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## MESSAGE FROM NEIL B. GODICK

Russia's worst ever summer heat and draught has triggered some innovative thinking. Water could become a 'strategic resource'.

With proper water management, Russia's vast water resources may soon become a 'strategic resource' as the global water deficit increases. This is a new position being taken by Russia's Security Council.

Throughout history there are numerous examples of when a lack of water has led to armed conflicts. There are estimates that the world may find itself in a global water crisis well before 2035. Russia has some of the world's biggest fresh water reserves. But, it does not use the resource efficiently. This waste creates a serious threat to the country's national security rather than being a strategic advantage.

In a bid to ward off a future water crisis, Russia's Water Strategy through 2020 plan is designed to ensure the rationalization of water usage and modernization of water supply systems across the country.

*We do not intend for these reports to solve any need our readers may have. We do intend to keep everyone current on technology developments in Russia. If you would like any additional information on any of the developments reported – send us a note.*

**Monolithic carbide mills  
with polyfunctional  
nanocomposite coatings**

Production tests for a pilot batch of monolithic carbide mills with polyfunctional nanocomposite coatings are in progress at the **Yu.A. Gagarin Aviation Production Association (KnAAPO)**.



The tools are used to machine high-strength titanium alloys. In the development's first stage a pilot batch of monolithic carbide mills were produced from purchased blanks. During the development's

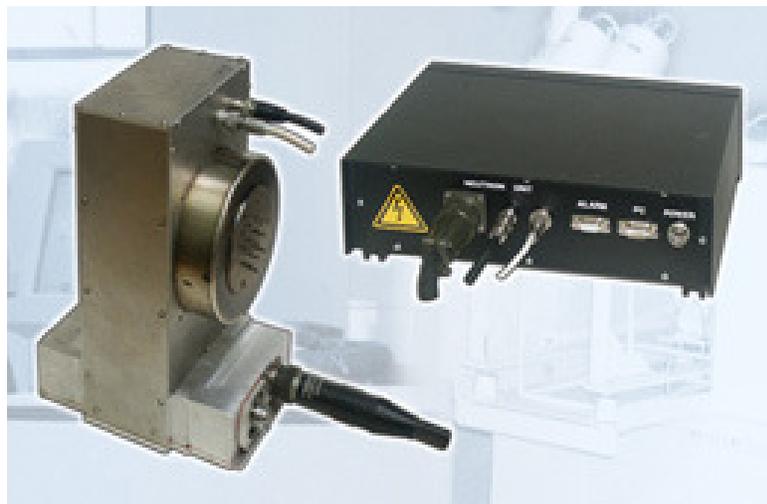
second stage hard carbide alloys without cobalt binder as a working medium will be used for the tool. This will greatly increase the tool material's heat resistance and also enhance its strength characteristics.

At the **Nizhniy Novgorod Physico-Technical Research Institute** a pilot batch of carbide plates were produced. Carbide alloys without a cobalt binder with grains sized down to 200 nanometers have been obtained.

#2010-08-105

Developed in Russia:  
neutron generators for  
detecting hazardous  
substances in vehicles

**All-Russia Research Institute of Automatics (VNIIA)** has developed neutron generators for detecting hazardous substances in public places. ING-27 is a small, new-generation neutron generator. ING 27 uses a sealed gas-filled neutron tube with a built-in multipixel detector with accompanying alpha-particles. It is designed for devices used to detect and identify hazardous substances by the "tagged" neutrons method (neutron nanosecond analysis method or Associated Particle Imaging (API) method).



In 2011 the devices will be installed in the Moscow subway network. Approximately 30 ING 27 devices have been supplied to foreign customers, including EU based and USA based customers. Each device costs approximately US\$100,000.

VNIIA is the only company in Russia that has the full-scale research, design, and fabrication capabilities to develop and produce the portable neutron generators.

The neutron generators and the hardware systems based on them have a number of applications:

- Petroleum and uranium well-logging;
- Monitoring industrial processes and product certification;
- Detecting and identifying HE and toxic agents;
- Neutron therapy;

- Neutron radiography and tomography;
- Research for the physics of the nuclear reactors and fuel assemblies;
- Detecting and monitoring nuclear materials;
- Scientific research.

VNIA neutron generators have the unique specifications:

- Neutron yield up to  $10^{11}$  neutron/s;
- Pulse duration 0.01  $\mu$ s to 10 ms;
- Pulse frequency from single up to 10 kHz.

