farabi, who devoted many of his scientific works to mathematics and music theory at the same time.

A. Khakimov: What is the role of mathematics in the development of such new technologies as artificial intelligence, robotization, and other modern scientific trends?

Sh. Ayupov: Mathematics affects them in the same way as all the above areas and creates the basis for their rapid development since they are all based on algorithms. If you remember, once upon a time chess players played against computers. Then there was still a chance for a person to defeat a computer, but now, thanks to the modernization of software systems, this is no longer possible.

A. Khakimov: Did it help that you were good at math when playing chess?

Sh. Ayupov: In chess, knowledge of mathematics is not entirely important, it is more important to sort through the options quickly, and the computer does it better. Or, many people ask me - now mental arithmetic is very popular among children, and will mental arithmetic help a child succeed in mathematics? I answer them that mental arithmetic is the ability to quickly count and perform operations on numbers, which is gymnastics for the child's brain, but mathematics is the ability to set tasks and draw conclusions logically. Therefore, the main thing for a mathematician is the ability to think logically, this is called mathematical thinking. Why am I against tests in mathematics - you will never know from the result whether a student can think mathematically and logically. I do not quite support the test system when entering a university, especially at the Olympiads. At mathematical Olympiads, in addition to the answer sheet, drafts are also collected, and according to them, the jury of the Olympiad evaluates whether the student reasoned mathematically correctly and how he came to his answer.

A. Khakimov: How do you see the prospects for the development of national science and its flagship, Uzbekistan Academy of Sciences, on the threshold of its 80th anniversary?

Shavkat Ayupov with students

Sh. Ayupov: It should be noted that, in general, the structure of the Academy of Sciences has proved its worth in its time. As for our Institute of Mathematics, there is one essential difference. It is that all departments of our Institute of Mathematics are located in universities, and we ourselves have specifically requested that our new building of the Institute be built near the National University of Uzbekistan since we are all very connected with students. It is necessary that leading scientists have a connection with universities, that there is continuity of generations. Otherwise, there will be an ageing of science. But still, the Academy of Sciences needs to retain its independence.

A. Khakimov: Thank you, Shavkat Abdullaevich, for this interesting and informative conversation. We wish you further success, and new scientific achievements for the benefit of the prosperity of mathematical science in Uzbekistan.

Energy of Uzbekistan: A new vector

Qahramon Allaev,
Academician

The main goal of the energy policy of Uzbekistan for the period up to 2030 and beyond is a sustainable energy supply for economic growth and improving the quality of life of the population. The leadership of the republic has taken a radical course towards changes in the economy, social and legal spheres, including in the energy sector. Over the past six years, the socioeconomic situation in Uzbekistan has noticeably improved, which contributed to the achievement of positive changes in the energy sector. As noted in the International Energy Agency (IEA) 2022 report: "The broad energy sector reform that began in 2019 continues at a steady pace. Its scope and scale are ambitious compared to other countries, and the IEA applauds the government of Uzbekistan for the progress made to date."

At the same time, the country's leadership has set even more ambitious tasks for the development of the country's energy sector. By 2030, the country's power engineers should increase electricity generation to 120 billion kWh. This is almost twice as much as electricity generation in 2022 - 74 billion kWh. Achieving this result is especially important in the context of the ambitious goal that Uzbekistan sets for itself: to achieve an economic breakthrough and by 2030 become one of the 50 most advanced countries in the world.

The energy sector of Uzbekistan, including the electric power industry, is one of the developed sectors of production not only in the CIS, but also in the world. Currently, the main source of generation in Uzbekistan is 11 thermal power plants (TPPs), including 3 heat stations (HSs). As of January 1, 2023, the installed capacity of power plants in Uzbekistan amounted to more than 17.0 GW, including more

than 14.5 GW of thermal power plants, and more than 2 GW of hydroelectric power plants (HPPs).

In general, in the structure of the total installed capacity by plant type, the share of TPPs/HSs is about 90%, and the share of HPPs is about 10%. Thermal power plants/HSs use natural gas as fuel (90.8% of the total consumption of mineral fuels in the electric power industry), coal (7%), fuel oil (2%), and coal synthesis gas (0.2%).

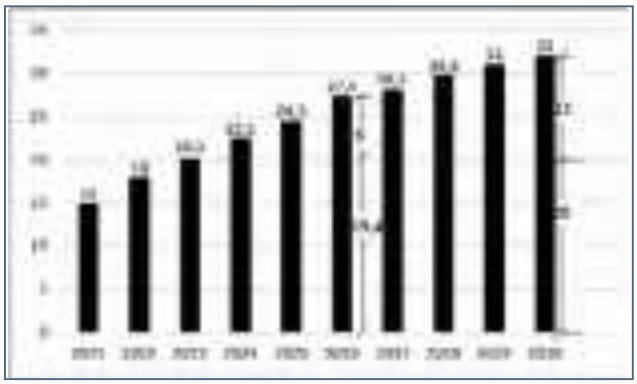


Fig. 1. Forecast of the growth of installed capacities of electricity sources in the energy system of Uzbekistan (author's calculation)

Fig. 1 shows the values of the installed capacities of the energy system of Uzbekistan with the allocation of electricity generation by renewable energy sources (RES) in 2026 and 2030, respectively: 8 GW (29.2% of the installed capacity) and 12 GW (37.5%), and the rest consists from the total capacities of TPPs and HPPs.

Until 2050, according to forecasts under the carbon-neutral scenario, the installed capacity of power plants in Uzbekistan may increase up to 100 GW (Fig. 2).

According to JSC «Uzbekneftegaz», the current reserves of natural gas in the country will last for 20-30 years. As a result of the implementation of comprehensive and large-scale measures of the state, the energy sector of Uzbekistan will receive a powerful impetus for development, and the structure of electricity generation will become diversified. The range of priorities in the development of the energy sector includes the following positions.

1. Development of combined cycle technologies and installations (CCGT). At the moment, the total capacity of CCGT units introduced into the energy system of Uzbekistan is more than 3,000 MW, with an installed capacity of the energy system of about 17,000 MW. The transition from traditional steam turbine plants of thermal power plants to CCGT

increases the fuel utilization factor by 2 times, i.e. from 30-35% to 55-60%.

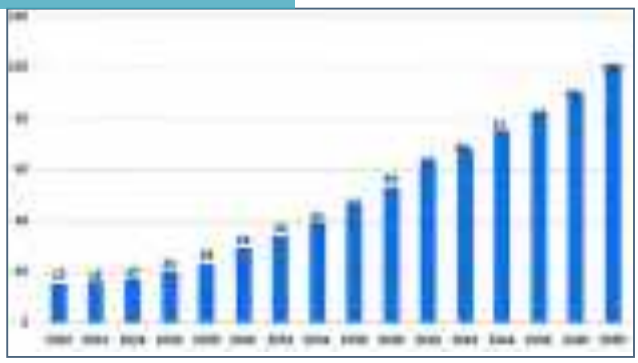


Fig 2. Forecast of changes in installed capacities of power plants in Uzbekistan under the carbon-neutral scenario by 2050

The leadership of Uzbekistan has also set the task of maximizing the involvement of coal in the development of the state's economy. At the same time, it is necessary to decide which stations, except for the Novo-Angrenskaya TPP, will be converted to coal and at what capacities new coal-fired TPPs will be built. It is also necessary to solve financing issues, predict the cost of electricity generated, determine the impact of these stations on the environment, etc.

2. Renewable energy sources of Uzbekistan. Large-scale work has begun in Uzbekistan on the use of renewable energy sources (RES) - the sun, wind, and other types, the real potential of which by 2030 is estimated at about 8,000 MW. Their share in the country's energy sector is planned to be increased to 25% by 2030.

In August 2021, the country's first solar power plant with a capacity of 100 MW and a cost of $110 million was put into operation in Uzbekistan. The station will generate 252 million kWh of electricity per year. This will save 80 million cubic meters of natural gas and prevent the emission of 160,000 tons of greenhouse gases into the atmosphere.

The experience of foreign countries shows that the integration of small volumes of variables for the generated RES capacity into modern energy systems within (5-10)% of the total capacity of the energy system is not a particular problem. The main problems with the management of power system modes, their reliability, and costs, begin when the share of variable RES exceeds 20% or more of the installed capacity of the power system. At the same time, for every 1 GW of renewable energy capacity, it is necessary to have (300–500) MW of reserve capacity for thermal or nuclear generation.

3. Creation and development of nuclear energy in Uzbekistan. In Uzbekistan, for the first time in the Central Asian region, by 2030 it is planned to complete the construction of a nuclear power plant (NPP) with a total capacity of 2400 MW with two WWPR-1200 generation 3+ units, with a capacity of 1200 MW each. WWPR-1200 units meet all safety requirements of the International Atomic Energy Agency - IAEA.

An important incentive for the construction of nuclear power plants in Uzbekistan is the presence of developed uranium deposits in the country. The nuclear power plant will make it possible to reorient gas for export or deep processing in the country and increase additional revenues to the republic's budget. As a result of the launch of the nuclear power plant, Uzbekistan will annually save 3.7 billion m3 of natural gas. Even if the saved gas is exported without its processing, Uzbekistan will receive 550-600 million US dollars per year. Every dollar invested in the construction of a nuclear power plant gives about 6 dollars in return: 2 dollars to local suppliers and about 4 dollars to the Gross General Product (GDP) of the country.

4. Creation and development of hydrogen energy in Uzbekistan. Uzbekistan notes the importance and prospects of hydrogen production and the development of hydrogen energy for the formation of a «green» economy of the state. In this regard, the Decree of the President of the Republic of Uzbekistan "On measures to develop renewable and hydrogen energy in the Republic of Uzbekistan" dated April 9, 2021, was adopted.

In order to create an infrastructure for hydrogen energy in Uzbekistan, the National Research Institute for Renewable Energy Sources was organized under the Ministry of Energy of Uzbekistan. At this Institute, a hydrogen energy research center and a laboratory for testing and certification of renewable and hydrogen energy technologies are being created. It should be noted that all nuclear powers are now involved in nuclear-hydrogen research. In the US, generating hydrogen from electricity generated at nuclear power plants is already recognized as a promising strategy, and since 2019 large grants have been allocated for experiments in this area.

5. Accumulation and storage of energy. The main task of energy storage devices is to optimize electricity generation by leveling the load schedule of the countries' energy systems and other electricity infrastructure. Absolute leadership in the structure of energy storage in the world (95%) is occupied by pumped storage power plants (PSPPs), however,

experts expect that in the long term the share of other types of energy storage will increase. Currently, the following types of lithium-ion batteries are the cheapest batteries for electricity: «nickel-cobalt-aluminum» and «lithium-cobalt», costing $ 150-210 / kWh. The price is expected to continue to decline and reach $94/kWh by 2024 and $62/kWh by 2030.

6. Energy intensity. In Uzbekistan, by the end of 2030, the demand for energy resources will increase by 25.5% compared to 2013 and will amount to more than 43.5 million tons of oil equivalent (toe). The energy intensity of Uzbekistan's GDP from 2001 to 2019 decreased from 0.738 koe/$ to 0.152 koe/$. at a world average of 0.11 k.o.e./USD, i.e. more than 4 times, and has the potential for further decline. Fig. 3 shows data on the energy intensity of GDP in a number of countries of the world.

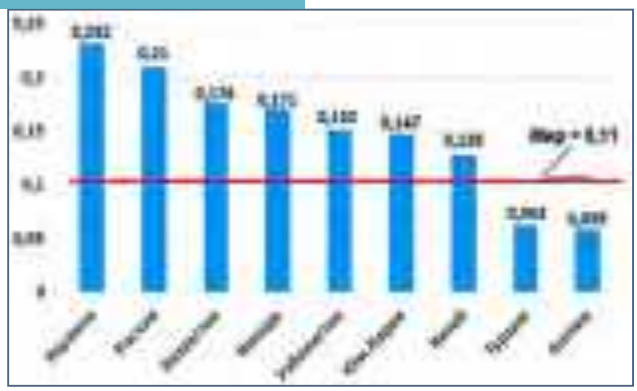


Fig.3. Energy intensity of GDP of some countries of the world in 2019

The most important achievement of the energy sector of Uzbekistan is the completion of the first stage of the automated system for commercial accounting of electricity (ASCAE). By January 1, 2020, about 7.5 million electronic meters have been installed for electricity consumers, which will lead to a significant (about 7-10%) reduction in electricity losses. Next in line is the introduction of a higher-level automated information and measuring system for commercial electricity metering (AIMSCEM), which is the basis of the intelligent energy system of Uzbekistan.

7. Ecology and energy. Currently, the problem of climate change is the most discussed topic in the global and domestic energy sectors. It should be noted that Uzbekistan joined the UN Paris Climate Agreement (2015) in April 2017. Uzbekistan's contribution to the fight against global warming will be strengthened:

Windmills

Uzbekistan intends to reduce greenhouse gas emissions by 2030 not by 10%, as previously accepted, but by 35% compared to 2010 levels. This was reported in November 2021 at the annual UN conference on climate change. CO2 emissions from energy combustion, which were declining by 7% per year between 2011 and 2015, have unfortunately started to rise (+3% per year), reaching 113 million tons of CO2 in 2021. Fig. 4. The dynamics of CO2 emissions per capita in the world, the Russian Federation and Uzbekistan are given.

Developing a prospective energy policy is key to achieving decarbonization goals and keeping global warming below the 2°C threshold. In particular, the provision of low-carbon electricity is an important '2°C' compatible energy system and entails the electrification of much of the world's economy.

The indicators of greenhouse gas (GHG) emissions from the use of primary energy sources are as follows:

- coal energy shows the highest rates of 751-1095 gCO2/kWh;
- a natural gas combined cycle plant can emit 403-513 gCO2/kWh;
- renewable energy sources, hydropower show the greatest variability since emissions largely depend on the location of the territory, ranging from 6 to 147 gCO2 / kWh;
- solar technologies generate GHG emissions in the range of 27-122 gCO2/kWh for CSP and 8.0-83 gCO2/kWh for photovoltaics;
- GHG emissions from wind energy vary between 7.8-16 gCO2/kWh for land-based turbines;
- nuclear energy shows the lowest emissions of 5.1–6.4 gCO2/kWh.

