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## MESSAGE FROM NEIL B. GODICK

The following are taken from recently published polls and statistical reports published in Russia. Did you know?

- Almost half of Russians (45%) have a poor assessment of living conditions in their cities. The most worrying issues for Russians are poor road conditions (71%) and poor street lighting (54%). Respondents are also concerned about waste collection and removal (34%), air pollution and environmental conditions (33%). Further down on the list was the absence of greenery.

- In the most recent data about income inequality and structural changes in the wealthiest layer of the population: well-to-do officials are pushing entrepreneurs and professionals aside. Moreover, the highest incomes are collected by those officials who are in charge of redistribution of wealth. 10% of the country's poorest get only 1.9% of total revenues whereas 30.5% of the total volume of revenues went to 10% of the country's richest individuals.

The funds coefficient the ratio between the incomes of the richest and poorest 10% of the population have been on a steady rise since 1992. The rates at which the wages of the wealthiest population are rising are unbeatable. The annual indicators of 70% to 90% are unreachable for poor Russians.

- 40% of Muscovites spend more than an hour each way commuting to work or school. For comparison, *Forbes* found that the average American spends 26 minutes commuting one way. Moving closer to one's employment is not an option for most Russians.
- Law enforcement agencies, the armed forces, local self-government and Health and Social Development Ministry agencies are the agencies against whom the most cases have been opened over corruption charges.
- 70% of society is displeased with the president's modernization program. This number includes the political establishment. They would like to retain the status quo. They long for the good old days when conservator Vladimir Putin was in the Kremlin. Experts maintain that this is a corollary of

the prosperous pre-crisis years. It was then that state officials grew accustomed to oil export dividends and stopped thinking in terms of the future. Modernization is promoted by a coalition of a fairly small segment of innovation businesses, a handful of intellectuals, and even fewer sophisticated civil servants.

*We do not intend for the following 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.*

### Physicists evaluate X-ray sources

X-ray and neutron radiation sources are used to study complex structures like nanomaterials or thin substrates. Vacuum devices (X-ray tubes) serve as X-ray sources. Their key elements are the cathode (electron source) and anode. Electrons interact with anode surface and radiate an electromagnetic field, which forms X-ray radiation. X-ray tubes are used in medicine, chemistry and materials science. The anode focal spot (area that emanates radiation) size is an important tube characteristic. During these tubes' manufacture and operation it is necessary to evaluate the focal spot properties. An X-ray tube's defect will depreciate any data obtained with its aid.

**Scientists from the Institute of X-ray Optics** developed a polycapillary optical device to determine the focal spot. The phenomenon used in polycapillary optics is multiple X-rays reflection from the smooth lens surface. Each reflection turns the beam by a small angle. Lenses can be designed to repeatedly turn the ray. This helps achieve the predetermined total reflection angle. By focusing the ray bundle it is possible to produce a virtual X-ray source.

A polycapillary lens and an X-ray radiation detector comprise the new optical device. Rays emanating from the tube being examined are focused by the lens and form a virtual source. The detector evaluates the radiation intensity. The device is connected to a PC. The PC calculates the focal spot size. The software also produces a 3D anode focal spot model and detects its flaws. Neutron radiation sources use a similar operating principle; so the device can also be used to evaluate neutron flux.

#2011-03-149

### Scientists obtain a nontoxic erythropoietin preparation

Erythropoietin is a hormone that increases red blood cells and hemoglobin content in blood. This protein should not be taken perorally because it decomposes in the digestive tract and loses its activity. These preparations are introduced intravenously and subcutaneously. The injections cause an extremely strong immune reaction. **The Russian Academy of Medical Science (RAMS) Siberian Branch Institute of Pharmacology** established that, by immobilizing proteins on low-molecular polyethylene glycol, they will be better protected from digestive enzymes. In the immobilized form, this drug is either injected intravenously or swallowed. When

immobilized, the preparation reduces the immune system's reaction. Also, when immobilized the preparation's action lasts longer.

Immobilization is performed by electron-beam synthesis using a directed accelerated electron flux. The technology uses electron accelerators. This makes it possible to produce a directed accelerated electron flux from several MeV. The technology precisely determines the time and radiation dose absorbed by the object. When biologically active molecules and polyethylene glycol are jointly exposed to radiation, the polymer combines with the active agent to form strong covalent bonds.