#2010-08-106

MGU microbiologists and chemists have learned to produce electricity from impure hydrogen



Biotechnological hydrogen production has been mastered by researchers from the **Chair of Microbiology, Biology Department, Moscow State University (MGU)**. The group's lead scientist is **Dr. Andrey Shestakov**. For their work the biologists singled out eight microbial communities from the great variety of microbial communities found in nature. They have been cultivating them in their laboratory for about a year and regularly obtaining hydrogen from them. First the communities are grown in glass vials with a nutrient medium in a thermostat at 60 C. The bacteria are fed hard-to-digest cellulose. For the next stage (obtaining electricity from hydrogen) the scientists solved the problem of hydrogen power engineering. They learned how to use bacterial hydrogen without purification. To achieve this, the scientists had to replace platinum or palladium catalysts in the fuel cell with new catalysts. To develop an enzyme hydrogen electrode, the scientists immobilized hydrogenase molecules on a fabric carbon base. The correct position had to be determined to increase the coating area. The scientists claim, a waste biodegradation system with simultaneous electricity generation is currently economically viable. Today bacteria can process 20–40% of cellulose. These scientists expect to increase this figure to 50–60%. They are currently developing fuel cells to operate for 500–800 hours

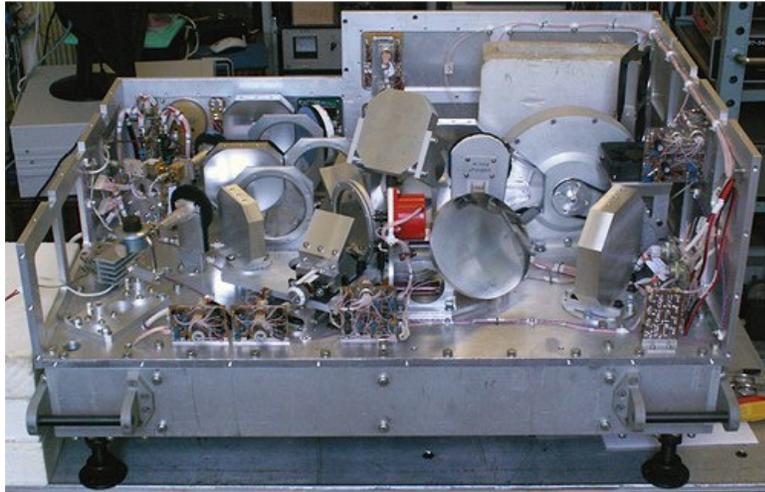
without enzyme replacement.

Microbe-processed biomass, enriched with useful agents, can be added to farm animal feed.

#2010-08-107

### Mobile millimeter RF range ozonometer

**P.N. Lebedev Physical Institute, RAS (FIAN)** has developed a mobile millimeter RF range ozonometer. The ozonometer monitors vertical distribution of ozone content in the air. The device has application in land-based networks for atmosphere composition monitoring stations.



The device was developed at the Laboratory of Millimeter Wave Spectroscopy (lead scientist: Sergey Solomonov, DSc (Phys&Math)). The work began in mid-1980. The millimeter wavelength range device was originally developed for radio astronomic studies on the RT-22 F telescope at FIAN. The device was adapted by the authors for atmospheric ozone monitoring. Tests for the new mobile ozonometer have been initiated. #2010-08-108

### Asphalt with *Unirem* modifier

In 2004, asphalt with *Unirem* modifier was laid on Russia's highway M10 between Moscow-St. Petersburg.



Rubber microparticles from used tires obtained using high-temperature shear grinding were added to the asphalt-concrete coating. The technology was developed at **OOO Unikom**. Using the *Unirem* nanomodifier made it possible to increase the asphalt-concrete coating durability by a third. Some characteristics (e.g., resistance to freeze-thaw cycles) can be improved more than tenfold. Recent tests conducted by the MADI road laboratory on the asphalt status showed that, after five years, the experimental section was almost as good as new. Foreign companies have expressed interest in this Russian development.

#2010-08-109

Biosensor for measuring the fatigue level by sweat composition

Sport, surgery, and food quality — in all these seemingly unrelated areas, lactic acid salt (lactate) concentration needs to be measured.