The implementation of program tasks arising from the laws of the Republic of Uzbekistan and Decrees, Resolutions of the President of the Republic of Uzbekistan, will ensure the development of energy and energy security of the country in the medium and long term. To this end, Uzbekistan has a rich resource base, powerful production potential, and qualified scientific and technical personnel.

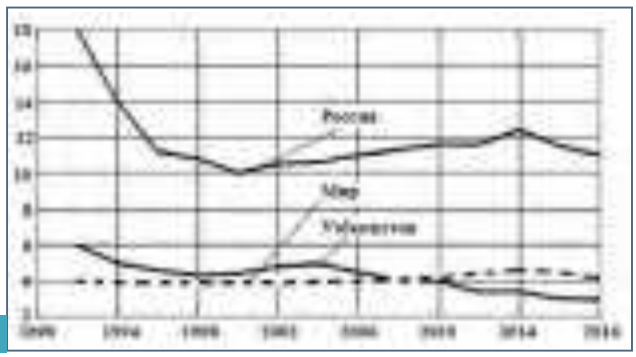


Fig. 4. Dynamics of carbon dioxide (CO2) emissions per capita

Coal mining

The Sun is the Source of Life on Earth

Isroil Yuldoshev,
Doctor of Technical Sciences

In the world energy sector, the traditional method of producing electrical and thermal energy using fossil fuels – coal, oil, and natural gas is still dominant. The use of fossil fuels is fraught with a number of negative factors leading to global crises and catastrophes in the world. Among them are:

– limited reserves of fossil fuels around the globe;

– high costs in the development of deposits, production, and transportation;

– atmospheric pollution due to emissions of harmful substances, carbon dioxide, and greenhouse gases;

– technogenic danger during extraction, transportation of fuel, and operation of power plants. For example, the volume of global emissions of carbon dioxide CO2 into the atmosphere from the combustion of fossil fuels - coal, oil, and natural gas, according to data from November 10, 2022, by the experts of the international research project Global Carbon Project today amounted to: from coal combustion - about 40% of CO2 emissions, from oil combustion - 33%, from gas combustion - 22%.

One of the promising ways to create an environmentally friendly type of generation of electrical and thermal energy in the energy sector is the use of renewable energy sources (RES). Thus, at the G8 Leaders' Summit held in Okinawa (Japan) in July 2000, a special international group was created to achieve significant changes in the development of global renewable energy. In a report prepared by this group a year later, at the Summit in Genoa, the goal was to provide 2 billion people in the world with energy from renewable sources in 10 years. Solar energy systems can produce clean energy, they are silent, do not consume fuel, operate in automatic

process, and their maintenance costs are negligible compared to the maintenance costs of electrical transformer substations.

Among all available renewable energy sources, solar energy is the cheapest in terms of natural resources. The state of development of solar energy in the world can be judged by the following figures. For example, in 2019, the installed capacity of solar power plants exceeded 650 GW. In terms of installed capacity, solar energy in terms of 650 GW is ranked 4th among other energy sources after coal - 2100 GW, gas generation - 1810 GW, and hydroelectric power plants - 1160 GW. According to the forecast, at such a pace of development, at which capacities in the range of 130-170 GW are commissioned annually, by 2030 solar energy may take first or second place.

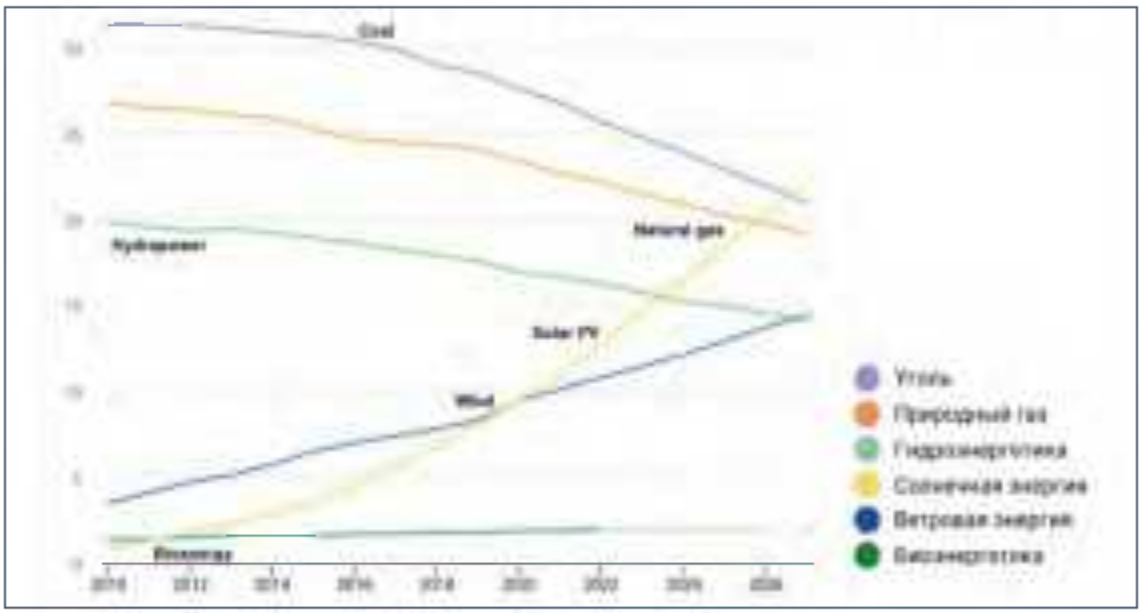
The International Energy Agency (IFA) released the report «Renewables 2022. Analysis and forecast to 2027» («RES 2022. Analysis and forecast to 2027»), according to which the growth of renewable energy capacities will be accelerated mainly due to solar and wind generation. According to the IFA report, global renewable energy capacity will grow by 2,400 GW between 2022 and 2027, roughly the same as China's current electricity capacity.

In the following graph, you can see the ratio of energy production technologies from various energy sources for the period from 2010 to 2027. As can be seen, the capacities of solar and wind energy, according to the development forecast for this period, increase significantly.

China will remain the world leader in renewable energy production, according to the IFA, with a total installed wind and solar power capacity of 1,200 GW by 2025. At this pace of development, China can achieve its 2030 target of increasing the share of renewable energy capacity in its energy mix by 5 years ahead of schedule.

The growing pace of development of solar energy around the world, and the development of promising technologies for photoelectric conversion of solar energy into electrical and thermal energy have made it possible to make a significant contribution to the development of solar energy in Uzbekistan. Thanks to the support of the policy of introducing a «green economy», and «green energy» from the Government of the Republic of Uzbekistan, large-scale work has begun to build solar photovoltaic stations (SPVS).

In 2019, Uzbekistan became the first country outside of Africa to join the World Bank Group (WBG) Scaling Solar program. As part of this program, the project "Scaling Solar Energy in Uzbekistan-1" was implemented and for the first time in Uzbekistan, on the basis of public-private cooperation with MASDAR (UAE), in 2021, a 100 MW SPVS was launched in the Karmana district of the Navoi region. The successful operation of the SPVS project in the Navoi region made it possible to allocate funds from the World Bank for the second stage of financing projects for the construction of new SPVS in the regions of the republic. Thus, the Board of Executive Directors of the World Bank allocated 12 million US dollars to



Infographics of the power of energy resources

Uzbekistan for the implementation of the Scaling Solar Energy in Uzbekistan-2 project. This project will expand the capacity for the production of clean and renewable energy in the country. This project will make a significant contribution to the energy sector in realizing the government's plans to transition to a «green economy» and accelerate the process of reducing carbon dioxide and harmful emissions into the atmosphere.

As part of a public-private partnership (PPP), the winner of tenders for the construction of two new solar power plants with a capacity of 220 MW each in the Kattakurgan district of Samarkand region and Gallyaaral district of Jizzakh region, MASDAR (UAE) offered low tariffs for electricity generation in the country and in the Central Asian region. This PPP project is supported by the WBG Solar Scaling Program. As part of this program, IFC (International Finance Corporation) provided consulting services for organizing a tender, and the World Bank will provide bank guarantees for fulfilling obligations to purchase electricity generated by the stations for a total amount of up to 12 million US dollars.

Solar PPPs in Samarkand and Jizzakh regions will be able to generate up to 1.1 billion (kWh) of renewable electricity per year. Their work will prevent emissions of carbon dioxide on average in the amount of about 110,000 tons per year, or a total of about 3.4 million tons over the entire life of these plants.

In order to accelerate the development of renewable energy in the country, the Decree of the President of the Republic of Uzbekistan No. PP-57 dated February 16, 2023 "On measures to accelerate

the introduction of renewable energy sources and energy-saving technologies in 2023" was issued. This Decree has the goal of the widespread introduction of renewable energy sources in the social sphere, housing and communal services, and various sectors of the economy. This Decree provides for the commissioning of renewable energy sources with a total capacity of 4300 MW in 2023, including large solar and wind power plants with a total capacity of 2100 MW, solar panels installed on buildings and structures of social facilities and business entities, households, 1200 MW, as well as small photovoltaic

Solar panels installed in a residential building

stations built by entrepreneurs with a capacity of 550 MW.

It also provides for the production of an additional 5 billion kWh of electricity in 2023, saving 4.8 billion cubic meters of natural gas through the construction of renewable energy sources, switching consumers to alternative energy and introducing energy-saving technologies.

Funds totaling USD 15.4 billion are allocated for these purposes, including funds from investors in the framework of PPP projects - USD 13.4 billion, loans from commercial banks - USD 1.1 billion, own funds of enterprises - 610 million US dollars, funds of foreign financial organizations - 150 million US dollars, funds of the State budget equivalent to 100 million US dollars.

The resolution approved an address list of construction projects for 27 new high-capacity solar and wind power plants based on PPP in 2023, as well as an address list of projects for connecting high-capacity solar and wind power plants to power transmission networks.

In addition, from April 1, 2023, individuals and legal entities that have installed renewable energy sources with a total capacity of up to 100 kW are exempt from paying property tax on these installations, land tax on plots occupied by these installations. They are exempt from income tax

charged on profits for electricity sold by legal entities for the general grid, from the date of their commissioning for a period of 3 years, and in the case of their installation with an electric energy storage system - at least 25% of the capacity of installed solar panels on up to 10 years.

Since the 2016-2017 academic year, the Tashkent State Technical University was one of the first in the country to open the area "Alternative Energy Sources" (by type) in the field of renewable energy sources. At the moment, more than 250 undergraduate students and more than 30 master students are studying in this direction.

Leading specialists of the Tashkent State Technical University, together with specialists from the Ministry of Higher Education, Science, and Innovation of the Republic of Uzbekistan, as well as on the basis of the USAID project, developed and implemented the program «Science, technology and the use of «green» hydrogen» in the area 60711000 - bachelor's degree in alternative energy sources (hydrogen energy) and in specialty 70711002 - master's programs in hydrogen energy and technology in cooperation with the University of Delaware (USA).

State support in the field of creation and implementation of renewable energy sources, including solar energy installations in a large-scale format, allows the transition to a «green economy», and domestic entrepreneurs to expand their areas of activity, to profit from the sale of energy produced at renewable energy installations.

Ultimately, all these measures taken in recent years by the leadership of the Republic of Uzbekistan will contribute to the successful development of the country's energy sector, as well as the comprehensive recovery of the economy of Uzbekistan and the well-being of the population.

Installation of solar panels

Earthquake forecasters

Qahhorboy Abdullabekov,
Academician

At the beginning of 2023, the most powerful earthquake in Turkey and Syria caused great human losses and the appearance of earthquakes, causing destruction, the subsequent actions of earthquake informers, and the reasons for their occurrence became more relevant. This issue is also considered important for Uzbekistan, and the country's leadership is paying great attention to the problem. Today, the scientists of Uzbekistan studying seismology face the task of preparing the complexes of earthquake harbingers and creating a model for determining the regularity of their manifestation. Scientists of the Institute of Seismology named after G.A. Mavlonov, Uzbekistan Academy of Sciences, are actively working on this urgent problem. Its solution requires continuous predictive monitoring of earthquake-prone zones in Uzbekistan and neighboring countries. For this purpose, special seismic sensors were installed at the monitoring points of the activity of the earth's crust to detect the harbingers of possible earthquakes. Local seismologists continuously monitor the most earthquake-prone zones from the earth's surface with geophysical sounding methods. This sensing-based long-term (up to several years) methods are the latest models for self-diagnostic prediction of the timing, strength, and location of the most likely earthquakes.

It is scientifically proven that earthquakes are related to the occurrence of earthquakes even if there is a fine microscopic movement of tectonic plates located at a great depth in the thickness of the earth's lithosphere, the constant movement of some plates relative to others. It is on these tectonic plates that both the Earth's two poles and the world's oceans are located. The Earth's lithosphere consists

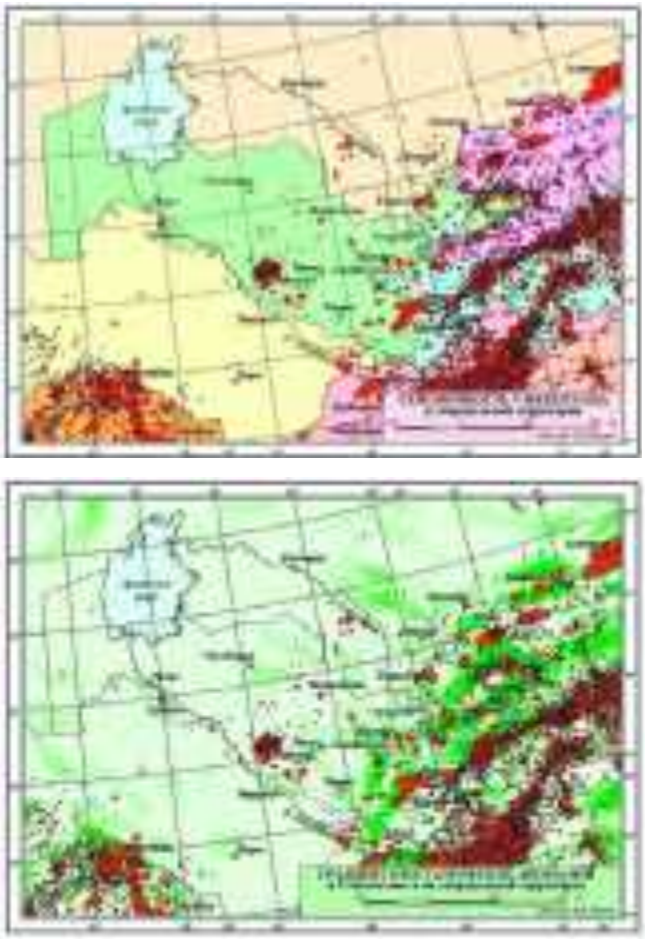
of 8 giant plates, dozens of medium-sized plates, and many small plates. Small plates are located in arches between large plates. All seismic, tectonic, and magmatic activity is concentrated on the boundaries of these mobile plates. There are 3 main types of movement of tectonic plates relative to each other: plate movement, plate convergence, and movement along geological faults.

