

TECHNOPOLIS OF THE VOLGA REGION

popular science edition

TOP DIGEST 2019



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TOP DIGEST 2019

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Dmitry Bykov, Rector of a flagship university, Honorary Figure of Russian Higher Education, chief editor of the journal Technopolis of the Volga Region

Dear colleagues!

In 2018 - 2019, Samara Polytech continued to develop steadily as a major center of Russian engineering education. Its recognition at the international level has grown. We have new partners from European and Asian universities - North-West Polytechnic University of Chinese Xian, Wroclaw University of Science and Technology, etc. This increased the interest of foreign citizens in Samara Polytech. Now more than 620 foreign students from 57 countries of the world have already been studying with us, and we expect that soon there will be more.

Among the obvious scientific breakthrough of the last two years are the synthesis of the first metal-organic polymeric materials, or metal-organic frameworks (MOF), carried out under the supervision of the head of the laboratory of the International Research Center for Theoretical Materials Science (IRCTMS), Candidate of Chemical Sciences **Evgeny Aleksandrov** and Doctor of Technical Sciences **Andrey Pimenov**. Why are scientists and practitioners interested in these materials? Firstly, they demonstrate record sorption characteristics with respect to various volatile substances and gases. This is a kind of a crystalline sponge, but with unique parameters. One gram of such a substance has a pore surface area comparable to the area of a football field. Secondly, MOFs can combine several useful properties: magnetic susceptibility, luminescence, electrical conductivity, catalytic activity, and much more. This allows to create advanced materials for sensors and pickup units on their basis, for storing and processing information, photocells, nanoreactors.

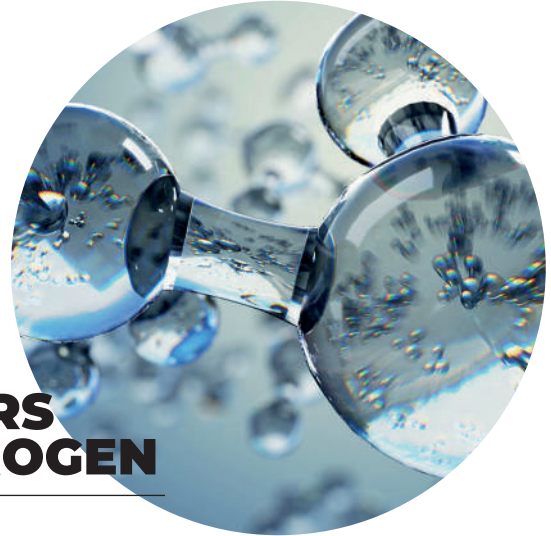
The remarkable results of the scientists' research in the field of artificial intelligence should be recognized. The staff of the Department "Chemical

Technology and Industrial Ecology" invented a new method of high-quality irrigation of agricultural fields. It is based on regulating the water supply from sprinklers by means of a preliminary remote measurement of soil moisture using a special spectroscope. The moisture measurement in the soil is carried out on the basis of processing images obtained from a scanner - a camera operating in the near infrared and visible range of the spectrum. After the spectral analysis, a computer opens the sprinkler valves in a dry area of the field and closes them in the wetted area.

In its turn, Doctor of Technical Sciences, Head of the Department "Electronic Systems and Information Security", chairman of the board of directors of the research and production company "Smart Solutions" **Petr Skobelev** is creating an intelligent system that will facilitate the work of farmers. The "Smart field", with the principles of precision farming, is suitable both for increasing the yield enhancement traditionally cultivated in the Samara Region and for exotic rice growing. Already there are results of this work, which are being implemented in several farms of Samara and other regions. Opportunities for implementing similar projects in China, Thailand, India and Sri Lanka are currently being discussed.

These achievements and remarkable people working in Samara Polytech, discoveries and prospects are in the university's popular science journal "Technopolis of the Volga Region". It has been published since 2014 for friends and partners of the university. We invite everyone to use the publication as an open media platform to strengthen friendly ties and mutually beneficial cooperation.

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THREE YEARS WITH HYDROGEN

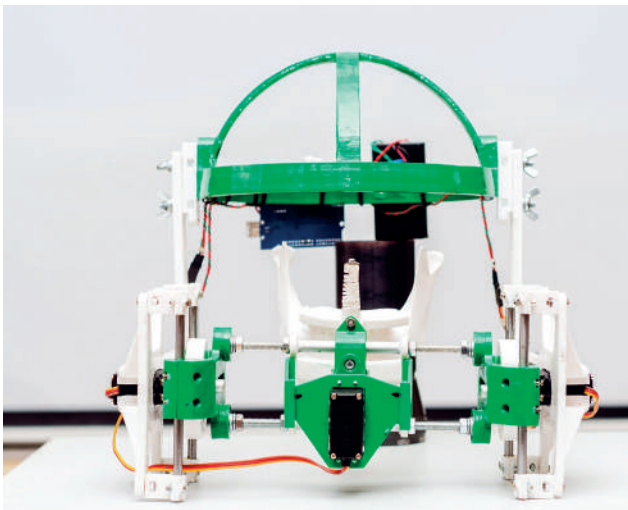
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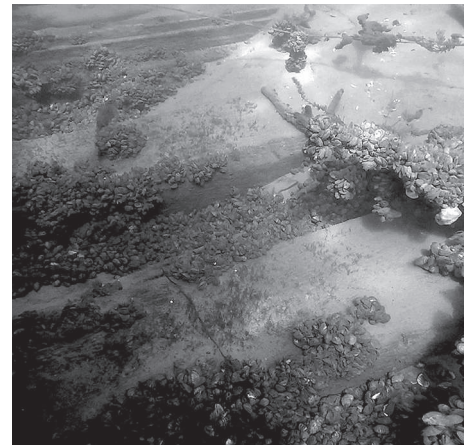
RICE ZONE

VLADISLAV BLATOV: **“A WORLD-CLASS LABORATORY CAN BE ESTABLISHED EVEN IN A SCIENTIFIC “COUNTRYSIDE”**





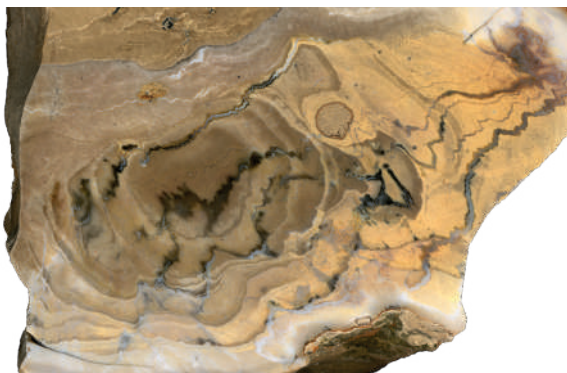
10 METERS BELOW THE VOLGA LEVEL



INNOVATIVE JAW MECHANICS

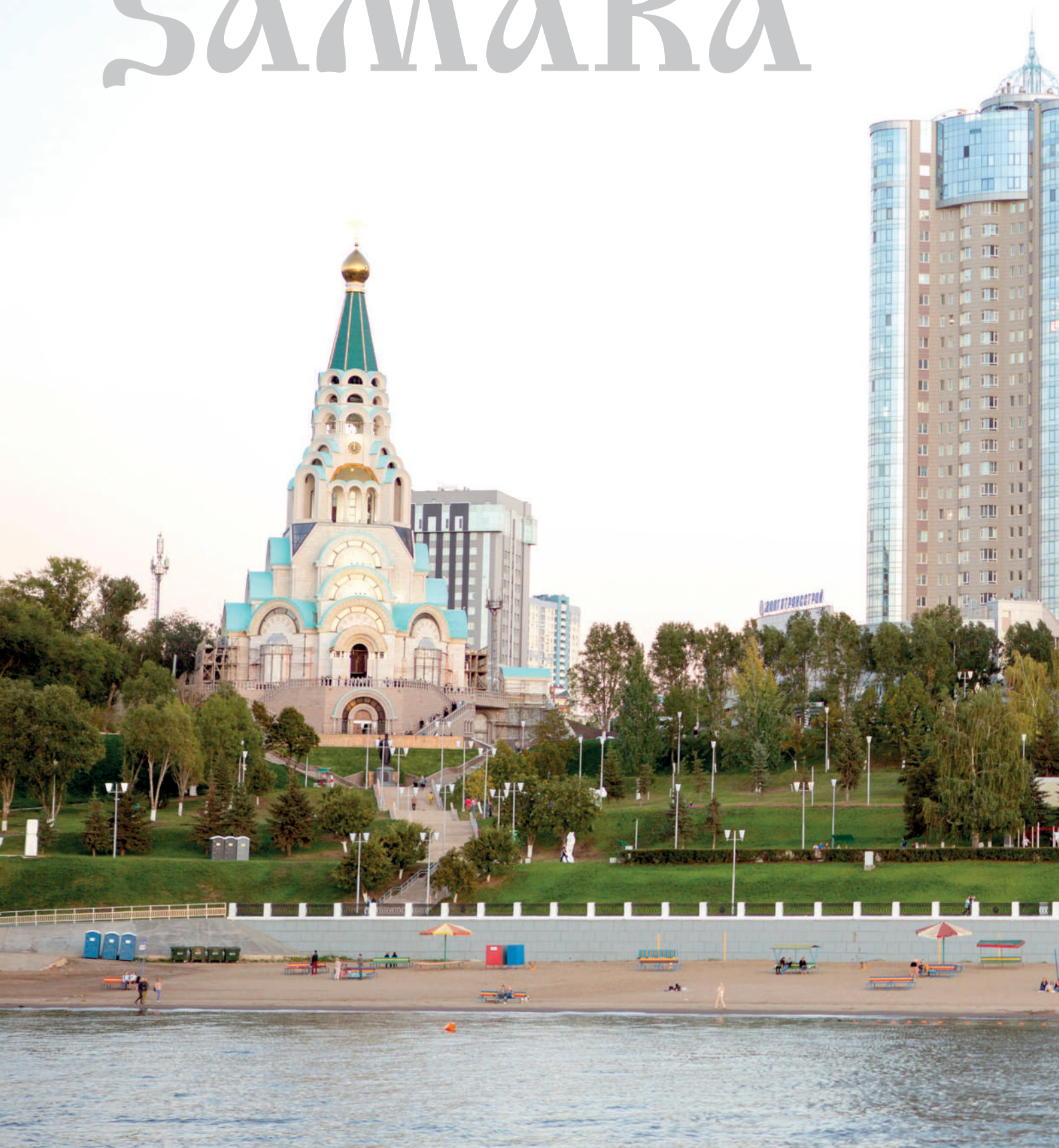
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FELLOW MINERALS



The best fashion of our life

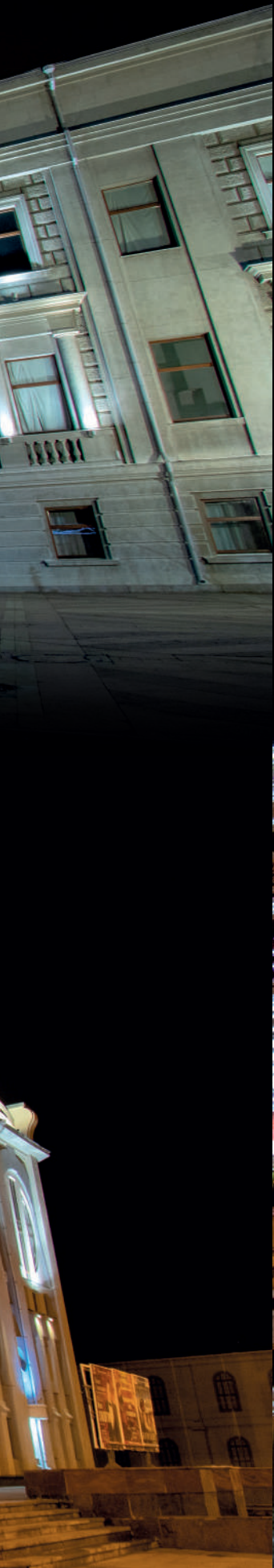
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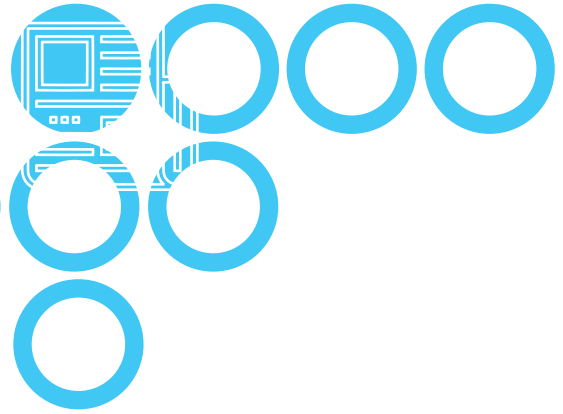




SAMARA



SAMARA POLYTECH AND THE WORLD IN 2019



A STUDENT OF POLYTECH GRADUATED WITH HONORS FROM THE BRICS SUMMER SCHOOL

In the summer 2019, the sixth BRICS school ended in Shanghai, with students and young researchers from Russia, Brazil, India, China and South Africa participating in it. Fifteen of the best students of the school received a scholarship that fully recovered the cost of training, registration fee, insurance and accommodation.

Previously, the Russian delegation included representatives of Moscow, St. Petersburg and the regions of the Far East. This time, one of the five Russian scholarship holders for the first time was a resident of the Samara region - a third-year student of Samara Polytech, **Diyora Pirova**.

"In a motivation letter, I talked about how my specialization - mathematical modeling - can contribute to the development of international relations, and what contribution I can make to this process," Diyora explains.

The student of our university received the highest marks in Shanghai, and then an international diploma and an official invitation from Fudan University, where the lectures were held, to continue studying in the Master's course.



A POLYTECH EMPLOYEE PRESENTED THE DEVELOPMENT AT HANNOVER MESSE 2019

At the large international exhibition of industrial technologies Hannover Messe 2019, held in Germany, **Aleksey Tabachinskiy**, Senior Lecturer of the Department "Theoretical and General Electrical Engineering" of Samara Polytech, presented the development 'Induction machine's innovative construction for renewable energy and vehicular applications'.

"I am engaged in renewable energy technologies, and increased attention is being paid to it," the young scientist said. "In particular, companies such as Groschopp AG, Metallwarenfabrik Gemmingen (brand GEKO), Capstone, EMOD Motoren GmbH are interested in it. The import of domestic technologies abroad, as well as discussions, open lectures, and presentations were held at the exhibition."

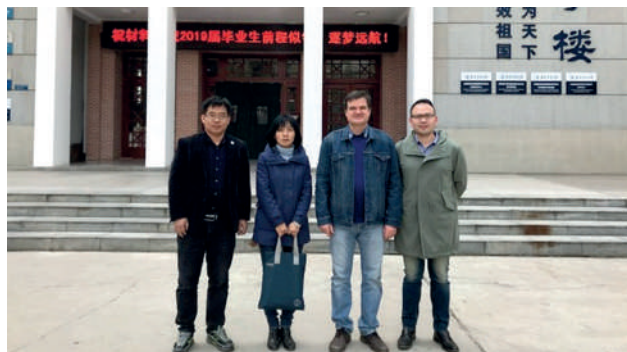


STUDENTS OF SAMARA POLYTECH BECAME THE PRIZE WINNERS OF THE INTERNATIONAL FORUM

In April 2019, the international youth forum of architecture and design ARCH'Pacific-2019 was held at the Far East Federal University. Students, graduate students, teachers, representatives of professional communities from Russia and countries of the Asian-Pacific region - Japan, Korea, China, Australia, Mongolia attended the forum. Among them there were talented students of the architectural department of Samara Polytech. They presented their works at the exhibition-competition of architectural and design creativity of the youth "Parallels-2019", the exposition of which included more than 500 works. As a result, five of our students were among the winners in the nomination "Composite painting".

Valeria Vagner was awarded the 1st degree diploma for the 'Line and spot' composition, **Anastasia Potogina** with the work 'Arch-Music' won the 2nd degree diploma, and three students received the 3rd degree diplomas - **Viktor Gavrilov** ("Dynamics" composition), **Anna Predyus** ("Still Life with a Pumpkin" composition) and **Alsu Makhmudova** ("Still Life with a Guitar" composition).

The international youth forum of architecture and design ARCH'Pacific is a creative workshop and a universal platform for exhibitions, conferences, open lectures, master classes and round tables. Its participants can not only discuss current problems in the development of architecture and design, and exchange innovative ideas, but also establish professional contacts.



ADVANCED STUDIES HAVE BEGUN AT THE POLYTECH INTERNATIONAL RESEARCH CENTRE

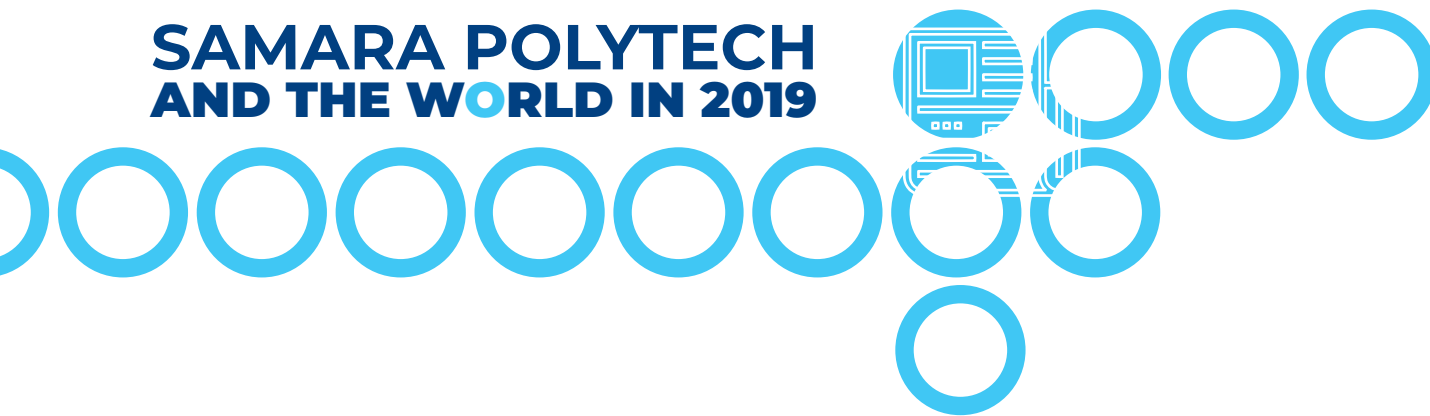
Director of the International Research Center for Theoretical Materials Science (IRCTMS) of Samara Polytech, **Vladislav Blatov** began working with scientists from the Northwest Polytechnic University (NWPU, Xi'an, China). Cooperation is ongoing under the agreement on the establishment of a Chinese-Russian innovation center based in Samara Polytech and NWPU, which was signed last year.

Under the aegis of the center, the research is being conducted in several directions. With the group of Professor **Qingfeng Zeng**, Professor **Vladislav Blatov** continues to work on developing a topological model of phase transitions and predicting new inorganic compounds. Scientists invent new methods for modeling porous materials for 3D printing.

With the professor **Junjie Wan**, the Samara scientist has already begun the search for new electrodes - an unusual class of materials containing isolated electrons, and **Blatov** with the professors **I Wang** and **Xiaoli Fan**, plans to find new high entropy alloys.

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CHEMISTS FROM FRANCE HELD A SEMINAR AT SAMARA POLYTECH

A four-day seminar with the participation of foreign guests was held at the Samara Polytech Department "Chemical Technology of Oil and Gas Processing". The results of collaboration with scientists from the flagship university were presented by **Carole Lamonier**, Professor of Lille University of Science and Technology, and her colleague, Associate Professor **Christine Denise Lancelot**.

The reason for the meeting was a discussion of the results obtained during the work on the topic "Development of TRI METAL nanoscale Ni (Co) MoW sulfide catalysts for the deep hydro-processing of oil fractions and residues." This study began in 2014, after the scientists from both universities met at the international symposium on the molecular aspects of catalysis with sulfides. Two years later, the joint application of scientists won the competition for the provision of subsidies from the federal budget as part of the implementation of the Federal Target Program, and then a grant of the Ministry of Foreign Affairs



and International Development and the Ministry of National Education, Higher Education and Scientific Research of France was won.

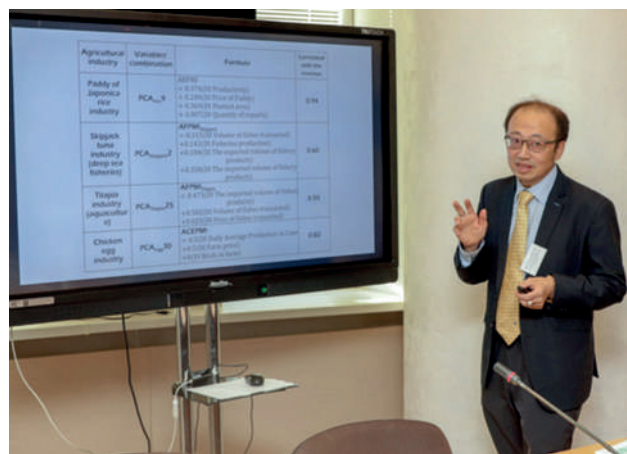
"We complement each other due to the fact that we have a strong analytical part, we have access to the synchrotron and those analysis methods that are not everywhere available in Russia," Professor Carole Lamonier said. "Polytech has created a good base for testing catalysts, and our interaction leads to synergy that ensures the successful solution of fundamental and applied problems. The result of joint research will be a technology for the synthesis of trimetallic catalysts."

SAMARA POLYTECH DISCUSSED THE APPLICATION OF ARTIFICIAL INTELLIGENCE IN AGRICULTURE

At the end of December 2019, the university hosted the international seminar “Artificial Intelligence for Precision Farming”. Scientists from the leading universities of the region, representatives of industrial companies and public organizations, foreign delegations attended the meeting. During the seminar, the parties discussed the results of ongoing projects and the development of an AI roadmap for precision farming, as well as the possibility of international cooperation in this field in Russia and Southeast Asia.

Vice President of the International Association for Sustainable Agriculture Development (Singapore), Professor of the Digital Marketing Department of National Chun Hsin University (Taiwan), Professor **Tsong Ru Lee** shared the experience of farmers based on the use of digital technologies. Agriculture in Taiwan is one of the six main sectors of the economy, for each of which an activity analysis using AI is carried out. Obtaining information from the farmers themselves, experts can predict at what time of the year it is profitable to invest in a particular area, whether it is fishing, pig breeding, or rice growing.

Russian scientists and practitioners, in their turn, introduced domestic digital platforms and smart



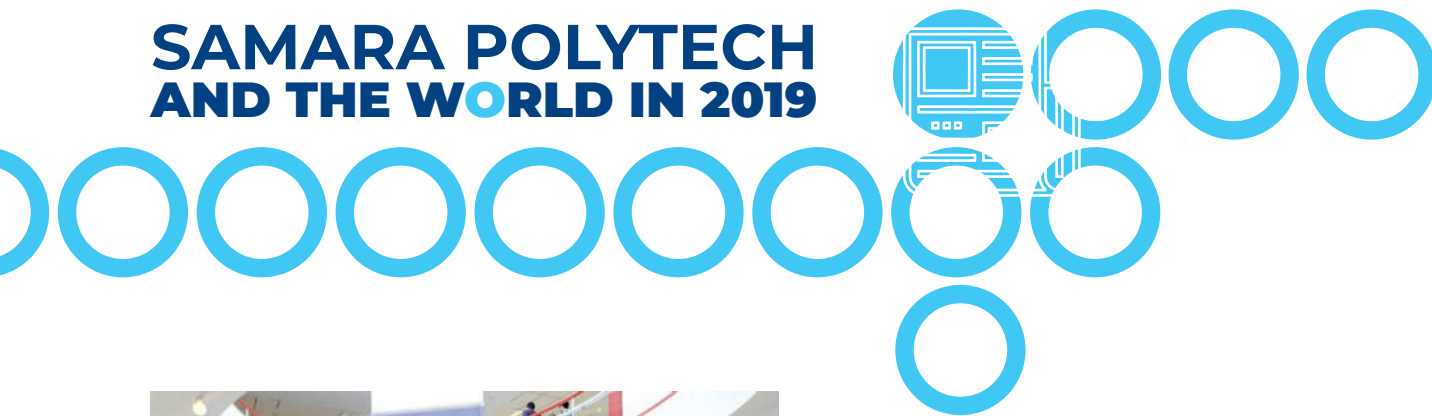
services. The head of the Samara State Agrarian University, Professor **Aleksey Brumin** spoke about the development of intelligent agriculture 4.0 in the Samara region. Representatives of the Institute of Image Processing Systems of the Russian Academy of Sciences spoke about intelligent image processing and Big Data technology for the agricultural sector.

Samara Polytech is also creating an original system of “smart” farming, which will facilitate the work of agricultural producers in caring for such a capricious crop as rice. The work is conducted under the guidance of Doctor of Technical Sciences, Head of the Electronic Systems and Information Security Department, chairman of the Board of Directors of RPC ‘Smart Solutions’ **Petr Skobelev** and Doctor of Technical Sciences, Vice Rector for International Cooperation **Andrey Pimenov**.

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SAMARA POLYTECH AND THE WORLD IN 2019



POLYTECH SCIENTIST SPEAKS AT THE WORLD CONGRESS

The Third World Congress on Achievements and Research in the Biotechnology Industry (BIT's 3rd International Biotechnology Congress or IBC 2019) was held in Singapore. The key topics of the congress were industrial microbiology and new enzymes and biocatalysis, new biomaterials, biomass and bioenergy, aquaculture and marine biotechnologies, as well as environmental biotechnologies, bioprocesses and green bioproduction, trends in the development of biotechnologies.

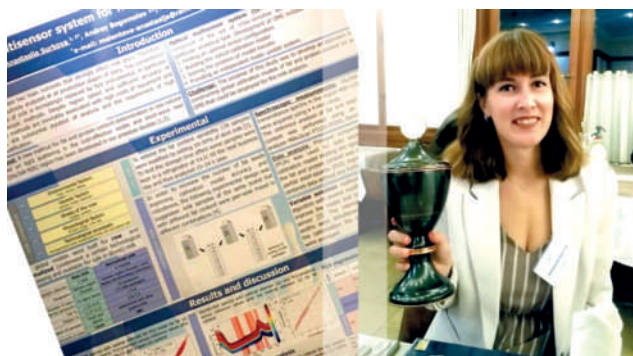
Samara Polytech was represented by the assistant professor of the Industrial Heat Power Engineering Department **Dmitry Pashchenko**.

"Traditionally, the congress was dedicated to the development of energy and production technologies in harmony with the environment. In 2019, it was held under the motto "Let's make the world our garden", which fully repeats the motto of Singapore "Let's make Singapore our garden," the scientist said. "My report was devoted to the problem of using biofuels in thermochemical heat recovery systems of industrial power plants."



POLYTECH REPORTED ON THE EXPERIENCE OF WORKING WITH FOREIGN STUDENTS

At the Peoples' Friendship University of Russia (RUDN), a forum of employees of international departments of universities "From the priority project 'Development of the export potential of the Russian education system' to the federal project "Education Export" was held. **Elena Prokofyeva**, Head of the Department for Collaborations with Foreign Students of Samara Polytech, shared with the participants of the forum the experience of the flagship university. In particular, she presented a new project "Creating a Web-resource for promoting an educational program 'Oil and Gas Business' in the foreign language segment on Internet in order to illustrate the competitive advantages of the program and attract talented foreign applicants". It is implemented as part of the grant received from the Ministry of Science and Higher Education of the Russian Federation.



THE REPORT OF A POLYTECH EMPLOYEE WAS RECOGNIZED AS THE BEST AT A CONFERENCE IN HUNGARY

On September 8-12, 2019, the 37th international conference Conferentia Chemometrica 2019 was held in the city of Karcag (Hungary), dedicated to the current aspects of chemometrics and chemical informatics. Its participants included more than 50 scientists from Germany, Poland, Italy, France, Slovenia, the USA, Iran and other foreign countries. Our country was represented by two researchers, including the head of the laboratory "Multidimensional Analysis and Global Modeling" of Samara Polytech **Anastasia Surkova**. Her report was devoted to the transfer of calibration models between analytical devices, and the theme of her poster report was "An optical multisensor system for determining fat and protein in milk". Both works are devoted to the problems of developing inexpensive portable analyzers - optical multisensor systems. The presentations were co-authored with **Andrey Bogomolov**, senior researcher of the Multidimensional Analysis and Global Modeling laboratory, and **Dmitry Kirsanov** and **Andrey Legin**, colleagues from St. Petersburg State University.

Following the results of the conference, Anastasia Surkova took the first place in the poster program and became a challenge cup winner. Her report won the "Best poster award".



UNIVERSITY OF WROCLAW BECAME A PARTNER OF SAMARA POLYTECH

Samara Polytech and Wroclaw University of Science and Technology signed a cooperation agreement. In 2019, 15 students from Samara visited the summer school of Wroclaw University, and Polish academicians gave open lectures at Samara Polytech, took part in the international scientific conference 'International Conference on Civil, Architectural and Environmental Sciences and Technologies (CAEST)', which took place at our university during the forum of architectural and construction innovations "Cities of the future" on November 19-20.

More news on our web-site





POURING OIL ON THE FIRE

SCIENTISTS OF "THE ORGANIC CHEMISTRY" DEPARTMENT ARE DEVELOPING NEW METHODS OF PRODUCING HIGH-TEMPERATURE LUBRICATING OILS FOR GAS-TURBINE ENGINES

Text: Ksenia MOROZOVA

The simplest gas-turbine engine consists of a rotor with blades, a compressor and a combustion chamber. Unlike a piston engine, it doesn't require a sophisticated gas distribution mechanism and it doesn't convert reciprocal motion into rotary. A gas-turbine engine operates due to the gas flow. Of course, it's a much more complex machine now compared to what it was like when first invented: today it has several shafts with turbines, heat exchangers, nozzle blocks, pipelines. But it turned out that even the engines that drive aircrafts,

ships and railroad locomotives need the chemists' help in order not to end their days in the dead-end of evolution. Here's a short story about chemistry helping the aviation to be up-to-date and innovative, and about the experts of Samara Polytech known for their achievements in the farm technology area, who began to develop a totally new scientific area and succeeded in it – as always.

Here is what it's all about. The main 'enemy' of gas-turbine machinery is temperature. Gases inside the engine can heat up to 800-1500 °C. Not every engine is

HOW NEW INDUSTRIAL LUBRICATIVE OILS WITH SPECIAL PROPERTIES ARE MADE



Studying the properties (viscosity-temperature characteristics, flash point, freezing point, thermal-oxidative stability) of bases for oils used in heat-stressed gas-turbine engines, figuring out how these properties are related to the structure of the substances.



Picking up structurally similar alcohols of adamantane series and analyzing the existing methods of their production.



Optimizing the existing methods of synthesis of such alcohols or developing new ones that require a cheaper raw material and allow to reduce the number of steps and increase the overall yield of the product.



Producing small amounts of basic adamantane polyatomic alcohols and developing laboratory synthesis methods for them.

able to withstand such tough conditions in combination with high shaft speed (up to 12,000-20,000 rpm), to say nothing of lubricating materials. The chemists of Samara Polytech, under the guidance of **Yuri Klimochkin**, Doctor of Chemical Sciences, Head of the Department, have been working for several years to find substances that would increase the thermal resistance of industrial lubricating oils; it seems that now they are closer to victory than never before.

“Of all the requirements imposed to the oil quality, the most important one is the high thermal-oxidative stability, i.e. the ability of a lubricating oil to maintain the required level of all physical-chemical and operating properties when exposed to high temperature and long time of engine operation,” explains Elena Ivleva, Candidate of Chemical Sciences, assistant professor of the Department.

The scientists plan to achieve this goal by adding compound ethers (produced on the basis of the adamantane derivatives) to the oil.

