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MESSAGE FROM NEIL B. GODICK

This month we present technology developments in *physics, health sciences, and biotechnology.*

During the years of the Cold War, the Former Soviet Union (FSU) outspent the United States in scientific research 2:1. With the collapse of the FSU, there was a simultaneous collapse of funding for research. Despite inadequate funding Russian scientists labored on and remained prolific. Now, with oil revenues enriching the Russia government: by Presidential Decree $35 billion was recently designated for *nanotechnology* research and development. Russia's goal is to be the world leader in nanotechnology.

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.

Physics

Moscow specialists have developed a new method of making atomic force microscopy probes. The probes are microscopic silicon pyramids made on a silicon substrate. These pyramids are designed with a heavy-base and a short ultrasharp top. The diameter of the top is as small as 2-3 nm, while the cone angle at the top is only 2-3 degrees.

Atomic-force microscopes are used for examining surfaces whose relief is measured in fractions of a nanometer. The essence of this method lies in placing a probe over the surface of an object, the probe being a very sharp mobile needle, with the device measuring its vertical displacements corresponding to the relief. This finally creates a three-dimensional surface *relief map*.

The sharpness of the needle point (its radius) determines the measurement accuracy. The sharper the probe tip the finer details that can be detected. Scientists have learned to grow these probes (very strong and ultra sharp). Pilot production of the probes has already started with commercial production planned to begin within a year.

Researchers at N.N. Semenov Institute of Chemical Physics, RAS

have discovered a method for making a new propulsion jet engine with detonation combustion of fuel. The scientists achieved transition of TS-1 aviation kerosene combustion to detonation. This results in an explosion similar to the one that pushes automobile engine pistons. Detonation is used for increasing the velocity of the gas flow exiting from a jet engine. Accordingly, the plane's velocity is increased, while not increasing fuel consumption. The scientists conducted their tests in a wind tunnel in a continuous air mix flow at atmospheric pressure.

However, the development of an air-feed kerosene jet pulsed detonation engine is prevented because an air-aviation kerosene mixture burns but does not explode. To facilitate fuel explosion active chemical components and fuel emulsions are added. The kerosene is mixed with other combustible substances and saturated with active gases, or it is premixed with oxygen or air. These methods can cause fuel detonation. But it is dangerous to use them in aircraft. Another solution to the problem is to create physical constructions facilitating fuel detonation. The Moscow scientists used a combination of techniques: increasing the fuel's detonation ability, accelerating the flame using regular obstacles and multiple reflection echoes of the shock wave in a special focalizing device — a coil pipe.

The Moscow scientists' findings create the opportunity to develop new jet motion systems based on detonation combustion.

Medical Diagnostics

Researchers from Barnaul have developed a unique device that can "hear" joint diseases and correctly diagnose these diseases at an early stage. The device is called *arthro-phonograph* and consists of a microphone fastened with an elastic bandage to a joint and connected to a PC. The patient is asked to do specific movements (bending, crouching) and a spectrum of sound is displayed on the computer's monitor. Healthy joints produce sounds similar to music; diseased joints produce the sounds of clicks, claps, crashes or sawing.

It quite often happens that a trauma or disease are present but cannot be seen in an X-ray and has to be diagnosed using indirect means. The newly developed method provides diagnosis that is both earlier and with higher accuracy. A joint starts producing abnormal sounds long before any external illness manifestations. To define the parameters corresponding to the norm, the developers have examined a considerable number of young people and then studied specific features of the sounds produced by patients with various pathologies. Analysis of this data made it possible to produce a database of characteristic sound spectra. Currently the method has only been developed to examine the knee joint. The scientists plan to develop methods to examine elbow, shoulder and ankle joints.

Drug Discovery

Russian microbiologists have developed a new method of making hypoallergenic vaccines, having no side effects. The vaccines used

today contain "ballast", i.e. proteins that take no part in the development of immunity from this or that disease. The new method eliminates these proteins from the vaccine. Eliminating these proteins reduces or eliminates the cause of allergic reactions, and side effects. Moreover, the method enables combining several proteins in a single vaccine, allowing inoculation from several diseases simultaneously. Using the in-depth purification method, a combined vaccine can be produced and applied at the safest possible level. The specialists are currently experimenting on animals. Vaccines against tularemia, brucellosis and leptospirosis have already been developed.

Specialists note that their method for purifying vaccines is much less expensive and safer than those commonly used.

Biotechnology

A team of Moscow and Yoshkar Ola researchers are developing effective sorbents based on fungal chitin. It is well known that mushrooms accumulate heavy metals. This is explained by realizing that mushrooms contain compounds whose structure includes chitin — a polysaccharide possessing effective sorbent properties. The scientists by using these substances and with their help "catch" heavy metals to purify water and aqueous solutions.

To find mushrooms containing agents with the necessary properties, they collected many different mushrooms — representatives of classes *Basidiomycetes* and *Ascomycetes*, dried and ground them. Then, from the powder, consecutive extractions with sodium hydroxide solutions, hydrochloric acid and hydrogen peroxide were performed. Complexes of chitin with other biopolymers, and chitin-glucanic and chitin- glucan-melanine complexes were obtained. The authors identified the isolated compounds and investigated their sorption properties for cadmium and nickel ions.

An adequate heavy metal sorption process takes about an hour, with stirring.

The scientists are completing similar research for lead in water as well as research aimed at developing a product from the compounds extracted from mushrooms.