Earthquakes mainly occur in three seismic zones of the world. 80% in the Pacific Ocean, 15% in Central Asia, and about 5% in the Mid-Atlantic belt and other parts of the planet. The territory of Central Asia, including Uzbekistan, is located in the Mediterranean-Asian seismic belt. Earthquakes in Uzbekistan are related to the processes of mountain formation as a result of the convergence of the Indian plate with the Eurasian plate.

As a result of the interaction of the boundaries of these plates of the earth's crust, great stress is gradually created. This can be manifested in the rise of the earth's surface layers, the appearance of local cracks, as well as the appearance of huge waves in the world's oceans. This, in turn, creates primary vertical and secondary horizontal seismic waves of different speeds (vertical waves travel faster). They cause catastrophic damage to civil and industrial buildings, as well as irreparable human losses. Moreover, in the shock zone of the earthquake in this hypocentric region, the deceleration of this stress after the mainshock continues for a very long time (sometimes up to several months or more). In the process of slowing down such tension, it is possible to observe earthquakes, so-called seismic activity, with the appearance of new destructions, losses, or new explosions. A terrible earthquake event with the catastrophic destructive power of this level occurred in Turkey on February 6, 2023 (wave shocks m = 7.5 and 7.8 on the Richter scale), and a series that occurred in Hatay province on February 20 earthquakes (m = 6.5 and 6.8 on the Richter scale) was observed. But a logical question arises - how to get information about the time and place of new earthquakes, at least approximate, their approach, strength, forecast to the population, and related services? It is for this purpose that earthquake detectors are identified, systematized, and continuously monitored by scientists.

In order to create a model of earthquake sensors, a large number of materials collected by scientists of Uzbekistan from 1968 to the present on the basis of long-term magnetometric observations by seismologists with stationary methods, including data, the direction of repeated earthquakes and prognostic studies of regions analyzed in the following order:

Aftermath of the earthquake in Turkey



Maps of focal seismicity were first compiled for the territory of Central Asia. Ulomov, 1974

- Tashkent, Fergana, Kyzylkum geodynamic landfills;

- the most important huge man-made structures (Charvak reservoir, Poltoratsky underground gas storage, areas of gas and oil fields, etc.);

- Epicenters of strong earthquakes in Uzbekistan (the total length of repeated routes is more than 7750 km, the number of repeated measurement points is about 1110, the presence of stationary stations is 15-25, and in some periods they reached 37).

Since the beginning of the 19th century, the information and research results obtained and collected from geomagnetic observatories around the world, as well as the global network and catalogs, are analyzed and summarized.

Based on these data, all earthquake indicators are divided into 3 types according to the time of their manifestation: long-term, medium-term, and short-term. It was determined that the preparation of earthquakes in several stages is a long-term, medium-term, and short-term process. Together, these processes create the laws of earthquake occurrence. Each type of earthquake has specific physical-mechanical, chemical, and other processes associated with its spatiotemporal parameters in the preparation zone. The main overpressure accumulated during the earthquake occurrence was identified as long- and medium-term earthquake indicators. Short-term forecasters are like the «control lever» of an earthquake. The time of appearance and the number of accumulated overpressures are less in short-term earthquake detectors than in long-term and medium-term earthquake detectors. The preparation time for earthquakes can be from several years to 15-20 years, depending on their magnitude. On average, for long-term earthquake harbingers, depending on the strength of the future earthquake preparation is from several years to 15 years, and medium earthquake harbingers are from several months to 2-4 years. At the final stage of preparation for an earthquake, short-term loggers appear, lasting from one to ten days. After a certain period of time, long-term abnormal changes are replaced by medium-term changes. At the same time, the level of anomalous growth of earthquake harbingers changes.

It was determined that with the appearance of medium-term harbingers in the field of earthquake preparation, the number of small cracks on the surface of the earth increases sharply in certain areas, and then medium-term harbingers are replaced by short-term ones. In this final stage of preparation, much larger, trunk-extending faults form in the hypocentric regions of the earthquake. Summarizing the processes of formation of cracks, we can say that they are the main messengers of earthquakes. Earthquakes are prepared in several stages. The preparation process of each earthquake is manifested in long-term, medium-term and short-term messengers. In addition to these three-stage earthquake detectors, there is also an aftershock stage. For example, the $M=5.3$ magnitude Tashkent earthquake that occurred on April 26, 1966, which lasted for 3 years and consisted of more than a thousand earthquakes, can be used as an example of the aftershock phase.

Thus, possible earthquakes can be explained as follows. Initially, the entire region is in a state of deformation stress. In the preparation zone for a strong earthquake, excessive dense stresses, expressed in long-term harbingers, begin to accumulate. The stronger the future earthquake, the longer it will take to form. In case of accumulation of main dense stresses, in order to reliably predict the location, power, and time of future earthquakes, it is necessary

to organize monitoring of not only short-term but also long-term and medium-term harbingers based on complex seismic prognostic observations. The achievements of scientists of seismologists in our republic lie in the prediction of earthquakes that may occur in the territory of Uzbekistan.

Thus, the scientists of seismologists of our country identified and predicted medium-term anomalous changes in geomagnetic and other fields and a number of future large earthquakes, including: - Isfara - Botken January 31, 1977, M=5.75 magnitude; - Tovasoy December 6, 1977, M = 5.2 magnitude; – Altai November 2, 1978, M=6.8 magnitude; - Chimyon May 6, 1982, M=5.8 magnitude; – Pop February 17, 1984, M=5.5 magnitude; - Hamzaabad June 28, 1985, M=4.8 magnitude; Marjonbulok May 26, 2013, M=6.2 magnitude and other earthquakes. For example, we pay attention to the prediction of magnetometric earthquakes using geodetic methods.

According to «Instructions for the prediction of earthquakes by magnetometric method», published in 2019 at the Institute of Seismology of the Uzbekistan Academy of Sciences, the detector of an earthquake of magnitude M=5 is spread to a distance of R=115 km and T=171 in time day.

When abnormal changes are recorded, the reporter is reliable for repeated complex route observations at 5-10 points of complex forecast stations in several parameters. For the first time, scientists in our country created models of long-term, medium-term, short-term, and other earthquake harbingers based on the hydrogeoseismological analysis of the electromagnetic complex obtained from Uzbekistan and foreign countries. As an example, we give a model of short-term earthquake harbingers created by local scientists based on the registration of abnormal changes related to the magnetic field at the stationary seismological station «Andijan» during the 1978 Altai earthquake. A sharp change in the magnetic field began a week before the earthquake. By October 30, it had reached its maximum, and on that day there was a change in the sign of the field anomaly. Within 2 days, pulsed electromagnetic radiation of the Earth's crust appeared.

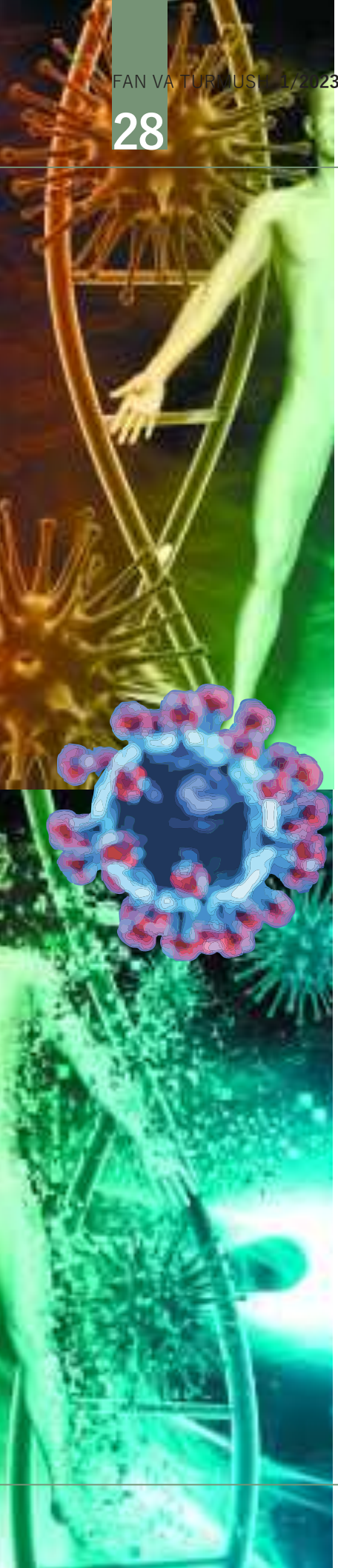
It happened on November 2, 1978, 130 km south of Andijan station two days after this earthquake changed the sign of the magnetic field anomaly, the force of magnitude m=6.8 through the appearance of strong electromagnetic radiation of the earth's crust and the manifestation of abnormal changes in the gas-chemical composition of the underground water.

Rescue work after the earthquake in Turkey

Cracks in the roads – the consequences of the earthquake

It should be noted that since 2019, all complex systematic prognostic observations will be carried out by the Republican Seismoprongostic Monitoring Center of the Institute of Seismology, Uzbekistan Emergency Ministry (former experimental-methodological expedition complex of the Institute of Seismology of the Uzbekistan Academy of Sciences). The results of complex seismoprognostic monitoring are analyzed every week by the interdepartmental commission consisting of leading scientists of the Institute of Seismology and the employees of the Republican Seismoprongostic Monitoring Center and sent to the official authorities. The work carried out by the scientists of our country on the prediction of earthquakes in the near future, based on a comprehensive study of the characteristics of earthquake harbingers, creates a real basis for their early prediction. It forms a model of seismology for building earthquake-resistant houses, taking necessary measures, as well as registration and systematization, for the competent republican services and informing the public about the impending seismic hazard.


HIDRON

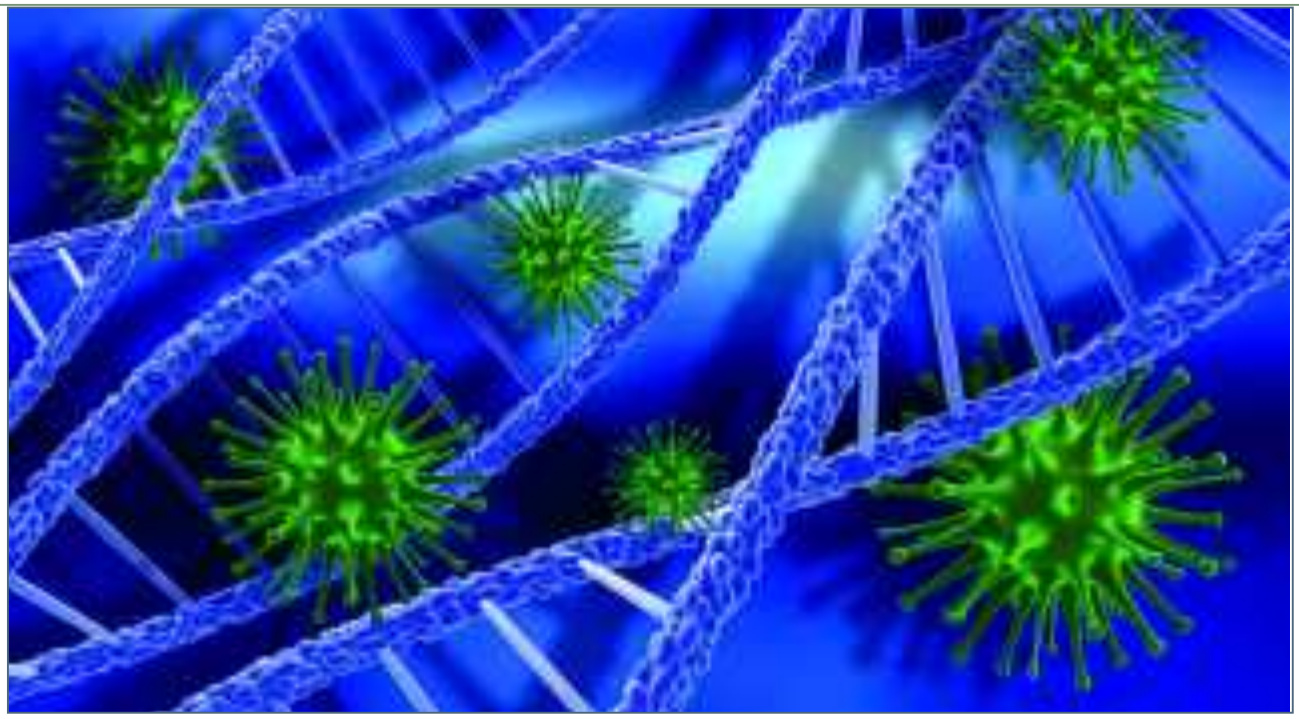


Human immunity and Covid-19: it's time to rewrite the immunology textbooks

T.U.Aripova,
Academician, Director of the Institute of Immunology and Human Genomics, Uzbekistan Academy of Sciences,
D.N.Muratkhodjaev,
Candidate of Medical Sciences

For the last 3 years, humanity has been living together with a new type of coronavirus COVID-19. There is still debate about the origin of this extremely dangerous virus, which has led to such a widespread spread in all countries of the world, to a pandemic, and numerous losses of human lives. Measures are being taken to create a number of vaccines that have passed rapid tests and are recommended by anti-epidemic authorities for widespread use, including Pfizer (USA), Sputnik (Russia), Xonvac (China), Moderna, and others. At the same time, questions should be asked: - how does the human body cope with this dangerous virus; how can its immunity against this virus be activated; - what age and other disease-prone categories of people have contraindicated vaccination against COVID-19 and what is the role of advanced virology and biomedical science in the development of problems of the emergence, spread, and counteraction of this pandemic disease of viral etiology??