The chemists of Samara Polytech say they choose these compounds because of unique adamantane framework which is extremely close to spherical structure. The position of hydrogen atoms in it is just like in diamond lattice so adamantane shows superior thermal stability. Introduction of thermal stable framework structure of adamantane into the composition of combustibles and lubricants allows to produce lubricating materials with enhanced properties, in particular thermal and thermal-oxidative stability.

At the end of the last year the scientists came close to development of a new method for production of high-temperature base for oils. They have already chosen the



prospective sample of compound ether to be introduced into the oil composition, and studied its properties. Now the project is on the stage of working out the laboratory operating procedures. ■

5

Producing experimental samples of compound ethers on the basis of adamantane polyatomic alcohols and aliphatic

6

carboxylic acids. Checking if physical and chemical properties of the synthesized substances are compliant to regulatory requirements for home-produced oils, as well as requirements

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of foreign specifications. Picking up the best sample and optimizing

8

its production technology. Studying physical and chemical properties of the base for the oil with adamantane compound ether

9

introduced to its composition. Working out the laboratory operating procedures.

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Hydrogen
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GAS TO GAS

SCIENTISTS OF SAMARA POLYTECH TOGETHER WITH GAZPROM CREATE COMPETITIVE DEVELOPMENTS FOR THE GLOBAL HYDROGEN MARKET

Text: Svetlana EREMENKO

IN NOVEMBER 2019, SAMARA POLYTECH WON THE GRANT OF THE FEDERAL TARGET PROGRAM "RESEARCH AND DEVELOPMENT IN THE PRIORITY DIRECTIONS OF THE SCIENTIFIC AND TECHNICAL COMPLEX OF RUSSIA FOR 2014-2020". FOR TWO YEARS, UNIVERSITY SCIENTISTS SHOULD DEVELOP TASKS FOR DESIGNING EXPERIMENTAL INDUSTRIAL COMPLEXES OF HYDROGEN AND METHANE-HYDROGEN MIXTURE AND IMPLEMENT THEM IN EXPERIMENTAL DEVELOPMENTS.

BEST SOLUTIONS, NEW COMPETENCIES

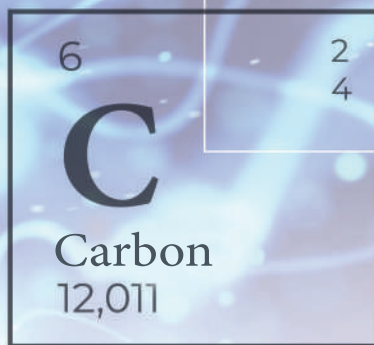
The prerequisites for the development of the hydrogen theme appeared several years ago after the implementation of the Paris climate agreement. Then the country began large-scale work on the formation of new requirements for environmental performance of industrial equipment and the introduction of the best available technologies.

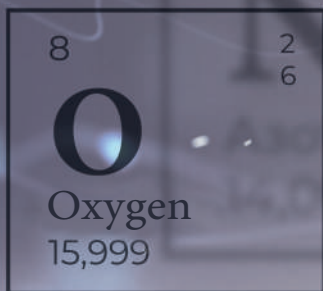
Taking into account the fact that by 2050 the EU countries should completely abandon the use of natural gas as fuel, its



main supplier, Gazprom, currently defines the hydrogen theme as one of the key in the innovative development of the company. And if in the near future the production and use of methane-hydrogen mixtures and hydrogen will become an important direction for gas companies to diversify their business and increase the efficiency of natural gas use, then in the medium term, hydrogen and energy resources based on it can act as a tool for the transition, as they say now, to a low emission economy.

"The scientists' task is to provide Gazprom with a globally competitive technological solution for its dominant presence in the global hydrogen market," the immediate prospect of the research team of the Department "Gas Chemistry and Special Chemical Technologies" recently organized at the University, was outlined by its head, Doctor of Technical Sciences, Professor, prize winner of Gazprom in the field of science and technology **Andrey Pimenov**. "For Samara Polytech, the work on creating technologies and designing equipment for the generation of hydrogen and its





mixtures is an opportunity to realize the existing potential and develop new competencies, satisfying the needs of the company in the future.”

A MIXTURE OF THE FUTURE

Gazprom has already initiated research on resource conservation and improvement of the environmental performance of gas pumping units - gas compressor units (devices designed to compress natural gas at compressor stations of gas pipelines and underground storage facilities). The task was also set to reduce emissions and increase the efficiency of gas turbine plants. The next step is the creation by university scientists of an experimental stand for the production of hydrogen and a methane-hydrogen mixture based on the technologies of catalytic pyrolysis of natural gas in liquid metal media. The final stage of work on the project should be the construction in Russia of experimental industrial complexes for the production of hydrogen and methane-hydrogen mixtures (with a hydrogen concentration of 20–27 percent) for the domestic needs of the gas industry, in particular for use in gas transportation facilities.

Samara Polytech coordinates the work of the consortium of executors of this grant, which includes the Institute of Petrochemical Synthesis named after A.V. Topchiev RAS, Institute of Problems of Chemical Physics RAS, Institute of Catalysis named after G.K. Boreskov Siberian Branch of the Russian Academy of Sciences, Grozny State Oil Technical University named after Acad. M.D. Millionschikov. The industrial partner of the project

Industrial partner: PJSC GAZPROM

GRANT:

Development of the scientific foundations of the technology and design of hydrogen generation equipment for the production of methane-hydrogen mixture and the needs of hydrogen energy in the framework of the federal target program “Research and development in the priority areas of development of the scientific and technological complex of the Russian Federation for 2014 - 2020”

was Gazprom Transgaz Samara. The total amount allocated by the state and the company came to 100 million rubles.

“For our university, the work on the project is a big step towards obtaining the status of a flagship university of Gazprom,” Professor Pimenov said. “In particular, in this case, we will have the right to enter into contracts without tenders for gas research and development with gas specialists.”

Large-scale cooperation in testing innovative technological solutions will ultimately lead to a decrease in the carbon footprint of our civilization. Currently, the global economy consumes 50 percent more resources each year than the planet can regenerate over the same period. The development and implementation of hydrogen technologies is one of the ways leading to the green economy of the future. ■

EFFECT OF USE OF METHANE-HYDROGEN FUEL AS FUEL GAS COMPRESSOR UNIT



WE SAVE

fuel gas up to **25%**



WE REDUCE

carbon dioxide emission
by **30%**



WE REDUCE

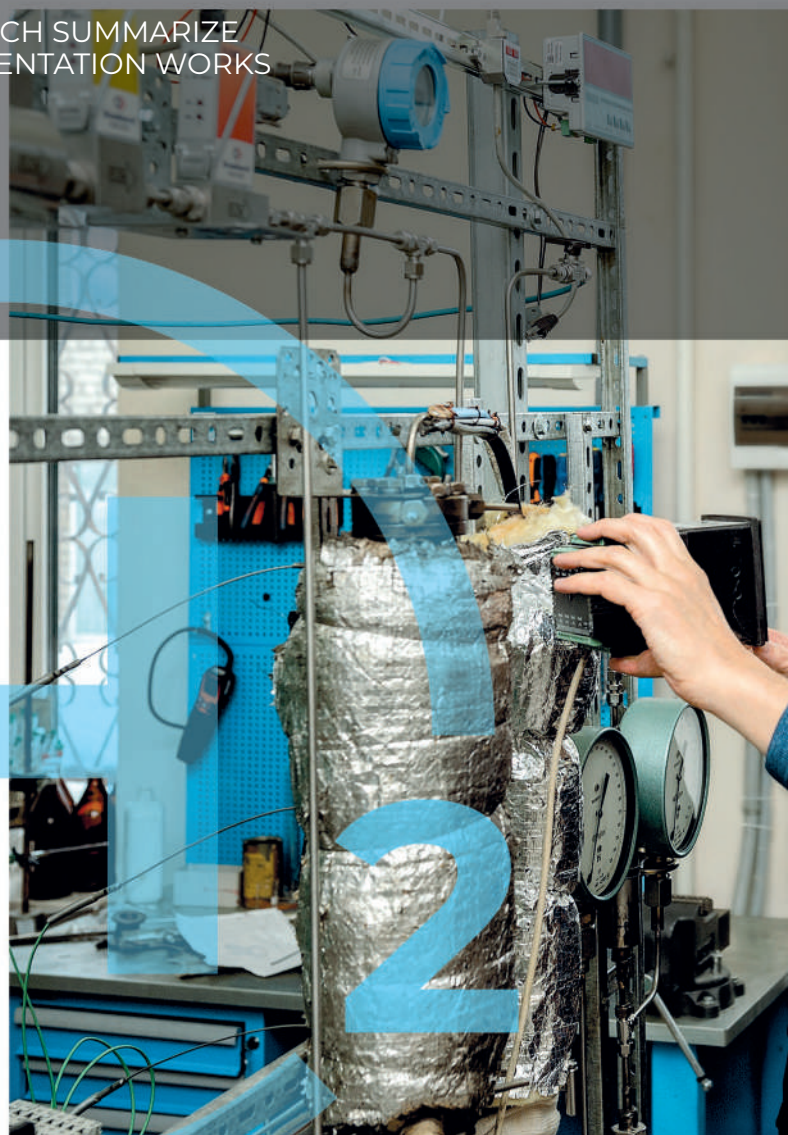
the volume of nitrogen oxides
and carbon monoxide polluting
the air by **4,5 – 5** times

THREE YEARS WITH HYDROGEN

SCIENTISTS OF SAMARA POLYTECH SUMMARIZE THE SUBSIDY PROJECT IMPLEMENTATION WORKS

Text: Tatyana Plekhanova

ANDREY PIMERZIN, HEAD OF THE "GAS AND OIL CHEMICAL REFINING TECHNOLOGY" DEPARTMENT, AND PROFESSOR OF UNIVERSITY OF ROSTOCK (GERMANY) **SERGEY VERYOVKIN** HAVE ALREADY SPENT OVER 1,000 DAYS TO FIND THE OPTIMAL CHEMICAL COMPOUNDS CAPABLE OF ACCUMULATING HYDROGEN. THEY WERE ALSO RESEARCHING FOR INNOVATIVE WAYS TO OBTAIN BIO FUEL FROM NATURAL RAW MATERIALS. IN 2016, THE PROJECT CALLED 'THERMODYNAMICS AND CATALYSIS AS THE BASIS OF STRATEGY TO ESTABLISH HIGH-POTENTIAL PROCESSES TO OBTAIN FUELS FROM RENEWABLE SOURCES AND TECHNOLOGIES OF ACCUMULATING THE HYDROGEN USING NON-SATURATED ORGANIC COMPOUNDS' OF OUR SCIENTISTS WAS AMONG THE RUSSIAN GOVERNMENTAL SUBSIDIES COMPETITION WINNERS. THE UNIVERSITY RECEIVED RUB 90,000,000 AND SAMARA POLYTECH ESTABLISHED A LABORATORY SUPERVISED BY VERYOVKIN.



ENERGY OF HYDROGEN

Today, scientific community considers hydrogen as an environmentally-friendly power carrier. Yet, development of hydrogen power industry is currently hindered due to lack of suitable storage systems. Gaseous hydrogen has very low density which

can be enhanced by three ways: compressing the gas to hundreds of atmospheres, cooling it down below boiling temperature or putting it into the bound state. It should be noted, though, that compressed and liquefied gas may be dangerous during transportation and operation.

"Our task is to find process solutions and chemical substances capable of ensuring safe accumulation and

release of hydrogen,” notes Sergey Veryovkin. “After that we will be able to obtain fuel similar to diesel or gasoline, but ecologically friendly”.

Scientists consider the liquid organic hydrogen carriers (LOHC) as alternative option for hydrogen storage. Generally, these are poly-aromatic molecules containing sufficient number of double links, capable of taking and



releasing hydrogen molecules. In this state, hydrogen can be safely stored, transported and used in existing fuel infrastructure.

While developing concept of LOHC, Pimerzin and Veryovkin experimentally examined energy properties of many chemical compounds. This allowed to create a data base of potential hydrogen carriers for various practical purposes. Also, three patent applications were filed, where styrole oligomers and reaction resin still bottoms, gas-oil fractions, derivatives of diphenylmethane and

diphenylethane were offered as LOHCs. The researchers of the "High-potential processes to obtain fuels from renewable sources and technologies of accumulating the hydrogen using non-saturated organic compounds" laboratory also examined energy properties of reactions and catalytic systems and found the reactions to be capable of ensuring efficient LOHC-based system operation during multiple cycles without losing activity.

Thus, the scientists of Samara Polytech got an opportunity to individually select LOHC-based power storage technology according to customer's requirements, whether providing power for cars, homes, schools or for the whole town.

POWER OF PLANTS

Another task of the research of Pimerzin and Veryovkin is connected with oil refining industry. The scientists assess possibilities to produce bio fuel which is the fuel of today made of renewable plant sources combined with raw oil materials.

“Fossil energy sources, such as oil, gas and coal are finite, so the mankind should be prepared when the sun and bio mass become main power sources. Energy contained in bio mass (those are trees, water weed, vegetable oils) is enough to fulfill all human needs,” says Sergey Veryovkin.

Due to lack of special refining plants today it is hard to work with renewable raw materials in their initial state. The researchers of Samara Polytech offer a solution: joint refining of plant and oil raw materials at oil refineries. But bio oil has oxygen- and nitrogen-containing compounds that quickly deactivate industrial catalysts. In order to solve this issue, the scientists started looking for new stable catalytic systems.

For three years, they have been examining the impact of chemical properties of catalyst components – carriers, active metals and modifiers – on physical and chemical properties, activity and stability of these catalyst components when obtaining ultra-clean components of motor fuels. Currently, tests are being carried out on the real raw materials. They will allow the scientists to determine an optimal composition which can be ►

produced at the Russian catalyst factories and allows to make a fuel of combination of fossils and renewable energy carriers.

TO BE CONTINUED...

The three-year study comes to its end. But it seems that the project will

be extended. The scientists note that their work initially didn't imply technical implementation of the idea, the aim was just to make an intellectual property, such as articles and patent applications. But Veryovkin and Pimerzin undertook to implement this idea: at the beginning of the next year they will create a functioning prototype of the unit allowing to obtain environmentally-friendly energy from hydrogen.

It is worth noting that subsidy provision conditions allow the researchers to extend works for two more years.

"We already filed an application to extend work terms to the Ministry of Science and Higher Education of the Russian Federation," Andrey Pimerzin says. "We will focus further researches in hydrogen energetics: we will make the procedure of the liquid organic hydrogen carriers selection more detailed and develop LOHC-based technologies". ■

MEGA-SUBSIDY in figures

90 million ₺
subsidy

1 LABORATORY

"High-potential processes to obtain fuels from renewable sources and technologies of accumulating the hydrogen using non-saturated organic compounds"

3 patent applications

31 articles in scientific journals

3 years of research

Partners of the laboratory

Казанский федеральный университет
Kazan Federal University

ESRF
European Synchrotron Radiation Facility (France)

Ломоносовский государственный университет
Lomonosov Moscow State University

Université de Lille
Lille University of Science and Technology (France)

ВНИИ НП
All-Russian Oil Refining Research and Development Institute

ИОХ
N.D. Zelinsky Institute of Organic Chemistry Russian Academy of Sciences

ИХХ СО РАН
Nikolaev Institute of Inorganic Chemistry

ЮФУ
Southern Federal University

ИИИ
National Research Center "Kurchatov Institute"



SCIENTIFIC AND ANALYTICAL CENTER "INDUSTRIAL ECOLOGY OF SSTU"

**CONDUCTING CHEMICAL ANALYSES OF SOILS, WASTE, SEWAGE AND
SURFACE WATERS**

ENVIRONMENTAL AUDIT OF ENTERPRISES

**MONITORING OF THE ENVIRONMENT STATE IN THE ZONE OF MAN-MADE
OBJECTS IMPACT**

**DEVELOPMENT OF ENVIRONMENTAL JUSTIFICATIONS FOR THE
ACTIVITIES OF ENTERPRISES OF HAZARDOUS WASTE MANAGEMENT**

**CERTIFICATION OF HAZARDOUS WASTE, CALCULATION OF HAZARD
CLASS**

**DESIGNING OF LANDFILLS FOR INDUSTRIAL AND DOMESTIC WASTE
DISPOSAL**

**SCIENTIFIC DEVELOPMENTS IN THE FIELD OF WASTE MANAGEMENT
IMPROVING**

**ECOLOGICAL SUPPORT OF DESIGN DOCUMENTATION OF CONSTRUCTION
OBJECTS**

Accreditation and licenses for the relevant types of work. Maintenance of the coordination of the developed documentation in controlling bodies (Federal Service for Supervision of Natural Resource Usage , Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing , Russian Federal Service for Ecological, Technical and Atomic Supervision, Ministry of Emergency Situations, patent support)

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DEPICTED IN SCOPUS

WHICH IDEAS DOES POLYTECH ENRICH THE WORLD SCIENCE WITH?

IT IS SAID THAT WITHOUT FOOD, YOU CAN LIVE A MONTH, WITHOUT WATER - THREE OR FOUR DAYS, WITHOUT AIR - MAXIMUM FIVE MINUTES. BUT THERE IS ONE THING WITHOUT WHICH AN ADULT PERSON IN THE MODERN WORLD WILL NOT LIVE LONG. ODDLY ENOUGH, THIS IS THE ABILITY TO COUNT. PEOPLE ARE OBSESSED WITH THE CALCULATION. THEY COUNT EVERYTHING: MONEY, CALORIES, AREA OF LAND PLOTS, AND NUMBER OF DAYS BEFORE HOLIDAYS.

The work of scientists is now also in the tight grip of scientometric calculations. First of all, we are talking about citation indicators of scientific papers. The most famous indicator - the Hirsch index - was invented by professor of physics at the University of San Diego Jorge Hirsch in 2005. It is based on the dependence of the total number of publications and the number of citations of these publications. It is believed that the higher this index, the greater the scientist.

Counting publications and the number of citations is carried out using bibliographic and abstract databases in which articles, books, and other copyright materials are automatically indexed. There are dozens of such bases around the world. There is one in Russia - the Russian Science Citation Index (RSCI). However, Scopus and Web Of Science are considered the largest and most reputable international databases.

We acquaint readers with some Scopus publications of scientists of Samara Polytech and evaluate their scientific "tactical and technical" parameters.

Scientific vocabulary:

The Hirsch Index is a scientometric indicator based on the dependence of the total number of publications of a scientist and the number of citations of these publications. It is believed that the higher this index, the greater the scientist.

The impact factor is a numerical indicator of the importance of a scientific journal. It is calculated as the ratio of the number of links to articles in this journal to the number of articles published in it for a certain period. In the Scopus database, an analogue of the impact factor is the CiteScore indicator.

Quartile, Q is an indicator reflecting the level of citation, demand for the journal by the scientific community. Each journal falls into one of four quartiles: from Q1 (highest) to Q4 (lowest).

Anna Tarasenko,

Candidate of Physics and Mathematics, Associate Professor of the Department of Higher Mathematics

Anna Tarasenko began to study equations in the graduate school of Samara Polytech under the guidance of a Doctor of physical and mathematical sciences, professor Oleg Repin. In this case, the scientist is considering a mixed type equation. For $y < 0$, it is a model of second-order hyperbolic equations, and for $y > 0$ it is a fractional order diffusion equation. Various tasks of the equation have been studied, starting from particular boundary conditions and ending with more general ones. Using the modified Tricomi method, the uniqueness theorem of the problem is proved. The results of the work have both theoretical and applied value. The problem, the solution of which is proposed by Tarasenko, arises in mechanics and mathematical physics in the mathematical modeling of processes of various nature (hydrodynamic, aerodynamic and many others).

Anna Tarasenko

Scientific articles – **20**

Hirsch index – **3**

Articles in international scientific citation databases Scopus и Web of

Science – **9**

ARTICLE:

On Solvability of Nonlocal Problem for Loaded Parabolic-Hyperbolic Equation

JOURNAL:

Russian Mathematics (Impact-factor - 0,33; Q3)

**Evgeny
ALEKSANDROV**



Scientific articles – **17**

Hirsch index – **7**

Articles in
international scientific
citation databases
Scopus и Web of
Science – **17**

ARTICLE: Distinguishing
Metal-Organic
Frameworks

JOURNAL: Crystal Growth
& Design (impact-factor-
3.972, Q1)

Evgeny Aleksandrov,

Ph.D. (Chemistry), Head of the Laboratory
for the Synthesis of New Crystalline
Materials of the International Research
Center for Theoretical Materials Science

Evgeny Aleksandrov is known for the research in the field of crystallochemical analysis and the design of crystalline materials. His favorite subject-matters are sorptive technologies for the separation of gases and liquids, energy storage and conversion. The article, co-authored with foreign scientists Senja Barthel, Davide Proserpio, Berend Smit, is devoted to a completely new development.

It presents a general approach to the determination of unique structures and structural isomers in large structural databases using the ToposPro computer program. The development of this methodology is not only an important fundamental issue. In practice, it is useful in predicting the structure of optimal materials for the adsorption storage of combustible and toxic gases, the separation of gaseous and liquid mixtures, in the production of sensors, catalysts, solid fuel elements, electronics, photonics, and metal-ion batteries.

Scientific articles – **67**

Hirsch index – **5**

Articles in international scientific citation databases Scopus и Web of Science – **15**

Dmitry PASHCHENKO



JOURNAL:

Energy
(impact-factor - 5.582, Q1)

ARTICLE:

Pressure drop in thermochemical recuperators filled with catalysts of various shapes: experimental and numerical studies

Dmitry Pashchenko,

Candidate of Technical Sciences, Associate Professor of the Department of Industrial Heat Power Engineering

A scientist and a bicycle traveler Dmitry Pashchenko has been engaged in the research in the field of conversion of physical heat into chemical energy for several years. (A prototype of a thermochemical battery created with his participation was introduced several years ago in engineering industry.) In the article the scientist continues to share the results of studying the dynamics of the gas flow in thermochemical heat exchangers, which are filled with porous nickel-aluminum catalysts. The author conducted several physical experiments and built a computer model of this process in the ANSYS Fluent program. Experimental and simulated results, the difference between which amounted to no more than eight percent, prove the numerical model. It promises to be a real alternative to traditional research methods, because it allows you to predict the pressure change in recuperators filled with porous catalysts rather quickly and with high accuracy..

Sergey Evdokimov

Candidate of Technical Sciences, Associate Professor, Head of the Department of Environmental Protection and Hydrotechnical Construction

Scientific articles – **124**

Articles in international scientific citation databases Scopus и Web of Science – **8**

Hirsch index – **16**

**ARTICLE:**

Analysis of the results of cavitation studies of the impeller blades of a hydraulic turbine.

THE PROCEEDINGS OF THE CONFERENCE:

MATEC Web of Conferences 27. Серия: 27th R-S-P Seminar, Theoretical Foundation of Civil Engineering (27RSP), TFoCE 2018.

Vladimir Seliverstov

Candidate of Technical Sciences, Associate Professor of the Department of Environmental Protection and Hydrotechnical Construction

Scientific articles – **58**

Articles in international scientific citation databases Scopus и Web of Science – **4**

Hirsch index – **10**



The area of scientific interest of **Sergey Evdokimov** is related to the development and improvement of the design of power plants based on renewable energy sources. Recently, a scientist of Samara Polytech has been looking for the new ways to ensure the reliability and durability of hydropower installations. The last article, co-authored with the Candidate of technical sciences, associate professor **Vladimir Seliverstov** and the Candidate of technical sciences, professor **Aleksey Romanov**, who worked as the director of the Zhigulevskaya hydroelectric power station for 25 years, describes the methodology for conducting full-scale tests using high-speed erosion. On the blades of the impeller of a hydraulic turbine, scientists glued aluminum plates and tested the installation in three modes. By the nature of the damage to the coating, they determined the degree of erosion intensity. Based on the results of the experiment, the researchers developed recommendations for the maintenance of hydraulic equipment.

**Aleksey ROMANOV**

Doctor of Technical Sciences, Professor

Scientific articles – **21**

Articles in international scientific citation databases Scopus и Web of Science – **3**

Hirsch index – **3**



Vasily KUDINOV

Doctor of Physics and Mathematics, Head of the Department "Theoretical Foundations of Heat Engineering and Hydromechanics"

- Scientific articles – **>250**
- Articles in international scientific citation databases Scopus и Web of Science – **64**
- Hirsch index – **5**



Igor KUDINOV

Doctor of Technical Sciences, Professor of the Department "Theoretical Foundations of Heat Engineering and Hydromechanics"

- Scientific articles – **>150**
- Articles in international scientific citation databases Scopus и Web of Science – **38**
- Hirsch index – **5**



Vitaliy ZHUKOV

Assistant of the Department of Industrial Heat Power Engineering

- Scientific articles – **>40**
- Articles in international scientific citation databases Scopus и Web of Science – **6**
- Hirsch index – **1**

Anton ERYOMIN

Candidate of Technical Sciences, Head of the Industrial Heat Power Engineering Department

Scientific articles – **>150**

Articles in international scientific citation databases Scopus и Web of Science – **30**

Hirsch index – **3**

ARTICLE:

Resonant and bifurcation oscillations of the rod with regard to the resistance forces and relaxation properties of the medium

JOURNAL:

Mechanics of Solids (impact-factor- 0.418)



An article of the scientists from the Faculty of Thermal Power is devoted to the development of a mathematical model of elastic vibrations of a rod under the influence of an external harmonic (vibration) load. The model takes into account the relaxation behavior of the material, i.e. property of a metal to change the initial stresses in a loaded state and with constant deformation spontaneously. The experimental part of the study

was carried out together with the specialists of the RKTs "Progress" as part of the RSF grant for the project "Experimental and theoretical study of the influence of the relaxation properties of materials on vibrational and thermal processes in order to build new, more accurate mathematical models". In general, interest in this topic and the first publications of researchers appeared in 2016.

Sergey GUBANOV

assistant and postgraduate student of the department "Development and operation of oil and gas fields"

Scientific articles – **>21**

Articles in international scientific citation databases Scopus и Web of Science – **3**

Hirsch index – **2**

ARTICLE:

Effect of increasing temperature of the reservoir on the performance of high-viscosity oil

JOURNAL:

Arabian Journal of Geosciences (impact-factor - 1.141)

Researchers have been working on new technologies for the extraction of high-viscosity and bituminous oil for several years. The authors of the article substantiate a method involving opening a formation with a borehole with a dual system of holes: a layer is heated through one hole, and heated oil is produced through another. The proposed technology should significantly accelerate the process of extracting "difficult" oil and reduce operating costs for heating the formation.

**Valeriya OLKHOVSKAYA**

Candidate of Technical Sciences, Associate Professor of the Department "Development and operation of oil and gas fields"

Scientific articles – **112**

Articles in international scientific citation databases Scopus и Web of Science – **8**

Hirsch index – **6**

**Vladimir ASTAFYEV**

Doctor of Physics and Mathematics, Professor of the Department "Development and Operation of Oil and Gas Fields"

Scientific articles – **200**

Articles in international scientific citation databases Scopus и Web of Science – **42**

Hirsch index – **9**

**Kirill OVCHINNIKOV**

Candidate of Chemical Sciences, Head of the Department "Development and Operation of Oil and Gas Fields", Dean of the Department of Petroleum Technology

Scientific articles – **33**

Articles in international scientific citation databases Scopus и Web of Science – **4**

Hirsch index – **2**

**Victor KONOVALOV**

Candidate of Technical Sciences, Associate Professor of the department "Development and operation of oil and gas fields"

Scientific articles – **156**

Articles in international scientific citation databases Scopus и Web of Science – **9**

Hirsch index – **5**

Pavel Grachev

Doctor of Technical Sciences, Professor of the Department of Theoretical and General Electrical Engineering

Scientific articles – **114**

Articles in international scientific citation databases Scopus и Web of Science – **15**

Hirsch index – **5**

ARTICLE:

New stator design and modeling of energy-efficient generators for wind turbines

JOURNAL:

IEEE Transactions on Industry Applications

Alexey Tabachinskiy

Senior Lecturer, Department of Theoretical and General Electrical Engineering, a postgraduate student, Faculty of Electrical Engineering

Scientific articles – **29**

Articles in international scientific citation databases Scopus и Web of Science – **12**

Hirsch index – **4**

Together with his supervisor, Doctor of Technical Sciences, professor of the Department of Theoretical and General Electrical Engineering **Pavel Grachev**, the senior lecturer of the department and graduate student **Aleksey Tabachinskiy** is developing an asynchronous generator for renewable energy installations. The original design allows you to reduce the weight of the device without losing the quality of the electromechanical conversion.

Aleksey presented the research results at many conferences both regional and federal, as well as international. For example, last year, a young scientist completed an internship at the National Institute of Wind Energy in the Indian city of Chennai, and then

published an article in the scientific publication of the Institute of Electrical and Electronics Engineers (IEEE - an international association specializing in the creation and promotion of technology for the benefit of mankind (the author's note)).

In April 2019, a prototype of one of the options for an asynchronous generator was presented in Germany at the Hannover Messe 2019 industrial technology exhibition, and in September at the Coiltech 2019 international exhibition in Italy. By the way, with this development Tabachinskiy won the UMNİK program last year. He became the finalist of the regional start up accelerator "KB 37" and also received other awards.

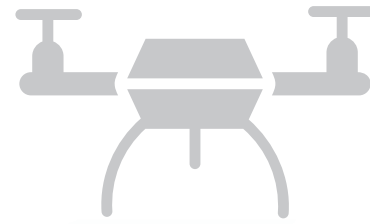
RICE ZONE

OUR SCIENTISTS DEVELOP THE ORIGINAL SYSTEM OF “SMART” AGRICULTURE

Text: Ksenia MOROZOVA

THIS REFERS TO THE CREATION OF AN INTELLECTUAL SYSTEM THAT WILL MAKE THE PROCESS OF FARMERS WORK ON RICE CARING EASIER. THIS PROJECT DOES NOT ONLY OPEN POSSIBILITIES FOR THE REGION TO ENTER INTO THE AGRICULTURAL MARKETS OF SOUTH-EAST ASIA. THIS “SMART FIELD” IS BASED ON THE PRINCIPLES OF PRECISE AGRICULTURE, SUITABLE BOTH FOR EXOTIC CROPS, AND FOR THE INCREASING CROP IMPROVEMENT, TRADITIONALLY CULTIVATED ON THE TERRITORY OF THE SAMARA REGION. DOCTOR OF TECHNICAL SCIENCES, VICE-RECTOR FOR INTERNATIONAL COOPERATION **ANDREY PIMENOV** AND DOCTOR OF TECHNICAL SCIENCES, HEAD OF THE DEPARTMENT “ELECTRONIC SYSTEMS AND INFORMATION SECURITY”, CHAIRMAN OF THE BOARD OF RESEARCH AND PRODUCTION COMPANY “SMART SOLUTIONS” **PETR SKOBELEV** TOLD ABOUT SOME OF THE DETAILS OF THE INNOVATIVE DEVELOPMENT.





HOW WAS THE IDEA FOR RICE PRODUCTION CREATED IN SAMARA POLYTECH?

We are constantly expanding the international geography of projects. So, after the business trip of our scientists to Taiwan in 2018, National Pingtung University of Science and Technology (NPUST), one of the largest universities in Southeast Asia, became interested in the developments of Polytech in the field of artificial intelligence (AI). Foreign colleagues proposed to develop a project collaboratively to implement a system for decision support for the cultivation of rice and other tropical crops. We agreed that Samara Polytech will help Taiwan Agricultural University to formalize its knowledge and “wrap” it in a computer-understandable form, which in the future will allow robots to make recommendations for farmers and make the right agricultural decisions.

In general, the “Smart Field” is the first intellectual system for agriculture in our country. We began to develop its prototype in cooperation with colleagues from the Samara Research Institute of Agriculture named after N.M.Tulaikov two years ago as part of a grant from the Ministry of Science and Higher Education of the Russian Federation. The results of this work are already introduced in the village of Orlovka in the Samara Region and in three other farms in other regions.

