Technological Optimism Returns to Russia

Jonathan Tennenbaum reports on exciting developments in high-speed transportation, aerospace, and nuclear energy.

During a visit to Moscow May 13-20, the author had the opportunity to see one of a remarkable series of films made for Russian national television by the young producer Ivan Sidelnikov, which take a fresh and upbeat look at Russia's past and future position in the world. The fourth in the film series, entitled "Russkaya Karta" ("Map of Russia"), focusses on the perspective for a "technological break-out" for the country: how to mobilize Russia's scientific-technological potentials, to lift the nation in a short time out of its present weakened and impoverished state, into that of a prosperous and leading world power.

Obviously aiming to rally Russian youth to that perspective, the film presents some fascinating examples of the kinds of technologies, already in advanced stages of development in Russia, which, taken together, could revolutionize the economic life of the country. Among them are the "flying saucer of Saratov," the Unitsky high-speed cable-rail transport system, and several other ingenious and (to my mind) typically Russian inventions in the areas of transport, energy, and construction, that are especially suited to the task of developing the vast Northern and Far Eastern regions of the country.

Building up a network of high-speed transport corridors criss-crossing the country's entire territory can transform one of the main disadvantages of Russia's economy—its extremely long transport distances—into a strategic advantage. Spanning nine time-zones from eastern Europe through northern Asia, all the way to touch the western-most tip of North America, Russia is predestined to become the heart of a worldwide system of transcontinental air, land, and water transportation in the 21st Century. "Russkaya Karta" puts this concept across to the viewers in a wonderfully pedagogical way, by showing what appears at first glance to be a typical colored schematic map of the subway system of a city like Moscow or New York; on closer examination, we see that the "stops" include Berlin, Stockholm, Beijing, Tokyo, Anchorage, etc., together with the main cities and northern outposts of Russia! A beautiful sight indeed to someone who, like the present author, has spent the last decade organizing for Lyndon LaRouche's strategy for the "Eurasian Land-Bridge"!

Sidelnikov's film typifies a noticable shift in Russia toward a more optimistic outlook, reflected in the science orientation of President Putin's May 11 annual Message to the Federal Assembly (*EIR,* May 19), and accompanied by the launching of nuclear energy projects and related high-technology endeavors. The present article aims at supplying a certain amount of detail and background on those efforts, whose strategic significance was underscored by the June 15 Shanghai Cooperation Organization summit meeting.

To avoid misunderstandings, I should emphasize that the concrete measures implemented by the Russian government in the indicated directions, are still very, very far from constituting an adequate response to the real situation in the country and the world generally. On the contrary, as I pointed out in a previous article (*EIR,* June 2), the so-called liberal reformers continue, as before, to dominate the Russian government and their destructive policies continue unabated, in glaring contradiction to the ostensible intentions of the President, as articulated in his May 11 address. The overall situation thus remains unresolved, and evidently depends not only on Russia, but most crucially on the outcome of the gigantic struggle going on inside the United States, over policies to be adopted in the face of the greatest global economic and financial crisis in history.

That being said, the pro-technology impulses emerging in Russia now, and reported in part here, cannot be overlooked. They point in the direction of a positive solution not only for Russia, but for the world as a whole.

Before going into the new developments in the nuclear field, I want to supply some detail on two of the technologies featured in "Russkaya Karta," which serve to illustrate the fresh approaches under discussion in Russia these days.

High-Speed Cable-Rail: A Revolution in Ground Transport?

Readers familiar with the Eurasian Land-Bridge concept put forward by LaRouche and his collaborators, will have noted the emphasis given to the technology of magnetic levitation. This technology has unique advantages, particularly for passenger and high-value freight transport in densely travelled corridors. But the coming era of transcontinent development will depend on the complementary roles of many different land, sea, and air transport technologies. This goes especially for the many areas of Eurasia where extreme natural conditions make existing modes of land transport difficult, if not impossible.

In the 1980s, the Russian Academician Anatoly Eduardovich Yunitsky began to think about a new type of ground

FIGURE 1
The Yunitsky Cable-Rail System

Source: Anatoly Yunitsky.