Electron microscope image of the SARS-CoV-2 virus



Many scientists and scientific organizations from various countries of the world, including Uzbekistan, are working intensively to solve these issues. In this regard, the scientists of the Institutes of Human Immunology and Genomics, as well as Bioorganic Chemistry of the Uzbekistan Academy of Sciences are particularly interested in solving the problem of activating the human immune system in countering the COVID-19 coronavirus.

In particular, new approaches are being developed to establish mechanisms to counteract this virus at the cellular level, as well as the domestic immunostimulating drug Rutan has been created and recommended for use in order to increase human immunity, diagnostic and detection systems for COVID-19 have been created and other topical problems are being investigated. In parallel, medical scientists are solving the issues of reducing the aggravating consequences for people who have suffered from COVID-19 disease, and especially those suffering from chronic diseases, including cardiovascular, gastrointestinal systems, lungs, hearing, vision, muscular system and other diseases. The role of the development of immunological science in solving these problems and developing new concepts of the body's response to these challenges is great.

As it is known, the history of any scientific discipline moves from one paradigm to another as new facts and discoveries are accumulated that cannot be described within the existing theory. A striking example of such a transition is the change of Aristotle's geocentric model

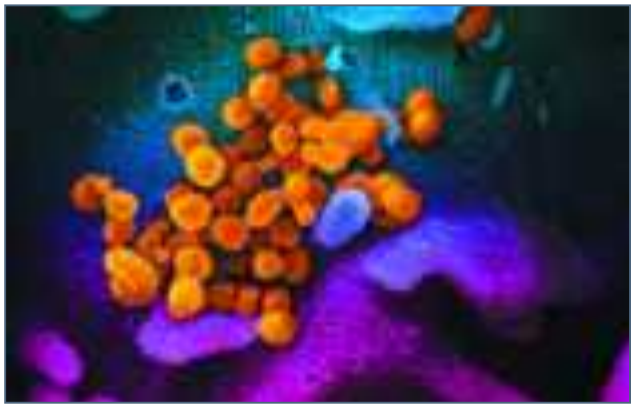
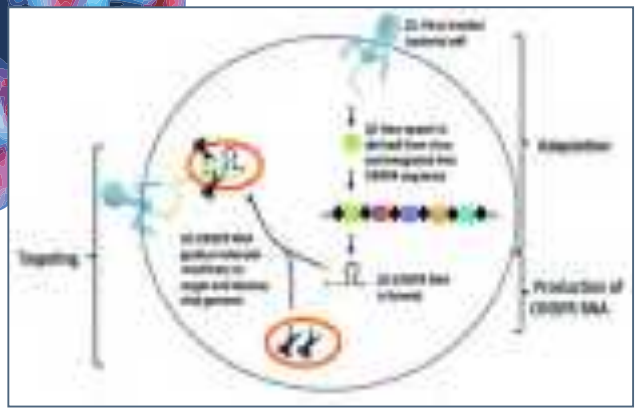


Image on an electron microscope coronavirus laboratory SARS-CoV-2 virus (yellow)

Test kit for Definitions of SARS- CoV-2

Test kit for laboratory detection of coronavirus SARS-CoV-2



Scheme 1. Antiviral system CRISPR-Cas

of the solar system with well-fitting Ptolemy's epicycles to the heliocentric one, where the center is no longer the Earth, but the Sun. Then, with the help of the telescopes that appeared, absolutely amazing facts were revealed by scientists that contradicted Aristotle's celestial spheres. Craters and mountains were found on the Moon, the trajectories of meteorites were determined, the rings of Saturn were discovered, and the movement of Mars was clearly calculated. These facts had to be interpreted, which was ultimately expressed in the heliocentric model development.

So in immunology, such a time has also come – to change the existing theoretical positions on the basis of new knowledge. The discoveries in the late 90s of the 20th century of the mechanisms of CRISPR-Cas and RNA interference summed up the theoretical basis, and the current COVID-19 pandemic provided gigantic factual material for the creation of a new theory of antiviral protection.

It became clear that high titers of antibodies against SARS-CoV-2 are directly related to the severity of the disease, widespread vaccination leads to excess mortality, and analysis of the incidence of COVID by age directly indicated the aggravating role of the immune system in viral infections. All this forces us to reconsider the old dogmas of immunology. One such dogma is that the memory of infection is formed only by T- and B-cells. Immunologists are well aware that this is only part of the picture and that innate immunity can remember and learn. It has long been known that bacteria, plants, and invertebrates lacking T and B cells are capable of developing systemically acquired resistance. Think about it, 100% of the flora (i.e. plants) and 97% of the fauna (this is the percentage of invertebrates among the described animal species) do not have lymphocytes, respectively, do not have antibodies and T-cells, but still, successfully cope with viruses. The question is how this is happening?

Let me remind you that viruses do not have a metabolism and they need a host cell to synthesize their molecules. For this reason, they are unable to reproduce outside the cell, and it seems that without cells there were no viruses, but it has recently been found that viruses co-evolved with cellular ancestors. Some self-organizing protein structures were synthesized for the first time a very long time ago (for example, the capsid proteins of viruses), and some of them were synthesized by the viruses themselves, while they still had such an opportunity, but then they chose the evolutionary-reduction (parasitic) path. Thus, it is safe to say that viruses have ALWAYS been companions of the cellular life form. Today it is estimated that there are more viruses on Earth than there are planets in the Universe - namely 10 to the 39th power. The approximate ratio of viruses to cells, whether it is a single bacterial, plant, or animal cell, ranges from 10 in 1 to 100 in 1. So, there is a huge numerical advantage of viruses over cells, which implies constant evolutionary pressure from viruses! The question arises - how was cellular life possible in such an environment of enemies and how do cells cope with viruses?

It turned out that this is carried out by an RNA-controlled antiviral system. Let's start with prokaryotes, these are unicellular non-nuclear organisms, these include bacteria and archaea. Interestingly, in terms of biomass and the number of species, prokaryotes are the most representative form of life on Earth. For example, prokaryotes in the ocean make up 90% of the total mass of all organisms, and in one gram of fertile soil, there are more than 10 billion bacterial cells. So, it turned


Andrew Zachary Fire *Craig Cameron Mello*
Laureates of the Nobel Prize in Physiology or Medicine (2006)

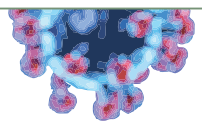
out that prokaryotes, who first appeared on Earth as much as 3 and a half billion years ago, have a way of security. Bacteria and archaea were able to create an intracellular defense system that keeps the memory of past encounters with viruses. This information is located in special DNA regions that appear after a collision with the genome of a foreign virus and form CRISPR arrays (shown as colored squares in Scheme 1).

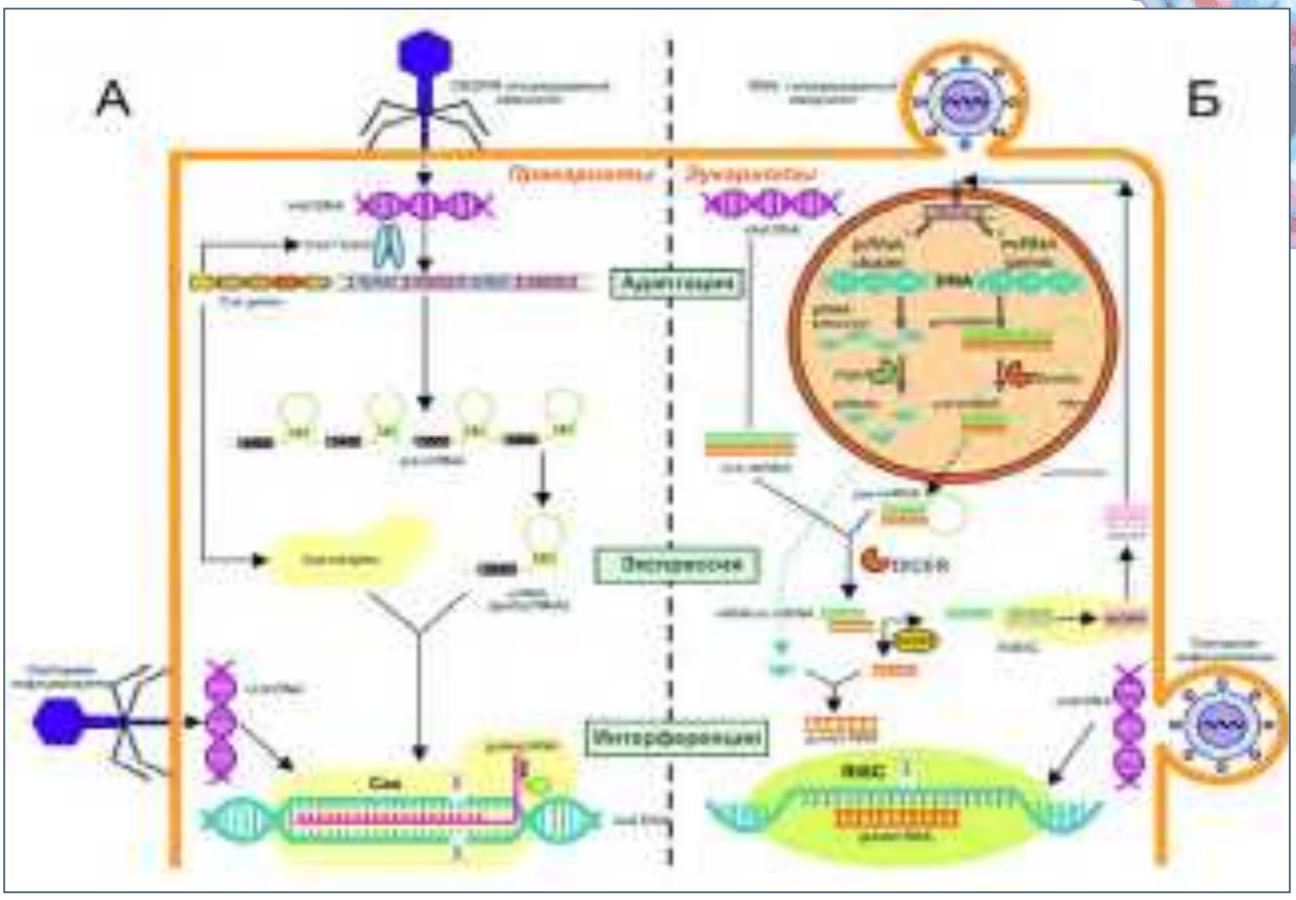
How is the memory of this invasion preserved? A virus that has entered a bacterial cell is detected using Cas (CRISPR-associated) proteins, a type of nuclease that acts like scissors and cuts the nucleic sequences of the virus. Then a certain part of the virus is integrated into the bacterial DNA in the form of a so-called spacer. And when re-infected, copies of this spacer in the form of microRNA direct these same nucleases to destroy the foreign genome. All this was created by nature just ingeniously!

Thus, CRISPR-Cas is a true adaptive immune system with a memory of past encounters with foreign viruses, which is stored in unique spacer sequences derived from viral genomes and inserted into CRISPR arrays. By the way, by the order in which spacers appear in this array, you can find out which viruses this bacterium encountered and in what order. Unfortunately, for us, eukaryotes, there is no such information yet! The CRISPR-Cas system turned out to be so effective that it retained its role in multicellular organisms, slightly changing, taking into account the presence of a nuclear membrane and terminal chromosomes. In multicellular organisms, and the first eukaryotes appeared only 2 and a half billion years later, there is a similar mechanism called RNA interference. RNA interference was first discovered in 1998 in the nematode Caenorhabditis elegans by two American scientists in the field of molecular genetics - Andrew Zachary Fire and Craig Cameron Mello, and they were later awarded the 2006 Nobel Prize in Physiology or Medicine. By itself, RNA interference is a mechanism for suppressing the work of a gene by interacting microRNA (the same spacer) with messenger RNA (mRNA), as a result of which this mRNA does not reach the ribosomes. Probably, it is necessary to recall the central dogma of biology - DNA - RNA - protein. That is, for a gene (and this is a DNA molecule) to show its activity, which is expressed in the synthesis of a specific protein (and this is a chain of amino acids), a transmission link is needed - a messenger RNA. This mRNA must pass from the nucleus, where it was read from the DNA molecule to the cytoplasm, where the synthesis of a certain protein on the ribosomes would take place.

But on the way, this thread passes through a kind of customs inspection, in a special RISC complex (abbreviation for RNA-induced silencing complex). These checkpoints have pictures (in the form of miRNAs) of wanted sequences that SHOULD NOT be allowed into ribosomes for protein synthesis. If there is a complete match of photographs (nucleotide sequences), then this mRNA is destroyed by nucleases, and even if it is incomplete, then such messenger RNA is delayed until clarified! Accordingly, the protein is not synthesized, which means the gene is silent! It is an essential part of our body's epigenetic control. Indeed, in every cell of different tissues the same set of DNA, but they are all different. And this diversity is largely supported by RNA interference. It turned out that it is thanks to RNA interference that specific antiviral protection is formed. These checkpoints also contain images of viruses that block the reproduction of viruses in the cell. Sceme 2, taken from our last article, compares the main stages in the formation of antiviral defenses in prokaryotes (A) and humans (B). So, cells fight viruses (interference stage) namely due to the presence of special nucleoprotein complexes RISC in humans at the bottom right and CRISPR-Cas in bacteria on the left. In these complexes, the viral genome is cut by special nuclease enzymes directed by microRNAs (prints from spacers) formed at the expression stage. The final stage of "vaccination" of a target cell after a viral invasion is the insertion of a spacer into the DNA of the cell itself (adaptation stage). When this virus enters the cell again, the microRNAs synthesized in this case are loaded into a complex of nucleases and directed to cut the foreign genome. Thus, there is a complete analogy between these two systems of RNA-controlled antiviral cell immunity.