Opportunities for implementing similar projects in China, Thailand, India and Sri Lanka are currently being discussed. Everything that we develop for the intellectual agricultural technology of rice cultivation will be used in the future for Samara cultures.

WHAT IS THE “SMART” SYSTEM FOR RICE PRODUCTION?

It is a specialized digital platform, a rice knowledge base, and intelligent decision-making services for managing rice farms. Such a multifunctional system will be able to show the boundaries of any field, its history and 3D reliefs. AI will monitor the growth and development of plants, using satellites, and the drones will identify problem areas, accurately distribute the necessary resources, including equipment, fertilizers and pesticides.

If the first experiments are successful, then perhaps one of the new services will be the mobile spectral monitoring of the soil, which allows to determine its agronomic properties and mineral composition with a given error.

WHEN DOES THE SYSTEM START ITS WORK?

The project is designed for three years. After its completion, it is planned, together with Taiwanese partners, to develop an intelligent rice management system for other countries in Southeast Asia. ►

WHAT ARE THE BENEFITS FOR THE SAMARA REGION?

Our region is interested in the development of scientific and technical potential and international cooperation, as well as in the export of high-tech goods and services to international markets. Equally relevant is the task of developing advanced precision farming systems in our region to improve agricultural efficiency.

Unfortunately, it is not an easy task to quickly integrate into international projects in such a high-tech country like Taiwan, especially with the prospect of selling products and services to all of Southeast Asia. Therefore, the opportunity on an equal footing to implement a project with such a partner as NPUST is a great success and recognition of the high merits of our scientists.

In addition, international cooperation is one of the conditions for participation in large-scale scientific projects of federal significance, for example, in the development of a digital platform for agriculture, which, in turn, promises significant investments in the agricultural sector of the region's economy.

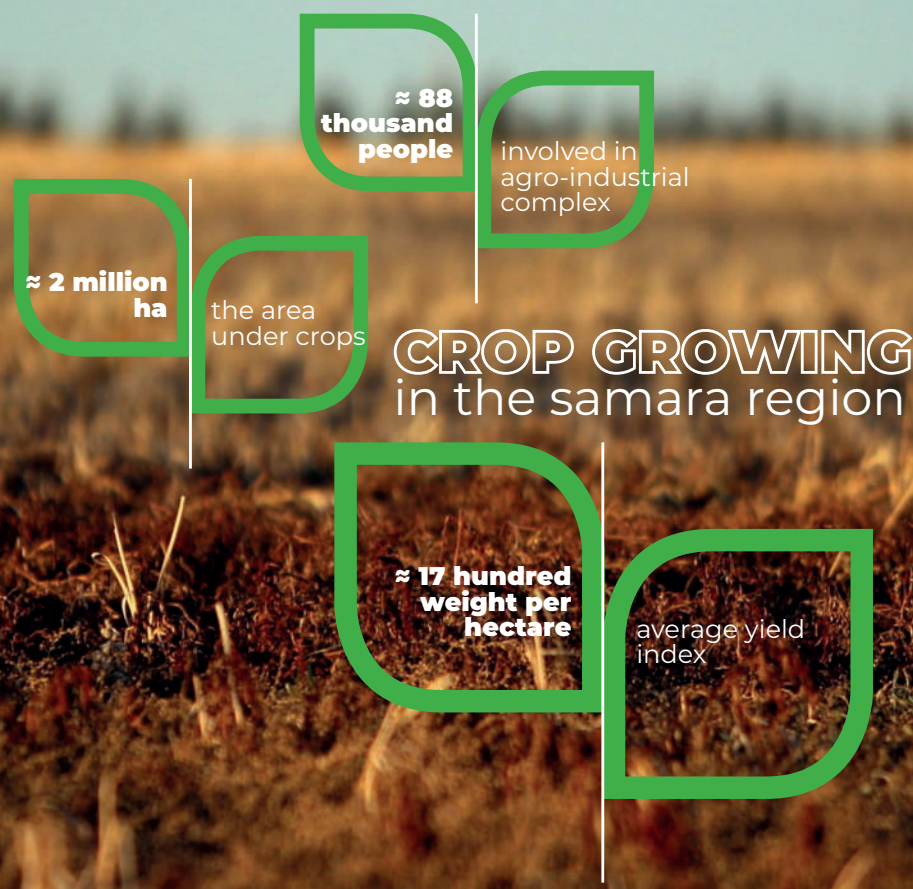
WHO FINANCES THE PROJECT?

The Ministry of Agriculture of the Samara Region invests five million rubles, and the same amount will be attracted by our university independently. The main expense items include the salary of specialists developing a knowledge base about rice, the creation of specialized software services, field experiments, translation of documents and programs into English and Chinese, and the promotion of development results in the markets of Southeast Asia.

The University of Taiwan will also finance the creation of its own services and the knowledge base containing information on plant nutrition, pest control, and soil structure improvement. ■

WHAT IS GROWN?





Data taken from open sources



Chickpeas



Flax



Ginger



Millet



Mustard



Sorghum



Soy



Sunflower



Triticale



Wheat

A DROP IN THE FIELD

POLYTECH SCIENTISTS WILL TEACH RUSSIAN AGRARIANS TO APPLY SPACE TECHNOLOGIES IN THE FIELDS

Text: Svetlana EREMENKO

A NEW METHOD FOR QUALITATIVE IRRIGATION OF AGRICULTURAL FIELDS IS DEVELOPED AT THE DEPARTMENT OF CHEMICAL TECHNOLOGY AND INDUSTRIAL ECOLOGY. THE POSSIBILITY OF REGULATING THE WATER SUPPLY TO AGRICULTURAL AREAS FROM SPRINKLERS BY MEASURING THE HUMIDITY OF THE EARTH ALLOWS TO SAVE WATER AND ENERGY CONSUMPTION SIGNIFICANTLY.

SPECTRUM-PAINTING

Instead of plowing, sowing, fertilizing and watering their crops in an archaic way, that is, "by eye", today farmers are able to continuously monitor the condition of the field, accurately calculate the required amount of moisture and fertilizers, and also water only problem areas and apply as much water as plants need. Recently, our scientists, members of the interdisciplinary project team (IPC) of Samara Polytech, became the owners of a patent for an invention that allows you to remotely determine the degree of soil moisture and, based on this, control the water supply from the sprinkler.

The picture of the application of the Polytech invention is approximately the

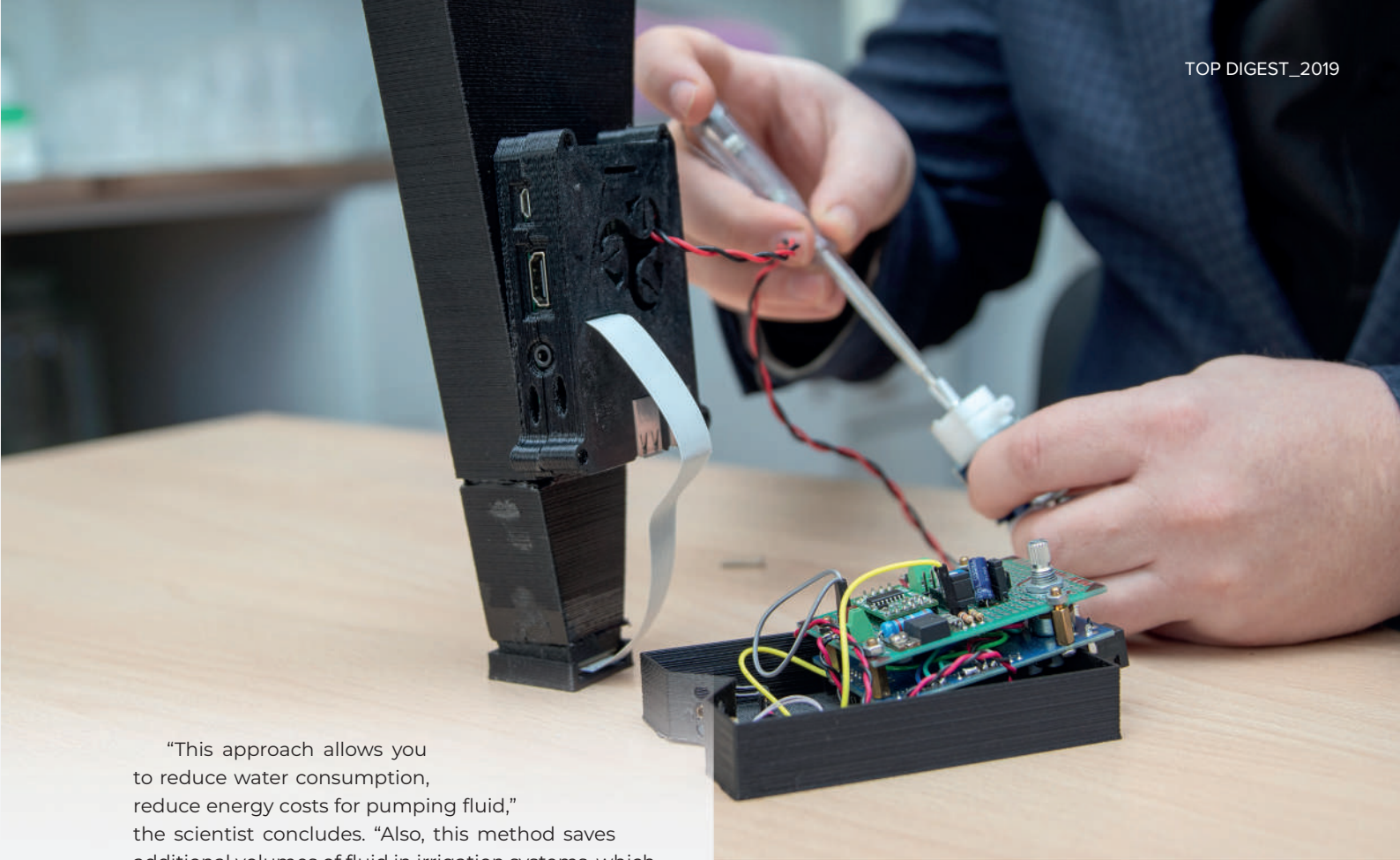


following. A large field. Green young crops. Here and there are dark bald spots. The sprinkler moves along the field. A scanning spectral camera is installed on the remote sprinkler bar. The spectroscope is placed on the machine in such a way that the area ahead of the machine across the entire width of the working field of the sprayer section falls into its field of vision. Since wide-coverage sprinklers are assembled from sections and several sprinklers are installed on each section, each spray device has its own control system. Measurement of moisture in the soil is carried out on the basis of processing images obtained from a scanner - a camera that works in the near infrared and visible range of the spectrum.

MOISTURE REGIME

"After receiving the image from the camera, the computer analyzes the pixels' brightness of the green region line of the spectrum, and the camera does not identify the strip falling out of the red color and makes it almost white. And then, for each section, the so-called NDWI index is calculated," the head of the IPC, candidate of technical sciences **Vasily Ermakov** says.

For accurate calculations, the usual norms of watering cultivated crops are introduced into the computer memory in advance. The maximum dry area is assigned a value of 0, the maximum wet - 1. After spectral analysis, the computer gives a command to regulate the sprinkler valves. The device opens the valves completely in a dry area of the field and closes it in a humidified area.



“This approach allows you to reduce water consumption, reduce energy costs for pumping fluid,” the scientist concludes. “Also, this method saves additional volumes of fluid in irrigation systems, which is especially important in arid lands.”

SMALL, BUT SMART

The spectroscope is compact, its dimensions are 20 x 5 x 10 cm. The device can be installed on any irrigation machine. Our engineers are also considering the option of autonomous operation of the water supply regulator using a compact generator.

There is another example of a spectroscope created by a team of engineers and scientists. It is designed to

NDWI is a normalized difference water index. One of the best-known parameters used in remote sensing to analyze vegetation on the earth’s surface.
NIR - the brightness of the pixels

$$\text{NDWI} = \frac{\text{Green} - \text{NIR}}{\text{Green} + \text{NIR}}$$

line of the spectrum

of the line near the infrared region of the spectrum
GREEN - the brightness of the pixels of the green region

determine the content of humus in the soil. By the way, 25 types of soils with different contents of humus and oil products were modeled for its testing. This year the device was upgraded: it decreased by one and a half times and decreased in price.

Using spectral monitoring methods, you can control the moisture level in the fields, the necessary doses of fertilizers, even the density of the population of cereal flies. The theme of such a “smart field” was the continuation of several developments of the IPC in terms of remote sensing of the Earth. ■

RATTLING NEUROS

SCIENTISTS OF THE INSTITUTE OF AUTOMATION AND INFORMATION TECHNOLOGIES TAUGHT ARTIFICIAL INTELLIGENCE TO RECOGNIZE RAILWAY DEFECTS

Text: Svetlana EREMENKO

A NEW INTELLIGENT COMPUTER SYSTEM DEVELOPED BY POLYTECH STAFF CAN REPLACE YOUR RESEARCH LABORATORY, DOZENS OF BRAIN ENGINEERS AND A BODY OF LINESMEN.

THE SCIENTIFIC HEAD OF THE NEURO-COMPUTER CENTER OF THE COMPUTER TECHNOLOGY INSTITUTE OF AUTOMATION AND INFORMATION TECHNOLOGY TOLD HOW TO USE DEEP MACHINE TRAINING TECHNOLOGY IN PRACTICE.

THOUGHT FROM THE MACHINE

Artificial intelligence is far from a new subject. World science has been doing it for some time. The basis of the machine mind is in artificial neural networks (ANNs) - computer structures, the action of which resembles the work of the human brain. Today, neural network algorithms are used everywhere: in medicine, economics, education.

Neural networks that analyze the situation in real time are equipped with unmanned vehicles. Face recognition systems, where the machine itself sets up the features by which it recognizes the object, are generally at the peak of popularity.



However, artificial intelligence cannot do without human help yet. For a neural network to work reliably, it needs to be trained, selected and loaded with a large amount of source data. Scientists of Samara Polytech, engaged in deep machine learning, in fact, make the machine think like a person: to reason, to solve problems, to interact with the environment, to improve the accuracy of recommendations and forecasts, based on the experience gained. Of course, a lot of preliminary work needs to be done in order for the ANN to "think" faster.

NEURONET IS ON ITS WAY

"The Department of Computer Engineering has accumulated extensive research experience in this area, which allowed to organize the neurocomputer center at the beginning of this year," **Sergey Orlov** says. "The staff of the center included teachers, graduate students and undergraduates of the department, engaged in

research in the field of artificial intelligence. We received our first order from the Research and Production Center INFOTRANS, a world leader in the development and production of innovative scientific and technical products for railway transport. Thus, a diagnostic artificial neural network (DANN) was created to recognize and classify defects in rail fastenings on a railway track."

DANN is installed on a specialized computer and synchronized with a video camera mounted under a laboratory car. Based on a large array of photographs of various railway faults, scientists trained the network to recognize nine classes of rail fastenings with an accuracy of 98.4 percent. As a result, it became possible to automatically detect breakdowns and defects.

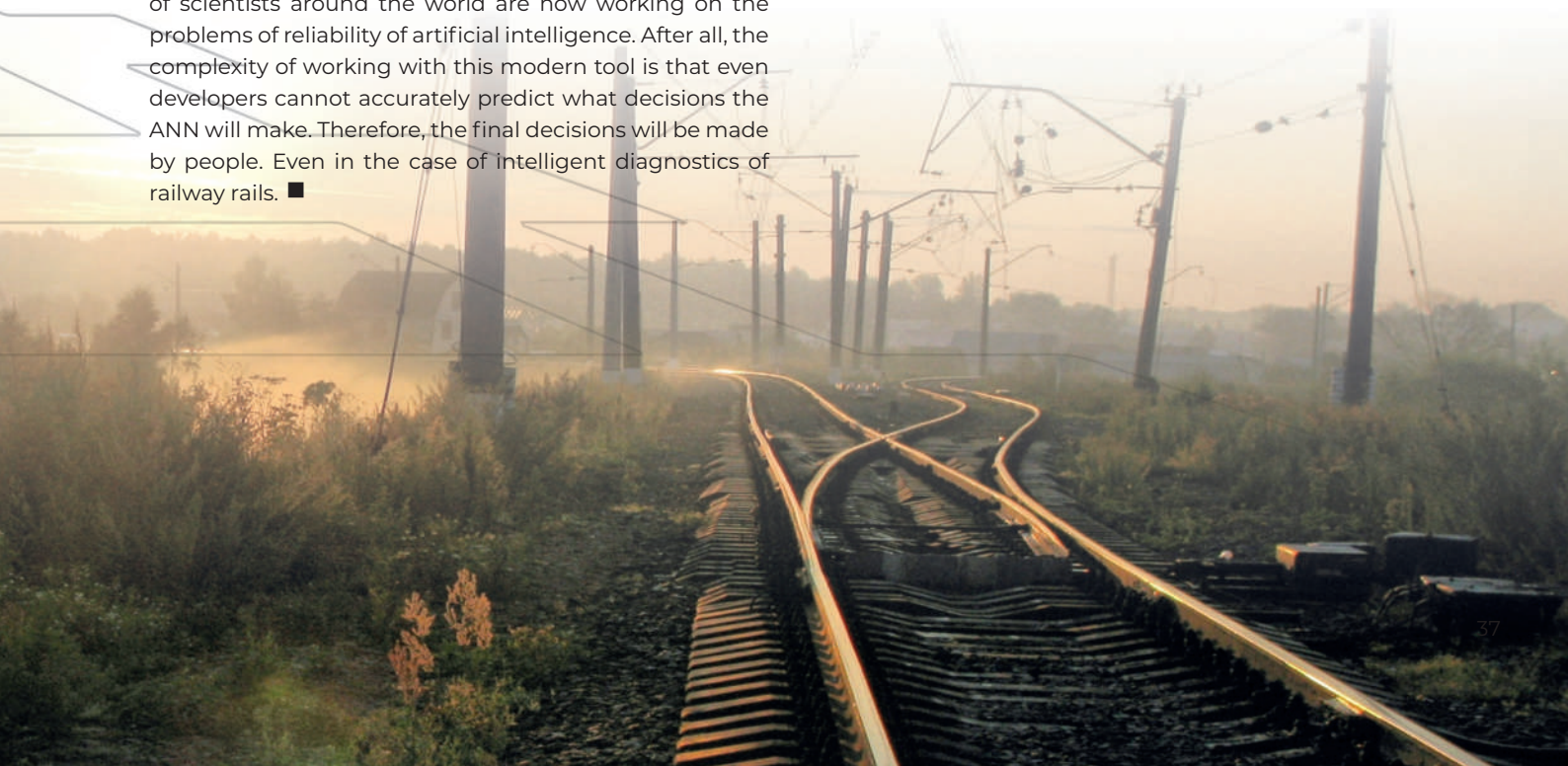
The "freshly trained" network has already been tested in business. The tests took place in a laboratory car on the section Voronezh - st. Castornoye. Of course, we had to solve a number of problems associated with the introduction of neuronet in real conditions. So, filming a track can be difficult due to insufficient lighting, pollution, or the speed of the laboratory car. Despite the fact that various images were used in the training set, it was impossible to guess all possible cases. In addition, when testing in a laboratory car, the equipment of a computer system of lower productivity was used, this required the development of software. However, the deep so-called convolutional neural network overcame all barriers and showed good results in the quality of classification of defects of railway tracks in different operating modes. Now the project has been successfully completed, and the developers are discussing with the customer the plans for further improvement of the system.

Artificial intelligence, of course, has become even closer to us. Interestingly, one of the problems that arises in this case is trust in neural networks. The groups of scientists around the world are now working on the problems of reliability of artificial intelligence. After all, the complexity of working with this modern tool is that even developers cannot accurately predict what decisions the ANN will make. Therefore, the final decisions will be made by people. Even in the case of intelligent diagnostics of railway rails. ■



Anton IVASCHENKO,
Doctor of Technical Sciences, Head of the
Department of Computer Engineering:

"The neurocomputer center was created as a center of competence of the Institute of Automation and Information Technology in the field of machine learning and artificial intelligence. At present, deep learning technologies allow to create effective industrial application systems. Now we can solve the problems of the real sector of the economy in identifying and classifying defects in various objects. This can improve the quality of medical diagnostics or, for example, remote sensing of the earth. At present, the department has strengthened the training of students who carry out educational and research projects in the field of big data analysis, machine learning, and parallelization of computing. We have found a balance in the development of fundamental disciplines, equipment and system programming, which allows us to prepare demanded specialists in the field of practical application of computer technology."



VIRTUAL OF HABITAT

SCIENTISTS OF SAMARA POLYTECH ARE DEVELOPING A VR SIMULATOR FOR OIL-INDUSTRY WORKERS

Text: Elena ANDREEVA

THE DEVELOPERS OF A VR TRAINING HARDWARE AND SOFTWARE PACKAGE FOR LOCALIZATION AND ELIMINATION OF ACCIDENTS ON HAZARDOUS OIL PRODUCTION FACILITIES ARE PLANNING TO IMPLEMENT SUCH PACKAGES INTO OIL REFINERIES AND PETROCHEMISTRY, ELECTRIC POWER AND MECHANIC-ENGINEERING FACILITIES AS WELL.

Here is the idea. Top trends of the digital age haven't affected the sphere of industrial safety and labor protection in any way yet. In particular, personnel is trained 'as in the old times', training of firefighting on hazardous objects is performed in conditions that are far from real, a technogenic accident is imitated by just a burning barrel with diesel fuel. In other words, traditional training does not include any kinds of interference and risks that are common for a real industrial accident.

Today, however, there are hardware and software forms of training as well. Specialists are trained to control a model of process unit during an accident using a computer. But this kind of training has its drawbacks – it's too factitious and simplified.

Experts of the "Oil and Gas Field Development and Operation" Department came up with a totally different approach.

"One of the premises of starting this project was the experience we gained during the development of the 'Poligon' simulator which was supposed to give soldiers the basic skills of weapons proficiency; it was developed by the experts of the "Automation and Information Technology" Department of our university," says **Kirill Ovchinnikov**, Candidate of Chemical Sciences, Head of the Department. "When I saw this product I realized that such simulation instrument as virtual reality could be very useful as a training hardware and software package for elimination of accidents on a production facility."

It should be noted that such technologies have already been extensively implemented in various spheres of industry and economy, for example, to train bank employees and to simulate emergency situations. So it's natural that the concept of developing a simulator for the personnel of oil production companies came next.

The VR-platform is being developed by the IT and industrial safety experts of Samara Polytech in cooperation with oil industry specialists. One of the oil loading stations owned by 'Samaraneftegaz' company was used as the real-life prototype for a virtual object. The company staff members took part in working out the action plan.

The process consists of several stages. First, the real object is digitized and turned into a 3D model; its dimensions should be the same as those specified in technical documentation. Then, scenarios of emergency situations are described: depressurization, accident, fire or explosion; algorithms of staff actions are made up. Then all this content is passed to the programmers who develop the software.

The university gave the team of developers money to buy all necessary high-performance equipment for the VR-simulator. In December the developers will present the results of their work to the 'Samaraneftegaz' authorities. The

first training on localization of an accident using the virtual reality technology is expected to take place at that period too. In case the pilot version proves to be effective, the scientists will continue. But even now its great potential is obvious because emergency situations on industrial facilities can be developed in many ways. What makes virtual reality attractive is that it can simulate an accident in any place and at any object without injuring people.

"A human receives 60-70 per cent of information through vision," Ovchinnikov explains. "Once a specialist undergoes training on our simulator several times and analyses his mistakes, he will be able to adapt to a real emergency situation as well." ■

VIRTUAL REALITY (VR)

– a technology of visualization, interaction and control of a computer-generated digital environment



AUGMENTED REALITY (AR)

– a system that combines virtual and real environments, adds virtual elements to the real world but doesn't replace it completely



VR APPLICATION AREAS



EDUCATION

Modeling of training environments in different subject fields



SCIENCE

Studying simulated worlds: atomic, molecular, underwater, etc.



MEDICINE

Virtual surgical operations



ARCHITECTURE AND GRAPHICAL DESIGN

Building houses and other objects in virtual environment



ENTERTAINMENT

Playing videogames, visiting art galleries, travelling

2020 ■ FORECAST

> \$3 billion – world market volume of VR devices

65 billions of copies – total number of VR/AR devices

All data is provided by public sources

MISSION «EMISSION»

SAMARA POLYTECH LEARNT HOW TO DETERMINE THE QUALITY OF METAL BY SOUND PULSES

Text: Ksenia MOROZOVA

THE SPANISH WRITER AND PHILOSOPHER BALTASAR GRASIAN ONCE SAID: "THE METAL IS RECOGNIZED BY THE TONE, AND THE MAN BY THE WORD." IF THE SECOND PART OF THE QUOTE CAN BE PUT IN DOUBT BY SOMEONE, THE FIRST PART HAS BEEN PROVED BY SCIENTISTS OF SAMARA POLITECH. BY EXPERIENCE, THEY PROVED THAT BY SOUND, IT IS POSSIBLE NOT ONLY TO DETERMINE THE METAL VIEW, BUT THE QUALITY OF ITS STRUCTURE AS WELL.

IN MACROWORLD

Metals and alloys consist of numerous crystals (grains) that are tightly adjacent to each other. Their parameters largely depend on the conditions of the casting process. The smaller the grain, the higher the technological properties of the alloy: strength, ductility, etc. Therefore, technical control is an important stage in the foundry.

"As a rule, at modern metallurgical enterprises, testing of finished products takes several hours," **Konstantin Nikitin**, Dean of the Faculty of Mechanical Engineering of Metallurgy and Transport says. "First, a small fragment (template) is cut out of the workpiece, then it is ground, chemically etched (the surface layer of the material is removed), scanned using a special device, and the average grain size is measured from the image obtained. If the alloy



structure does not meet the requirements of regulatory documentation, the cast product is rejected."

THE MAIN THING IS TO BE ABLE TO LISTEN

The method proposed by the interdisciplinary project team of scientists of Samara Polytech will prevent production defects and simplify the process of producing alloys with high technological properties.

The principle of operation of the installation, created by the joint efforts of casters and IT specialists, is based on the method of acoustic emission - registration and analysis of acoustic waves that occur during plastic deformation and destruction of objects. The device will continuously monitor the process of grain formation and predict the structure of the future ingot, the presence of cracks, slag inclusions and porosities in it. Scientists learn about deviations from the required parameters by the sound vibrations that arose during the restructuring of the internal structure of the metal during crystallization and captured by special sensors.

"The signals may be different. It all depends on the speed of formation of grains, their size and morphology," explains Pavel Zobnin, the undergraduate of the Institute of Automation and Information Technology. "Our task is to fix these signals, analyze and build a mathematical model of the dependence of a particular impulse on changes in the metal structure. Now we are working with aluminum, but we will experiment with other metals and alloys based on them."

Today, the share of cast parts in various machines is 40-50%, so the development of scientists will be especially relevant for the defense, aviation and automotive industries. ■



Ekaterina YAROSLAVKINA,
head of the interdisciplinary project team,
Head of the Department “Information-
Measuring Equipment”:

“We developed a prototype of the installation together with the foundry technology center of the flagship university using L-card electronic measuring equipment. Today, the device is in the process of debugging and further testing in the metallurgical industry. We already have agreements on the implementation of the system at Samara enterprises.”



1

Molten up to 700 °C aluminum is put into a melting pot (a bowl made of fire-proof material)

2

A probe is put into the molten metal

3

Special sensors pick up the noises that occur during the crystallization process

4

The signals are converted into voltage and sent to the controller

5

The resulting digital code containing information about the metal structure (solidification time, sum of acoustic emission pulses, crystallization rate and temperature change) is decoded using the software developed by Samara Polytech specialists



FAME OF A FRAME

SCIENTISTS OF SAMARA POLYTECH SYNTHESIZED FIRST ORGANOMETALLIC POLYMERS

Text: Svetlana EREMENKO

FULLERENES, METAMATERIALS, COMPOSITES AND SUPERCONDUCTORS – ALL THESE ARE THE MATERIALS THE WORLD OF THE FUTURE WILL BE BUILT OF. AN ADVANCE BEING MADE BY THEORETICAL PHYSICS AND CHEMISTRY LITERALLY IN FRONT OF US LEADS TO THE TRIUMPH OF 'ALIVE' TECHNOLOGIES. FOR EXAMPLE, A RELATIVELY NEW CLASS OF ORGANOMETALLIC POLYMERS THAT WERE CREATED 15-20 YEARS AGO QUICKLY ATTRACTED THE SCIENTISTS' ATTENTION WORLDWIDE. SCIENTISTS FROM SAMARA, AS WELL AS THEIR COLLEAGUES, HAVE BEEN EXTENSIVELY WORKING ON ANTICIPATION OF THEIR STRUCTURE AND PROPERTIES, FIRST BY BUILDING A MODEL ON THE COMPUTER AND THEN BY SYNTHESIZING THE MATERIAL IN THE LABORATORY.



ANTICIPATION GAME

First organometallic polymer materials, or organometallic frameworks (OMF), were synthesized under the guidance of the chief of the laboratory of the international scientific research center of theoretical material science (ISRCTMS), Candidate of Chemical Sciences **Eugeny Alexandrov** and Doctor of Engineering Sciences **Andrey Pimenov**.

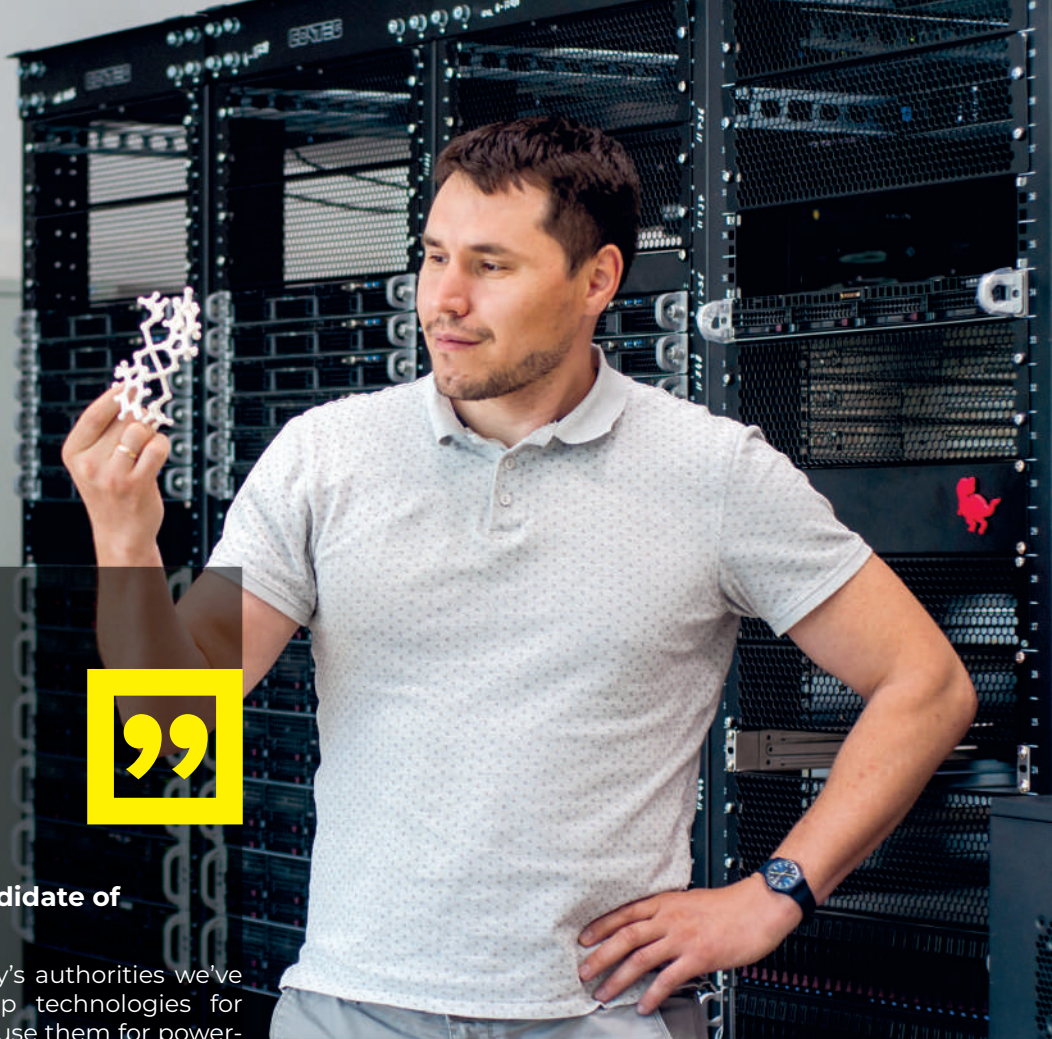
The researchers treat their scientific experiments more like design work rather than a traditional chemistry issue, sometimes calling it a Lego game. It really looks like a construction kit for children – you just put together separate molecule fragments of a certain configuration to form structures with anticipated shape.