The high-speed passenger transportation UST model. According to Yunitsky, the cable-rail system can sustain speeds of 250-300 km/hour or more.

Source: Anatoly Yunitsky.

Presentation of a pilot UST route to the governor of the Moscow region, 2001.

transport system, specially suited to the development of northern Siberia, the Far East of Russia, and other areas with very low population density and extreme climate conditions. In the far north of Russia, ordinary rail and highway connections are extremely difficult to build and maintain, and are subject to frequent disruptions due to weather conditions. With this in mind, Yunitsky designed a novel, suspended cable-rail system, which could make possible the creation of a vast high-speed ground transport network for Siberia and the Russian Far East, and perhaps even revolutionize ground transport in general.

In the new system, the function of the railroad track is played by parallel pre-stressed cables, suspended 5-10 meters above ground by supporting towers and placed under high mechanical tension (500 tons per cable), rendering the "cable-rails" nearly completely rigid and able to sustain the weight of the vehicles without significant deformation (**Figure 1**). The vehicles run along the cable-rails on a system of wheels, powered by electric motors (with power supplied from the cable-rails) or on-board internal combustion engines, and supervised automatically by a central computer system. According to Yunitsky, the cable-rail system can sustain speeds of 250-300 km/hour or more. The high-speed functioning of the system depends on electronic control systems for the vehicles, as well as the cladding of the cable-rails with special material. The supporting structures consist of weight-supporting towers, located at intervals of 10-100 m and horizontal stress-supporting, anchoring towers spaced at intervals of about 1,000 m.

The greatest single advantage of this system, documented extensively in the Sidelnikov film, lies in the ease and rapidity of construction, and in the 100% suspended mode of operation which makes travel independent of ground conditions. Assuming large-scale construction, the cost per kilometer for a double-tracked line, including all supporting structures, is estimated at $1-1.5 million for level areas and $2-4 million for hilly areas. That makes the cable-rail system three or more times cheaper than normal medium-speed rail, and about ten times cheaper than modern high-speed rail. An additional advantage, for less remote locations, is the very low use of land: The area between the towers is fully usable for other purposes.

As far as we know, the green light has not yet been given for the first cable-rail transport line. It does appear, however, that Unitsky is receiving significant support for its perfection. The Sidelnikov film interviews Unitsky on the backdrop of full-scale suspension towers and cable. (See also www.unitsky.ru.)

The Flying Saucer of Saratov

Given the vastness of the territory of the Soviet Union, it is hardly surprising that the development of civil and military aviation received an extremely high priority. A vast industry grew up, which was unique in the world for the enormous variety of types of aircraft created, and for the genius and technical virtuosity displayed by its legendary design bureaus. Not least of all was the attention given to heavy-lift aircraft, including not only the gigantic Antonovs, but also a variety of innovative aircraft utilizing novel aerodynamic effects to provide additional lift. A particularly famous example was the Ekranoplan, known in the West from satellite photos as the Caspian Sea Monster, which flew over water at heights of 5-100 meters, enhancing its lift by utilizing the so-called ground-effect interaction. Ekranoplans can combine the efficient cargo-carrying capability of ships, with the speed of aircraft.

The aircraft industry suffered a very heavy blow from the collapse of the Soviet Union, the separation of Russia and Ukraine (where a very substantial part of the U.S.S.R.'s aerospace capability was located) and the subsequent "shock therapy." Recently, however, President Putin has taken personal interest in this strategic sector, pushing forward the process of bringing Russia's aircraft-building capacities together into a powerful, unified structure.

At the same time, some of the revolutionary designs going back to the Soviet period, are reappearing again. One of them, the Flying Saucer of Saratov, has already become a legend in the international aeronautics community.

The basic design of the "saucer" was created by Academician Lev Nikolayevich Shukin, a student of the famous aircraft engineer S.P. Tupolev, in the U.S.S.R. in the 1980s. On account of its unique aerodynamic characteristics (see below), Shukin's saucer can carry 3-4 times more payload mass and a much larger volume of freight or passengers than conventional aircraft, relative to the weight of the vehicle itself. It is designed to fly at 500-700 km/hour at altitudes of 8-13 km, and to land at very low speeds (ca. 100 km/hour or less) on land or sea, using an air cushion in place of normal landing gear.