To date, the role of RNA interference in a variety of viral infections caused by the different types of viruses: - respiratory syncytial viruses, - human immunodeficiency viruses, - hepatitis B and C viruses, - influenza viruses,





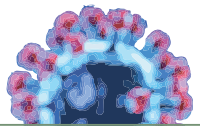
Scheme 2. RNA-guided antiviral systems

and coronaviruses has been firmly proven. In all viral diseases, the built-in mechanisms of RNA interference are activated. Let's return again to the evidence base and the treatment of viral infections. The presence of such spacers effectively prevents infection in mammals. It was shown that it is spacers in the DNA of target cells that inhibit the reproduction of bornaviruses. Moreover, Russian immunologists have already created and registered a drug against COVID-19 based on RNA interference. They matched miRNA to the polymerase complex of the SARS-CoV-2 virus itself - this is the MIR-19 preparation. This microRNA, when it enters the epithelial cells, takes its place at the post in the RISK complex and effectively directs the cell's defenses in the form of scissors-nucleases to split the viral genome.

At the present stage of scientific knowledge, only the question of the details of the incorporation of parts of the viral material into the DNA of cells remains not yet fully clarified (adaptation stage). The very existence of such mechanisms has long been known in the study of retrotransposons, where intracellular reverse transcriptase converts retroelement transcripts and cytoplasmic RNA into DNA. Interestingly, human telomerase, which is essentially a reverse transcriptase, actively uses proteins, in particular AGO-2, involved in RNA interference to synthesize telomeres with their subsequent integration into chromosomes. It should be noted that retroelements make up half of human DNA, and it is natural to assume that a significant part of the human genome is encoded DNA fragments of previously encountered viral genomes - the same spacers. And arrays of spacers, by analogy with a phone, are a black list of blocked numbers! Recently, a huge number of works have appeared proving the presence of antiviral protection in humans, based on RNA interference specifically against the SARS-CoV-2 virus. Thus, it was shown that SARS-CoV-2 spacers appear in the chromosomes of patients who have undergone COVID, in experimental cell models the formation of viral spacers of exactly 22 nucleotide pairs has been shown, which is 100% proof of the work of RNA interference.

Interestingly, these spacers are also formed after the administration of the mRNA vaccine, so that, despite all the side effects associated with their use, they still contribute to the formation of RNA interference.

The data listed above directly indicate the ability of



the cells themselves to resist viral invasion. Every cell in the human body has potentially retained an ancient anti-virus system based on the use of small RNAs. Moreover, the protection is adaptive, i.e. adapts to a specific virus, and forms a full-fledged intracellular immune memory!

Therefore, the main task for all genetic immunologists today is to convey this new knowledge to the general medical community because it is the current paradigm of antiviral protection that justifies the regular administration of vaccines and boosters, doctors sincerely believe that only antibodies and T-cell memory help fight viruses!

At the moment, a huge amount of evidence has accumulated confirming the lack of protective properties of these vaccines when the virus mutates, but the saddest thing is that the harm caused by these mRNA vaccines to the body of vaccinated people with each new dose is becoming more and more noticeable. It is now possible to separate the risk/benefit of getting COVID-19 and taking vaccines, that were created for these viruses struggle. Publicly available data for the UK, Germany, and Israel directly point to an increase in mortality from non-COVID-19 causes in all age groups. And the concomitant decline in male and female fertility is directly expressed in depopulation statistics. Moreover, this trend is most pronounced in those countries where the largest percentage of the vaccinated against the COVID-19 population is. But this topic requires a separate story, as well as an explanation of why the involvement of a specialized immune system in the face of T- and B-cells worsens the prognosis of a viral disease.

Doctors sincerely believe that only antibodies and memory T-cells help to actively fight viruses, including such formidable ones as COVID-19!

Artificial Intelligence in 2023: Importance, Trends and Conclusions

Artificial intelligence (AI) has become part of our daily lives. From «Hey Siri, make an appointment with Josh for Wednesday noon» to «How does Netflix know I'll like this movie?». Even the government of Madrid has achieved a 25% reduction in annual energy consumption by analyzing information about passenger traffic, trains and other metro-related fares using AI.

This is not surprising, since about 80% of everyday devices are equipped with some form of artificial intelligence, and 77% of people use AI-based solutions. Moreover, financial reports say we are in the middle of an AI revolution: the global AI market is projected to grow to $309.6 billion by 2026 at a CAGR of 39.7%. AI will continue to evolve in 2023 but will face strict rules. In today's article, we reveal the importance and trends of AI in 2023, along with a quick implementation guide.

Why is AI so important in 2023?

Accuracy, cost-effectiveness, and improved user experience are well-known benefits of AI. But they are quite general and do not take into account the current situation. Today we analyze the real value of AI in 2023.

The world is still coping with the challenges that 2020 will bring. Businesses need help digitizing their operations as users are accustomed to fast and highly efficient online services. This trend is here to stay in 2023, and AI is the best way to replace manual work, make shipping more accessible, and create user-friendly digital products.

The medical industry will also need artificial intelligence. The ongoing pandemic has highlighted the need to improve the performance of assistive systems and other related software to improve the quality of care for physicians and patients.

At the end of 2022, thousands of people had lost their jobs. The problem is two-way, as businesses are shifting from non-automated processes to automated ones, and potential employees need tools to quickly and easily find new jobs. This seems to be a good prerequisite for developing AI products. In the first two months of 2022 alone, 212,485 cybercrimes were registered. For comparison, this is more than the total in 2018. Forecast

7 Key AI Trends for 2023

We don't know for sure what will happen in the world of technology this year. But we can set the direction of development and transformation. Here you will find seven

of the hottest artificial intelligence trends and ideas for their implementation in a particular business segment.

AI assistants

Have you ever spoken to a customer service representative or an online store manager? These conversations contain valuable information that helps streamline various business operations. In 2023, AI-enabled virtual assistants are essential because they can analyze information about emerging issues based on voice recordings or text messages and thus continuously improve the customer experience. The goal of any business is to satisfy (or even predict) customer needs. To make this possible, the technology can analyze the context, mood, semantic similarity, speech nuances, and even accents. This information can be used to create scenarios to better deal with similar problems in the future. For example, your customer asks to return a purchase. If there are difficulties during the return process, AI analyzes the call or message of the client, associates the problem with its solution, and more effectively solves similar problems in the future.

Content generation

Generative AI is an advanced tool for creating augmented content, be it images, texts, or even videos. AI-based solutions use several different sources and transfer-style learning (a machine learning technique where we reuse a pre-trained model as a starting point for a model for a new task) to create the required content. Craiyon, for example, generates images based on text descriptions. AI is already streamlining the work of the marketer, but we expect it to help media professionals in the future as well. One day, we will be watching movies entirely created by artificial intelligence and will be able to recreate old movies in HD quality several times faster.

Explainable AI

Explainable AI (XAI) is a set of tools that help people understand decisions or predictions made by AI. This contrasts with the «black box» concept in machine learning, where even its developers cannot explain why the AI came up with a particular solution. It is an analytical set of tools and platforms that help understand and characterize AI-based forecasts. In addition, explainable AI smoothes the AI adoption process. Managers and entrepreneurs receive not only forecasts but also their justification and justification. It's not just «What?» but also «Why?»

In 2023, the demand for explainable AI will increase significantly in the healthcare and financial sectors. Medical professionals will only issue an AI-based prescription for good reason, just like a bank employee cannot reject a loan application without giving reasons.

Chess game: human versus artificial intelligence

The biggest problem with implementing explainable AI is ethical lapses. But this issue can be resolved with the help of thorough checks and checks carried out by legal and public structures.

Edge AI

Peripheral intelligence or edge AI is a combination of artificial intelligence and edge computing. Therefore, to understand edge AI, you need to understand what edge computing is.

Let's imagine the Apple Watch. It is a standalone device that communicates with other smart devices via the Internet of Things (IoT). Edge computing helps to achieve a seamless exchange by moving data closer to its origin. In this way, the functions remain «on the edge» and do not move around the cloud storage. «The Edge» can be a car, a laptop, a medical device—anything closely related to a smart device. Simply put, edge AI means applying intelligent algorithms to the edge computing environment. It provides secure storage and faster processing of huge amounts of content and business information, purchase records, and other big data outside of the cloud.

Edge AI is likely to bring changes to several industries. In healthcare, sensitive patient information can be stored in one local repository, allowing healthcare organizations to perform real-time analytics without compromising security. In the automotive sector, fast data processing can help autonomous vehicles provide safer driving for their passengers.

AI-based non-contact shopping

Have you ever wondered if information about the behavior of customers in a physical store can be useful for business? Previous shopping experiences and other information collected and analyzed by AI open up new horizons for retail. Let's take a look at the following example of hassle-free shopping with computer vision (CV) AI and edge AI. Buyers enter the store and scan the QR code through a special application through which they have a payment method connected. Customers then simply select the items they need and walk out of the store with them. This stream is called Just Walk Out (JWO) technology. But wait, what exactly just happened?

Our end-to-end system identified all the items that shoppers put into their shopping carts using smart cameras and special sensors on the shelves. In this way, the system knows which product the buyer has chosen, so payments are automatically withdrawn through the application. Shoppers will finally forget about long queues and get personalized recommendations for their next purchase on a regular basis. Information for process improvement will be obtained through video analytics, real-time analysis, and integration with past purchase histories.

Information Security

In 2023, more companies plan to invest in measures to prevent business data leaks and cyberattacks, which are mainly caused by accessing corporate servers from personal devices. How can algorithms help with this? Automated AI-enabled security models monitor large-scale networks and databases to assess risk and provide appropriate recommendations for improving security. This approach helps to automate manual work and quickly detect threats.

Federated learning

Federated learning is a direct result of recent AI advances in cybersecurity. It is a new way to train decentralized machine learning models on multiple peripherals such as regular smartphones or more sophisticated medical instruments. The big advantage of this method is that the devices continuously train the model but do not send the data to a central server, unlike traditional machine learning methods. In addition, homomorphic encryption allows information to be exchanged between client and server without risking privacy. This type of encryption allows users to perform calculations on encrypted data without decrypting it first. Manufacturing companies can use federated learning models to develop predictive maintenance models for equipment. Proactive maintenance may encounter some obstacles such as customers who do not want to share their personal data or problems with exporting data from different countries/sites. Federated learning can deal with these issues by using local datasets.

Peer-to-peer (P2P) lending is one of the engines of financial technology (FinTech). FL can improve P2P implementation, whereby lenders will have better information about a borrower's ability to repay a loan to lenders. And it's also a case of credit analysis where traditional banks (like P2P lenders) can assess a particular borrower's creditworthiness with their data without requiring the borrower's data to leave their phone. This provides efficiency and speed in determining credit scores for borrowers, as there is no need to clone the borrower's data to a central server so that the machine learning algorithm can perform analysis before the credit report is generated on the device. Instead, a machine learning algorithm performs credit analysis on the borrower's device.

Google has already launched a beta version of an integrated learning environment called TensorFlow Federated.

The article was prepared by **Z. Muhsinova** based on materials: https://www.linkedin.com/pulse/artificial-intelligence-2023-insights-trends-importance-chisoftware?trk=organization_guest_main-feed-card_feed-article-content

Profile of the Man of the Future: Elon Musk

Our hero was born on June 28, 1971, in the city of Pretoria, South Africa, in the family of engineer Errol Musk and nutritionist, famous model Maye Musk. He has a younger brother, Kimbal, who owns The Kitchen restaurant chain, and a younger sister, Tosca, who is currently a film director and producer.

Musk made his first $500 when he was 12 years old by selling a video game he made called Blastar. He spent the money received on shares of a pharmaceutical company. After his parents divorced, he sold his shares and left South Africa for Canada. He studied for a while in Canada and transferred to the University of Pennsylvania. There he received a bachelor's degree in physics and economics. Then he entered Stanford. A few weeks before graduation, he started his own business: Musk opened Zip2 Corporation with his brother Kimbal. He pitched the software to news firms and later sold Zip2 to


SPACEX

the American PC company Compaq, pocketing $22 million of his share.

Electronic payment system X.com. Merged with Confinity, renamed it PayPal, and was acquired by eBay in 2002 for $1.5 billion. Musk's share was more or less 180 million dollars.

Musk's only public company. In fact, he did not found Tesla Motors, but engineers Martin Eberhard and Mark Tarpen started it in 2003. And our hero joined the team only after a year and invested part of the proceeds from the sale of PayPal. However, the company is associated with his name for good reason: it was he who took this business to a completely new level. Thus, the Tesla Model S 70D won the «Car of the Century» in 2015, and the 2013 Tesla Model S won the «Car of the Year» award in the last 70 years. The company also includes SolarCity, which sells solar panels and rechargeable batteries.

The space technology company is Space Exploration Technologies Corporation or SpaceX. This campaign produced the Falcon 1, Falcon 9, Falcon Heavy and Dragon spacecraft. Snake has long been full of ideas about space flight and the future colonization of Mars. So, in January 2020, he said that he intends to send 1 million people to Mars by 2050. In ten years, he plans to design thousands of reusable ships developed by SpaceX. But now the main business of the company is the delivery of cargo to earth orbit.

It aims to provide high-speed Internet delivery anywhere in the world. The Starlink near-Earth satellite system includes the launch of 12,000 satellites into orbit by the mid-2020s. In April 2020, 418 satellites appeared in orbit.