So why are scientists and practical workers so interested in these materials? First, porous organometallic frameworks have extremely high sorption characteristics towards various volatile substances and gases. It's a kind of crystalline sponges with unique parameters. One gram of such substance has pore surface area equal to that of a football ground. Second, they can have several useful properties at the same time: magnetic susceptibility, luminescence, electrical conductivity, catalytic activity and many others. It allows to use them as a basis for creating advanced materials for sensing and detecting devices, storage and processing of data, photoelectric cells, nanoreactors etc.

LIQUID FROM NOTHING

OMFs are already being used for power-efficient sorption gas separation, adsorptive cooling for computers, capture and storage of greenhouse, toxic and explosive gases, organic synthesis. For example, there is a technology that allows to capture carbon dioxide from the atmosphere and turn it into gaseous, liquid or solid fuel using photocatalytic conversion. This process is similar to natural photosynthesis. And there is a device designed on the basis of organometallic frameworks; it produces up to three liters of water per one kilogram of the material per day from dry air, i.e. literally from nothing.

OMF can be also considered as one of the most prospective materials for portable storage of methane and hydrogen – 'fuel of the future' for cars. For example, you've got a small tank with high-pressure methane. If you put some organometallic powder there, its capacity will increase about 3-5 times. The cars utilizing this technology have already been designed and used in the USA and Germany. ►



Eugeny ALEXANDROV,
head of the laboratory, Candidate of
Chemical Sciences:

“With support of the university’s authorities we’ve got a real chance to develop technologies for synthesis of new materials and use them for power-efficient sorption gas separation in Samara. We have made queries to two science foundations to support our research; we also work in cooperation with our industrial partner NTF BAKS.”

Organometallic polymers possess great potential in terms of separation of branched and linear components of gasoline. Linear components have a higher detonation value and lower octane number. They are removed by means of fractionation separation reaction which requires large amounts of energy. An energy-saving alternative is to ‘sift’ the mixture of hydrocarbons through a porous membrane – a kind of a molecular sieve consisting of organometallic frameworks.

There’s a number of other interesting OMF technological applications. They can be used in photochemistry and production of sensors and even refrigerators. Organometallic polymers also serve as the basis for designing supercomputer cooling systems utilizing the water adsorption-

desorption principle. Such materials are essentially a platform for further modifications and can be used in various areas of science and engineering.

WIKIPEDIA FOR CRYSTALL-CHEMISTS

Today there are two samples in the ISRCTMS laboratory – nanocrystals of copper trimesinate (II) (HKUST-1 or MOF-199) and chrome terephthalate synthesized by the Polytech student **Andrey Goltsev**. These materials are highly porous, stable and sorptive towards the components of natural gas, air, gaseous and liquid production waste. Together with **Lyudmila Onuchak**, professor, Head of the "Physical Chemistry and Chromatography" Department of Samara University, the scientists plan to synthesize composite materials on the basis of these samples, study their surface texture and their ability to hold various substances – for example, natural gas components – on their surface.

Synthesis of new materials in the ISRCTMS laboratory is based on the concept of ‘going from experience to knowledge, from knowledge to practice’. Traditionally, anticipation of material properties is done by the experts – people with much experience and knowledge. Latest advances in the area of artificial intelligence allow to



assign part of the work to automated software systems, or expert systems. By now, the scientists have already got much information about composition and properties of OMF polymers. The scientists analyze this information using big data analysis methods (association rule learning, decision tree derivation, clusterization, etc.) thus obtaining new information. For example, the data base is seeded with 'composition – structure – properties' correlations. Experts develop this base and use it to anticipate structure and properties of materials of different types: zeolites, intermetallic compounds, organic molecular crystals, solid electrolytes, etc. A data base containing information about correlations, rules and regularities used to solve problems in particular areas is the main component of an expert system. Today these automated software packages allow to develop new scientific areas at the junction of theoretical material science, crystal engineering, crystal chemistry and artificial intelligence.

By the way, such knowledge bases and expert systems in chemistry and theoretical material science have begun to develop only recently. There are no such systems in crystallography and crystal chemistry so far. In fact, scientists working in this areas all over the world create their own Wikipedia. ■



Vladislav BLATOV,
director of ISRCTMS, professor:

“I consider this first OMF synthesis to be a milestone in development of our scientific center. The Polytech ISRCTMS is very young: we were officially approved as a structural division of the university only at the end of 2017. But even within such a short period we finally did what we had been dreaming about for a long time – we began to put into practice our theoretical anticipations of new crystalline substances and materials in our laboratory – thanks to the support of the authorities of Samara Polytech. Until now, our researchers had to do experimental work in the laboratories of our partners, mainly abroad. Now we can quickly verify our theoretical models which will speed up their development right away; we'll also be able to create new materials not just on the computer screen.”

VLADISLAV BLATOV: “A WORLD-CLASS LABORATORY CAN BE ESTABLISHED EVEN IN A SCIENTIFIC “COUNTRYSIDE”

Text: Elena ANDREEVA

INTERNATIONAL SCIENTIFIC RESEARCH CENTER OF THEORETICAL MATERIAL SCIENCE (ISRCTMS) OF SAMARA POLYTECH IS A REAL LABORATORY OF MIND PROVIDING OPPORTUNITIES BOTH FOR BEGINNERS AND EXPERIENCED SCIENTISTS. THE DIRECTOR OF ISRCTMS, DOCTOR OF CHEMICAL SCIENCES, WORLD-RENOWNED PROFESSOR **VLADISLAV BLATOV** PLANS ON ESTABLISHING FEW MORE TESTING SITES ON THE BASIS OF THIS CENTER FOR YOUNG SPECIALISTS IN VARIOUS SUBJECT FIELDS. HE TOLD ABOUT HIS PASSION FOR CHEMISTRY AND DEVELOPMENT OF FUNDAMENTAL SCIENCE IN SAMARA REGION IN HIS INTERVIEW FOR THE “TECHNOPOLIS OF THE VOLGA REGION” JOURNAL



ON THE COMMUNIST YOUTH LEAGUE EXPERIENCE

“Do you remember the Stalker movie, when the Writer asked the Professor: “So you’re a chemist?” – “More like a physicist” – “It still sounds boring...” How did you choose your profession?”

“I was introduced to the science mainly thanks to my grandfather, **Andrey Alexandrovich Novopashin**. He was one of the first professors in Kuibyshev Engineering and Construction Institute (now it’s Architecture and Civil Engineering Academy of Samara Polytech – Ed. note), he always called himself a ‘silicate chemist’. Despite of his technical education he was always attracted to the fundamental science, trying to find correlation in structure and properties of the materials. I finished a regular high school. My parents were engineers. My father graduated from the Aviation Institute and worked at the ‘Progress’ plant, and my mother, by the way, graduated from the Industrial Institute as a chemist and worked in ‘Giprovostokneft’. But my grandfather influenced me most, he was a major scientist.

I was attracted by natural sciences, and, frankly speaking, I wanted to be a biologist, I even attended a ‘Young Biologist School’ in Samara State University. But when I started preparing for my exams, for some reason I decided to start with chemistry. I started reading ‘Guide for University Applicants’ by Khomchenko and I really got into it! There were many vague things in chemistry: all these correlations and why a reaction happens this way, and stuff... So I found my direction.

I remember attending extracurricular lessons of analytical chemistry when I already entered Kuibyshev Engineering and Construction Institute – I really liked qualitative analysis and finding substances compounds. But in summer I found that I spent my whole time in laboratory away from everyone, so I decided to make changes. This period was a kind of the end of childhood.

At that time, I was also offered to become a committee secretary of Communist Youth League of the whole

Chemical and Biological Faculty with 500 students. Of course, it was quite a challenge for me because I never dealt with so many people before. I wanted to change myself, so I worked in this position for two years.”

“What skills did you develop back then?”

“First things that got very useful in my life were some persistence and ability to face challenges. My work was challenging indeed as it used to take a lot of time and I also



needed to study. I never was paid for my Communist Youth League work and I had no administrative tools to force the students to do anything. So I had to learn how to convince. It was important just to stay an honest person and show that you don’t just do things for yourself but try to make people’s life better. One year later I realized that I can achieve many things but not all at once. I had to choose an area where I could really make my ideas real and the areas that I had to give up. But in the end I learned to communicate with people and now I am able to do public speeches and say something touching. For the years of working in the Communist Youth League I learned to plan my time and do many things simultaneously. On my 4th year of study I ►

prepared a person to replace me, I left my secretary work and dedicated myself to science. In the same time period, in 1985, my first scientific article was published in the 'Radiochemistry' scientific journal.

ON PATRIOTISM AND LOYALTY

“Did you graduate with honors?”

“Yes, and I was absolutely positive I should do science further on. I wrote

to let down my academic advisor, **Viktor Nikolaevich Seryozhkin**. I passed the Candidate of Sciences grade defense in 1991 in the USSR, but I was awarded with the grade already in the Russian Federation.”

“Do you regret preferring Kuibyshev over Moscow?”

“I was OK with it and still have no regrets. I had to decide what to do next anyway. In 1992, a sausage suddenly became 100 rubes instead of 5, and my monthly salary was about 700 rubles, equivalent to 7 Snickers chocolate bars. But the problem of giving up my scientific career wasn't acute: I lived with my parents at that time. Nevertheless, I tried to move abroad, in quite naive way: I wrote 10 letters



my graduation paper in Moscow, in Fine Chemicals Institute (today it is the Red Banner State Scientific-Research Institute of Chemical Reagents and High-Purity Chemical Substances – Ed. note). It was an amazing place, very much resembling the story called 'Monday Begins on Saturday' by Strugatsky brothers. The story described a unique substance examination laboratory with state-of-art and most expensive equipment in the USSR. And I was amazed with all this enthusiasm the laboratory experts had. I was invited to Analytical Reagents Institute for postgraduate study but I decided to do the postgraduate study in my alma mater. And I also didn't want

to the foreign scientists I knew by their published works. There was only one answer – it came from Germany: they were ready to take me in at my own expense. Back then, the Soviet chemists were actively recruited abroad, and many of them left Russia. But you had to know the ways and laboratories that hosted the competitions.

Today, I tell young people that work with me: “It's good if a scientist travels abroad for a year or two to see things and learn something new. But he still has to come back, because every person should have its homeland. If you just stay abroad, it's not exactly what you need. You may have a good job, but it's only a part of your life.”

“Still, you had to survive somehow in 1990's...”

“Immediately after the post-graduate study, at the beginning of 1992, I started teaching and worked as an assistant lecturer at my 'Non-organic chemistry'

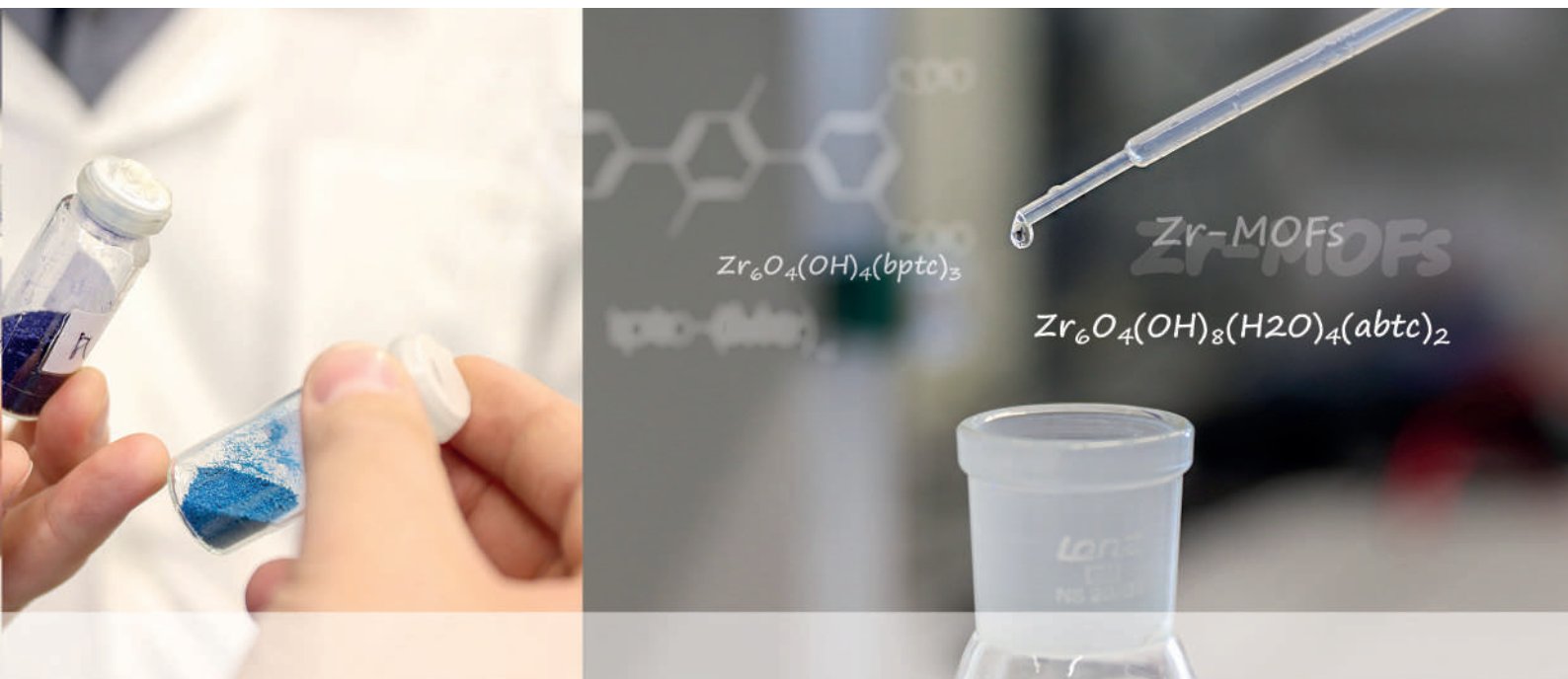
Department. I had to teach 5 cohorts of students, but my Communist Youth League experience really helped me out. In 1990's scientists weren't paid (and still don't get much), but at least we can get some subsidies in addition. I got my first \$500 from the American Chemical Society that hosted a competition for Russian scientists in 1994. It was an enormous amount, especially considering that my salary was only \$6."

"You were still teaching in the university?"

"Yes. In 1994 I became a senior lecturer, and later in 1996 – an assistant professor. In 1998, I passed my Doctor of Sciences thesis defense. It was quite unusual to defend a thesis in the age of 32 back then; usually people made

all, the science should predict and forecast things. Back then, together with my friend **Alexander Shevchenko** who graduated from my faculty four years after me, we started developing the TOPOS software package that made us famous. The main idea was to automate geometrical and topological analysis of crystals to the maximum extent, to facilitate analysis of experimental data in case it was too big to be processed manually. In 1993, we made our first publication on TOPOS.

This paper provided the basis for the laboratory which is now the international



their thesis works after 40. I defended both Candidate and Doctoral thesis work in Kurnakov Institute of General and Inorganic Chemistry of the Russian Academy of Sciences."

ON FATE AND DIVINE PROVIDENCE

"Have your scientific interests changed since then?"

"They definitely have. I was a classic chemist when I was defending my Candidate thesis work, synthesizing coordination compounds, spending my days in lab, and most of my work was experimental. Later I gave up experimenting completely because I thought it was time to do real science which, in my opinion, was searching for correlations and developing theories. After

scientific research center of theoretical material science (ISRCTMS) of Samara Polytech where we do many other things as well.

In 2000, I won my first Russian subsidies – in the Russian Foundation for Basic Research (RFBR) and a subsidy for young doctors of science, which enabled us to start a serious TOPOS development project. In 2003, we met Davide Proserpio, professor of the University of Milan, Doctor of Chemical Sciences, currently the ISRCTMS science advisor. It turned out that I could solve many challenges he faced and since then we are not only colleagues but real friends as well. In 2009 we won an Italian subsidy, ►

though it took 3 attempts, and if we failed, we wouldn't try for the 4th time."

"You didn't want to tempt fate?"

"I don't believe in fate or divine providence. There is no controversy here: the science deals with the material world, and spiritual matters are driven by faith, they are not related to each other. You



must believe in what you do, and if you believe, you will most probably overcome all issues and even lead the others. It is especially important for young people, you can't lie to them. I believe in the future of the Russian science and of our country, I've always been an optimist.

I conducted a kind of a social experiment in Samara: is it possible, while being in a 'scientific countryside', without involving famous scientists, to establish a laboratory of normal (okay, I'm not going to say 'top world') international level in



We cooperate with Chinese scientists of Northwestern Polytechnical University in Xi'an to forecast new non-organic compounds, search new electrifieds and new high entropy alloys.

all aspects? And I can definitely say now: yes, it is. And if one can do it in Samara, it is possible to do it everywhere in Russia, if one is determined enough."

"Do you have enough resources?"

"We actually have more than enough of talented guys. But young people are really confused, they don't feel protected

enough, they don't know what to do after graduation, they don't feel they'll be wanted here 5-10 years later. This is why the main purpose of our center is to establish a kind of portal into big science for students, so they felt completely involved in the world science while being in Samara.

Today, ISRCTMS is a unique facility of the Samara Region, but it still does not receive federal funding. We employ 25 people with service staff, and we only operate thanks to the money we earn. Today we use over 10 subsidies by the Russian Foundation for Basic Research and Russian Science Foundation which are sufficient to provide our employees with decent salary. We filed eight more applications."

"Today, Russian mass media talks a lot about establishing world-class scientific centers in Russia. How do you think, what criteria they should comply with?"

"In my opinion, there's only one criterion - how willingly the world leading laboratories cooperate with you. Their experts don't come here just for sightseeing - they want to cooperate. And, vice versa, our employees don't go abroad to break their backs for Euro salary, but to work on joint projects. We strictly follow this principle.

For example, Peter Leisegang Tilmann, Doctor of Sciences of Freiberg University of Mining and Technology (TUBAF, Germany), has been working with our center since 2015. Based on the methods of crystal structure topological analysis, we theoretically developed a new material - sodium-ion conductor - and German scientists synthesized it. Quite a progress. As to the results, we published three new articles in the first quartile journals just this year. Currently, we're preparing to publish a co-authored book, launching two projects and hope to implement one more together with Lomonosov Moscow State University and St. Petersburg University.

ISRCTMS already obtained lists of promising lithium- and sodium-conductive compounds and will soon get magnesium and aluminum-containing substances. We also research the materials for high-valence metal-ion accumulators; by the way, our colleagues from Freiberg suggested this.

Shortly, we expect announcement of results of the project competition we participated together with professor **Michael Anderson** (The University of Manchester, United Kingdom) and **Adam Hill**, a postgraduate. Our joint task is to develop a universal kinetic 3D model of space division to predict the growth of crystals of various nature. We published an article on this topic in the 'Nature' journal. The English scientists are interested in working with us because their programs don't work without ours, requiring a complex theoretical approach. It's like developing a method to erect a building, but the structural elements still remain unknown. This is

what their main problem was. And here we are, capable of naming the structural elements for any case.”

“Young ISRCTMS scientists are very active with science work. What are the main fields of their activity?”

“There are three main fields now. The first one is handled by **Eugeny Alexandrov**, head of the new Crystal materials synthesis laboratory. Together with **Andrey Pimenov**, Head of the "Chemistry and Technology of Nitrogen Organic Compounds" Department of the flagship university, they managed to synthesize the first organometallic frameworks (OMF). The obtained polymer materials show outstanding sorption characteristics towards other volatile substances, gases, liquids and ions. It's like a crystal sponge with unique parameters. One gram of such substance has pore surface area equal to that of a football pitch. They also possess some good properties: magnetic susceptibility, luminescence, electric conductivity, catalytic activity and many others. They provide the basis to make top-notch materials for sensors, data storage and processing, photocells and nanoreactors.

Our second field is the search of new aluminum-conductive solid electrolytes, handled by Peter Leisegang Tilmann, head scientist researcher of SCTMS. We also obtained some significant results here, including getting subsidies for research. In July, our head scientist researcher **Artyom Kabanov** won the competition hosted by the Russian Scientific Foundation of Presidential Programme for research projects managed by young scientists. Artyom also currently studies solid electrolytes. He runs the project called 'Theory, modeling methods and directed search of new high-valency ion conductors by means of crystal-chemical analysis and quantum-mechanical simulation'. In terms of this work he also makes a data base enabling a major breakthrough in searching appropriate materials for high-valency metal-ion accumulator and identify possible correlations between structure and ion-conductive properties of the crystals.

Finally, our third field is the joint work to develop a topological model of phase transitions and forecast of new non-organic compounds, search of new electrified and new high entropy alloys with scientists of Northwestern Polytechnical University (NWPU, Xi'an city, China). In 2018, an agreement was signed

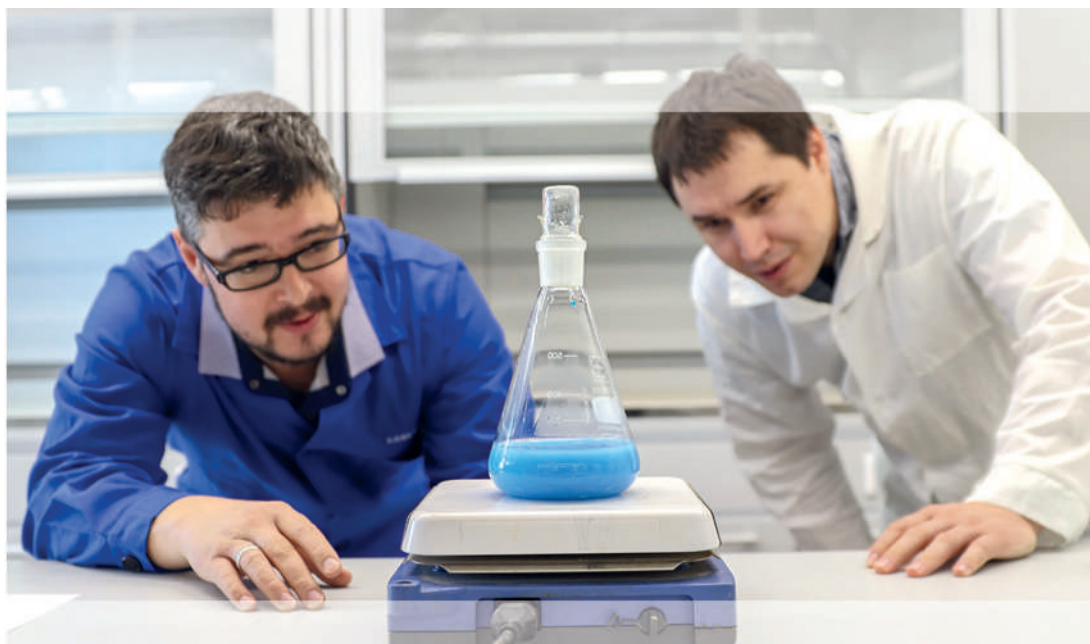
on establishing the Chinese-Russian Innovation center on the basis of National Engineering R&D Center of Ceramic Matrix Composites Production Technologies (Xi'an city), International Institute of Material Genome (Tsinghua University, China) and Samara Polytech. In October, we hosted a



Actually, our center is a combination of chemistry, physics and math, always with plenty of actual tasks to solve.

joint conference and scientific seminar on theoretical material knowledge methods.

We also develop some more topics. For instance, **Pavel Zolotaryov**, junior research scientist of ISRCTMS, studies design of molecular crystals. His project called 'Influence of physical and organic properties of solvents on polymorphism of organic crystals' also won a subsidy of the Russian Scientific Foundation. I hope we will start researching shapes and properties of molecular crystals in medicines in terms of cooperation with the medical university.

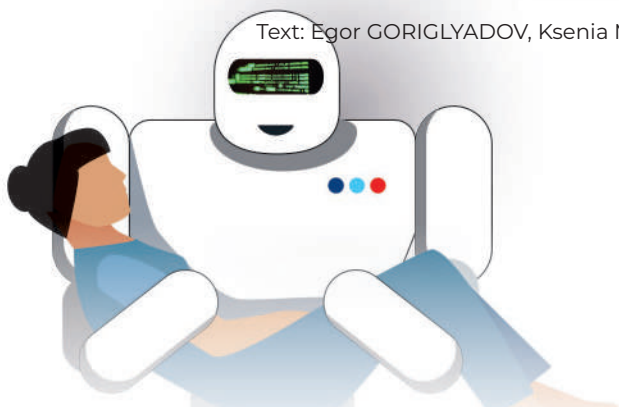


Actually, our center is a combination of chemistry, physics and math, always with plenty of actual tasks to solve. The life goes on and we're optimistic about our future." ■

PAIN SCOUT

DIRECTOR OF POLYTECH SCIENTIFIC AND TECHNICAL LIBRARY SERGEY NOVOKSHCHYONOV CREATES A PROGRAM FOR DIFFERENTIAL DIAGNOSTICS OF DISEASES

Text: Egor GORIGLYADOV, Ksenia MOROZOVA



USUALLY ALL SUCH STORIES START FROM SCRATCH. AB OVO - HOW THE ANCIENTS SAID. HOWEVER, TO REMEMBER THE ORIGINS OF THIS PLOT, WE HAVE TO START FROM THE MIDDLE, BECAUSE THE LAWS OF THE GENRE REQUIRE THE AUTHORITY OF INFORMATION, ACCURACY IN THE STATEMENT OF THE FACT, DYNAMISM OF NARRATION AND SUSPENSE.

So, as a child, Sergey Novokshchyonov wanted to be a doctor. But, having been educated as a software engineer, he became director of Samara’s largest university scientific and technical library. This multitasking often leads to interesting technical solutions.

HEALTHY EATING PROGRAM

Once the specialists of the intensive care unit of the clinics of Samara State Medical University turned to the director of Samara Polytech library for help in developing a computer program for the diagnosis of protein-calorie (in other words, nutritional) deficiency of patients. It is a condition provoked by an unbalanced diet. This leads to a decrease in body weight, metabolic disorders, weakening of the body’s defenses, a tendency to develop other

diseases. Early recognition of nutrient deficiencies in the body, the establishment of its causes and the appointment of treatment can quickly cope with the disease.

“Colleagues from the clinics of Samara State Medical University have already developed a method for diagnosing states of protein-calorie deficiency,” Sergey Novokshchyonov says. “I had to create an expert system that would allow a doctor to quickly determine the degree of nutritional risk, to appoint the necessary nutritional support.”

Based on the results of the medical research (most often a biochemical analysis of blood and urine), such an expert system determines the patient’s energy requirements, finds the necessary composition of micro- and macronutrients. The program itself can determine the type and volume of suitable nutritional mixtures and the methods of their introduction, in addition, it is able to calculate the probability of an error in the actions of a doctor.

DEVIATION CARD

When solving this research problem, the scientist had the idea to expand the scope of its application and create



a system of complex differential diagnostics. Its principle of action is the following: for each class of diseases included in the current International Classification of Diseases (ICD-10), the so-called maps of deviations from reference values are compiled. The program compares the results of medical examinations of the patient with these cards and gives a list of the most likely diseases and syndromes, shows what data is not enough to make a precise diagnosis.

Now the smart program is being finalized. Its description and experimental results will become part of the candidate's dissertation of Sergey Novokshchyonov.

GROUND ZERO

And now, when the storyline is almost complete, it's time to return to its origins. It turns out that the cooperation of technical and medical universities in Samara to create automated systems for diagnosing diseases began in the last century.

On March 14, 1973, copyright certificate No. 385286 was registered for a specialized ECM "Diama", a diagnostic machine developed by a group of scientists led by **Konstantin Kulikovskiy**, professor of the Kuybyshev Polytechnic Institute and the famous vascular surgeon, Head of the Department of Surgery Faculty, of the Kuibyshev Medical Institute, **Georgy Ratner**. This computer could already diagnose patients based on the introduced symptoms. The names of 150 symptoms of 21 diseases were located on its front panel. The doctor examined the patient and, if a positive symptom was detected, fixed it in the memory of the machine with an electromagnetic pencil. When the examination was completed, an ordinary compact tape cassette was inserted into the computer. The corresponding code recorded the specific weight of each symptom from the presented list of diseases. The machine analytically compared the program of the examined patient with

this code, counted the number of matches and produced the result in the form of numbers. The highest number is the most likely disease. The probability of subsequent diseases was determined in decreasing order of numbers.

In order to create an accurate program, it took many years of work by a large team of doctors of the Penza city emergency hospital under the supervision of the chief surgeon of the Penza region **Gennady Demidov**. Thanks



Yury KETSKO,

Candidate of Medical Sciences, Head of the Department of Resuscitation and Intensive Care of the Clinics of Samara State Medical University:

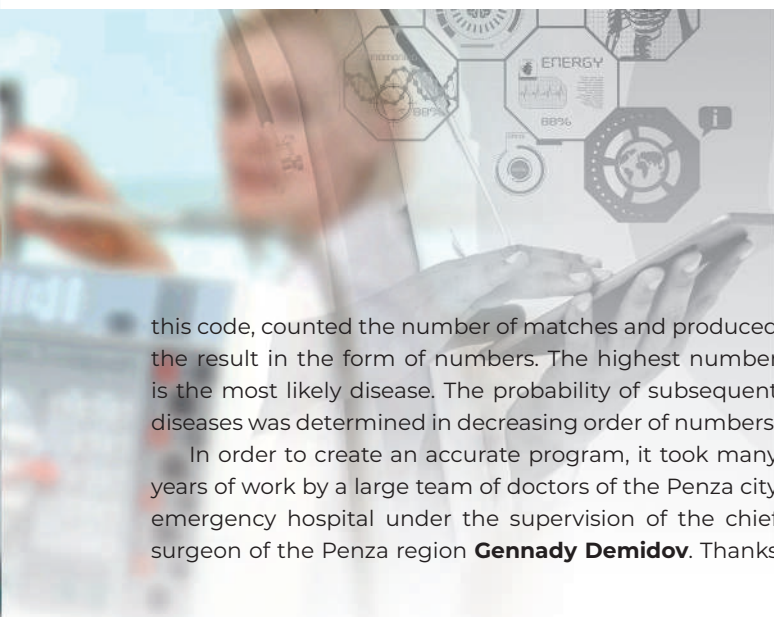
"Standards and calculation algorithms for adequate nutrition of a sick person exist, but the more severe the disease, the more factors must be taken into account. At the patient's bed, taking into account the constant lack of time, it is almost impossible to make such calculations with minimal errors. And the risks of overfeeding or underfeeding the patient are too great. In this regard, the idea came up to translate the available algorithms into a "smart" program for calculating the required calorie content, protein loss, and choosing the method of introducing nutrient mixtures."