Immobilized erythropoietin reduces allergy reactions and is resistant to splitting. The preparation was studied to determine its biological activity preservation. Experiments were made on mice using intraperitoneal carboplatin injections to induce anemia. Carboplatin suppresses blood cell formation in bone marrow. For the next five days the mice were administered immobilized erythropoietin, subcutaneously or perorally, every day. Mice from another group were subcutaneously injected with ordinary erythropoietin. The control was a physiological solution. On days 5, 7, 9 and 12, the mice's cellular blood composition and bone marrow hematopoiesis indicators were determined. Carboplatin administration caused anemia in the mice (the number of red cells and hemoglobin in the blood decreased). Their own erythropoietin content in the blood serum also decreased. Erythropoietin preparations administered, regardless of the form, significantly improved the situation. The ordinary erythropoietin administration effect becomes apparent two days earlier than the immobilized one. Also, it is more pronounced. The immobilized enzyme's action was weaker but still effective enough. Protein bonded with polyethylene glycol was absorbed via the gastrointestinal without losing its specific biological activity.

The available data indicate that proteins conjugated with polyethylene glycol have extremely low toxicity. They can be repeatedly administered without side-effects or complications. The researchers believe drugs based on immobilized erythropoietin will have good application prospects.

#2011-03-150

Moscow scientists  
suggest a new sperm  
storage method

When an animal dies, if its body is kept in a refrigerator its sperm retains viability for a considerable time. According to **specialists from the Lomonosov Moscow State University Biology Department** this storage method is very efficient. It can be used as the last chance to obtain genetic material from a dead animal.

Dead male spermatozoa can be of interest in two cases: if the male belonged to a rare species or had unique properties. Ilya Ivanov is a founder of the artificial insemination method for animals. In the first half of the last century, he noted that sex cells from testicles kept at

2 °C retain mobility 7–12 days after stallions, dogs and oxen were castrated. Successful inseminations with such spermatozoa are known.

Can it be that sex cells are better preserved in dead bodies than in synthetic and semisynthetic media specially developed for this purpose?

To answer this question, researchers experimented on sexually mature male mice. 18 corpses were kept in a refrigerator at 6 °C in an environment that prevented drying. They extracted spermatozoa from another 15 sacrificed mice and kept its suspension in a refrigerator. Every day the scientists dissected one refrigerated corpse, extracted spermatozoa and examined the cells under the microscope. The researchers' focus was on the cell's mobility and the normal mitochondria functioning. They were interested in the cells whose mitochondria continue synthesizing ATP. At the same time sperm samples kept in a test-tube over the same period were examined.

The test-tube spermatozoa motor activity fell to zero within the first few hours in the refrigerator, and their ATP concentration rapidly decreased. However, cells extracted from refrigerated corpses lost their mobility on day 14 or 15, and their ATP content fell at the same time. These processes are clearly interconnected; the ATP level ensures spermatozoa mobility.

The scientists are yet unable to explain why, during all that time, active spermatozoa with a constant and quite high ATP level are preserved in slowly decomposing corpses. But it is evident that the method for spermatozoa preservation within the dead animal's body is very effective and offers a chance to obtain genetic material from the dead animal.

#2011-03-151

In Novosibirsk,  
semiconductors are  
produced from alcohol

**Researchers from the RAS Siberian Branch Institute of Solid State Chemistry and Mechanochemistry (Novosibirsk)** found that, if a saturated aqueous urea solution is added to alcohol, alcohol molecules tend to form fibers. If this mixture is heated polyacetylene, an organic semiconductor can be obtained.

Electrically conducting polymers have several unique advantages over standard conductors and semiconductors. They combine their ability to conduct electric current with the mechanical properties typically found in plastics. Moreover, their production cost is often lower. One promising application for conducting polymers is flexible display.

In their ordinary state, polymer molecules look like twisted threads and are poor conductors. To make electron transfer between molecules more efficient, it is necessary to form intermolecular

aggregations from straightened polymer chains. The Institute uses saturated aqueous urea solution (carbonic acid diamide), an inexpensive and easily available compound, for this purpose.