OpenAI NPO dealing with artificial intelligence. The mission of the project is to create powerful artificial intelligence that will benefit all of humanity. Elon has repeatedly expressed concern about our future relationship with machines. He believes that artificial intelligence may pose the greatest existential threat to humanity and be even more dangerous than nuclear weapons.

The Boeing Company is a tunnel construction company. Originally a subsidiary of SpaceX, it was spun off in 2018. It is based on the concept that the urban transport system could consist of a vast network of tunnels for surface vehicles. «I think tunneling skills can be very useful for Mars,» Musk said.

Neuralink is a neuro technology company. In July 2019, the billionaire announced his N1 brain chip project. A small wireless device is implanted in the brain. It is designed to help people with mental retardation or paralysis. In August 2020, Neuralink held its first presentation of the chip, and in spring 2021, it demonstrated a macaque playing a video game with the implanted chip.

TESLA electric car

Yes, Elon Musk has officially broken the world record for spending his personal wealth and entered the Guinness Book of Records. But it did not break him. On January 6, 2023, his wealth was $207.63.

The article was prepared by **A'lo Anvar** based on materials:
https://trends.rbc.ru/trends/futurology/5eeb9edd9a79475e75f0c0e4
https://ru.m.wikipedia.org wiki/%D0%9C%D0%B0%D1%81%D0%BA,_%D0%98%D0%BB%D0%BE%D0%BD
https://m.gazeta.ru/tags/person/ilon_mask.shtml

SPACE X Satellite

SPACE X rocket

The Greatness of the Spiritual Heritage

Shoazim Minovarov,
Director of the Center for Islamic Civilization in Uzbekistan

The Center for Islamic Civilization in Uzbekistan, which is being built in Tashkent next to the Hazrati Imam complex, is becoming one of the most remarkable and unique buildings in the capital. As the initiator of the creation of the Center, the President of Uzbekistan Shavkat Mirziyoyev emphasized that this complex will become a symbol of the spiritual strength of our people. The study of the rich scientific and cultural heritage of our country, the contribution of great ancestors to the development of world culture, as well as religious and secular sciences is one of its main tasks. The emphasis on the term «civilization» reflects a well-thought-out strategy for its activities as a center of scientific, spiritual, educational, and museological activities.

The role of the cultural and spiritual heritage of Uzbekistan in the development of world civilization is generally recognized. Of particular importance in the

Model of the building of the Center for Islamic Civilization in Uzbekistan

rich heritage of our country is the Islamic period, which has a long history. The Islamic civilization of Uzbekistan incorporates the names of the greatest scientists, philosophers, historians, and poets, the greatest experts in Islam and theorists of Sufism, skilled craftsmen, miniaturists, and architects. In the 9th-12th centuries, such prominent scientists as Al-Khwarizmi and Al-Fergani, Al-Bukhari and At-Termizi, Al-Farabi, Abu Ali ibn Sina, Abu Raykhan Beruniy, Zamakhshari, Mahmud Kashgari, and many others worked in Central Asia. At the beginning of the 11th century, the Ma'mun Academy operated in Khorezm, which played an important role in the scientific and cultural development of its era. Thanks to the unprecedented development of sciences and spiritual culture, this period in the history of Central Asia was called the era of the First Eastern Renaissance. Its historical significance lay in the fact that it gave impetus to the development of scientific knowledge and culture not only in the Muslim world but also in Western Europe. In the 10th - 13th centuries, the philosophy of Sufism was widely spreading in Maverannahr, the brightest representatives of which were Khwaja Ahmad Yassawi, Abdukholik Gijduvani, Bahavuddin Nakshbandi, Najmiddin Kubro, and others. Their teaching had a huge positive impact on the development of the culture and spirituality of the people of the entire Muslim world.

After the devastating invasion of the Mongols, thanks to the activities of Amir Temur, cities and crafts were restored in Maverannakhr, and new majestic buildings were built. The 14th - early 16th century is the era of the revival and prosperity of the sciences, culture, and Islam, rightly called the Temurid Renaissance. At this time, a new impetus was given to the development of architecture and urban planning, poetry, literature, art crafts and the art of miniature flourished. At that time, the founder of the Uzbek language, poetry, and literature, the great poet and thinker Alisher Navoi worked.

During the First and Second Renaissance, hundreds of great scientists, thinkers, and spiritual figures of Islam created a huge amount of scientific works and discoveries that still serve humanity. These centuries also saw the creation of unique handicrafts, masterpieces of miniature, and architecture. However, this richest layer of our national heritage has not been studied enough, and the world community has an incomplete idea of the outstanding achievements of our ancestors. A deep and comprehensive study of the cultural, spiritual, and artistic heritage of our ancestors is one of the important scientific and educational tasks of the Center for Islamic Civilization in Uzbekistan. Among the tasks of the Center, one should also highlight the high-quality publication of medieval written sources and the popularization of the heritage of our country at the international level. In this direction, for a short period of scientific activity of the Center, books, articles, albums, and monographs were published that propagate the essence of Islamic civilization and the humane nature of the sacred religion of Islam.

The Center for Islamic Civilization in Uzbekistan aims to establish close cooperation with prestigious international scientific institutions and structures. The scientists of our Center held scientific and practical meetings with related scientific organizations and educational centers in Turkey, Iran, Pakistan, Saudi Arabia, Qatar, Malaysia, Indonesia, Morocco, Tunisia, and other countries. Photo exhibitions were organized in Istanbul and Ankara on the topics «Contribution of Uzbek theologians to world civilization» and «New Uzbekistan - the basis of the Third Renaissance.»

Over the past period, work has been established to identify ancient written sources created by our ancestors. In order to replenish the library fund of the center, measures were taken to deliver electronic or facsimile copies of sources on the history of Uzbekistan stored in foreign countries, including the manuscript fund of the Suleimani library in Turkey, the manuscript fund of libraries in India, the Tehran State Museum, the Al-Azhar manuscript fund, the manuscript fund of the Egyptian Academy, collection of the National Library of Egypt.

Researchers of the Center have translated into Uzbek and prepared for publication such valuable historical works and manuscripts as «Amir Temur Tuzuklari (Codices of Amir Temur)», «Devan-i Feruz», «Bayoni etiqodi ahli sunnat val-jamoat», «Mukaddimai ilmi faroiz», «Faroiz us-Sirojiya». Two volumes of the «State Register of Ancient Written Sources of the Republic of Uzbekistan», the collection «Our Great Ancestors», «Latoifu-l-Ku'ron» by Ahmad ibn Muzaffar Rozi, and the work «Vakfiya» by Alisher Navoi were also published.

Uzbekistan has a scientific potential that can significantly influence the development of areas of study of Islamic history, culture, and scientific heritage. The Center for Islamic Civilization takes on the character of a platform that coordinates its efforts and helps to realize the results achieved, and this gives its promising results.

Thus, the staff of the Center published an illustrated book entitled «Third Renaissance - New Uzbekistan», a catalog of rare books - «East and West». These publications are usually published in several languages - Uzbek, Russian, English, Arabic, and French. Among

the prominent publications of the Center, one should also note another illustrated book - «Encyclopedia of Renaissance Scientists» and «Scientific Centers of Maverannakhr», created under the guidance of Professor Z. Munavvarov, as well as the book «Uzbekistan in the context of world civilization» and the illustrated book - «History of Uzbekistan», created under the scientific guidance of J.Ismailova, D.Sc.

In the field of studying artistic heritage and art, it should be noted the publication of the fundamental work «History of the Arts of Uzbekistan» by Academician A. Khakimov in Uzbek, Russian, and English and his monograph «Islamic Art of Uzbekistan: Philosophy of Poetics». A colorful and informatively important publication is the illustrated book of the researcher M. Kuziyeva "Uzbek National Clothes of the Period of the Khanate", prepared under the scientific grant of the Center for Islamic Civilization, also published in three languages - Uzbek, Russian, and English.

Another important activity of the Center is the formation of its museum fund and exposition. To date, the museum's fund has received 630 historical exhibits, models, and replicas. For the monumental hall of the Quran, a collection of 28 rare copies of the Holy Scripture was formed. 1584 exhibits were prepared to form a museum exposition in 9 thematic and exposition areas.

The Museum of the History of Islamic Civilization is of great scientific and educational importance in the structure of the Center. Its concept was developed by leading scientists of Uzbekistan - archaeologists, historians, art historians, and orientalists with the active participation of religious leaders and representatives of the Spiritual Board of Muslims of Uzbekistan. This concept is based on the principle of historicism, due to which the exposition includes both the period of pre-Islamic civilization and the modern stage of development of our country.

The concept of this museum reflects all the historical stages and achievements of the Islamic civilization of Uzbekistan and consists of 9 main halls, in which the following sections are presented: 1. «Central Asia to Islam»; 2. «Spread of Islam in Central Asia»; 3. «Hall of Mus'hafi Usman»; 4. «History of the education system»; 5. «Progress and science»; 6. «Urban planning and architecture»; 7. «Arts and crafts»; 8. «Traditions»; 9. «New Uzbekistan - Third Renaissance». In order to improve the work on the exposition of the Museum of the History of Islamic Civilization in Uzbekistan, in the beginning of 2023, the Republican Scientific and Practical Conference was held, in which leading scientists and museum experts of Uzbekistan took part. The conclusions and recommendations of the conference participants are reflected in the activities of the Center's staff.

The Center of Islamic civilization in Uzbekistan serves as a solid bridge between the glorious past and the bright future of our country.

Construction progress of the building of the Center for Islamic Civilization in Uzbekistan

Wall paintings in the interior of the Center for Islamic Civilization in Uzbekistan

Masterpieces of the Ancient Art of Uzbekistan in the Louvre

Shakir Pidaev,
Director of the Institute
of Art History

The unique artifacts presented at the exhibition, which opened at the end of 2022 at the Louvre, embody the 2000-year history of the culture of our people. The exhibition covers the period from the 4th century BCE until the beginning of the 16th century CE, i.e. from the conquest of Transoxiana by Alexander the Great to the era of Amir Temur and the Temurids inclusive. This article is devoted to the section on the ancient art of Uzbekistan, samples of which were presented at this exhibition.

In 330-327 BCE Alexander the Great suppressed the people's liberation movements in Bactria and Sogdiana. As a result, these territories were transformed into one of the eastern lands of his vast empire and entered the cultural zone of the so-called Hellenistic world. After the death of Alexander the Great, these lands fell under the rule of the Seleucids and then became part of the Greco-Bactrian kingdom.

During the reign of the Greeks for almost a century, radical changes are observed not only in the political but also in the socio-economic and cultural life of Bactria and Sogdiana. Ancient cities were restored, dozens of new settlements were founded, and the handicraft industry reached new levels of its development. This can also be seen in the pottery most commonly used in everyday life. Pottery found in the course of archaeological research in the settlements of the southern and central regions of ancient Uzbekistan - Dalverzintepa, Khalchayan, Kampyr-tepa, Khatynrabad, Old Termez, Afrasiab, Yerkurgan, and dozens of other monuments, testifies to a peculiar symbiosis of local and Greek traditions. New forms of products appear - amphoras, oinochoes, and other products that bear traces of ancient Greek pottery. At the same time, local craftsmen did not copy

Greek samples but created pottery unique in silhouette on their basis.

The degree of penetration of the Hellenic culture into the public life of Bactria is expressed in the images on the coins of that time. On the obverse of the coins, with exceptional artistic skill, images of local kings and rulers are presented. On the coins, the medalists skillfully revealed not only the appearance of the ruler but also their characteristic features of the position of the hands and body. The reverse of the coins depicts the gods of the ancient Greek pantheon - Zeus, Hercules, Apollo, etc. Their interpretation is distinguished by high plastic skill, putting these coins along with the world masterpieces of ancient Greek and ancient Roman medal art.

From the middle of the 2nd century BCE the political position of the Greeks in Bactria and Sogdiana began to noticeably weaken, and they gradually left the historical scene. However, the influence of Hellenism retained its traditions in the culture and art of the indigenous peoples for several more centuries. How the processes of interaction between local and Hellenic traditions proceeded can be seen in the example of wonderful sculptures and frescoes found at the ancient settlement of Khalchayan, located in the Surkhandarya region of Uzbekistan.

Sculptures of Khalchayan were created from clay, and painted in dark red. The sculptors accurately conveyed the appearance of each character and his position in society. Undoubtedly, the sculptural images of Khalchayan are outstanding works of art, in which one can see a reflection of the Hellenic plastic traditions. Unlike the ancient Greek samples, which were mainly made in stone, Khalchayan's sculpture was created from clay, the plastic properties of which were perfectly mastered by local craftsmen. The Kushan era occupies a special place in the history of the ancient world. The Kushan state, which united the vast territories of India, northern Afghanistan, and southern Uzbekistan, was inhabited by various peoples and ethnic groups. For this reason, various religions were spread on its territory - Buddhism, Zoroastrianism, religious and mythological ideas of Ancient Greece, as well as religious and cult beliefs of nomadic peoples. An important role in the life of the Kushan state was played by Buddhism, which, thanks to the missionary activity of the Buddhist communities, became widespread in the territory of Southern Uzbekistan. The Kushan kings provided great financial support for the construction of Buddhist temples. Thanks to the work of Uzbek archaeologists, several large Buddhist temples were discovered on the territory of Southern Uzbekistan. They were decorated

Kushan prince. 1st century CE. Dalverzintepa. Surkhandarya

Seated Buddha. Triad. 2nd century CE. Fayaztepa. Surkhandarya

Bodhisattva. 2nd–3rd centuries CE. Dalverzintepa. Surkhandarya

with works of sculpture and wall painting, and on their territory were also found works of applied art of Indo-Buddhist content.

The policy pursued by the Kushan kings provided the Buddhist monks with every opportunity for the widespread dissemination of the Buddhist religion and culture. The largest center of the Buddhist religion and artistic culture was located in Termez. Such a center was a unique Buddhist complex, consisting of more than 15 temples, and located in the Termez region on the settlement of Karatepa. Another monumental Buddhist temple located near the settlement, Karatepa, is known today as Fayaz-tepa. An amazing sculptural composition of stone in the form of an image of Buddha and monks worshiping him, discovered in the Fayaz-tepa temple, became a symbolic invitation to an exhibition at the Louvre.