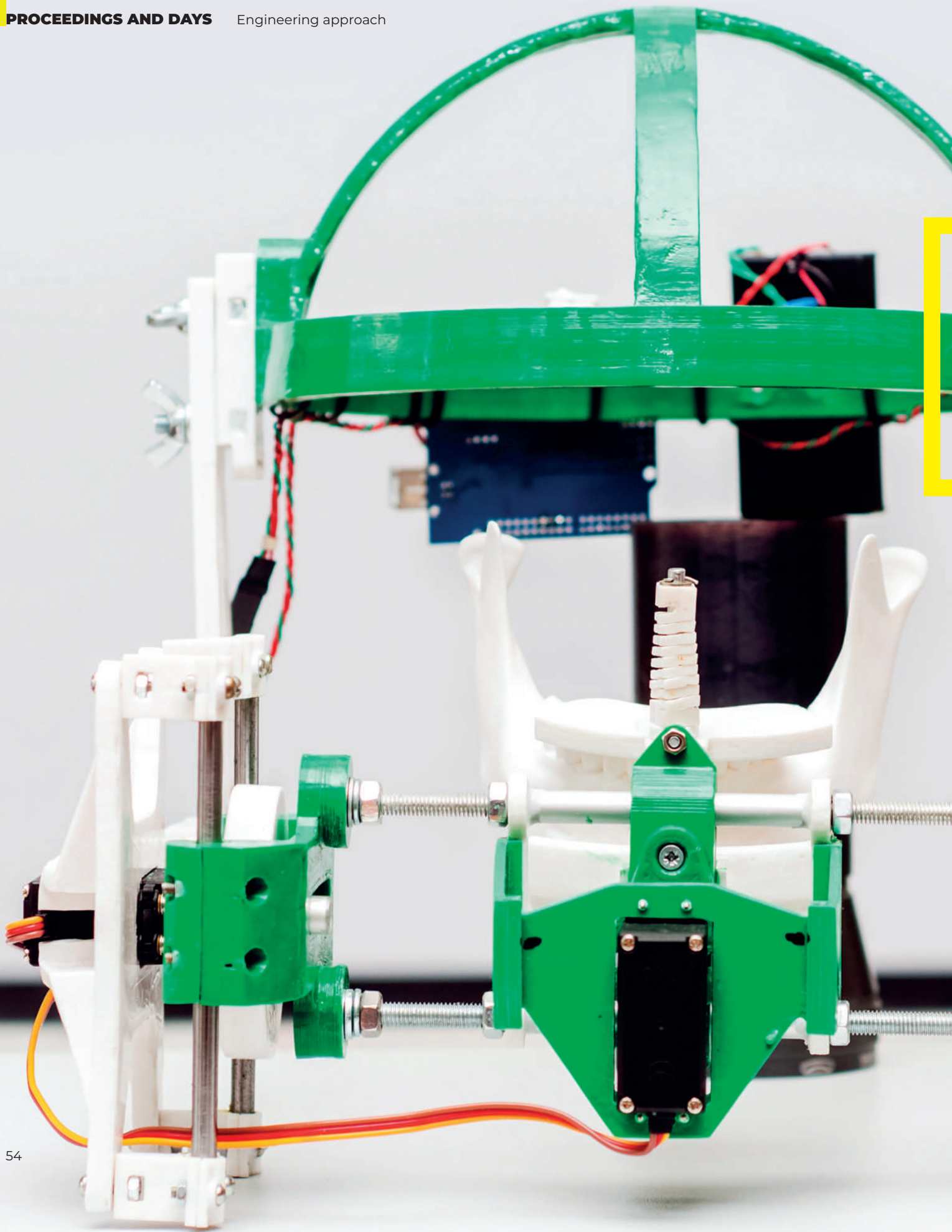
to this, a collective medical experience was laid in the memory of the machine, which a newcomer doctor could use at any time.

The researchers began working on the machine in 1971. Three experimental models were made: "Diama-1" (on electromechanical elements), "Diama-2" (on electronics), "Diama-3" (on microelectronics). The device measuring 380 x 450 x 80 mm weighed less than 5 kg. The computer was tested at the Department of Faculty Surgery and the Department of Nervous Diseases and Neurosurgery of the Kuibyshev Medical Institute. An agreement was reached with the Baku Radio Plant on the release of the first batch.

But rapid technological progress rather quickly deprived such devices of the competitive advantages over new computer technology. The era of Soviet computers passed. It seemed that the history of the Polytechnic developments in the field of medical diagnostics also ended.

But it turns out that at that time it has just begun. ■







INNOVATIVE JAW MECHANICS

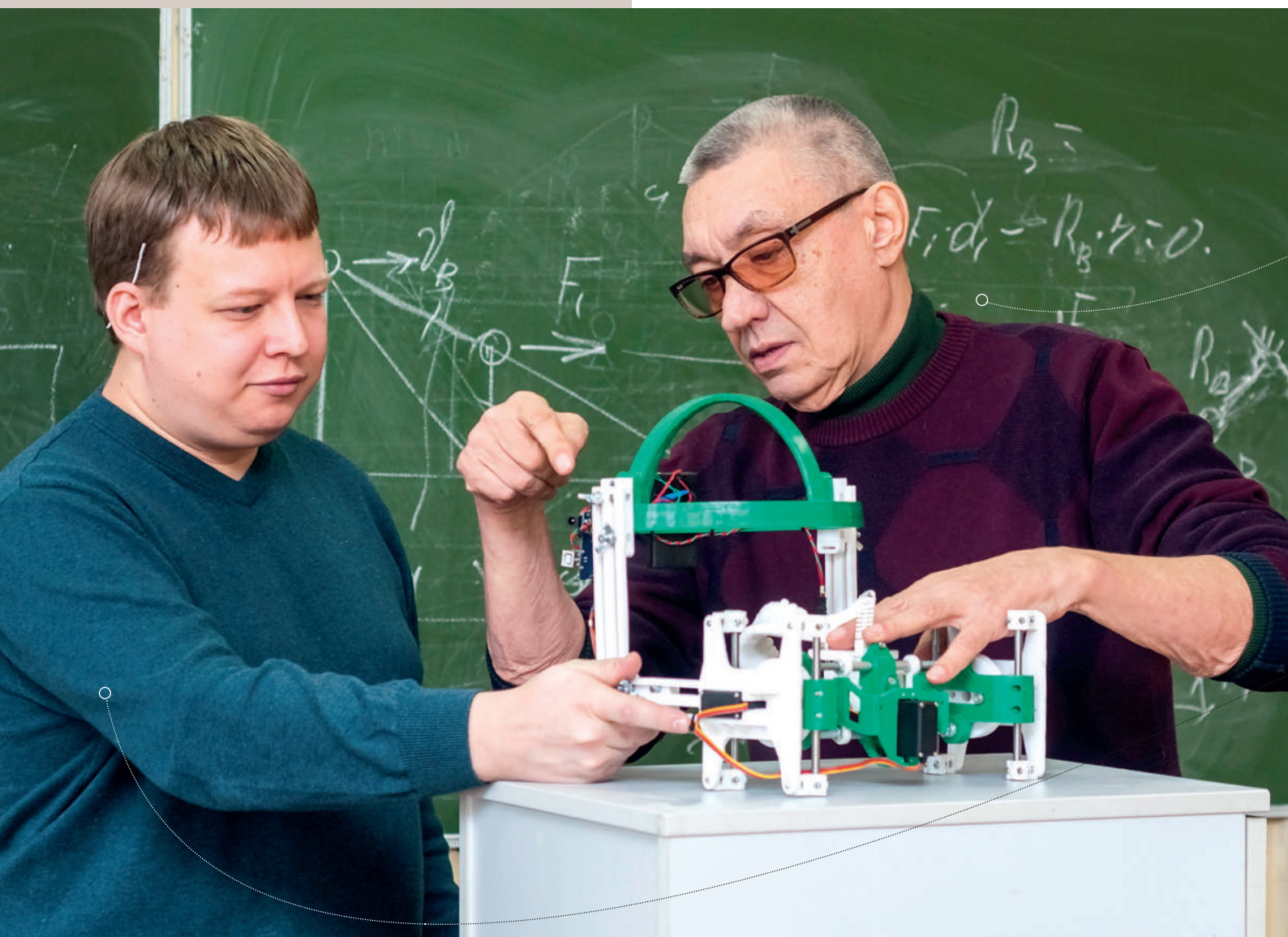
A UNIQUE SIMULATOR FOR PREVENTION AND TREATMENT OF THE LOWER JAWS PATHOLOGY IS DEVELOPED IN POLYTECH

Text: Elena ANDREEVA

THE ONLY MOBILE BONE IN THE HUMAN SKULL IS THE LOWER JAW. A UNIQUE MECHANISM MOVES IT. A TEMPORO-MANDIBULAR JOINT (TMJ), TO BE EXACT, TWO JOINTS - THE LEFT AND THE RIGHT ONE - OPERATING SYNCHRONOUSLY, LET US CHEAT AND SPEAK, AND WHAT IS MORE TO YAWN, SCREAM, SING AND LAUGH.

It is clear that this natural pair of joints experiences tremendous loads, allowing the jaw to make movements in different directions thousands of times a day: up, down, right, left, forward or backward. And while everything is in order with it, a person does not even pay attention to its work. But as soon as the TMJ fails, pain and discomfort appear, which immediately force us to limit the number of articulatory and chewing movements. In the latter case, this means that the food is poorly crushed in the mouth and enters the stomach not prepared for digestion.

Scientists of Samara Polytech together with colleagues from SSMU – Samara State Medical University - created a device for the prevention and treatment of diseases of this joint. ►



ANAMNESIS

In general, TMJ pathologies, which, according to various estimates, affect up to 60 percent of the world's population, are considered complex and multidisciplinary. Their treatment often involves not only dentists, but also vertebrologists, chiropractors, neurologists, and now also mechanical builders.

First, a group of scientists from Samara State Medical University under the guidance of Professor **Dmitry Trunin** got enthusiastic over the idea of a mechanical device that alleviates the suffering of patients with a TMJ.

“We came to the conclusion that such an apparatus is needed that, firstly, would allow our patients to independently develop the muscles of the maxillofacial area, and secondly, would enable us, specialists, to control this process, to establish the impact forces, the amplitude opening the jaw,” **Julia Reshetnikova** says, an orthopedic surgeon who deals with this topic. “Usually, when we prescribe a set of myogymnastic exercises during the treatment (a kind of physiotherapy exercises that is used in orthodontics to correct disorders in the dentofacial system (author’s note), we cannot observe how it is performed. And here, not only accuracy and sequence of actions are important, but also the load itself.”

Doctors began to study existing devices. As it turned out, there is nothing suitable to solve this problem on

the market. Such devices are not sold in Russia, while the simplest models that do not enter our country are produced abroad.

In general, doctors and engineers decided to work together. **Anatoly Litikov**, Head of the Laboratory of the Department of Structural Mechanics and Resistance of Materials, Department of Industrial and Civil Engineering, became the engine of the project. By the way, he was awarded "The inventor of the USSR", the owner of three copyright certificates in the oil field and more than 35 patents for inventions and scientific articles in the field of construction.

EPICRISIS

"At first, to tell the truth, I refused," Litikov explains. "The topic is completely unfamiliar. You need to scrutinize the matter thoroughly. But then I decided to discuss this with my colleagues. To do this we needed an electrician and an automation engineer. These are **Aleksandr Fadeev** (Candidate of Technical Sciences, Associate Professor of the Department of Mechanization, Automation and Power Supply of Construction of the Faculty of Civil Engineering (author's note)), a specialist

of the highest level, and the senior project executive of the research and production company Aleksey Lukin. And so, the three of us, looking at each other, at some point decided: let's try. Today, after a year and a half, we, of course, know about molars that can withstand loads of up to 70 kilograms and about the jaw, which can create effort of 360 kilograms, and about the unbearable pains when it "gets jammed", when people can neither speak, eat, nor drink. Our device must take into account all the needs of a person with dysfunction or trauma of the temporomandibular joint."

The calculations and drawings were followed by the manufacture of a 3D plastic model of a unique device that is worn on the head and mounted on the jaw. The device works in two areas: sagittal (up - down) and frontal (left - right). Following the guide, the jaw moves. Now this device, up to every node, is patented. ■

WHY DOESN'T TMJ WORK?

Arthritis is a disease in which an inflammatory process develops in the interarticular cartilage.

Arthrosis is a disease in which the inter-articular cartilage undergoes thinning, compaction and destruction, loses the ability to perform its functions.

Tenonitis is an inflammation of the tendons with which the muscles that control the joint work are attached.

Dislocation - a congestion of the condyle (head of the joint) that has left the fossa cavity in front of the articular tubercle.



MIRACULOUS TERRICONES

SCIENTISTS OF SAMARA POLYTECH ARE WORKING ON TECHNOLOGIES THAT ALLOW TO UTILIZE NATURAL RAW MATERIAL WASTE FOR PRODUCTION OF CONSTRUCTION MATERIALS

Text: Svetlana EREMENKO

EVERYBODY KNOWS THAT THE RAW MATERIAL FOR MODERN CONSTRUCTION MATERIALS AND BUILDING PRODUCTS – CERAMIC AND LIMESTONE BRICKS, BUILDING BLOCKS, GRAVEL, CEMENT OR KERAMZIT – IS PRODUCED FROM UNDER THE GROUND. AS THE RESULT, TERRICONES ARE FORMED – HUGE REFUSE PILES OF SUBSTANDARD MATERIALS THAT CONTAMINATE THE ENVIRONMENT



**Natalia CHUMACHENKO,
Doctor of Engineering Sciences, Head of
the 'Manufacture of construction materials,
products and structures' Department:**

“Good-quality raw material is a material which allows to manufacture a qualified product without any alternations of this raw material composition. From this point of view, production waste cannot be considered as having proper quality. But if we treat natural and production raw materials as united raw materials base of construction industry, we can set up production of a wide range of high-quality construction materials.”

PRACTICAL AND ECOLOGICAL

But these artificial mountains can give us a fairly large amount of cheap good-quality construction materials and solve the ecological problem of contamination of environment with waste at the same time. Our scientists are ready to make their contribution to this process.

“We have been studying the possibility of utilizing industrial waste produced by plants and factories that make mineral construction materials for a long time,” says **Natalia Chumachenko**, Doctor of Engineering Sciences, Head of the "Manufacture of Construction Materials, Products and Structures" Department. “Now the Ministry of Construction has become interested in our developments.”

Today the government of the Samara region is working on ways of increasing the housing quantity while lowering its price. A real decision is smart use of the industrial waste, i.e. the recycling. Chumachenko believes that this approach will help to establish a regional ecological construction system and improve ecological situation in the Samara region.

PUTTING SUSPENSION INTO MIX

Many citizens of Samara have heard of the Sokskiy quarry. In fact, it is the area of a real ecological disaster. Huge piles of bulk are clearly seen from the bridge across the Sok river near Tsarevshchina. When strong wind blows, white suspension raises up to the air making it hazardous to breathe. Terricones of so-called dross – the waste produced in the process of coal comminution – have been forming here for many years. Now they are slowly slipping down to the river making the ecological problem of the quarry even worse.

This material has already been partially used as additive in asphalt-concrete production. But experts of the Department came up with the idea of using dross for production of a number of things. The scientists have developed at least twenty ways of utilization of this industrial dust. It can be used in production of glass and air-hardening lime, as well as for gravel-sand surfacing and bed of motor roads and flight strips. As a mineral filler, it can be added to dry pack mortars, paints and varnishes, ►

roofing and waterproofing materials, linoleum, etc. It's also a cheap and environmentally-friendly deicing product, a fairly good alternative to toxic mixes that destroy tires and shoes.

OUT FROM THE THICK

Another major object which may be used as a rich source of secondary raw materials is refuse piles and landfills of the



shale processing plant in Syzran. Oil-shale have been produced there since 1920's. The refuse piles that have formed for over a century not only distorted natural landscape of the area but also changed the soil quality and vegetation cover. It's because there were spontaneous combustions in the refuse piles during the production of shale. Depending on combustion temperature and pile composition different kinds of burnt rock have formed – from sintered fragments to expanded masses.

“After studying the burnt rock we decided on ways of using this industrial raw material by dividing it in three groups according to the degree of natural baking and porization,” says **Alexandr Seikin**, the head of the Department laboratory. “Raw material from the first group – expanded rock with 50 per cent porization – can be used, for example, as a filler for lightweight and lightened concrete. Material without porization from the second group can be used as a component of heavy-weight concrete. We have developed compounds on basis of burnt rocks in our laboratory;

they can be used in production of wall materials. Due to their thermotechnical properties they are much more preferable than solid ceramic bricks or heavy-weight concrete.”

LOOK UP THE CATALOGUE

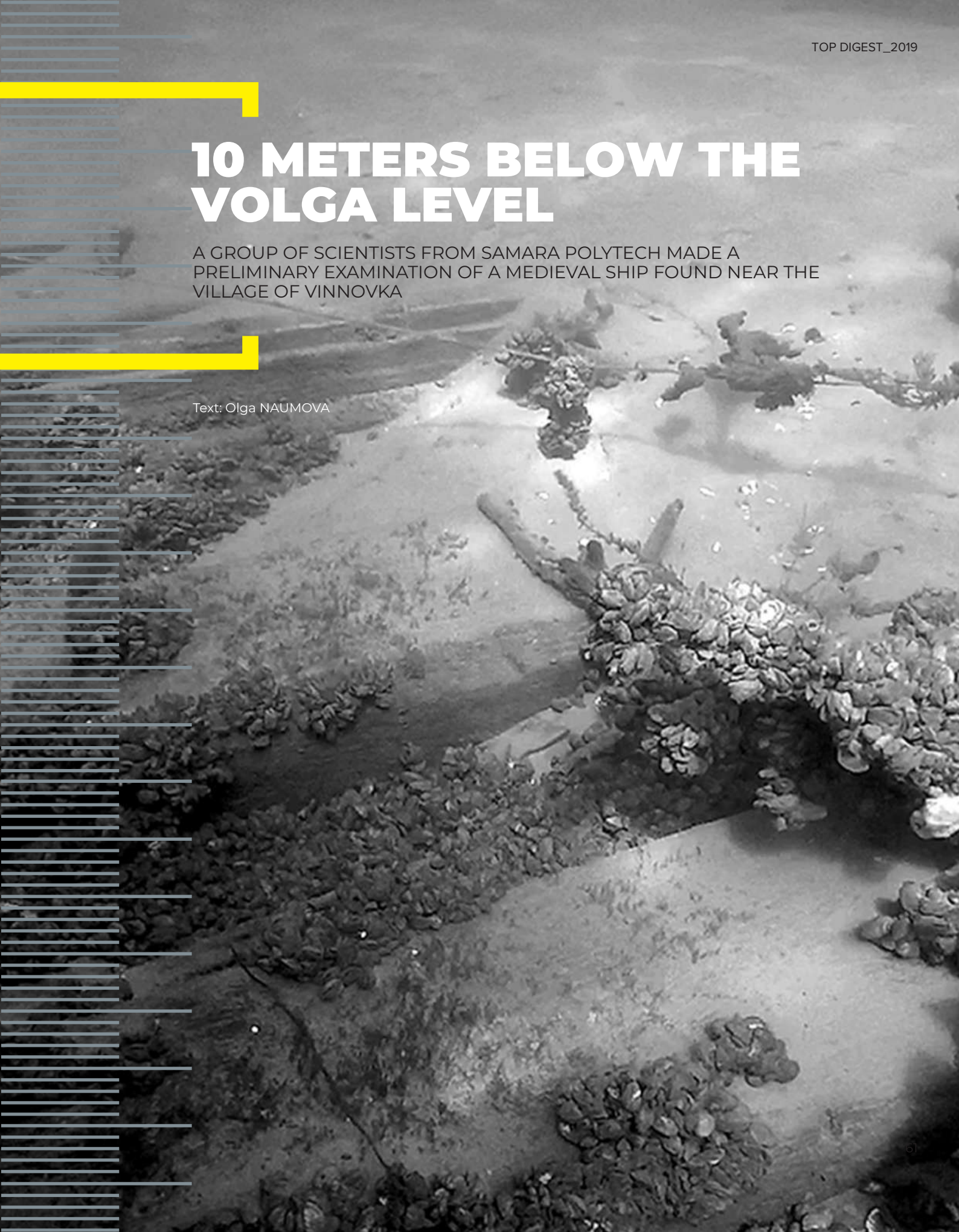
The SSTU scientists have already fully revised ten operating and non-operating deposits. Alongside with the Sokskiy and Kashpirskiy quarries they inspected refuse piles and landfills of the Troekurovo-Gubinskoe deposit of carbonate rocks, the Balasheiskoe deposit of moulding sand, the Zhigulyovskiy lime plant, the Timashevskoe deposit of brick and keramzit clay, the Zhigulyovskiy construction material plant, the Vozdvizhenskoe and Erzovskoe deposits of brick clay, the Podyom-Mikhailovskoe deposit of keramzit clay. Building experts developed at least five ways of utilizing the secondary raw material from each of these deposits. They also compiled a catalogue of waste that can be used in production of construction materials.

The scientists claim that there won't occur any technical problems in re-equipping the existing production lines that are used to manufacture construction products in our region. But at present just a few plants re-use their production waste as additives. Most plants still prefer to pay money – sometimes dollars – for 'pure' raw materials. ■

10 METERS BELOW THE VOLGA LEVEL

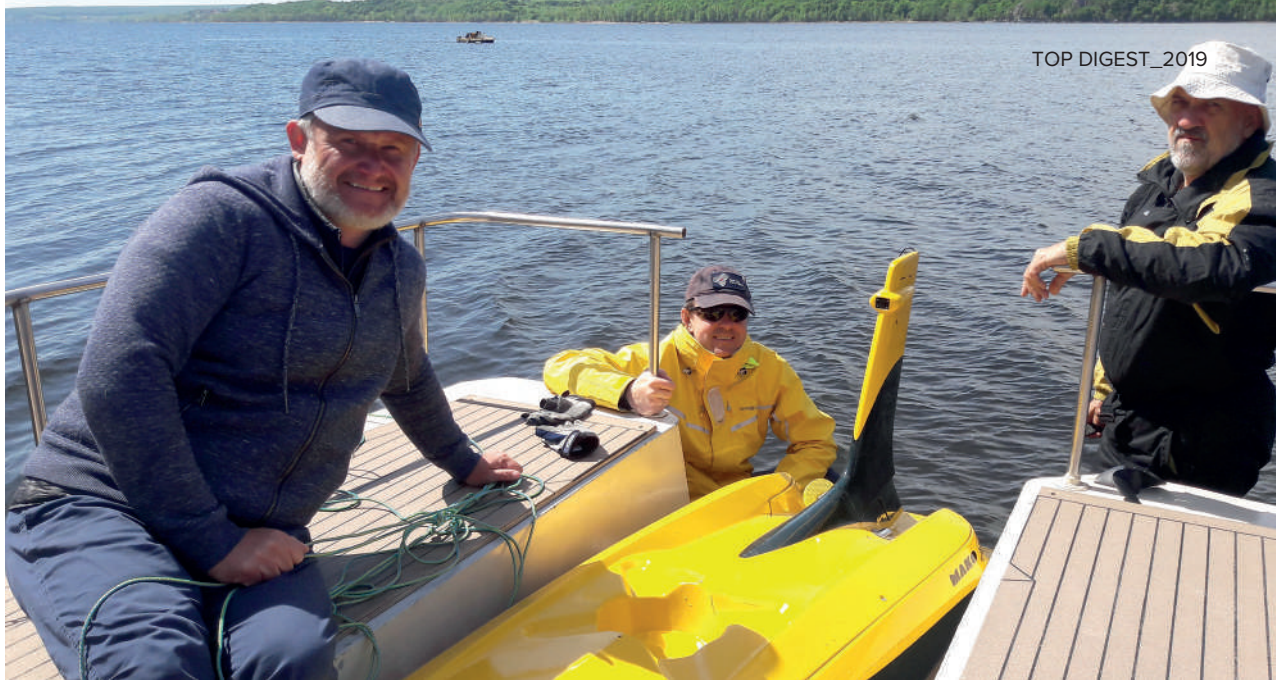
A GROUP OF SCIENTISTS FROM SAMARA POLYTECH MADE A PRELIMINARY EXAMINATION OF A MEDIEVAL SHIP FOUND NEAR THE VILLAGE OF VINNOVKA

Text: Olga NAUMOVA



BACK IN SPRING OF 2019 MONASTERY WORKERS FOUND AN UNUSUAL OBJECT IN THE VOLGA NOT FAR FROM THEIR MONASTERY IN THE VILLAGE OF VINNOVKA. THEY COULDN'T IDENTIFY IT AND ASKED THE SCIENTISTS OF THE FLAGSHIP UNIVERSITY TO HELP THEM. SPECIALISTS FROM SAMARA POLYTECH ORGANIZED A NUMBER OF EXPEDITIONS IN COOPERATION WITH PROFESSIONAL DIVERS AND EXPERTS OF THE "EKTRAN" RESEARCH AND PRODUCTION COMPANY (MOSCOW). THE OBJECT LYING AT A DEPTH OF 10 METERS WAS EXAMINED USING UNDERWATER ULTRASONIC SCANNERS AND AN UNDERWATER ROBOT (GLIDERON) DESIGNED BY THE SPECIALISTS OF OUR UNIVERSITY. THE RESEARCHERS WERE SURPRISED BY THE RESULT. THE OBJECT TURNED OUT TO BE A LARGE BOAT: 50 METERS LONG AND 20 METERS WIDE. ALTHOUGH MOST PART OF THE SHIP IS DEEP IN THE SAND, THE ULTRASONOGRAPHY IMAGES CLEARLY SHOW THE AFT AND REMAINING STIFFENING RINGS, WHILE THE VIDEO SHOWS A LARGE CHAIN AND OLD ROPES.





WOOD AND METAL FROM THE PAST

The divers managed to get a sample of the wood the ship was made of, as well as a forged nail about 50 cm long. Both pieces were sent to experts immediately. The results were revealed in October. In particular, on the basis of radiocarbon analysis of the piece of wood performed

by the experts of the laboratory at the Institute of monitoring of climatic and ecological systems of the Siberia branch of Russian Academy of Science (city of Tomsk) the object was age-dated – it was built in 1415 A.D. (± 85 years). Even considering this error, it turns out that there is a ship built back in the Ivan the Terrible's period on the bottom of the Volga.

"If the results of radiocarbon analysis are correct, then this ship belongs to the late 14th century or early 15th century," says **Ekaterina Semyonova**, Doctor of Historical Sciences, Head of the "Sociology, Political Science and National History" Department. "We are impressed by its enormous size. Even though the Volga region area wasn't the part of the centralized Russian state at that period, there were Slavic settlements on the banks of the Volga, and the Volga itself was a major navigable waterway used by many countries. A lot of questions occur about where this ship belonged to and what it was used for. It may be of Asian, Scandinavian or West European origin. We should also consider the version that this ship was somehow related to some Russian dominions. We don't have enough data to say whether it was used for commercial or military purposes. It should be pointed out that further in-depth investigation is required in order to identify the object precisely and answer the numerous questions. However, ►





we can say that no vessel of this size belonging to the specified historical period have been found yet in the water area of the Middle Volga and, in particular, within the territory of the Samara region”.

The sample taken from the metal nail was analyzed using different methods in chemical laboratories of Samara Polytech (X-ray fluorescence spectroscopy) and Samara University (X-ray emission spectroscopy). The two results were pretty much identical to each other and showed that the nail was 99,5 % iron.

The scientists think that this is the indication for the medieval origin of the sample, as most metals used today are doped alloys.



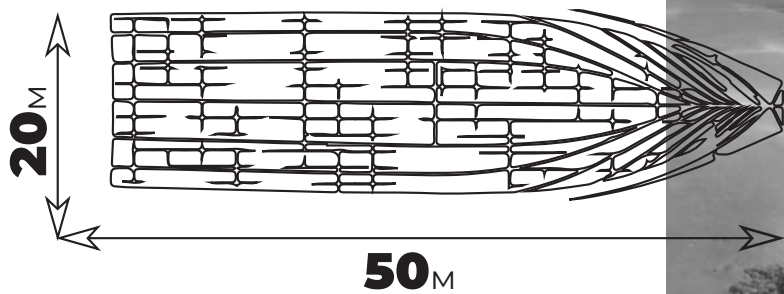
“From the very beginning of the analysis it was clear that it was an artifact made of iron. It was deeply corroded,” says **Andrey Pimerzin**, Doctor of Chemical Sciences, professor, Head of the ‘Chemical technology of oil and gas processing’ Department. “There is another interesting fact about it: the sample contained very little impurities such as carbon, sulfur or phosphorus. That was virtually pure iron which means a fairly high level of metalworking technology.

Another proof that we’re most likely dealing with an ancient object is that there are no dope additives – such as chrome, nickel or molybdenum – in it. On the other hand, we found a little amount of copper in it. We don’t essentially use pure iron today. At any rate, nails are not made of iron nowadays.”

STORY GOES ON

The scientists believe that the ship found in the Samara region is of historical and cultural value. In particular, this object will help clarify such issues as the kind of relations on the territory of the Middle, Upper and Lower Volga, trade, etc. The Samara ship is unique due to its age. For example, the large flat-bottomed boat of Nizhny Novgorod found in the Vetluga (a shallow feeder of the Volga) several years ago is 300-400 years old. The rowboat of Vytegorsk found in the Onega lake and considered to be ‘the dinosaur of Russian ship-building’ is believed to be built between the 17th and 18th centuries.

Further investigation of the ship can obviously give a new impetus to the development of the Samara region territory, gathering scientists and local history experts not only from Samara but also from other Russian cities, as well as from abroad. This object has every chance to become a ‘magnet’ to attract tourists from Russia and foreign countries. By the way, there are ships salvaged and turned into museums in some countries (for example the 17th century “Vasa” ship museum in Stockholm). Maybe some day we will see a real rowboat in Samara as well, not just the white stone stele on the Volga embankment. ■

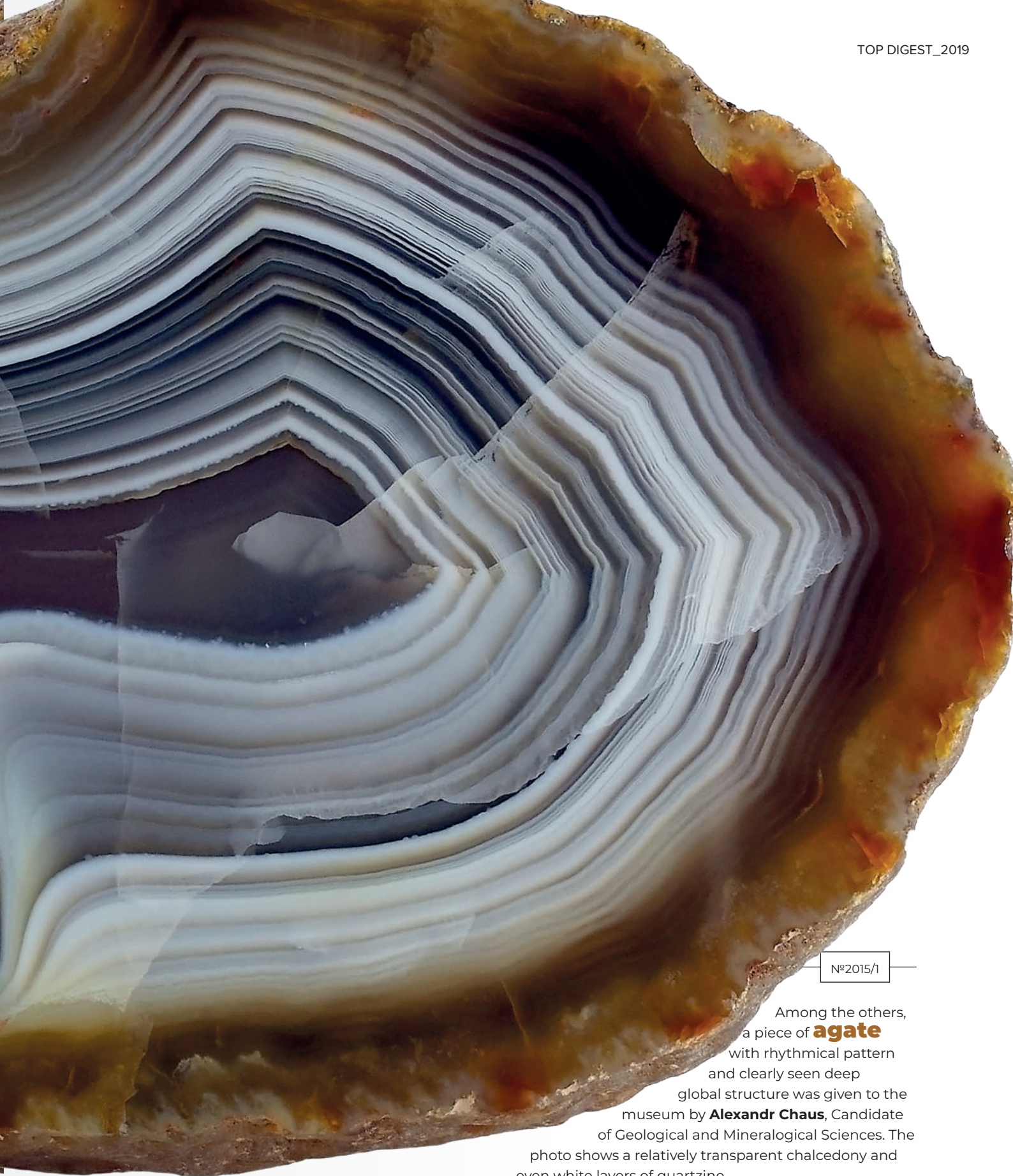


FELLOW MINERALS

THE COLLECTION OF THE GEOLOGICAL AND MINERALOGICAL MUSEUM OF SAMARA POLYTECH HAS BEEN INCREASED

Text: Tatiana PLEKHANOVA, Eugenia NOVIKOVA,
photo: Alexandr SIDOROV

THERE ARE MORE THAN 3300 EXHIBITS IN THE MUSEUM. LAST YEAR AND THE YEAR BEFORE MORE THAN 200 NEW PIECES – ROCKS, MINERALS AND FOSSIL FLORA AND FAUNA – WERE ADDED TO THE COLLECTION, MANY OF THEM BEING RARE AND VALUABLE TO SCIENTISTS. SOME OF THEM ARE PUT ON DISPLAY FOR THE FIRST TIME.