The Ekip, as it is called, encorporates a solution to one of the oldest and most central problems in aerodynamic design. When a solid body moves through air or water, it invariably leaves behind it a trail of vortices. These vortices are constantly formed at certain locations on the surface of the body, and then detach from the body in a process called "vortex shedding." Leonardo da Vinci studied this process in detail back in the 16th Century. Naturally, the formation and shedding of vortices constitutes work done at the expense of the forward motion of the body—an expenditure of energy that shows up as the main component of the drag, as well as much of the vibration experienced by the body in its motion through the medium. Much of the preoccupation of aircraft and other aerodynamics designers consists in trying to reduce the drag from vortex formation to a minimum, to realize some approximation to a smooth, "laminar" flow around the body. This practice of streamlining the design, leads naturally to elongated structures in which the attempt is made to minimize the cross section in the direction perpendicular to the motion, often compromising the expense of passenger comfort and freight-carrying capacity in aircraft.

The Ekip has a much "fatter" profile and larger cabin volume, and yet at the same time a relatively much lower drag, than traditional aircraft. How is this achieved? The main secret is to control and regulate the air flow around the vehicle, trapping the main vortex near to the aerodynamic body and preventing it from separating from the aircraft (**Figure 2**). As a result, a minimum of power is lost in the shedding of vortices. The trapped rotational flows function something like wheels or ball bearings in a machine, mediating a stable and smooth air flow around the "fat" main body of the vehicle. The main body alone already provides 80% of the aerodynamic lift, making it possible to reduce the wings to short, stubby structures with very low drag. The relatively large area of the underside of the cabin, permits the use of an air cushion system like that of a hovercraft—in place of a conventional landing gear. The "saucer" takes off and lands at an extremely steep angle. It requires very little ground area, and can operate from unprepared land sites as well as from water.

FIGURE 2
'The Flying Saucer of Saratov'

Source: Ekip Aviation Concern.

A model of the Ekip vehicle, whose unusual "fat body" design reduces drag by controlling the air flow around the aircraft, trapping the main vortex near the aerodynamic body and preventing it from separating from the aircraft.

The large body volume also makes it possible to mount the engines inside the main body of the vehicle, instead of on the outside, again reducing drag. In addition, the larger volume available for storage of fuels will allow the "saucer" to fly over long distances on low-density fuels such as hydrogen and natural gas, or low-cost liquid methane.

Unmanned scale models of the Ekip have been undergoing flight testing for several years in Saratov. A first, full-scale version of the Ekip is scheduled for its first test flight next year, as part of a Russian-American project. (More on www. ekip-aviation-concern.com.)

Nuclear Energy and Russia's Youth

Earlier this year, Sergei Kiriyenko, the head of the atomic energy agency Rosatom, announced that Russia would build 40 new nuclear plants by the year 2030. People close to the nuclear sector confirmed to *EIR,* that for the first time since the collapse of the Soviet Union, "serious money" is flowing into new, large-scale nuclear projects in Russia, supported in part by the financial power of Gazprom. In fact, there is hardly any alternative to a program of large-scale nuclear-power construction in Russia over the coming two decades. Much of Russia's electricity-generation capacity, including many existing nuclear power stations, are coming to the end of their service life. At the same time, Russia faces the need to modernize its entire energy system, including not only electricity, but also the district heating systems which provide heat for most of the population in the urban areas. Recent government decisions reflect the simple fact, that modern nuclear power is by far the most economical electricity source available today, even for a nation with enormous reserves of fossil fuels.

An important issue, however, is to what extent the revived nuclear program will confine itself pragmatically to conventional nuclear reactor designs, or whether it will be broadened to embrace a "science driver" approach, mobilizing Russia's large nuclear scientific community to create entirely new technologies.