A special place in the exhibition in the Louvre is occupied by sculptures of bodhisattvas found during excavations of a Buddhist temple at the site of Dalverzintepa. They date from the 3rd - 4th centuries and attract the attention of the audience not only by their plastic originality but also by the impressive monumentality of their harmony. In the sculptures, we will not find the vitality and emotional energy inherent in the Hellenic tradition. Despite the graceful and beautiful facial features, Buddhist characters are distinguished by emotional impassivity.

Among the exhibits of the exhibition, two Dalverzin sculptures, recognized by experts as masterpieces of world significance, should be singled out separately - this is the head of the "Kushan Prince" and the image of a devata with an easily noticeable smile. A unique cultural monument of Northern Bactria is gold items found in 1972 as part of the famous hoard weighing 36 kg at the site of Dalverzintepa. According to archaeological data, the treasure dates back to the second half of the 1st century CE. This is the first time the treasure has been shown at an exhibition abroad. The main part of the treasure consists of golden tiles indicating the measure of weight, some of which are inscribed in Kharoshtha handwriting. The inscriptions indicate the weight of the tiles and read: «gift of the god Mithra». In addition to gold tiles, the hoard included a variety of jewelry - necklaces, bracelets, belt badges, etc. Jewelry from the Dalverzin treasure demonstrates the high technological level of work of ancient craftsmen. Thus, a necklace made by a complex combination of various techniques is one of the unique ones. Magnificent is also a golden plaque in the form of a beast curled up in a ring, grabbing one of its paws in its mouth. The art of Kushan Bactria was formed on the basis of a complex interaction of local

Bactrian and introduced Hellenic, Scythian-Asian, and Indian artistic traditions.

At the time when Bactria was part of the Kushan state, a number of territories between the Amu Darya and the Syr Darya, including Sogdiana and ancient Khorezm, were part of the Kangyui state. During this period, the traditions of the Hellenic culture were widespread in the large cities of Sogdiana, while the cultural traditions characteristic of nomadic tribes were the determining factor in the steppe zones of Transoxiana interfluve. Noteworthy in this respect is the belt bone plates discovered at the Orlat cemetery near Samarkand which were made by local craftsmen in the 1st - 2nd centuries CE. Despite some sketchiness of style, the images are filled with dynamism, characteristic of the art of the steppe peoples.

In ancient times, Khorezm preserved and developed its traditions of ancient Eastern culture, which can be seen in the wonderful frescoes discovered by archaeologists at the site of Akchakhon Kala, one of the capital cities of ancient Khorezm. These unique wall paintings, in the form of a gallery of portraits of representatives of the ruling house, were also presented at the exhibition in the Louvre. The images from Akchakhon Kala do not have that cheerful enthusiasm that permeated the aesthetics of the Hellenic culture. Nevertheless, these frescoes are distinguished by a peculiar style in the transfer of the characteristic features of the external appearance of the portrayed and excellent painting skills.

Taking a general look at the path of evolution of the ancient art of Central Asia, one cannot but be amazed at the richness of themes and motifs, images and compositions that it gave rise to. In general, the entire ancient era is characterized by the development of local art in its interaction with the traditions of the culture of the countries of the Near and Middle East, Ancient Greece and Rome, India, China, and the Steppe East, which led to a kind of symbiosis of various religious and artistic traditions. It is this remarkable transnational feature of the ancient art of Uzbekistan in the art that has become an attractive feature of our exposition in the halls of the Louvre, which has ensured an unprecedented interest in it from the audience and specialists from all over the world.

Gold buckle. Ist century CE. Dalverzintepa. Surkhandarya

Head of a noble lady. 1st century CE. Dalverzintepa. Surkhandarya

Kamaliddin Behzad. Portrait of Hussein Mirza Baykara. 500-1525

Behzad and Leonardo da Vinci – paradoxes of historical associations

Akbar Khakimov,
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In world culture, there are unique creations created in different regions and at different times, but which are aesthetically equivalent masterpieces. The grandeur of the Egyptian pyramids and the elegance of the Taj Mahal, the refinement of the wall paintings of Afrasiab and the attractive luxury of baroque architecture, the emotional fullness of Matisse's paintings and the coloristic expressionism of Uzbek suzanes, the endless play of oriental arabesques and the unprecedented melancholy of Malevich's "Black Square" - this is an incomplete series of equal in importance and stunning in the power of the soaring achievements of human genius. From a kaleidoscope of artifacts scattered across regions and eras, researchers can make comparative combinations that reveal the idea of the universality of world culture. In this comparative historical context, it is interesting to consider the creative heritage of Kamaliddin Behzad, a prominent representative of the Temurid Renaissance, and to try to identify, using specific examples, the features that bring the art of oriental miniature closer to the painting of the West during the 15th – 20th centuries.

At the end of the 15th century, the Venetian artist Gentile Bellini was the pride of the court of the Ottoman Sultan. He painted beautiful portraits in an oriental style while using the traditions of European painting. The Ottoman Sultan Mehmed II sent Bellini's paintings to the ruler of Herat, Hussein Mirza, in order to challenge the famous masters of the Herat school, headed by the brilliant Behzad, to some competition. It is he who Hussein Mirza instructs to give a worthy creative response to the artist Bellini. As a result, Behzad created a series

Gentile Bellini. Portrait of Sultan Mehmed II. 1480

Kamaliddin Behzad. A dervish from Baghdad. 1500

of portraits, unusual for the miniature painting of the East, in which one can feel the style of European painting of the 15th – 16th centuries. Among them is an amazing portrait of the "A dervish from Baghdad", the original of which is kept in the so-called "Bellini Album" in the library of the Top Kapi Museum in Istanbul and dates back to 1500. Behzad creates a surprisingly subtle psychological image, thereby confirming the idea of the high professionalism of miniaturists and their knowledge of the academic tradition of drawing and painting. Behzad successfully conveys the mood and facial expression of a person sitting in a humble pose. The white cap, somewhat carelessly wrapped in a turban, is a symbol of the dervishes of the Naqshbandi order, to which Behzad himself belonged. A simple woolen robe "aba" is on the shoulders of the dervish, and under it there is a blue shirt. Nothing distracts from the main thing - the expressive eyes of a dervish, looking at the viewer penetratingly, peacefully, and at the same time somewhat mysteriously. Mysticism and reality, everyday scrupulousness, and spiritual detachment are paradoxically combined in this portrait. Sufi inscriptions in rectangles on both sides of the portrait with fine patterns on a golden background enhance the sense of transcendence of the image. It was at the same time that Leonardo da Vinci's masterpiece «Gioconda» or «Mona Lisa» was created (the portrait of a dervish dates back to 1500, and the Gioconda was created in 1503-06), which also marked a new phenomenon in the psychological portrait art of Europe. When compared with the work of Behzad, very characteristic common features are found both in the external interpretation of images and in the interpretation of psychological nuances. This concerns the pose, the position of the hands, the gaze, and most importantly, the general emotional impulse emanating from both portraits. In contrast to ancient aesthetics, which cultivated the beauty of the visible world and the sensual body, the priority of the spiritual principle over the sensual is defended in the works by Behzad and Leonardo Da Vinci. Rejecting explicit "sensual visibility" and tangible clear lines of drawing, they create a pictorial symphony that conveys in thin and melting color transitions the deep spiritual world of the portrayed. It is this structural and musical commonality that allows us to draw conclusions about the similarity of the approaches of the two great masters to the interpretation of the characters they portray.

An explanation of the reasons for the typological correspondence or genetic commonality in the works of da Vinci and Behzad should be sought

in the common sources of historical and cultural genesis. The idea of a sage, a spiritual leader, a keeper of truth, preaching mystical revelations to the closest circle of disciples and followers, was a dominant theme both in the art of the East and in the painting of Europe. This compositional scheme was practically canonized in Eastern miniature and European painting.

The Quran and the Bible are great books that express the main essence of the worldview of the peoples of the Eurasian area, they are the essential basis for determining the universal features of the medieval art of the East and West. The plot-thematic commonality of a number of works by Eastern and European artists is made up of Quranic and biblical images and motifs. Their category includes angels - the winged assistants of the Almighty, who carry out his instructions, broadcast divine words or instructions, and bring the good news. Often, winged angels were depicted as beautiful, slender girls with a musical instrument in their hands, most often a European mandolin or an oriental lute. These images are found both in the works of Behzad and Leonardo da Vinci.

Sufi ritual dance "dhikr" becomes a popular subject in miniatures of the 16th – 17th centuries. In Behzad's miniature «The Dance of the Dervishes» one can feel the natural dynamics and inner spiritual impulse that engulfed all the characters who took part in the ritual action. The dancers are two gray-bearded old men and two middle-aged men, which is symbolically conveyed by the color scheme of their long-skirted robes - the brighter the color, the younger the character. The artist emphasizes the whirlwind movement of the dancing group with the help of writhing lines of sleeves and multi-colored light scarves serpentine in plasticity. In essence, dancing dervishes are the main semantic and plastic epicenter of the composition. Henri Matisse in his famous work "Dance", created almost four centuries after the miniature "A dance of dervishes", uses the style of Behzad's decorative planar forms in an even more exaggerated form. Matisse enhances the importance of contour lines and local color spots, due to which in his picture the decorative manner reaches the apogee of generalization. However, the main pathos of the pictorial idea in the works by Behzad and Matisse retains a common meaning - this is the idea of harmony in the movement of the soul and body of like-minded people. It is this feeling of universal impulse that makes up the philosophical and semantic basis that unites the works of the two geniuses of the East and West. Matisse himself made

Leonardo da Vinci. Gioconda. 1503–1506

Kamaliddin Behzad. A dance of dervish. 1490

no secret of the fact that he was fascinated by the aesthetics of oriental miniatures and tried to use the color and compositional techniques of oriental miniatures in his works.

The ornament was widely used in decorating handwritten books and often played an independent role in the form of ornamental medallions. Behzad, as a master of figurative compositions, also used ornament as a framing and decorating element. An example of a brilliant synthesis of figurative and ornamental principles is the exquisite composition "Young Man Among Flowering Branches", created by him in 1480. On a golden-yellow background, the graceful figure of a moon-faced youth, framed by lush plant patterns, seems to be floating. The figure seems to merge with the ornament, forming a kind of bright plastic metaphor, poetically glorifying the triumph of life and beauty.

This technique of merging the ornament and the human figure became the leading plastic leitmotif in the work of the famous Austrian artist of the early 20th century, Gustav Klimt. In his painting «Three Ages» (1909), depicting three naked figures - an elderly woman, a young mother, and her little daughter - one can see a virtuoso interspersing of a pattern into the overall solution of the composition. It is characteristic that the ornament is woven into the

Anri Matisse. Dance. 1910

texture of the body of a young woman and a child, thus playing a symbolic and semantic role. Here, the pattern, as in Behzad's miniature, symbolizes the life-giving power of nature.

The above examples show how wide was the range of stylistic and thematic trends in the miniature painting of the Temurid Renaissance, which had a huge impact on the development of all world art. In the works by European artists of the 20th century, we find much of what was previously done by the great artist of the East, Behzad (Behzad - Matisse - Picasso - Klimt - Malevich - Kandinsky). The art of the Temurid Renaissance, possessing an amazing power of artistic expression, gave the world true masterpieces of creativity, in which religious thought and philosophical, humanistic ideas were embodied in aesthetically virtuoso forms.

For a long time, the miniature of the East and its brilliant representatives, including the outstanding Kamaliddin Behzad, were studied mainly within the framework of this cultural, historical, and geographical zone. Meanwhile, miniature painting as a phenomenon of global significance, of course, should be considered in the context of the global artistic process.

Kamaliddin Behzad. A young man among flowering branches. 1480

Gustav Klimt. Tree of Life. Hugs. Expectation. 1905–1909

Silent movies of Uzbekistan

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The Uzbek people love cinema since the first miraculous image appeared on the screen. The first film screening in Uzbekistan took place in 1897 - in Tashkent, just two years after the famous first film screenings of the Lumiere brothers in Paris. Uzbekistan is the cradle of Central Asian cinematography. Since the mid-1920s, the first silent films have been shot in the cities of Bukhara and Tashkent. They were able to become a unique example that not only laid the foundation for the national cinematography of Uzbekistan, but also stimulated the formation of the national cinematography of the entire region.

From the end of the 19th century, the introduction of scientific, technical and industrial innovations of the developed world into Central Asia accelerated the urbanization process. Updates were carried out as part of the colonial policy of Tsarist Russia. «First of all, the construction of the strategically important Trans-Caspian railway in 1880 was the first technological «explosion» that was able to change the relationship between time and distance. The inventions of the telegraph, bicycle, photography, and other technologies that illuminate the city changed the daily life of Turkestan residents». Another important result of technological innovations was the introduction of the cinematograph to Turkestan. According to the newspaper «Turkestanskiye vedomosti», the first movie screening in the region was shown in 1897 at the Summer Garden Park in Tashkent, happened two years after Lumieres' first movie demonstrated in Paris. In a short time, special buildings designed for film screenings opened their doors in Tashkent. In particular, in 1910-1915, cinemas with more than ten antique names such as «Moulin Rouge», «Colosseum», «Modern», «Apollo», «Filma», «Odeon», «Elje», «Khiva» were put into operation with large and wonderful halls.

Since 1905, representatives of film companies such as Pathé (France), «Severnyy Medved» (Russia), and «Khanjonkov i K» (Russia) began to come to Turkestan to film the domestic and cultural life of local people and architectural monuments. In particular, the famous French cinematographer Felix Mesgish published his memories of his trip to cities such as Bukhara and Merv in 1933.

In the mid-1920s, the necessary technical base and sufficient national cinematographic staff were not available for the creation of national film production. Taking into account the situation, the Government of the Bukhara People's Soviet Republic decided to open a private film production company on February 13, 1924, and approached Russian film organizations with an offer of cooperation. On April 12, 1924, it signed a contract with the «Sevzapkino» organization.