N°2015/1

Among the others, a piece of **agate** with rhythmic pattern and clearly seen deep global structure was given to the museum by **Alexandr Chaus**, Candidate of Geological and Mineralogical Sciences. The photo shows a relatively transparent chalcedony and even white layers of quartzine.

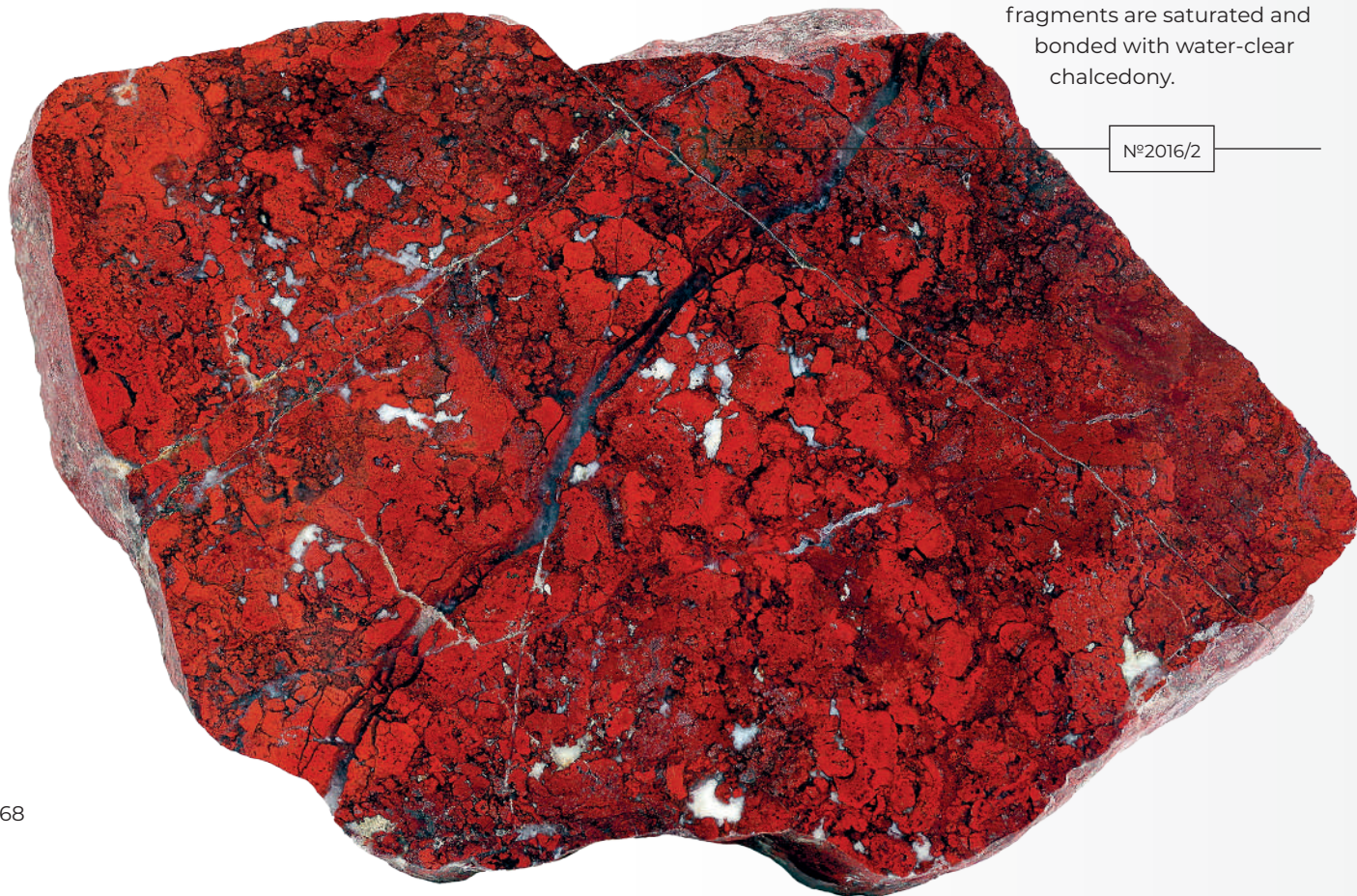
Our connection with space has become stronger – thanks to the graduates of Samara Polytech **Pavel Roshin** and **Vladimir Litvin** we got a **meteorite** from Mexico. The iron plate contains nickel and weights 93 grams. Both sides of the plate have regular-shaped patterns etched on them – so-called Widmanstätten figures. Etching the metal with nitric acid revealed the special structure of the metal and helped to discover two minerals in it – kamacite and taenite.



Nº1974

Jasperlike hematite siliceous shale

from Kirghizia has astonishing blood-red color because of iron oxides (hematite). Its fragments are saturated and bonded with water-clear chalcedony.



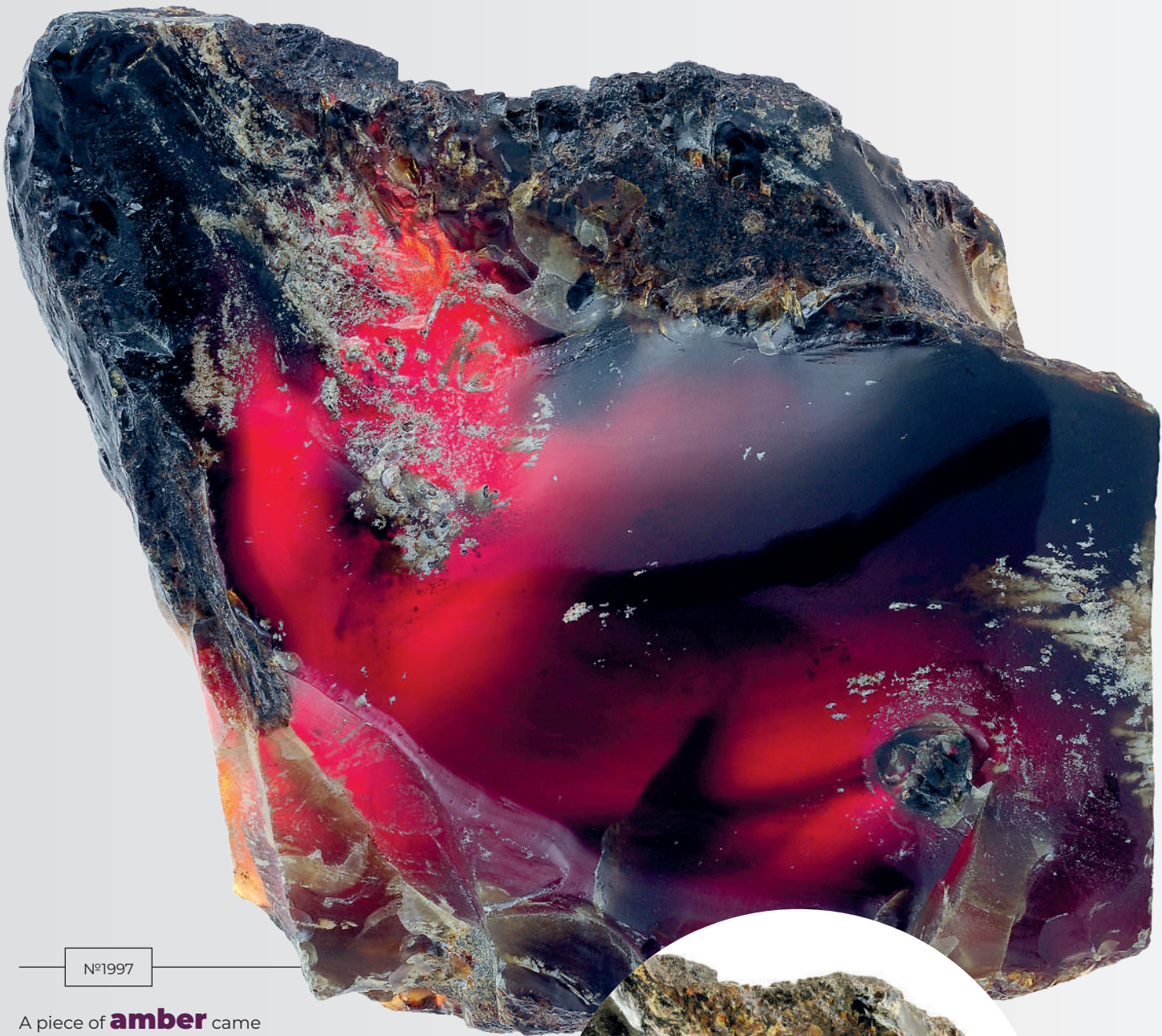
Nº2016/2

Another gift from Chaus is **rhodonite of Kirghizia**. Rare and new

minerals have been discovered in the piece. Brown spots are sonolite or alleghanyite. Ash-gray color of the right bottom part may be explained by the presence of tephroite – a relatively rare mineral found in rhodonite deposits.

N°2009





Nº1997

A piece of **amber** came to Samara Polytech from the Indonesian island of Sumatra. It can be cut with a properly sharpened knife and hand-polished with a piece of regular canvas. This piece of amber is dark brown but it turns out to be exquisitely cherry-red if you look through it.



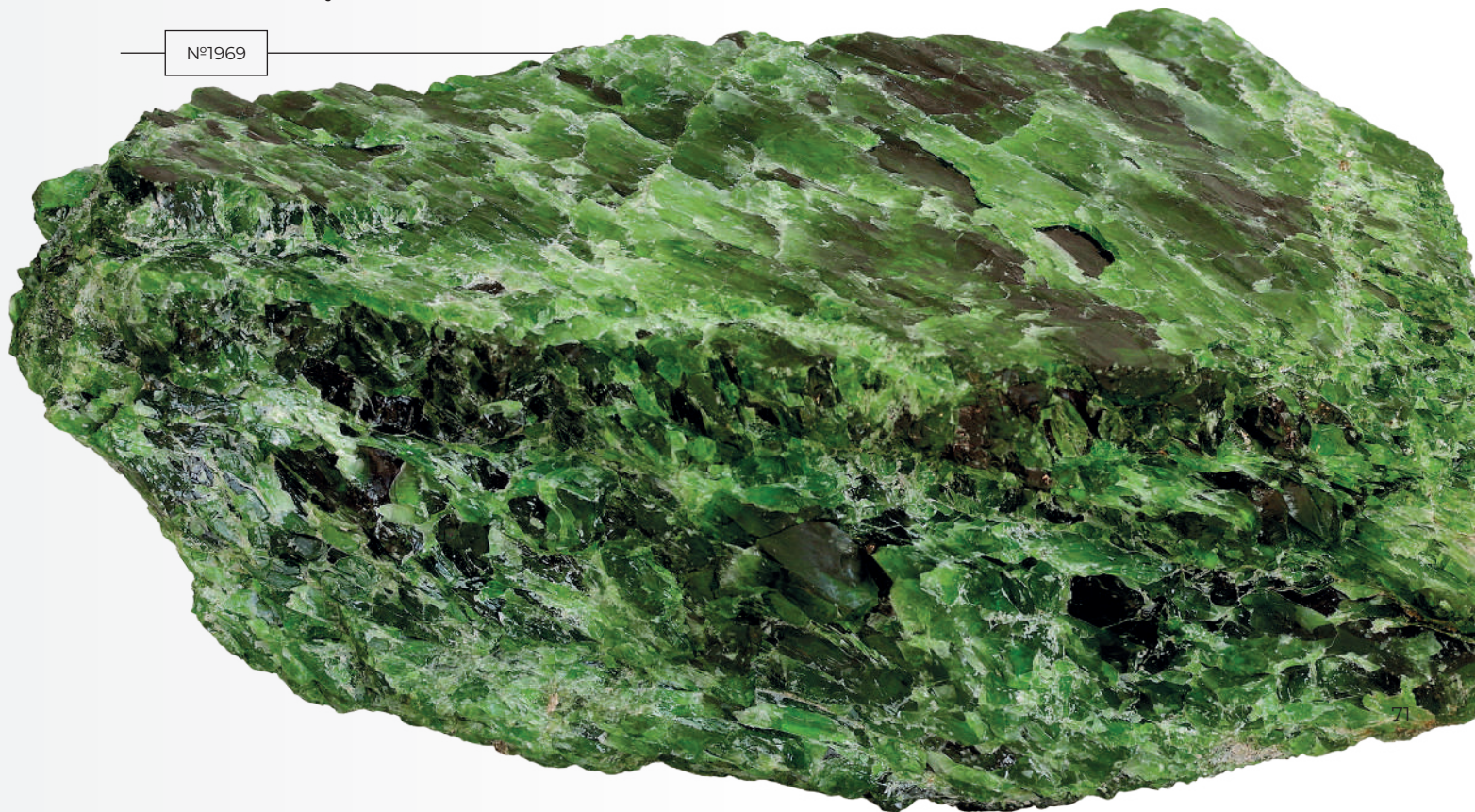
And there's a finding for those who admire black and white aesthetics – **aquamarine of Pakistan with impregnations of black tourmalin, foitite and a bit of garnet**. The 6.5 cm long aggregate of achromatous aquamarine crystals looks like an oil derrick. It was donated by **Victor Konovalov**, the lecturer of Samara Polytech.

Nº1995



Chrome-diopside from Brazil. After removing the layer of a white mineral it sparkles with bright green. **Alexandr Sidorov**, director of the museum, says that this piece is valuable to jewelers because its grains are very transparent. Such diopsides are considered to be next to emeralds. It is the gift of **Maksim Nenashev**, the vice-rector of Samara Polytech.

Nº1969





N°П0537

A new exhibit – **fragments of mosasaur jawbones with teeth in sandstone** from Morocco. Mosasaur may be a Eremiasaurussp or Prognathodontinisp species. The exact species of this sea reptile cannot be defined due to the absence of full characteristics.



№П0537

Mikhail Bortnikov, the lecturer of the 'Geology and geophysics' Department, donated 19 pieces he had collected in a chalk pit near the village of Ivashevka during the summer student intern. Among the findings were **the sea urchin shell, brachiopods**, imprints of bivalve mollusks, a shark tooth and a small spinal bone of a bony fish. Museum workers brought dozens of pieces from their expeditions including unique ones such as limestone with malachite from Mikhailo-Ovsyanka, imprints of Permian flora and others.

№П0514, length 6 mm, width 5 mm.





Vera Zhivaeva, Director of the Additional Education Institute, donated a piece of spectacular polished **Baltic amber**. Its color is very interesting. Layers with stratification planes stand out of unattractive swampy-shaded mass. These surfaces reflect light like mirrors thus giving the piece of amber a warm golden shade.

Bright reflections form beautiful transitions of golden and honey shades.

Nº2075/1

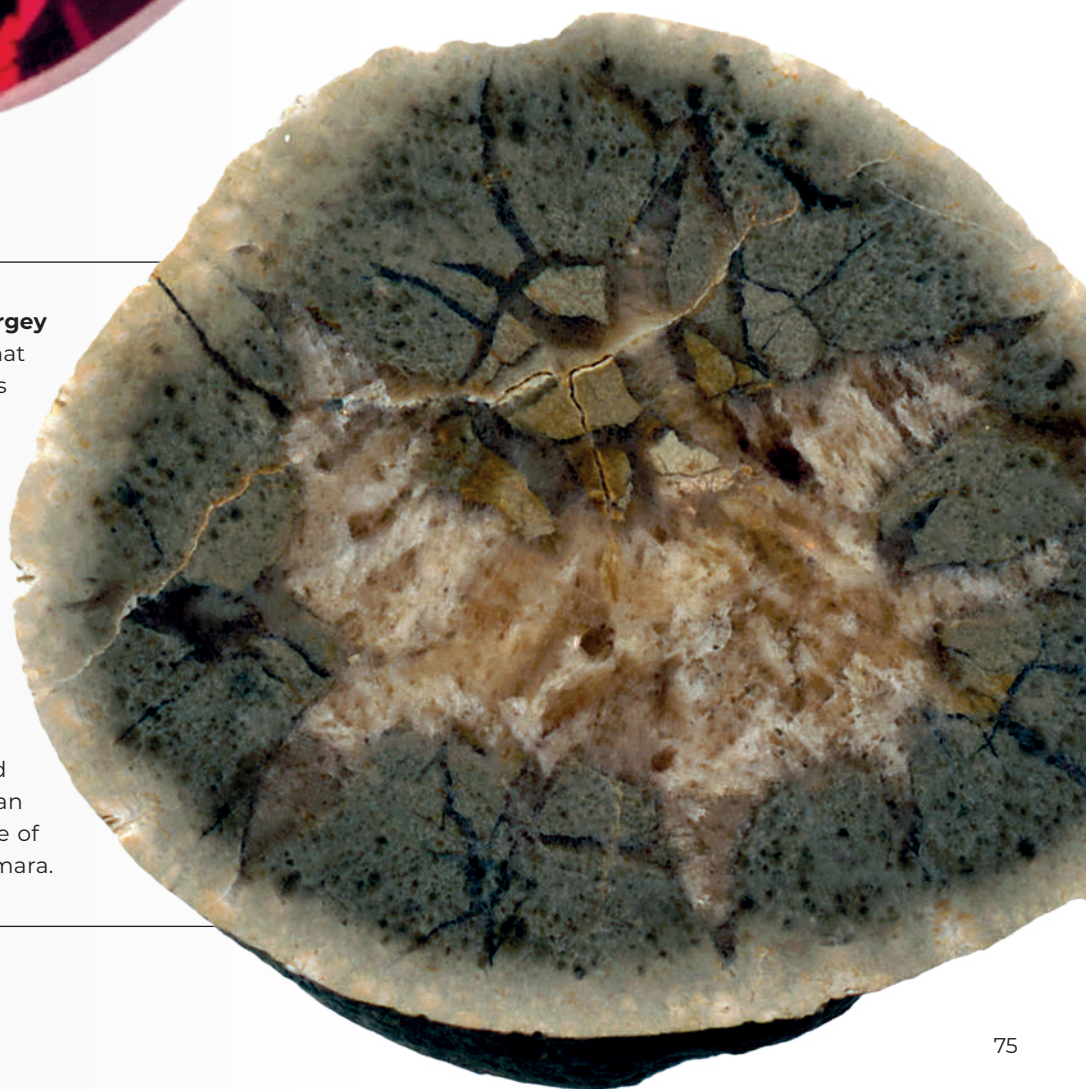


A collection of faceted gem stones began to form in the museum thanks to **Georgy Mozgovoy**, the lecturer of the 'Oil and gas wells drilling' Department. The first exhibit was a piece of **garnet** brought from Thailand. Numerous planes sparkling with all shades of red form a fanciful geometrical pattern and give a peculiar depth to the piece.

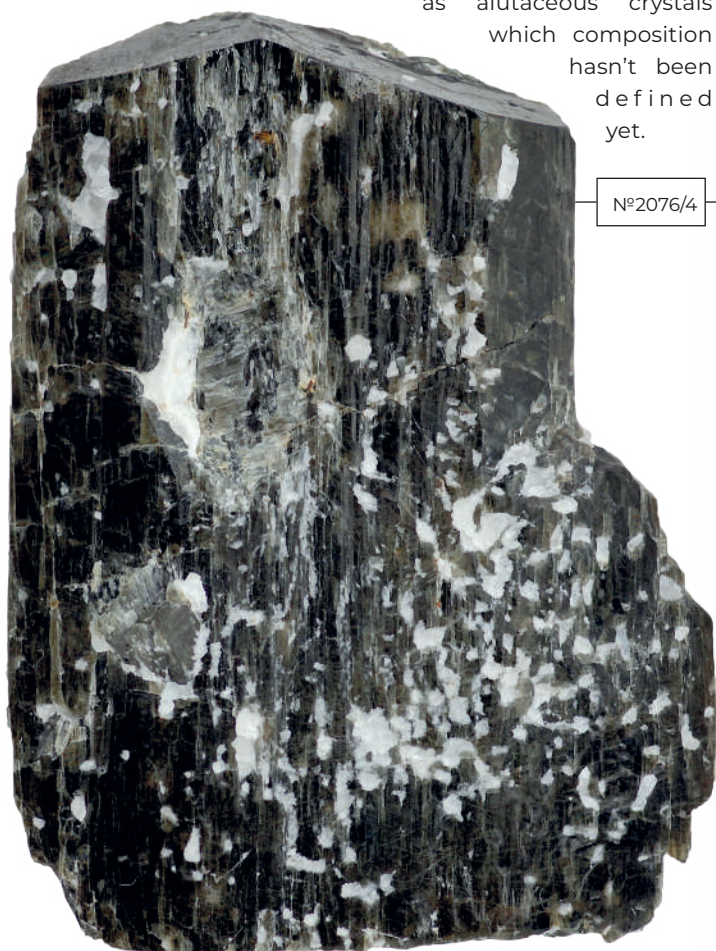
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№2047

The unique feature of the **Sergey Kirillov's** private collection is that all its exhibits – mineral buildups and paleontological remains – were found within Samara city limits, in the area of the Bolnichny and Postnikov ravines. Last year the owner of the collection gave a small piece of sawed and polished **septarium** to the museum. An extravagant picturesque pattern formed by veinlets and fractures can be clearly seen on the sawed side. This piece is quite an unexpected finding as this type of minerals is not common for Samara.



Dmitry Tonkacheev and his colleague **Michel Zavadski**, a mineralogist from Belgium, gave the museum two more unusual stones. The first one which has never been displayed in the museum before is a crystal of **fluororichterite** brought from the Ontario province in Canada. This mineral was first discovered on the territory of Russia but it is usually found in form of small grains or plates in our country. It's Canada where the crystals of noticeable sizes come from. Asbestiform aggregates – mineral intergrowth spots – can be seen on the lateral surfaces of fluororichterite. There are imprints left by small light gray crystals – quartz, as well as alutaceous crystals which composition hasn't been defined yet.



N°2076/4



N°2076/2

The second gift of **Tonkacheev** and **Zavadski** also came from Canada. It's a crystal of **apatite**. The museum has this mineral already but the new stone is rather unusual due to its tender pinky shade. Thus, this mineral expands not only the geographical spread but also the color palette of the apatites in the collection of Samara Polytech.

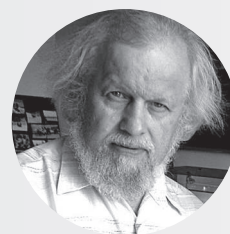
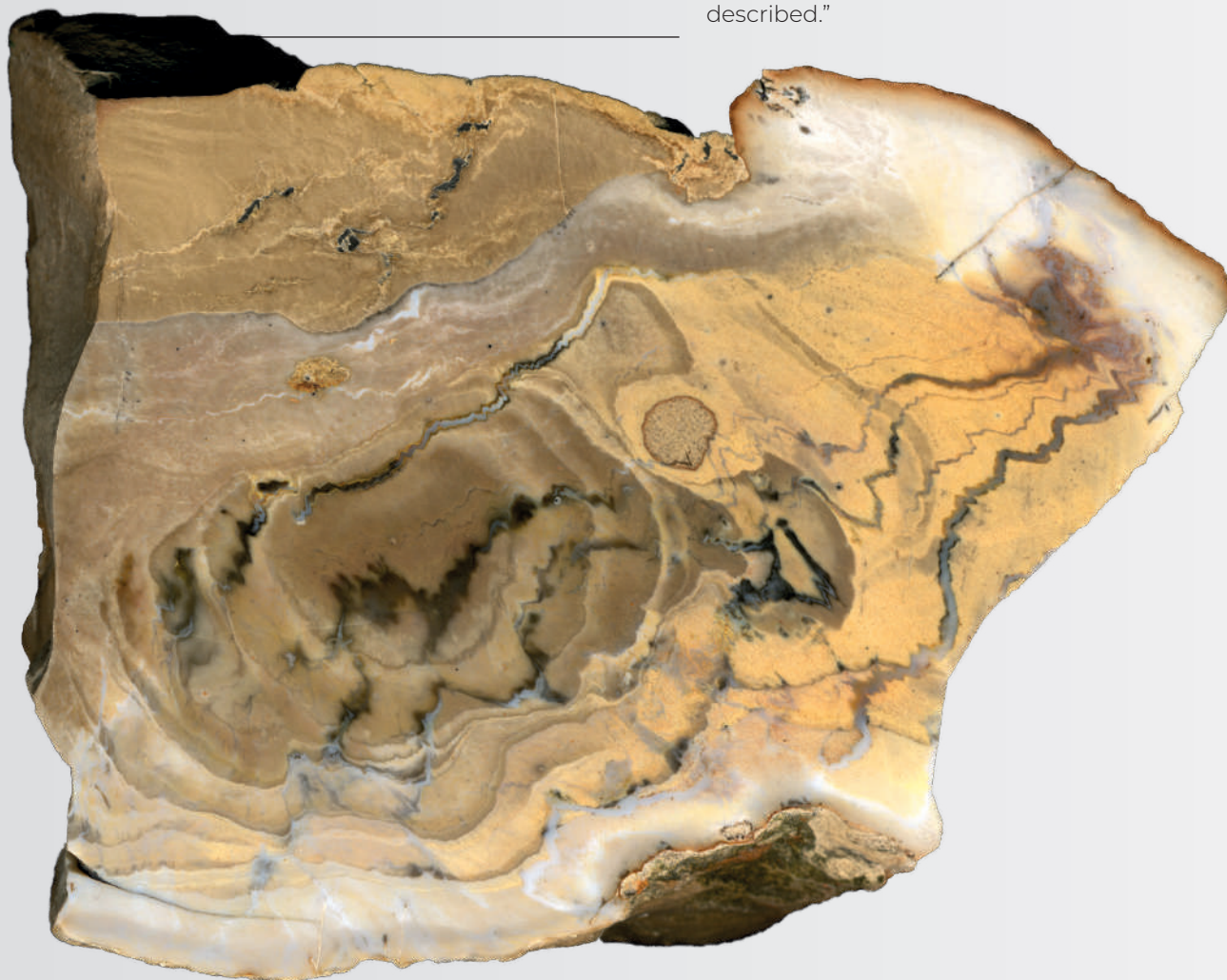
№2076/6

Cordierite donated by **Dmitry Tonkacheev**, a mineralogist from Moscow and an old friend of the museum, became a new type of minerals in its collection. Sparkling Pamir mineral brought from Tajikistan has a distinguishing blue and violet color. Its interesting feature is that crystal lattice of cordierite is similar to that of beryl but there are ions of aluminum and partially silicon instead of beryl ions. Cordierite is quite a rare and interesting gemstone.



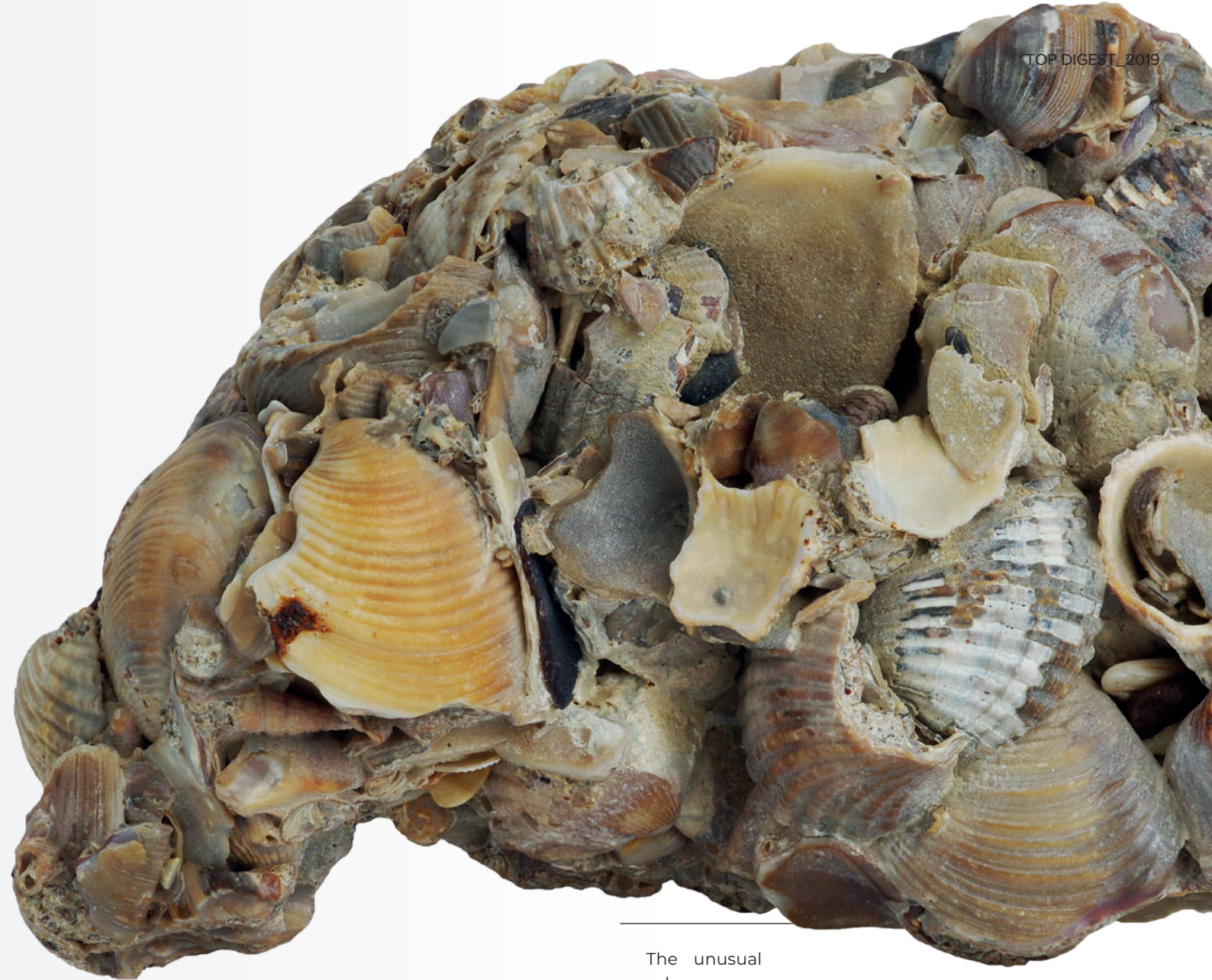
№2070/3

Last summer the geologists from Samara Polytech found a rare stone on the Volga bank. It was a piece of **unusual flint** with double pattern. The polished sample has a distinguishable roundish core with oval stratifications around it. At the same time, the second pattern – zigzag-shaped – can be seen. These are the stylolite seams that form during earthquakes. This structure is unusual for the flints found in Samara.