The scientists mixed a saturated aqueous urea solution with 10 % polyvinyl alcohol (PVA) solution and kept the mixture at room temperature for several days. Fibers as long as 1 cm formed in the solution.

The urea's effect on the ordered structure formation was studied by transmission electron microscopy. A mesh was wetted in solution with a lower PVA content. Then urea molecules were removed from the sample surface, and the PVA-coated mesh was placed in the electron microscope chamber. Characteristic strips (filamentous formations traces) were detected in the images.

Molecular interaction between urea and alcohol was confirmed by IR spectroscopy and combinational scattering spectroscopy. Urea molecules, when added to the solution, obviously promote specific filamentous aggregation formation and then settle in cavities between them. Scientists suggest that the polyacetylene fibers obtained after drying be used for synthesizing organic semiconductor.

#2011-03-152

A sandwich-like microcircuit: what is concealed inside

**Lomonosov Moscow State University Physics Department's Laboratory of Microscopy and Electron Micro Tomography** developed a novel method for contactless nondestructive sample examination.

The Laboratory uses an electron-probe to diagnose microelectronic products, materials, and instruments. In recent years there is a strong trend from microelectronics to nanoelectronics, so research is more focused on nanotechnologies. Control and diagnosis become much more complicated because microcircuits' components keep getting smaller and smaller. The units previously considered were micron, then submicron in size; now the focus is on tens of nanometers. For example, in large computer processor microcircuits, the active area is just a few millimeters, and may contain over a billion components.

Microcircuits are mostly made multilayered. If there is a problem in one of the layers, it is extremely difficult locate the flaw. Optical microscopes cannot solve this problem. A focused beam electron microscope can help solve the problem, as it can magnify 100,000 times.

The laboratory used a micro tomographic method. This method provides a better quality image for each single thin microstructure layer. It is based on detecting inversely scattered electrons screened for their energy levels.

Electrons reflected from a certain depth under the surface have an energy level that is inversely proportional to the reflected layer's depth. The deeper the micro-heterogeneity in a 3D structure, the further the electron travels. Accordingly it loses more energy. By detecting electrons with a definite energy level, it is possible to visualize the sample layer positioned at an established depth. To analyze electrons, the scientists used a novel spectrometer with toroidal electrodes. They adapted it for use with a scanning microscope to obtain quality images.

To obtain additional data on the potential barriers' distribution in the sample being examined, the electron-induced potential on the sample must be simultaneously detected. In this mode, the signal comes from a metal ring placed directly between the spectrometer and the sample structure surface. This signal is displayed on the microscope screen and forms the picture of all electrically active semiconductor crystal or microcircuit fragments.

The examination method also enables monitoring the layer-by-layer microstructure by depth and electrically active microcircuit elements. This diagnosis is nondestructive and does not require electromechanical contacts for accessing any microcircuit elements. It can be used for testing and quality control at each production process stage.

#2011-03-154

### Face detection and emotion recognition technology

At first glance this technology's essence is simple enough. A software program detects a human face video image. Then, by indirect signs, it recognizes emotions typical for the object under observation. The software, **developed under a Russian Federal targeted program**, has a separate module including an algorithm that identifies people by the way they walk (this characteristic being unique like a signature). The development mainly differs from other face recognition software in that the object does not need to be placed in a definite zone to be recognized.

Moreover, the program can detect a human face even when it is partially concealed. Of course, in these cases detection would not be always consistent. However, it works on some frames. In response to every movement by a person a small green square appears in the area of his/her face on the screen. This sign means that the system has detected the person. The system recognizes many races of people and people with different appearance types.

The technology can automatically recognize human face expressions. First a face is detected and then, by the face shape, the program determines the person's emotional state type. In the top right-hand screen corner the system indicates the current facial expression recognized.

This development could be very useful for security systems (e.g. in the metro or airports). It could be used in health care to treat patients with mental disorders, or in education to assess students' attention level in class.

For example, this could be useful for surgery operation modeling or for restoring the human image by specialists in crime detection or archeology. The algorithm does not require any special equipment for structured lighting or artificial illumination. A stereo-system from two calibrated cameras is quite sufficient. The calibration algorithm used in this system is the company's own development.

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