In 1924-1925, the shooting of the film «Ajal Minorasi (Tower of Death)» was carried out. The first screening of the film took place on December 8, 1925, in Bukhara. Although the film was harshly criticized by the Soviet censors as a work based on ideologically shallow, light-hearted plots, «Ajal Minorasi» was demonstrated in many countries. In particular, it was demonstrated in Germany, Hungary, Romania, and South American countries under the title «Haram Asirasi (Prisoner of Haram)».

In March 1925, the first film studio in Central Asia - «Sharq Yulduzi (The Eastern Star)» film factory - was opened in the building of Eshonquli Madrasa in Tashkent. In 1936, the name of the studio was changed to «Uzbekfilm» and it has been kept under this name until today (from 1941 to 1958, it was operated as the Tashkent feature film studio). The activity of the film studio consisted mainly of two directions - films based on «oriental exoticism» and propaganda pictures fighting against the old order. Although the films «Ravat Kashkirlari (Wolves of Ravat)» (1927), «Soyabonli Arava (Phaeton)» (1928), «Leper» (1928), «So'nggi Bek (The Last Bek)» (1930), «Eshon Qizi (The Daughter of Ishan)» (1931) were shot at the film studio, they were criticized by official bodies, were a great success among the people. «Chadira (?)» (1928), «Arabi (Arab)» (1930), «Yuksalish (Rising)» (1931), «Ramazan» (1932) used an avant-garde style of montage, and eccentric plots and characters appeared together with majestic images of Soviet reality. The inclination towards the cinema avant-garde was also reflected in the names of its films, such as «American from Baghdad», «Yuksalish».

Uzbek silent cinema was also announced in posters and announcements in such genres as «psychological drama» or «movie drama». In fact, it was a social melodrama. The leading type of melodrama - the film with a modern plot «based on real life» has become

Actors Suleiman Khadzhaev and Safiyat Askarova in the film "Chadra". ("Veil"). 1927

Poster for the film "The Second Wife." 1927 Rachel Messerer as Adolat

a favorite subject in cinematography, and a unique aesthetic of national cinema has been formed on the basis of this genre. The main role in the film «Ikkinchi Khotin (The Second Wife)» (1927) was played by the bright star of the silent film Rokhil Messerer (mother of the famous Russian ballerina Maya Plisetskaya). Uzbek actresses Shahodat Magzumova, Oktamkhan Mirzaboeva, and Zuhra Yoldoshboeva took part in this film for the first time with the efforts of Nabi Ganiev, who started his career in cinema as an assistant director. «Ravat Kashqirlari», which was released in 1927, was one of the first silent films that achieved great success among the Uzbek audience. The main reason is that almost all the roles were performed by Uzbek actors - Sulaymon Khojaev, Rustam Ahmedov, and Rahim Pirmuhamedov, and another reason was related to the work specially written by the ethnomusicologist V. Uspensky to accompany the screening of the film.

In 1925-1937, a total of twenty-two silent feature films of historical and cultural significance and about one hundred chronicle plots were shot in the «Sharq Yulduzi» film studio. They depict an entire era - people, nature, urban and rural architecture, and scenes of domestic life. In this sense, silent film products of Uzbekistan are the richest treasure of the past. It managed to reflect the panorama of national life for the future generation not only in documentary chronicles but also in artistic tapes. The important edge of silent cinema in black-and-white frames - capturing the mood of the era came to the fore.

"Sharq Yulduzi" Film factory in the Shaykhantaur madrasah. Tashkent 1925

The founders of the national cinema - Nabi G'aniev, Suleiman Khojaev, Ergash Hamroev, Komil Yormatov, Malik Qayumov, Yoldosh A'zamov, Boriy Haydarov, Akhmadjon Saidov, who first crossed the threshold of the former Eshonquli mosque where the «Sharq Yulduzi» film factory was located, connected their fate with this place. These creators, who started their careers in cinema with simple jobs, later became leading representatives of feature and documentary films.

Structural features of the new Uzbek cinematography emerged from the first films. Elements of national identity began to appear in Uzbek cinematography through the films «Ramazan/Ramadan» (1932), «Tong Oldidan (Before Dawn)» (1934), «Yigit (The Lad)» (1935), made in the first half of the 1930s. In Nabi Ghaniev's film «Ramazan» nationalism is manifested in the character of the hero and the delivery of vital materials, while in Sulayman Khojaev's film «Tong Oldidan» it is expressed through the ideological essence of the film. The name of Sulaymon Khojaev should be mentioned among those who carried out professional work together with artistic research. His film career started at the same time as Nabi Ganiev, Kamil Yormatov, Ergash Hamroev. In 1934, S. Khojaev, who started his career as an actor, household consultant, and assistant director, shot the film «Tong Oldidan» based on the script he wrote. However, the film was not released. The theme of the film, dedicated to the events of the Jizzakh uprising, was completely negatively evaluated by the official control bodies as propaganda of national separatism and was accused of violating the historical truth and inculcating complete aggression. The movie (1934) was treated as a complete «mistake» and the local press slammed it. As a result, Sulaymon Khojaev was arrested and soon shot. After that, almost all the first generation of Uzbek filmmakers were arrested and the most common charge against them was «bourgeois nationalism». This is the fate of N. Ganiev's work «The Lad» (1935) also came to mind.

It should be noted that in the early 1930s, as in other forms of art, cinema faced political repression, which was brutally «purged». During this period, widespread persecution continued actively until the WWII. During these years, almost all the leading creative forces of Uzbek cinematography - Sulaymon Khojaev, Khudoibergan Devonov, Nabi Ganiev, Ergash Hamroev - were repressed. In 1937, Sulaymon Khojaev and Khudoibergan Devonov were arrested and shot on charges of anti-Soviet nationalist activities. Thus, the

rapid development of national cinematography faded away in the whirlpool of political repressions. These years coincided with the transition to tone movies. The situation around filmmaking was becoming very tense. The atmosphere of mistrust in relation to national personnel, and the sharp limitation of creative freedom led to a complete rejection of the truth in the author's interpretation of national cinematography. Only by the time of WWII, the film process, which had been forced to a halt, was restored and regained its footing.

It is known that each era discovers its own historical-political, sociocultural features. Silent cinematography is also important as a unique «document of the era», a historical-cultural resource. The first Uzbek «silent» films have an important role in creating the nation's spiritual-intellectual history, and life-visual chronicle. Although the creation and development of Uzbek silent films were under Soviet ideological pressure, the scenes, images, and images recorded on the tapes are valuable as a unique historical source. There are very few sources and special archives reflecting this period of Uzbek cinema, and film tapes tend to become obsolete and unusable over time. In this sense, the transmission of information about silent films, which formed an important period of our national culture, for future generations is gaining relevance today. Currently, Uzbekistan has an opportunity to re-present the heritage of silent cinematography to the audience. The period and evolutions of the past century have made silent films forget their ideological basis and made the historical-cultural characteristics and national values reflected in them even brighter.

In recent years, the silent film phenomenon has become an object of great interest all over the world. Unfortunately, information about national silent film schools, including Uzbek silent films, is scarce and only available to a narrow circle of film historians. At the time, these films were sharply criticized and accused of primitivism, eclecticism, and promoting the ideological games of their time. Of course, one can still watch these movies today and see all the weak moments and miscalculations. But these films have historical and cultural significance. They capture time itself - images of people, architectural landscapes, and details of everyday life. In this sense, the richest treasure of Uzbekistan's cinematography is considered to have been created in the 1920s and 1930 s.

Natalya Vendelin as Jemal in the film "Ajal Minorasi (The Minaret of Death)". 1925

Director Nabi Ganiev as an actor. During the casting of the film "Bakht Quyoshi (The Sun of Happiness)". 1926

Discoveries of Uzbek Scientists

Nature is revealing its secrets

Scientific research in Uzbekistan has a history of more than one and a half centuries. Collected large empirical data are mainly collected in six volumes of «Flora of Uzbekistan» and 10 volumes of «Determiner of Central Asian Plants» published in 1941-1963. A rich collection of herbarium specimens, which form the fundamental basis of botanical knowledge, has been collected, and the National Herbarium of Uzbekistan (TASH), which has more than 1.5 million copies, is among the top 30 major herbariums in the world and indicates a high level of knowledge in botany in the region. Modern research conducted at the Institute of Botany shows that the natural landscapes of Central Asia, especially Uzbekistan, contain plant species that have not yet been discovered for science. During the years of independence, scientists of the institute discovered 55 plant species.

A new plant species belonging to the Ayiktovan family was found in the mountainous regions of the Surkhandarya region. A new biological species that is a product of cooperation between scientists from Uzbekistan, China, and Russia was named Ranunculus tojibaevii Schegol. & Turgunov. It is recognized that the last ice age had a great influence on its appearance in the mountainous regions of Central Asia and its formation as a biological species. Morphologically, taxonomically and genetically close relatives of the new species are Ranunculus belonging to the local flora and having a range of distribution, and this scientific innovation confirms the theory of the existence of a secondary species center in the mountainous regions of Central Asia.

One of the scientific facts that shows the importance of Central Asia and its neighboring mountainous regions for representatives of the Umbrelliferous family is one of the new species belonging to the genus Aulacospermum Ledeb found in the border areas of Tashkent and Namangan regions which has been proven once again. This series consists of 14 species, and 5 species were previously known in Uzbekistan, spread from the European part of Russia to the Himalayas, and all of them are endemic to Central Asia. The new species found on the Betagalik Plateau of the Kurama Ridge differs from its close relatives by the yellow color of its flowers, the polycarp life form, and a large number of main stems (up to 9-11). In addition, molecular-genetic and carpological studies have confirmed that the fruit found in the Kurama ridge belongs to a biological species not yet known to science

The discovery of a new elementary particle

A group of scientists from the Institute of Physics and Technology of the Uzbekistan Academy of Sciences, led by Academician Behzod Yuldashev, experimentally

determined the existence of a new elementary particle. It is known that all substances in nature are composed of atoms. Atoms, in turn, consist of nuclei and electrons. Nuclei are composed of protons and neutrons. Protons, like neutrons, are composed of the three most elementary particles of matter - quarks.

When analyzing collisions of carbon nuclei with a kinetic energy of 3.4 GeV per nucleon with target carbon nuclei, a new elementary particle with eight quarks was found in a system consisting of two protons and one pi-meson.

Uzbek scientists have found an elementary particle with eight quarks, which is the world record for the number of quarks. The newly discovered short-lived particle has a mass of about 2118 MeV/s2. The width of the mass distribution of the new resonant particle does not exceed 4 MeV/s2, which indicates that the lifetime of this particle was about 10−22 seconds. The results obtained about the new elementary particle were published by the authors in the scientific journal «International Journal Of Modern Physics E (Nuclear Physics)» of the prestigious international scientific publishing house «World Scientific».

New species of geckos have been discovered

In 2021, employees of the Institute of Zoology of the Ubekistan Academy of Sciences discovered two species of reptiles unknown to the world fauna - Alsophylax sp. nov. (ferganensis) and Alsophylaxsp. nov. (Emilia). The first one was found near the village of Shorsu, in the low mud deposits near the southern border of the Fergana region and Tajikistan, and the second one was found in the hills of the Pop district near the Jiydalisoy reservoir.

The discovery of a new species of gecko of the genus Alsophylax in one of the most densely populated areas is remarkable and indeed sensational news. High densities of endemic species are associated with continuous habitat reduction and severe isolation of suitable habitats from each other, resulting in a high concentration of suitable habitats per hectare.

READING

INTERESTING FACTS IN THE WORLD OF SCIENCE

Interesting facts in World Science

Discovery opportunities for growing seaweed for food, feed, and fuel

Expanding global seaweed farming could go a long way toward addressing the planet's food security, biodiversity loss, and climate change, according to research led by the University of Queensland. Seaweed has great commercial and environmental potential as a building block for nutritious food and commercial products, including animal feed, plastics, fibers, diesel, and ethanol. The study found that expanding seaweed farming could help reduce demand for land crops and reduce global agricultural greenhouse gas emissions by 2.6 billion tons of CO2 per year.

Using the Global Biosphere Management Model, the researchers mapped the breeding potential of 34 commercially important seaweed species. They assessed the ecological benefits of a range of scenarios based on land-use change, greenhouse gas emissions, water and fertilizer use, and projected changes in species availability by 2050.

https://scitechdaily.com/unleashing-the-power-of-seaweed-farming-for-food-feed-and-fuel/

A new blood test can detects Alzheimer's disease 3.5 years before clinical diagnosis

Blood tests can be used to predict Alzheimer's risk 3.5 years before clinical diagnosis, according to new research from King's College London's Institute of Psychiatry, Psychology, and Neuroscience.

A study published on Jan. 27 in the science journal 'Brain' suggests that components of human blood may modulate the formation of new brain cells, a process called neurogenesis. Neurogenesis occurs in an important part of the brain called the hippocampus, which is involved in learning and memory. Although it

affects the formation of new brain cells in the hippocampus in the early stages of Alzheimer's disease, previous studies have only examined neurogenesis at later stages through autopsy.

https://scitechdaily.com/new-blood-test-detects-alzheimers-disease-3-5-years-before-clinical-diagnosis

A 2,400-year-old sewage toilet was found in China

A 2,400-year-old sewage toilet was discovered in ancient Yueyang, China. Scientists were able to find only the lower part of the equipment, as the upper part is missing, it is not clear how the toilet was used. There are speculations that it was squatted or a seat was installed. The toilet itself is inside the building, and the pipe goes to the hole outside the building. Perhaps the servants poured water into the bowl each time.

The equipment was considered luxurious. The model scientists have found was used in the period during Xin Xiaogong (381-338 BCE) or his father Xin Xianggong (424-362 BCE) or Liu Bang, the first emperor of the Han Dynasty (256/247-195 BCE).

Until this artifact was found, the first flushing toilet was believed to have been invented by John Harrington for Queen Elizabeth I in the 16th century.

https://ria.ru/20230221/arkheologiya-1853134068.html

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