**Alexandr SIDOROV,
director of the museum, Candidate of
Physical and Mathematical Sciences:**

“We don't just collect stones, we collect pieces of history. The mineral is interesting itself – so is the person who donated it. Of course, stones donated by the Samara Polytech academics are the most valuable exhibits of our museum. We have friends outside our university as well – donors from Samara, Moscow and other cities of our country and even from abroad. The stones come mainly from Russia, as well as from Tajikistan, Ukraine, Italy, Canada, the USA, Thailand and Switzerland. There are 3500 exhibits in our collection today and about 1500 raw samples which are to be prepared and described.”



The unusual sample was brought from Anapa by **Vasily Danilushkin**, assistant professor of the 'Industrial power supply' Department. The **fragment of a shell stone** is essentially a cluster of scallop shells and fragments of bivalve mollusks and gastropods. Its shape is unusual. If you look carefully, you can see that these scallops form a shape of a pre-historical animal: a beak, an eye and other body parts. The director of the museum Alexandr Sidorov called this creation 'a natural Arcimboldo-style painting made of shells'. (an Arcimboldo-style painting is an allegoric representation of a real or mythological character consisting of vegetables, fruit, flowers, snags, wheat heads, etc. It was named after the Italian artist and decorator Guiseppe Arcimboldo (1526-1593) who made active use of this technique. – Ed. note).



STONES TO CUT

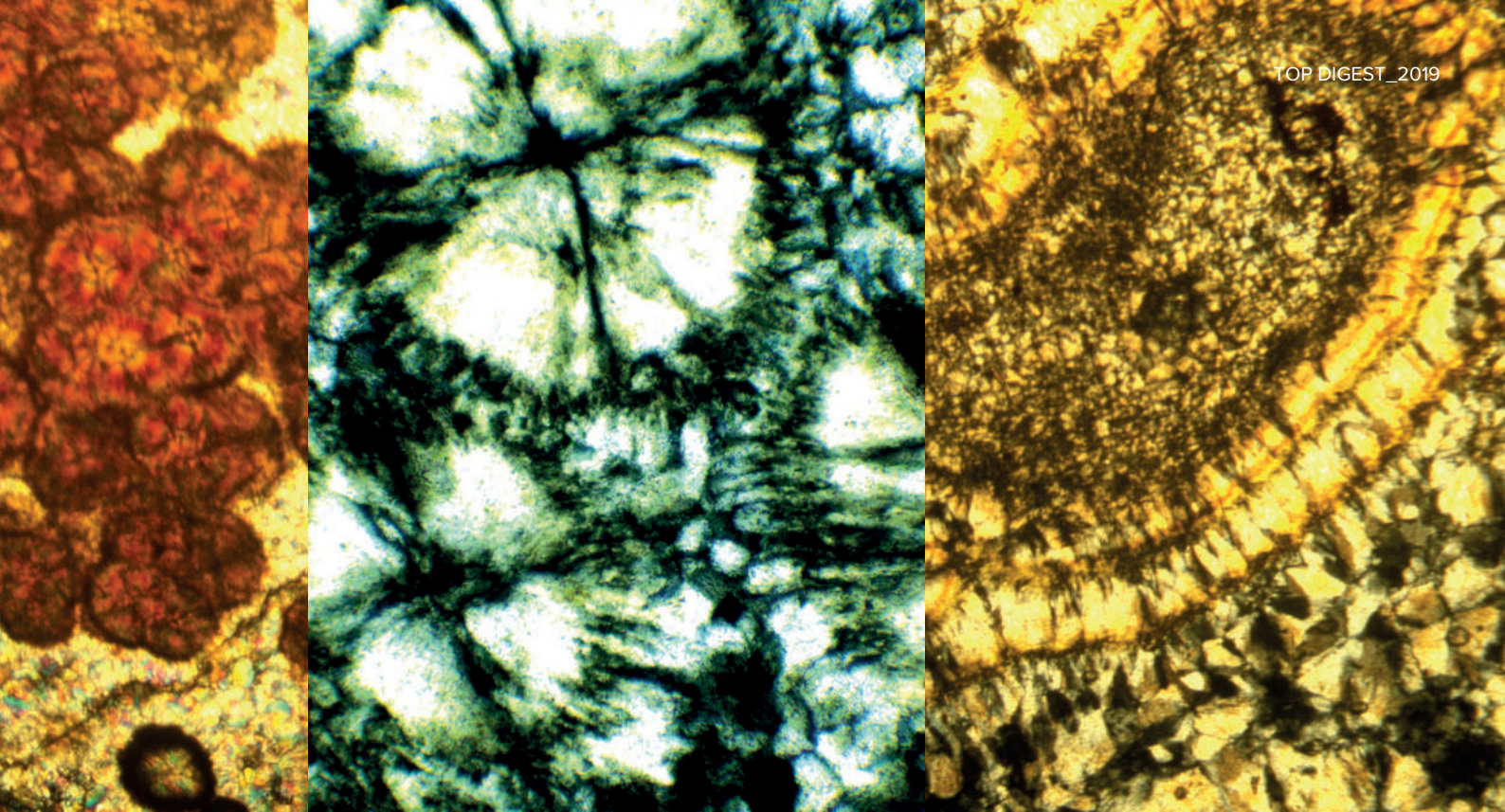
IN SAMARA POLYTECH THIN SECTIONS OF ANY ROCKS ARE MADE

THROUGH THE SPECIMEN PREPARATION LABORATORY OF THE FLAGSHIP UNIVERSITY, ALL SAMPLES OF ROCKS AND PALEONTOLOGICAL MATERIALS REACHED BY THE UNIVERSITY IN GEOLOGICAL EXPEDITIONS GO THROUGH. HERE THEY ARE MADE SUITABLE FOR SCIENTIFIC RESEARCHES WHICH THE SPECIALISTS OF THE GENERAL PHYSICS, GEOLOGY AND PHYSICS OF OIL AND GAS PRODUCTION CARRY OUT.



The main profile of the laboratory's specialists is the manufacture of thin sections. Each thin section is the thinnest, almost transparent section of any rock: metamorphic, sedimentary or magmatic and carries very important information. Using thin sections, experts study the mineral composition, rock structure, pore space, fracture, type of cementation between particles. This information is essential, for example, to determine hydrocarbon reserves in oil and gas strata and the conditions of their production.

“When you start working with an unfamiliar rock, you don't know how it will behave,” the laboratory engineer



Aleksandr Vasilyev says. “To what temperature the sample can be heated, in what modes it can be grinded. To get a high-quality thin section, sometimes you have to redo it several times.”

This process is very lengthy. Making one hard-rock thin section can take a week. And it can take months to extract a paleontological exhibit from a rock.

First, the material is washed. The most “talking” samples are taken from it, which can give the researcher an idea of the sedimentation process. The rock is studied visually, and a thin section of it with a thickness of not more than 0.03 mm (30 microns) is examined under a microscope. In general, the cut size of each rock is strictly individual.

“For example, a plate of the well-known Volga agate with insufficient fineness looks in the eyepiece of a microscope as an accumulation of colored feather clouds in an impressionist painting,” the master explains. “The view of the finished thin section, on the contrary, is gray and boring. But it is what gives an idea of the properties of the rock, its mineral composition, and the conditions of formation. The more successful the thin section, the sharper the image of the structure under the microscope.” ►





Preparations for polished sections made of rocks are first cut on a diamond wheel. Such a cutter is considered the most durable and safe. Then grinding continues on the machine using an abrasive powder - carborundum (silicon carbide). The hardness of its microparticles

is comparable to diamond. One thin section consumes up to ten tablespoons of the abrasive, depending on the rock. The final fine-tuning of the material is carried out manually using microcorundum powder (a synthetic mineral of the same group with ruby and sapphire), which is softer than cosmetic powder.

"It is very difficult to get a thin section of a large area from chalcedony," Vasilyev shares his experience. "The thinner the sample layer of these rocks, the more chips it has, and manual processing can take up to several days."

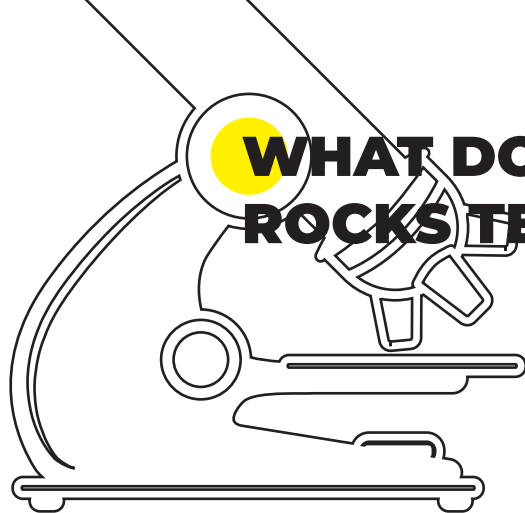
But the samples from the sludge of the drilled wells must be "demagnetized" before grinding begins, i.e. metal particles from the drill bits from the material are removed. By the way, thin sections from sludge and other loose rocks, in particular sand, are made according to a special technique. First, a monolith is made of them using epoxy glue.

A special approach is also applied in the treatment of rocks containing clay minerals, such as marl. The water required during the grinding process is then replaced with glycerin.

In this delicate work, there is another important stage: the piece must be glued onto a glass slide using Canadian balsam - Canadian fir resin. This natural material allows maximum transparency, since the light refraction indices in such a resin and glass are approximately equal. The glass surface is pre-matted on a grinding machine for better adhesion, and before bonding, the glass and the sample are heated. ■

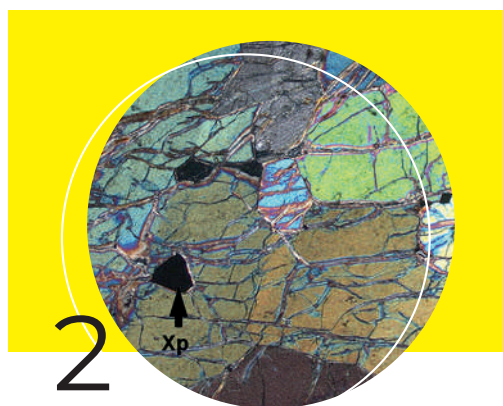
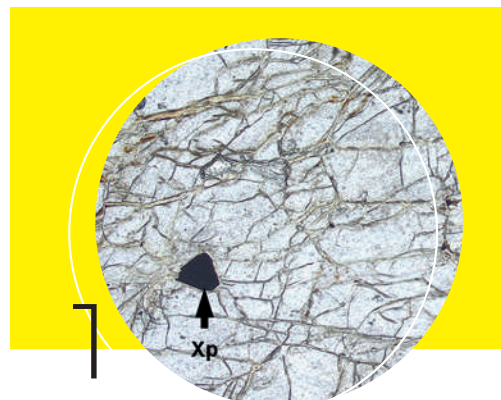


WHAT DO THIN SECTIONS OF ROCKS TELL US ABOUT?



A plate of a thin section in polarized light under a microscope looks like a gray homogeneous fractured surface, against the background of which only opaque or highly colored minerals confidently

show up. ►



▲ Olivine mineral crystals (Ol.) look like the brightest glasses in a kaleidoscope under a polarizing microscope.



▲ Sections of minerals that are found in sedimentary rocks-reservoirs containing oil and gas are usually gray. Sometimes under a microscope you can see biotite (Bi.) in them - a brown speck of dark mica.



▲ In sandstones sometimes very specific micrographic textures are found, characteristic of two minerals - quartz and K-feldspar. According to this picture, the specialist concludes that the oil has left the inter-pore space and the rock has undergone strong secondary changes.



▲ Calcite is the most beautiful mineral of carbonate rocks. On the surface of its grains and crystals, you can see the striped mother-of-pearl double strips.

SEE YOU VETLUGASAUUR!

UNIQUE FINDINGS MADE BY THE GEOLOGISTS OF SAMARA POLYTECH

Text: Tatiana PLEKHANOVA



WHEN THE SCIENTISTS OF THE FLAGSHIP UNIVERSITY WERE SETTING OUT ON THEIR ANNUAL GEOLOGICAL AND PALEONTOLOGICAL EXPEDITION TO THE SOUTH-EAST OF THE SAMARA REGION, THEY DIDN'T KNOW YET THAT SOON THEY WOULD MAKE A SENSATIONAL SCIENTIFIC DISCOVERY. THE GEOLOGISTS INCIDENTALLY FOUND THE REMAINS OF VETLUGASAUR SKELETON IN THE LAYER OF CLAY; THE SKULL THEY FOUND TURNED TO BE THE MOST COMPLETE VETLUGASAUR SKULL ON THE WORLD

It should be noted that these fossil amphibians are 'old friends' of our geologists. In 2016 during the expedition at the Obshiy Syrt the scientists of Samara Polytech found incomplete skulls of early species belonging to two labyrinthodont families – Capitosauridae and Benthosuchidae. Back then, those findings once again made it clear to the researchers that the paleofauna of the Obshiy Syrt was unique and couldn't be found anywhere else in the world.

THE WORLD'S MOST COMPLETE SKULL

This time the goal of the expedition was to monitor the Trias deposits. Besides the flagship university geologists there were other participants: experts from Paleontological Institute of Russian Academy of Science (Moscow), Samara regional local history museum n.a. Peter Alabin, Togliatty local history museum and Samara Paleontological Society. The scientists were searching around the area of the Samara and Orenburg regions.

One summer day the researchers found a piece of rock with bones sticking out of it. The value of this finding was recognized later. It turned out to be a skull of vetlugasaur – the extinct amphibian. Up to that time paleontologists couldn't give a detailed description of this creature as there were not enough bones found to reconstruct the complete skeleton of the fossil pangolin. Only a few teeth, fragments of a jaw and ribs, complete limbs and almost complete tail were found. And now the scientists were lucky to find the almost complete skull.

"We had found fragments of fossil amphibian skulls before so at first we

Labyrinthodont is an extinct subclass of amphibian that inhabited the Earth mainly during the Paleozoic and Mesozoic eras (390-150 millions of years ago). Labyrinthodonts are the ancestors of all the mammals we know today, from mice to elephants. They inhabited the area we now live in before the dinosaurs appeared. These creatures got their name because of their teeth: their cross-section looks like a labyrinth.

didn't pay much attention to this finding," says **Alyona Morova**, the senior lecturer of the 'Geology and geophysics' Department. "Moreover, a fragment of another skull of similar creature was found during the excavations."

But after the expedition was over the finding was taken to Moscow, to the top Russian Paleontological Institute of Russian Academy of Science. When the experts began making a preparation they clearly saw the teeth and internal nostrils – choanas – from the palate side. It was then when it became clear that it was the most complete skull in the world. That was quite unexpected news both for the Moscow scientists and their colleagues from Samara.

Now the experts of Paleontological Institute are performing a close study of the skull under the guidance of the lead researcher **Igor Novikov**.

LOOKS LIKE A LABYRINTH

When the expedition was about to end, the scientists hit upon a labyrinthodont skeleton. They collected more than 170 fragments of spinal column and ribs – all belonging to the same animal. **Dmitry Varenov**, the chief researcher at the ►

Vetlugasaur – fossil amphibian belonging to the subclass of labyrinthodonts that inhabited the European part of Russia 250 millions of years ago, at the beginning of the Triassic period. These animals got their name from the place their remains were first found at – the Vetluga river in the Kostroma region.



Department of nature of the museum n.a. Peter Alabin, says that paleontologists often come across the remains of fossil amphibians during their expeditions. But this finding is unique for the Samara region. Usually the scientists find only separate fragments of bones. An expertise carried out in Paleontological Institute revealed that this skeleton is the second most complete skeleton in the world.

Another thing that makes this finding rather unusual is that it was found in completely different river deposits than it was supposed to.

“We were looking for bones in rough detrital conglomerates,” says Alyona Morova. “The point is that when a river carries the material, rougher bones move together with coarse-grained sedimentary rocks. In other words, the bigger the rock debris, the bigger the bones that can be found in them. Going layer by layer we were going up until we reached the layer of tenacious clay. And there we were lucky to find this unexpected thing.”

The skeleton was lying at the bottom of a small former cavin. The paleontologists

believe it to be a source area – a hole or a turn of a river stream. The animal fell into this hole, clay eventually hardened around it and became a kind of sarcophagus that retained the integrity of the skeleton. As judged by the remains, the amphibian was about one meter long.

Unfortunately, there were neither a skull nor a tail or limbs among the skeleton fragments. As the scientists say, each species of labyrinthodont had its own particular shape of the skull while spinal bones and ribs were similar. That is why it is impossible to reconstruct the appearance of the animal so far. But the scientists still hope to find the missing bones next year.

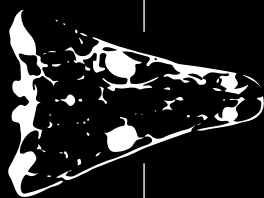


Alyona MOROVA, senior lecturer of the "Geology and Geophysics" Department:

"Modern classification divides the fossil amphibians in three groups according to the spinal bones morphology. For example, there is a vast group of Temnospondylous amphibians; their spinal bones consist of several separate parts each with well-pronounced hypocenter – it's large and crescent-shaped. Species of two Temnospondylous families – Benthosuchidae and Trematosauridae – dominated at the Obshiy Syrt (the rise on the territory of the Samara and Orenburg regions) in the early Triassic period."



Benthosuchidae were benthic predators with big flattened head and eyes looking upwards.

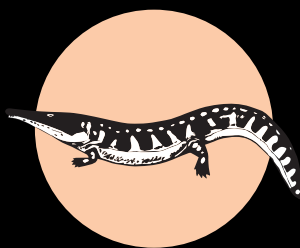


They preyed on fish and other small vertebrate animals attacking mainly from ambush and hiding in river mud.

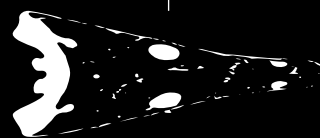
Syrtosuchus and Samarabatrachus belong to the earliest Benthosuchidae. They characterize the recently distinguished Zaplavnensky horizon.

The next horizon – Rybinsky – characterizes the later genus of Benthosuchus.

The vetlugasaur species replace benthosuchus in the next – Sludkinsky – horizon.



Trematosauridae – Thoosuchus and Angusaurus – gradually replace benthosuchidae in the Ust-Mylsky horizon.



The distinctive feature of this family is a longer skull, high and narrow, with eyes looking sideward and forwards which allowed Trematosauridae to chase their prey – fish or even their own juveniles – in water.

At the end of the late Trias water streams from the Ural didn't reach our territory anymore thus stopping the deposition of sedimentary material; the later fauna can be found in the Transurals region only. ■



ROUND AND ECOROUND

EXPERTS OF THE SCIENTIFIC AND ANALYTIC CENTER OF INDUSTRIAL ECOLOGY (SACIE) OF SAMARA POLYTECH TOLD US ABOUT THEIR BIGGEST ECOLOGICAL PROJECTS

Text: Elena SHAFERMAN



Development

Unit for biodestruction of oil-contaminated waste and ground



Legal protection

The Russian Federation patent no. 2584031 – Method of oil sludge processing and oil-contaminated ground treatment



Status

completed

BIODESTRUCTION FOR RE-CULTIVATION

At one of the plants we needed to perform layer-by-layer replacement of the ground on the site during the construction of new process facilities, and to provide levelling control. At the same time, we needed to deactivate the ground which had been under the facilities being dismantled for decades.

Samara Polytech already had the solution for this kind of problems. In 2009 the experts of SACIE designed the unit for deactivation (biodestruction) of oil-contaminated ground for the ‘Samaraneftegaz’ company, and it proved to be quite useful on three deposits of this oil-production company. It will be put into operation at the oil refinery for the first time.

The biodestruction unit allows to deactivate large capacities of oil-contaminated waste by using various biological products and mineral fertilizers. The resulting re-cultivation materials can be used as ground to dump the territories and roads of a plant.



Development

Technology for preparing sites for the construction of new production facilities at oil refineries



Status

completed

NOBODY BUT US

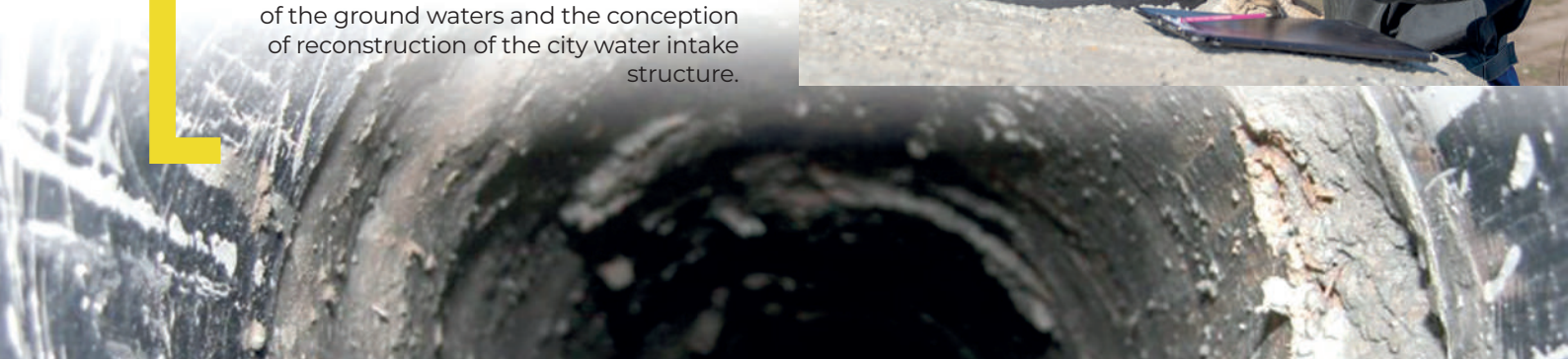
Back in 2007 the scientists of Samara Polytech joined the process of upgrading the three oil refineries of the Samara Region. The experts of SACIE began to develop projects of sites for new production facilities. Back then, no design organization wanted to deal with such problems because of constrained environment of an operating facility and complicated communication system in the area where old facilities were situated.

“We needed to dismantle both above- and underground structures, move all operating networks away from the construction site while maintaining the conditions of their operation,” recalls **Konstantin Chertes**, one of the developers of the project, Doctor of Engineering Sciences, professor of the "Chemical Technology and Industrial Ecology" Department. “It’s quite a time-consuming process – finding out the exact facilities all these process pipelines, heating, ventilation, water supply and water disposal systems belonged to.

There were neither archive materials for the operating pieces of equipment nor process regulations for the equipment put out of operation, which caused a lot of problems during the work scope coordination in the Federal Environmental, Industrial and Nuclear Supervision Service of Russia. At first we had to inspect the facilities and only after that we were able to develop the project of dismantling and moving the operating networks away from the construction site. We gained much experience. Now we can work in very constrained environment of an operating facility, make quick decisions, synchronize putting the communications in and out of operation in a limited period of time. We also got experience of self-organization and cooperation with various customer’s departments – technologists, construction workers, automation experts – and now we use it when cooperating with other companies. But in general, this kind of work is usually performed by a major design institute.” ►



On the 21st of May the first session of the Gubernatorial Environmental Safety Social Council of the Samara region took place. Among the participants there were officials from government body and local government, monitoring and oversight departments, industrial enterprises, public associations and academia of the region. The scientists working in the Samara Polytech scientific and analytic center of industrial ecology told their colleagues about their projects for providing ecological safety of Novokuibyshevsk – in particular, the results of monitoring study of the ground waters and the conception of reconstruction of the city water intake structure.



Mathematical model of oil product lenticle change in geological environment of an area exposed to industrial impact



in progress

LENTICLE UNDER CONTROL

Modernization of plants – building modern parks, moving communications up to the overhead racks – allows to reduce the contamination of the ground with oil products. However, the waste accumulated as the result of the oil refinery operation still affects the environment in the negative manner. In 2018 the flagship university signed a long-term contract with industrial facilities for monitoring the condition of underground hydrocarbon lenticles. Here is the idea. A network of observation wells is created within and around the territory of some plants and petroleum storage tanks; these wells are to be used to control the conditions of underground waters but they can't track down the dynamics of the lenticle movement. It turns out that this essential parameter showing the degree of ecological safety has never been evaluated. At the same time, ground stability under the engineering structures depends on it, as pumping the products from the lenticles leads to the formation of voids.

"It is very hard to forecast essential parameters of a lenticle, its capacity and quantitative composition of oil products it contains without knowing the processes of geophysics, hydrodynamics of ground waters and how

they move in ground layers within the particular area," explains Olga Tupitsyna, the project manager, professor of the "Chemical Technology and Industrial Ecology" Department.

She is the head of the interdisciplinary team of the scientists and students of Samara Polytech who developed a program for ground waters research; this program allows to forecast the direction of the lenticle movement due to seasonal changes of water level in water storage reservoirs, extensive use of water intake structure and the impact of main production site on the ground layer. The resulting mathematical model will also allow to define the location of oil products accumulation points, extract them immediately and effectively treat the ground and ground waters.

The observation period will last till 2020. By that time, the model of the underground oil products lenticle movement will have been 'field-proven'. This will be the first time the problem like this is solved in the Russian Federation. In order to interpret the collected data and to forecast the lenticle behavior the ecologists will need the help of geologists, geophysicists, hydrologists, as well as experts from other scientific branches. ■

AMAZING CHLORELLA

POLYTECH SCIENTISTS LEARNED TO PREPARE BIOFUELS AND FERTILIZERS FROM ALGAES

Text: Svetlana EREMENKO

MANKIND HAVE BEEN USING BIOFUEL - FUEL FROM PLANT RAW MATERIALS - FOR SOME TIME NOW. AS THE BASIS FOR ITS PRODUCTION, RAPES, AND CORN, AND RICE, AND WHEAT ARE USED. SCIENTISTS OF SAMARA POLYTECH ARE WORKING ON THE ORIGINAL TECHNOLOGY FOR PRODUCING FUEL FROM ALGAES.



ENERGETIC ONE-CELLED

Algae appeared on the planet 600 - 650 million years ago. To clarify what kind of historical gap it is they began to conquer the world 400 million years before dinosaurs' time. Meanwhile, the Earth gradually got out of the ice captivity, thawing and heating up.

Now one-celled algae are a reliable and promising source of hydrocarbon production. It is not yet clear when they will finally replace oil with themselves, but experts say that the potential of these organisms is huge.

Firstly, unlike fossil raw materials, green algae are a renewable natural resource. Secondly, for their life they need only water, sunlight and carbon dioxide. Algae are easy to maintain, they grow rapidly and give a large mass of substance. These organisms are adapted to grow even in polluted or salt water. An important detail: sea and freshwater algae produce a significant part of the oxygen on the planet.

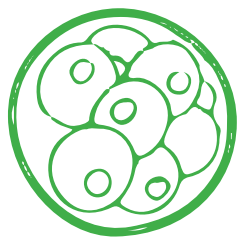
FEEDING ALGAES

As a source of biofuel, specialists from the Department of Chemical Technology and Industrial Ecology of Samara Polytech suggest using chlorella (*Chlorella vulgaris* or *Chlorella infusium*). This simplest one-celled green algae in appearance resembles a microscopic motionless green ball up to 15 microns in diameter. A chlorella cell contains up to 40 percent of complete proteins, 20 percent of lipids, 35 percent of carbohydrates.

Scientists have created their model installation of a photobioreactor for the cultivation of algae. They experimented with light, medium, temperature, and species of algae. With the autoclave method, under high pressure and temperature conditions, lipids were extracted from chlorella to obtain an oil that can be used as the biofuel. ►

A graduate student **Olga Semikhvostova** studied various technologies for the synthesis of biofuel and proposed a simple scheme of the production process for growing chlorella.

“At the first stage,” Olga explains. “Nutrient and gas media are formed in which chlorella will live. Then the inoculum is prepared - a substance used as a nutrient. It is brought to production cultivators. One milliliter of inoculum contains up to three million chlorella cells. After cultivation of the algae, it is further processed and the finished product is issued.”



Chlorella can be “fed” not only with CO₂, but can also be supplied with mineral nutrition from organic and organomineral mixtures, for example, from liquid manure or beer wastes. The choice of food source depends on the purpose of the grown chlorella. Algae, intended for the manufacture of biodiesel, has its own “menu”, for food additives, medicines, dietary supplements, livestock feed – another one. Chlorella is also used to clean ponds.

GO INTO THE VOLGA RIVER

The ideas of university science inspired Togliatti businessmen. They created a complex for the collection and processing of algae biomass in order to further obtain biofuel and organic fertilizers. An experimental system for this was the open system - the Volga.

In addition to chlorella, Togliatti citizens also collect blue-green cyano-algae. Annually, huge reserves of these organisms are formed in the Kuybushev Reservoir, because of which water “blooms”. During this blooming, the oxygen content in the bottom layers decreases, hydrogen sulfide is formed, and there is a danger of mass death of fish. The volume of the reservoir is approximately

Liliya SMAKHTINA, a Polytech postgraduate:

“Chlorella is the most promising genus of algae for biofuels. It multiplies rapidly, increasing biomass by five times per day. This effect is due to the fact that algae absorbs a lot of carbon dioxide and accordingly releases a lot of oxygen. Chlorella withstands temperature fluctuations from 5 to 30 °C.”

5.5 - 6 million cubic meters. It is estimated that about 3.6 kg of algae is contained in one cubic meter of water. And to get a ton of fertilizer you need 650 kg of biomass.

Turning a wet algae base into a fuel material is a rather complicated process. After “harvesting”, it is dehydrated, then a solvent, such as hexane, is used to extract triglycerides rich in energy from algae. The compositions obtained can, in fact, already be converted to fuel using standard industrial procedures. For example, to get biodiesel, you need to mix the extracted triglycerides with methanol.

In the meantime, entrepreneurs are focused on the production of fertilizers. They have already tested a special combine, which principle of working is the Samara Polytech algae processing technology. ■



BIOFUEL –

FUEL, made from plant or animal raw materials, organic waste and organisms

1st generation

Seeds of crops (sunflower, wheat, corn, etc.) with a high content of sugar, starch, vegetable oil; sugarcane, sugar beets.



2nd generation

Residual non-food parts of plants: stems, leaves, husks, peels, wood flakes, etc.



3rd generation

Algae



BIOFUEL TYPES



THE TWO OF THE BEST

STUDENTS OF SAMARA POLYTECH INVENTED AN ANTIPARKING DEVICE AND A HEAT GENERATION SYSTEM FOR BULLET-PROOF VESTS

Text: Svetlana EREMENKO

INVENTOR: Alexandr GOREV

INVENTION: antiparking device with friend/foe recognition system

DESTINATION: Autonet



The problem of traffic jams caused by careless drivers who leave their cars in inappropriate places is quite relevant for the citizens of any big city. Municipal services use various methods – warning signs, vehicle impoundment, heavy fines – to struggle against drivers who block specialty vehicles passages with their cars, leave them next to bus stops or road repair areas.