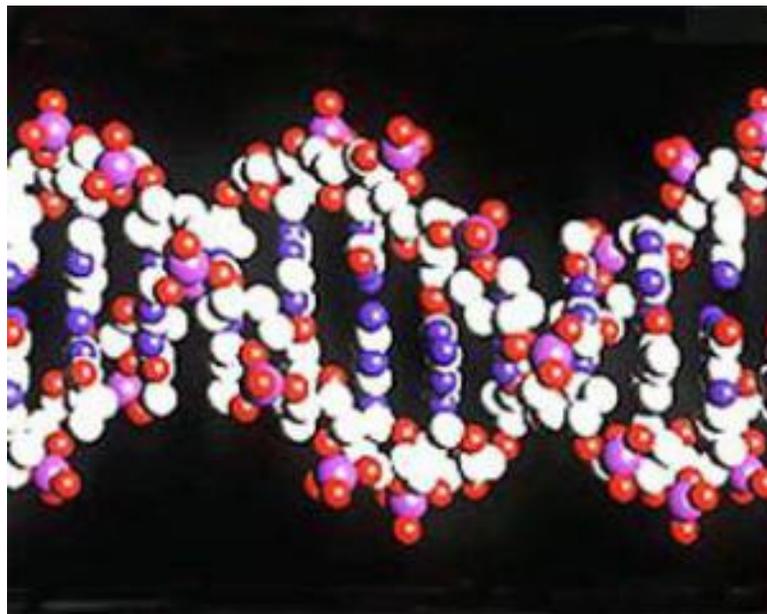


Lactates are formed in the body during oxygen-free oxidation. Their increase in blood or another biological fluid points to an oxygen shortage in the body. Lactate concentration in food products can indicate their freshness or natural origin. Electrochemical sensors for lactate were developed by a biosensor research group from the **Chemistry Department, MGU under Arkady Karyakin's, DSc (Chem)** guidance. The sensitive element is the lactate oxidase enzyme, which oxidizes lactate to pyruvate and hydrogen peroxide. The enzyme is very selective for lactate. Another component in the biosensor is Prussian blue salt (iron hexacyanoferrate), which serves as an electrochemical reduction catalyst for hydrogen peroxide. In this way, by the extent of hydrogen peroxide's reaction, the developers measure the lactate content. The biosensors are based on three-electrode electrochemical structures. A biosensor is placed in the analyzer where, once it comes into contact with biological fluid, an electrochemical reaction produces electrical current. This current's peak's size is proportional to the hydrogen peroxide concentration.

The latter is equal to the source lactate-anion concentration. The developers learned how to immobilize the enzyme on a substrate so that it would not lose its properties for an extended time. The sensors can be stored in a refrigerator several months and used up to a hundred times without losing their activity. The biological fluid being analyzed does not require pretreatment. It just needs to be diluted several times. The analysis is quick and simple. Using the lactate biosensors, chemists, working with specialists from the All-Russia NII of Physical Culture and Sport, have developed a method for assessing rapidly and painlessly an athlete's physical status. It is also possible to determine if an athlete's training regimen is optimum.  
#2010-08-110

Suspects are traced with the aid of biochips

Specialists at the **V.A. Engelhardt Institute of Molecular Biology, RAS and Moscow Physico-Technical Institute (State University)** have developed a biochip that identifies a person by trace DNA amounts. The chip has 99.6% accuracy.



The biochip includes typical DNA sequences of three genes: ABO, AMEL and HLA-DQA1. ABO gene determines human blood group (there are 90 possible variants of its sequence). HLA-DQA1 is the gene for general histo-compatibility complex, 2<sup>nd</sup> class (34 variants). AMEL gene encodes the protein that takes part in developing dental enamel. It is situated on X and Y chromosomes.

The sequences on X and Y chromosomes are different, which makes it possible to determine sex. By analyzing the variants of these three genes it is possible to divide people into 1,350 groups and attribute each person to a definite group. The biochip can be used in forensic medicine for expert examination to narrow possible suspects and identify cadavers.

#2010-08-111

Scientists from Bashkiria have invented new-generation dressing bandages

Innovative dressing material for patients transported over long distances has been developed at **Bashkirian State Medical University** (lead scientist: **Eduard Gaptrakipov, PhD (Med)**).



The new-generation bandages have antiseptic, immunomodulating and anti-inflammatory properties. The dressing materials include three proprietary therapeutic components. By using them it is possible to transport patients over long distances, They will also help stop bleeding and prevent wound infection. The claimed characteristics have already been verified through the pilot batch. The innovators are currently preparing for product certification. An agreement was signed on bandage production at Elabuzhsky factory for infusion and dressing materials. The cost of a package is inexpensive 10 rubles (\$0.33).

#2010-08-112