Alexandr Gorev, a student of the Engineering-Technological Department, came up with the idea based on drivers' habit to use a remote control for locking and unlocking their cars.

"I've always wanted to do something interesting and useful for our city," says Alexandr. "I'm a driver myself but

I don't like to see the carelessly parked cars. Not only they stand on pedestrians' and roadworkers' way and block passages for specialty vehicles but also spoil the look of a heavily populated city."

Alexandr invented a device which limits the ability to use the car alarm system in places where parking is prohibited. Let's assume that some driver is trying to park his car in an inappropriate place. It triggers the antiparking device mounted there; it generates interference noises on the remote control radio channel so this driver can't lock his car.

The advantage of this invention is that it is an electronic device while the majority of existing antiparking devices are mechanical.

Now the student is finishing the device under the guidance of his research adviser, Candidate of Engineering Sciences **Alexandr Nechaev**. They have already developed a basic principle of its operation; the mechanism that generates noise of the required frequency is being perfected while the best antenna design is being figured out. The technical parameters of the device are supposed to maintain its operation even in poor weather conditions – low temperature, fog, rain, snow, and also to identify 'friend' cars within its operating range and leave them unaffected.

The developers say that the gadget will be the size of a microwave oven. It can be mounted anywhere – for example, on a pole like road cameras.

INVENTOR: Vladislav LOBANOV

INVENTION: an adjustable heat flow generation system for bullet-proof jacket

DESTINATION: Technet

In 2012 the army of one of the European countries conducted an experiment. A volunteer ran several kilometers on the running machine in an isolated and heated room. As the result, he lost more than 700 grams of his weight.

A bullet-proof vest protects a soldier against bullets but it has no heat rejection system. This is the common problem that military men and security agents face when wearing bullet-proof vests for a long time. **Vladislav Lobanov**, a SSTU student, learned about this problem during the international EMPRETECH seminar that was held in Samara with support of the United Nations Conference of Trade and Development.

“People from organizations that make personal equipment for military and security services told me that military men, collectors and law enforcement officers had a hard time in summer,” Lobanov explains. “When the weather is hot, the bullet-proof jacket turns into the real



below and above zero. The system combines heating and cooling functions. The main components of the system are: temperature flow set block, Peltier elements with heat rejection device and adaptive regulator which changes the parameters of the electric signal depending on the temperature inside the bullet-proof vest. These elements last for 200,000 hours which is equal to about 13-15 years of operation. The device can be mounted into the bullet-proof vest made of any material: kevlar, titanium or ceramics.

In fact, engineers have been working on the problem of cooling ‘the armor’ from the inside for many years. For example, Swiss scientists proposed to equip the vest with pads filled with water; water was supposed to evaporate through the membranes thus cooling the body. The

A BULLET-PROOF VEST WEIGHS FROM 10 TO 15 KG, A SOLDIER WEARS IT FROM 5 TO 12 HOURS.

The heat flow generation system will make a bullet-proof vest just 3 kg heavier. The low-voltage battery is properly insulated so the soldiers won't get electric shock.

system also had a small ventilator to make cooling more effective. But this advanced development wasn't suitable for the military due to its short operation time.

Our scientists, unlike their Swiss counterparts, use the Peltier elements that proved to be very effective in terms of rejecting heat from the system. (We are talking about compact thermo-electric converters that work due to temperature difference.)

“With our system, soldiers will be able to perform their duties well no matter whether it's hot or cold. This development opens the door to a whole bunch of perspective research to create all kinds of special clothes with cooling and heating system,” Vladislav Lobanov sums up.

Now the experts of Samara Polytech are working on the design of the system work area. ■



instrument of torture. It's literally like sauna that a person has to wear. High temperature not only makes the person ‘boil in his own sweat’ but it also has a negative effect on his activity and concentration.”

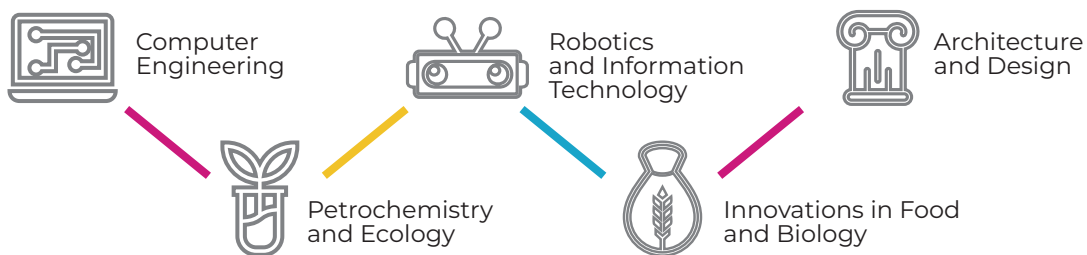
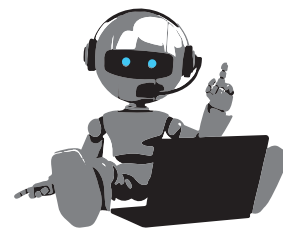
Vladislav Lobanov (Alexandr Nechaev is his research adviser too) designed an adjustable system that generates a heat flow in the bullet-proof vest. The device works as follows: thermo-electric converters get an electrical signal and transform electrical energy into heat. Depending on the signal the device can generate temperatures both

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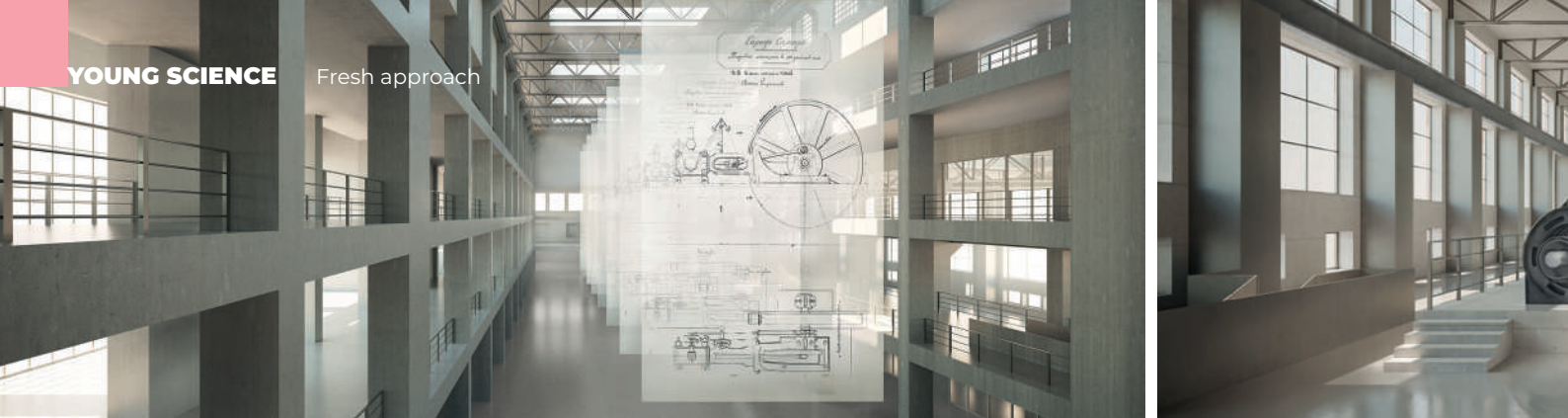
ARCHITECTS OF RESTRUCTURING

GRADUATES OF SAMARA POLYTECH PRESENTED THEIR PROJECTS FOR RENOVATION OF INDUSTRIAL STRUCTURE BUILDINGS

Text: Tatiana PLEKHANOVA

TWO GRADUATES OF THE "ARCHITECTURE" DEPARTMENT BELIEVE THAT ONE OF THE DIRECTIONS OF FURTHER DEVELOPMENT OF SAMARA MAY BE EFFECTIVE AND RATIONAL USE OF TERRITORY OF THE CITY'S INDUSTRIAL FACILITIES

Irina Zubkova and **Irina Belyaeva** have been thinking about the ways of using the space of the buildings of the Samara regional hydroelectric power plant and the Bezmyanka heat-electric generation plant under the guidance of **Vitaly Samogorov**, Candidate of Architecture, Head of the Department. Eventually they came up with two rather interesting projects that were highly appreciated by the experts of the Samara branch of the 'T Plus' company that owns these power plants. The power engineers assume that in a couple of years the Bezmyanka heat-electric generation plant may turn into an effective up-to-date boiler house and the now operating building of the Samara regional hydroelectric power plant may be put out of service. And then the ideas of the young architects from Samara Polytech may come true. ►



The Samara regional hydroelectric power plant is considered to be a ‘grandmother’ of the Volga region electric power industry. It was put into operation in 1900. Today the plant supplies heat to the citizens of central areas of Samara. Its rated output power is 61 MW while its rated heat output is 1827 Gcal/h.

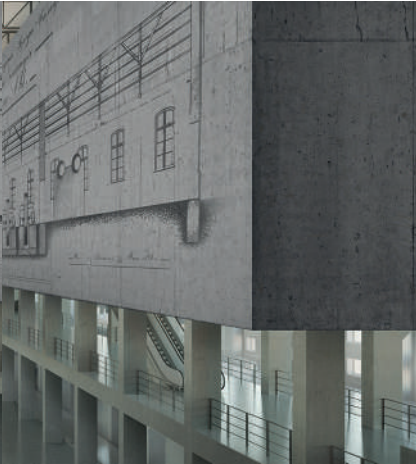


THE ‘ENERGOCOMBINAT’ SCIENCE AND TECHNOLOGY FORUM

CONCEPT OF THE PROJECT

According to this project, the buildings of the Samara regional hydroelectric power plant are to be transformed into the Science and Technology Forum; the city’s latest scientific and industrial advances will be presented here. The existing look of the plant – buildings built in the late 19th – early 20th century as well as buildings featuring the 1930’s Soviet constructivism architecture – will be preserved. The boiler room of the power plant is meant to be turned into an entrance hall and the main exhibition area while the turbine room will be converted into an exhibition gallery. There will be an embankment along the shoreline and terraces on the territory of the former plant. After the renovation the rooms architecture will feature light-and-shade contrast, high and low construction volumes, spacious and chamber areas. Main finishing materials will be concrete and metal.





PROJECT AWARDS

4th International competition of bachelor, specialist and master's degree graduation qualification works (projects) in the area of urban development, architecture and design

27th International competition of the best graduation qualification works in the area of architecture, design and art

1st degree
certificate

1st degree
certificate
By the Interregional public organization for architectural education support

Archiprix Russia
certificate

Certificate
of the Russian Academy of Architecture and Construction Science



Irina ZUBKOVA, the author of the 'Energokombinat' project:

"While studying specialized literature before starting my graduation project I noticed that the concept of renovation of industrial areas is relevant for Samara. There are many decayed or abandoned industrial buildings in our city; being built in past centuries, they are still monuments of architecture. In my opinion, we should preserve this heritage, for when such building is demolished, a piece of our history is destroyed too.

The Samara regional hydroelectric power plant is of great historical and cultural value for our city; its situation in the municipal planning structure is advantageous. I think that the plant's industrial look, its distinctive atmosphere and 'personality' are attractive and unique. Furthermore, there are only a few museums in Samara today that can hold the wide range of exhibitions. I will try to consider all these points in my project. I would like to add that I haven't finished working on the Science and Technology Forum yet. Now I'm doing my master's degree developing and perfecting my project." ►



THE 'BEZMYANLAG' REPRESSION MUSEUM



CONCEPT OF THE PROJECT

The territory of the Bezmyanka heat-electric generation plant is closely related to tough destiny of the prisoners of the 'Bezmyanlag' – a correctional labor camp that was situated in the Kuibyshev region in the period from 1940 to 1946. The plant area can be rearranged by building a group of glassed galleries on the pile foundation and using the existing auxiliary rooms that are not involved in the power plant's operation. The main part of the museum is compact and long symbolizing long and hard way of the prisoners. There are three zones in the museum: an entrance hall with administrative functions, a lecture hall and a recreational area with cafe. Glass doors that lead to the memorial hall serve as a viewpoint above the boiler and turbine rooms of the plant. Stained-glass window sashes are made of iron. The museum is designed to not affect the power plant's operation.

PROJECT AWARDS

4th International competition of bachelor, specialist and master's degree graduation qualification works (projects) in the area of urban development, architecture and design

1st degree
certificate

Construction of the Bezmyanka heat-electric generation plant began in 1938; it was supposed to supply electricity to the Kuibyshev hydroelectric complex near the Krasnaya Glinka. But eventually the plant supplied heat and electrical power mainly to defense plants and factories. It was put into operation in 1941. The plant is awarded with the Order of Lenin and the Red Banner of the State Defense Committee. Its rated output power is 169.7 MW while its rated heat output is 1445 Gcal/h.





Irina BELYAEVA,
the author of the Bezymyanka power plant
repression museum project:

“Even before I started to work on my graduation project I already knew that I wanted to design a museum. Samara is the city with great and interesting history, and museums and exhibition galleries help to preserve this history for the future generations. I visited the power plant and considered the functional aspect of production. My goal is to show hard labor of the ‘Bezmyanlag’ prisoners, and the best way to do it is glassed galleries. The museum viewpoints allow to look at the main facilities of the plant, the turbine and boiler rooms. Because all this was built by the prisoners.

The museum is supposed to be situated on the outskirts of the city which makes it not so easy to visit. But the obvious advantage of the exhibition area is that it’s designed right on the spot of the historical events.

Before the very presentation of my graduation project I thought “I could’ve added more galleries to the project, planned more rooms and designed the exhibition areas more thoroughly”. But now, three month later, I wouldn’t change anything. A museum dedicated to such a serious and tragic topic should look restrained and even ascetic.” ■



ROBOT SMELLING

A PUPIL STUDYING IN THE TECHNICAL CREATIVITY CENTER OF SAMARA POLYTECH INVENTED A ROBOT THAT CAN RECOGNIZE SMELLS

Text: Ksenia MOROZOVA

ONE OF THE REASONS OF HIGH MORTALITY RATE IN COAL MINES IN OUR COUNTRY IS INADMISSIBLE GAS CONTAMINATION OF THE UNDERGROUND MINING WORKINGS THAT ARE NOT VENTILATED PROPERLY. ONE OF THE WAYS TO DEAL WITH THIS PROBLEM IS DEGAZATION – A NUMBER OF PROCEDURES FOR DEACTIVATION AND REMOVAL OF HAZARDOUS SUBSTANCES. BUT IT IS EXPENSIVE. A ROBOT BUILT BY A 9TH-GRADER ALEXEY ALTYSHKIN IS MUCH CHEAPER AND CAN QUICKLY MONITOR AIR CONTAMINATION LEVEL



**Alexey ALTYSHKIN,
the 9th-grader from Syzran:**

“I come from a renowned family of miners so the problem of safety in coal mines is particularly relevant for me. In seven or eight months we created a device which is indispensable to the mining industry. There are robots similar to mine but as far as I know they are not used in real production.”

The invention looks like a small autonomous off-road vehicle. Its **tracks** provide good **adhesion** allowing the robot to move across loose ground. The robot uses the **ultrasonic range finder** to measure distance to obstacles and move around them. It works like this: the range finder emits a sound signal in a set direction, receives the reflected echo and calculates the sound travel time.

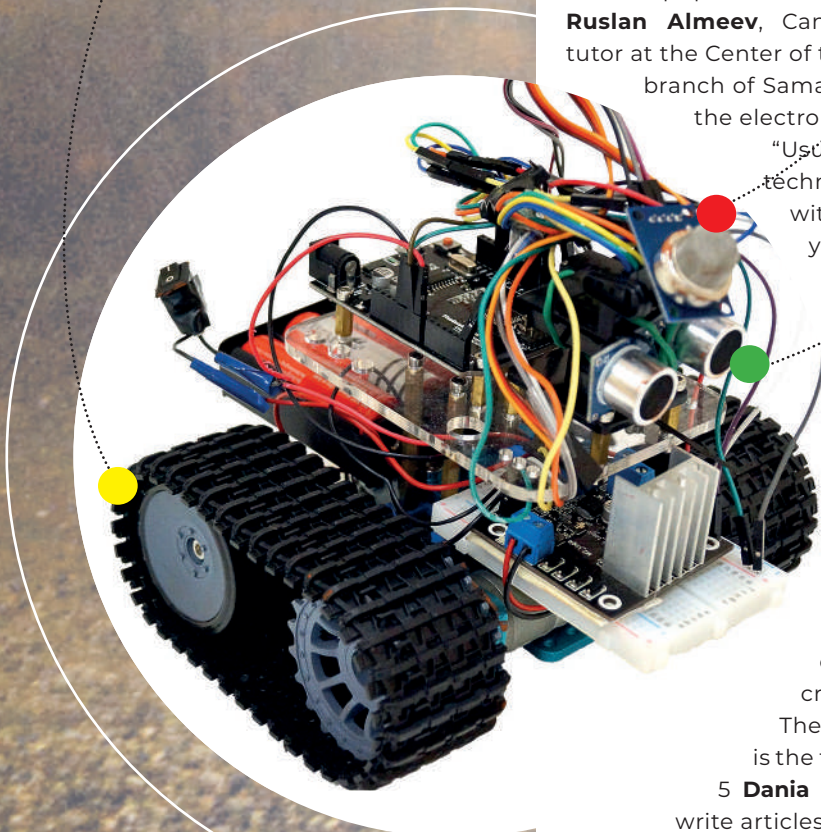
Special sensors on the robot's body measure the concentration of hydrocarbons in the air and allow to detect gas leak spots with maximum precision; the robot immediately sends images of faulty mine sections to its operator via the wi-fi channel. In case of explosive concentration the robot alerts the operator.

The pupil made the robot's body himself and **Ruslan Almeev**, Candidate of Chemical Sciences, tutor at the Center of technical creativity in the Syzran branch of Samara Polytech, helped him to wire the electronics and develop the software.

"Usually children study robotic technology in small groups but I work with Alexey individually," says the young designer's mentor. "Alexey wanted to build a unique robot. I think he did it great. Now we're planning on updating the robot's look and finishing the control software so that the robot could find leak spots even faster."

This year Alexey's project won the first stage of regional competition of R&D projects called 'Ascent' and the 5th International competition of pupils' R&D and creative projects 'Start in science'.

The research advisor of the project is the teacher of Syzran school number 5 **Dania Artemova**. She helps Alexey to write articles for scientific publications. ■



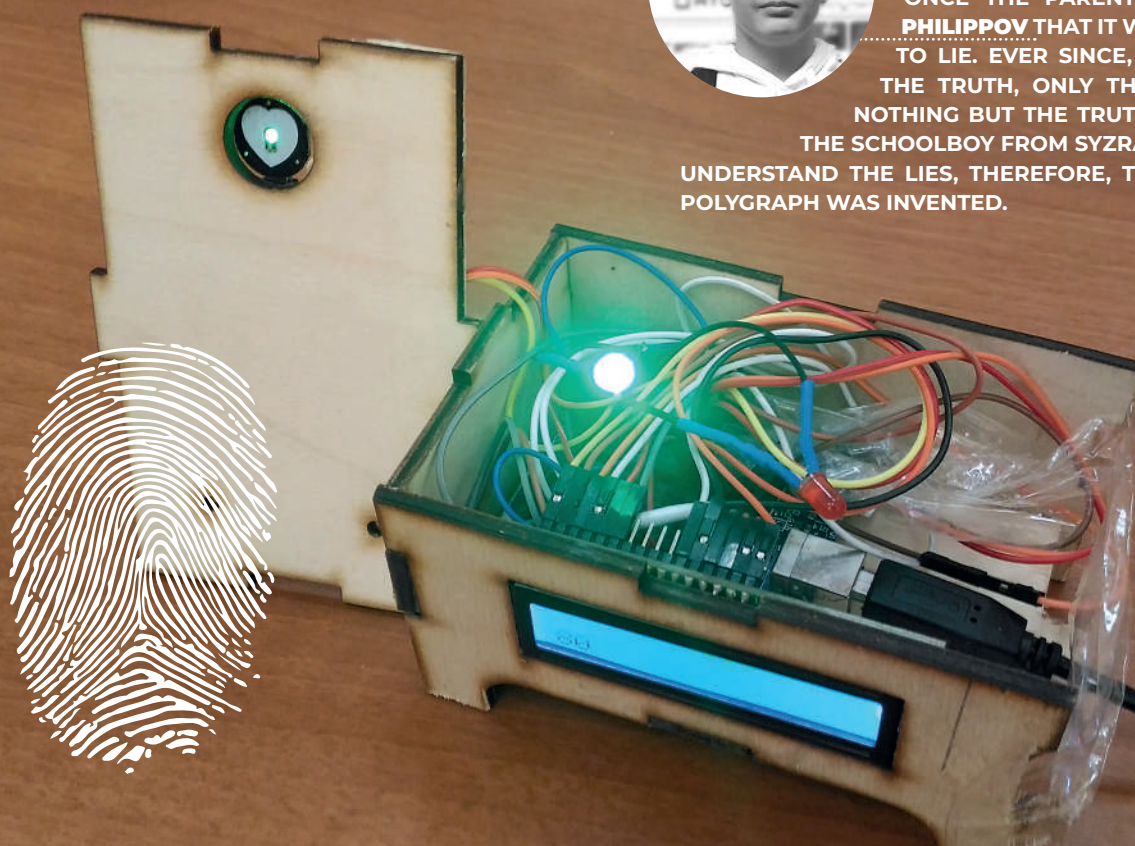
A WEB OF LIES

A MEMBER OF THE CENTER OF TECHNICAL CREATIVITY OF SAMARA POLYTECH INVENTED THE ORIGINAL DEVICE

Text: Ksenia MOROZOVA



ONCE THE PARENTS TOLD **DIMA PHILIPPOV** THAT IT WAS NOT GOOD TO LIE. EVER SINCE, HE HAS TOLD THE TRUTH, ONLY THE TRUTH AND NOTHING BUT THE TRUTH. MOREOVER, THE SCHOOLBOY FROM SYZRAN SET OUT TO UNDERSTAND THE LIES, THEREFORE, THE MINIATURE POLYGRAPH WAS INVENTED.



A BIT OF HISTORY

Our ancestors once noticed: a lying person's heartbeat quickens, the rhythm of breathing is broken, the timbre of the voice changes, it dries up in the throat. Therefore, in ancient China, for example, rice flour was put into the mouth of the alleged offender. If after a while the flour

remained dry, then the suspect was found guilty. The Italian psychiatrist Cesare Lombroso is considered to be the creator of the first technical device for lie detection. In the early 1880s he developed the hydro-sphygmometer device, which was based on the principle of fixing the parameters of blood pressure and the pulse. The registration of human physiological reactions is the main purpose of modern polygraphs.

POLYGRAPH OF PHILIPPOV

Dima's device consists of an optical pulse sensor, an Arduino microcontroller and a screen displaying the measurement results. The young inventor designed the device case in the form of a 3D model and cut it out of wood on a laser machine. The advantage of this polygraph is that anyone can handle it.

"It's quite simple: a person puts his index finger on the heart rate sensor," the eighth grader explains the principle of his device. "He is asked three neutral questions, and then the main one, to which they want to hear a true answer. If the subject is lying, then the pulse value changes dramatically."

The LED and a photo detector are installed on the heart rate sensor. A ray of light emitted by the LED, reflected from the fingertip, enters the photodetector. Vessels, being filled with blood, change their optical density, and the amount of light reflected from them decreases. A change in the sensor signal over time corresponds to the heart rate. Data from the sensor is transmitted to the microcontroller, processed using a special program and displayed.

As an experiment showed, in which 14 schoolchildren aged 12–13 years participated, the accuracy of the readings of the device is approximately 85 percent. For industrial polygraphs, this value varies from 70 to 95 percent. ■



Ruslan ALMEEV,

Candidate of technical sciences, teacher at the Center of Technical Creativity of the Syzran branch of Samara Polytech:

"Dima is a talented young inventor. He developed and built a lie detector on his own. Together with his mother, he asked for help only at the stage of finalizing the design documentation and submitting competitive applications. The project was highly praised by experts. Dima received a second degree diploma at the international competition "Start v Nauke" ("Start in Science") and took the third place at the regional stage of the "Vzlyot" competition. It is important that he approached his project comprehensively: not only assembled the device, but also conducted a full-fledged social experiment based on well-known testing methods."

2

The result of a polygraph test cannot be considered 100 percent reliable, since the device only records the body's reactions to specialist questions, the universal physiological activity of the human body that is characteristic of lies simply does not exist.

1

A modern polygraph is capable of simultaneously recording up to 50 physiological parameters: respiration, electrical resistance of the skin, redness of the face, contraction of the eye pupils, expansion of capillaries, voice timbre, etc.

3

In our country, the polygraph has been used since 1975, but during the Soviet period, the activities of polygraph examiners were classified.



5 FACTS about polygraphs

4

The duration of a standard polygraph test is an average of two hours.

5

The polygraph test includes from 100 to 300 questions, after the answers to which the polygraph examines the data received by the device and draws conclusions.

The best fashion of our life

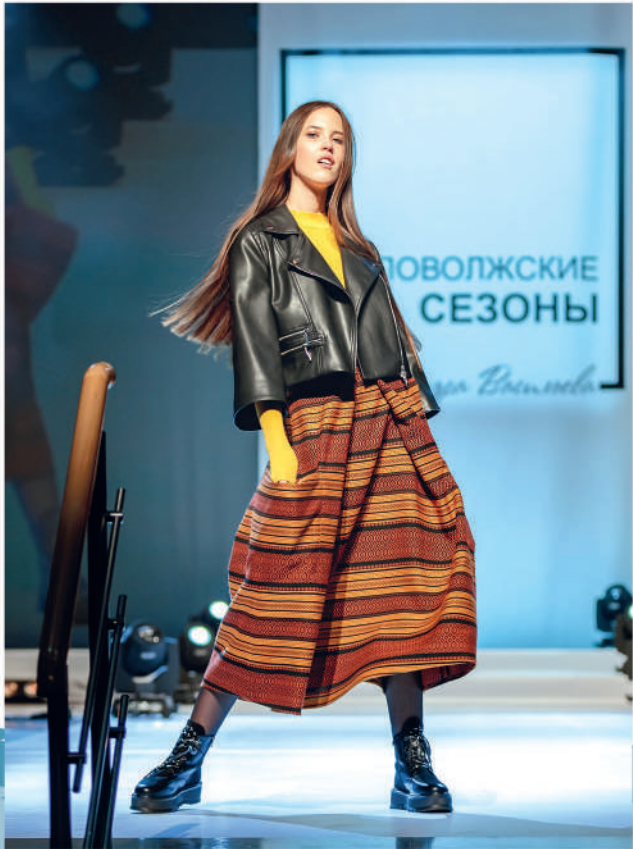


Among the 25 finalists of the fashion competition there were students of Samara Polytech, **Mariya Trifonova**, **Mariya Zenina**, **Alyona Purtova**, as well as graduates of the professional design training program "Costume Design. Designing" of the flagship university **Ekaterina Ananyeva** and **Tatyana Machkasova**. The advisor of their work is Associate Professor of the Design Department **Darya Arutcheva**.

Following the results of the "Volga Seasons", Mariya Trifonova's collection "Vzglyad" ("The look") was awarded a personal award, using the loud, screaming,

THE 9TH FESTIVAL OF FASHION AND THEATER COSTUME "VOLGA SEASONS OF ALEXANDER VASILIEV" WAS HELD IN SAMARA FROM 9 TO 13 OCTOBER 2019. THE TOPIC OF THE SEASON IS "FASHION AND THEATER".

but sophisticated style of Vladimir Mayakovsky. The art director of the festival, **Mariya Kazak**, presented the student with a certificate for teaching French from the "L'Alliance Fracaise de Samara" company. ►







Александра Васильева





ПОВОЛЖСКИЕ СЕЗОНЫ



THE DAY LASTS MORE THAN A HUNDRED YEARS

15 facts about Samara Polytech



1. In 1856 the oldest building of Samara Polytech was built; today it is the residence of Heat Power faculty. Originally it was built for the first public school for boys and it had two storeys. In 1930 two more storeys were added to it.



2. On the 3rd of June 1914 the Emperor Nikolai II ratified the law on founding the Polytechnical Institute in Samara.



3. **Nikolay Putokhin, Georgy Knorre, Mark Krein**, the founders of prospective scientific areas – thiophen chemistry, theory of cyclonic fuel combustion, theory of self-adjoint Hermitean operators – used to lecture in Samara Polytech in 1940's.



4. In 1943 the "Solid Chemicals Technology" Department was founded. Its founder and first Head was Doctor of Engineering Sciences, professor, honored inventor of the USSR **Victor Kozlov** – one of the founders of the method for determination of explosives sensitivity to impact friction; today this method is widely known as the Bowden-Kozlov method.



5. In 1944 students and lecturers of Samara Polytech donated money to build an IL-2 attack airplane ('shturmovik') named 'Kuibyshev Industrial Institute' for the 1st Ukrainian battle front.



6. In 1957 **Lev Polugaensky** graduated from the "Heat Power" Faculty. This man became the international chess grandmaster, winner of six World Chess Olympics, the USSR champion. One of the variants of Sicilian Defense in the chess openings theory is named after him.



7. On the 1st of September 1962 **Viktor Chernomyrdin** entered Samara Polytech – the future minister of the USSR gas industry, chairman of the Russian Federation government, ambassador extraordinary and plenipotentiary in Ukraine.



8. In December 1957 **Georgy Shlyonov**, the graduate of the "Automatic Electric Drive" Department, became the chief mate on the world's first atomic-powered ice-breaker 'Lenin'.



9. On the 30th of November 1967 **Vladimir Vysotsky**, the famous poet, actor, singer and songwriter, sang in the auditorium of Samara Polytech.



10. In September 1973 the 25-years-old graduate of Samara Polytech **Alexey Shor** became the world champion in weight category below 52 kg at the 1st World Unarmed Self-defense Championship in Tehran.



11. On the 9th of 1980 Samara Polytech was awarded the Order of the Red Banner of Labor by the Decree of the Supreme Council of the USSR.



12. On the 18th of May 1981 members of the 'Venceremos' student team from Samara Polytech met **Luis Corvalan**, the secretary-general of the Communist party of Chile. Not long before that the Chilean communist imprisoned in his country had been traded for Vladimir Bukovskiy, the famous Soviet political prisoner and dissident.



13. In 1990 a town appeared on the map of Russia, in the Yamalo-Nenets Autonomous District; it was named after the lecturer of Samara Polytech, the Head of the "Oil Industry" Department of the Middle-Volga Council of national economy, the Lenin prize and the USSR state prize winner, Hero of the Socialist Labor **Viktor Muravlenko**.



14. In 2004 a geological and mineralogical museum was founded in Samara Polytech. Today its collection consists of more than 3000 exhibits brought from all the continents.



15. In 2014 when the 100th anniversary of the Polytechnical Institute was celebrated, The Engineer monument – the first in Russia – was put up near the administrative building of Samara Polytech. It was designed by the sculptor **Ivan Melnikov**.

TECHNOPOLIS OF THE VOLGA REGION



■ TOWARDS BREAKTHROUGH SOLUTIONS

New interdisciplinary research teams have been formed in Polytech

■ FORM DAMPENS WAVES

Polytech's scientists have found a new way to control a mirror surface in telescopes

■ FORWARD, MARCH!

Polytech scientists invented a mechanism that can move from place to place on its own feet

■ PIXEL TO PIXEL

Developments of Polytech scientists in the field of hyperspectral monitoring will help Russia become the leader in remote sensing of Earth

■ THIS FUEL OR THAT

Researchers of the flagship university are working on the processes of hydrogen accumulation in aromatic molecules

Sport and entertainment center provides services to the students of Samara State Technical University and local residents: aerobics, martial arts, sports games, gym, and multimedia shooting gallery.

For children: swimming, karate, aikido, and dancing classes are available

SPORTS CENTER

Samara Technical University