From this standpoint, one of the highlights of my recent Moscow trip was a visit to the Moscow headquarters of a rather unique institution, called the Young People's Nuclear Academy. Founded in 2002 and oriented to the age group 13-18, the Academy is not simply a pro-nuclear organization like many others around the world, but aims to preserve and to pass down to the younger generation in Russia, the enormous store of knowledge and experience in nuclear-related science and technology, embodied in the older generations that pioneered nuclear energy during the Soviet period. The Academy's leaders sees this dialogue between the older and the younger generations, as a crucial element in a strategy to put the full potential of nuclear energy to work in developing Russia's entire territory, including especially her Northern and Far Eastern regions.

The Young People's Nuclear Academy has launched research projects on "The Role of Small-Scale Nuclear Stations for the Development of Russia's Regions," on "Nucleopolis—the Nuclear City," and on "Nuclear Consciousness in the 21st Century." An Internet magazine called *The Energy of Life* is published on the Academy's website (www.dya.ru), and every year the Academy sponsors an international competition for high-school-age pupils, for scientific essays related to "The Energy of the Future."

The Academy attaches a special importance to what they call "nuclear conciousness." I was told that despite the Chernobyl disaster, the vast majority of the Russian population does not attach the kind of stigma and irrational fear to nuclear energy, as is rather commonplace in Western countries. Nor does the Russian public generally regard the creation of nuclear weapons in the Soviet Union as a bad or shameful thing. Rather, "nuclear conciousness" (as I understand it) signifies the idea, that the emergence of nuclear energy and nuclear weapons in the course of the 20th Century, marks the beginning of a new era of human history. A "Manifesto of Nuclear Conciousness in the 21st Century," circulated by the Young People's Nuclear Academy, puts it this way: "We know that only the horror of nuclear weapons saved mankind from a new world war and guaranteed, for many long years, a period of relative tranquility in the world. Now we are going to live in the 21st Century, and we want to make the world safe, happy, and promising for all the peoples of the world and for each individual.

"The history of peaceful uses of nuclear energy is connected with the emergence of the Noösphere, as the sphere of action of human reason.

"Nuclear conciousness is defined by the desire and ability to safeguard the environment, while at the same time building up the technosphere of man-made systems for transforming nature—in the interests of developing the world and the creative potential of Mankind."

In fact, the decisive role of nuclear energy for the future of mankind and for Russia in particular, was proclaimed by Vladimir Vernadsky already in the 1920s, long before the discovery of nuclear fission and the realization of the first nuclear fission reactors. Vernadsky saw the prospect of man's tapping the energy of the atomic nucleus as a turning-point in history, marking the emergence of the Noösphere, in which human reason would begin to take on the task of conciously managing and developing the Earth's biosphere. The fundamental significance of nuclear energy lies in the fact, that—by implication at least—it signifies man's beginning mastery of the processes of synthesis and transmutation, that created the periodic system of chemical elements as we find them on the Earth. Thereby, man begins to free himself from long subservience to the existing mineral and biological resources of the planet, and progressively develops the ability in a certain sense to create and to regenerate resources.

A Broad-Based Nuclear Industry

From the very beginning, nuclear energy has always had a very special significance for Russia, linked to the enormous expanse of its territory and the difficult climatic conditions which render much of that territory extremely difficult to exploit for economic purposes. On the other hand, the largest part of the enormous mineral resources of Russia, including not only gas and oil but also strategic metals, is located in the remote northern areas of the country, where the most difficult natural conditions prevail. Very early it was realized, that nuclear energy held the key to opening up the entire territory of Russia for settlement and development; and that without nuclear technology, such comprehensive territorial development would be virtually impossible. This statement remains valid today; it provides the organic reason, why the current period of intended consolidation of the Russian state under Putin, coincides with the beginnings of a renewed emphasis on nuclear energy in Russia.

Looking at the real future needs of Russia and the world as a whole, it is clear that the present generation of large, light-water-reactor-based nuclear power stations will not suffice. Many different forms of nuclear energy will be needed, including small reactors to supply electricity and heat to population settlements, mines, and processing industries in remote areas (see below); nuclear power systems for desalination of water; high-temperature process-heat reactors for the chemical and metallurgical industries; breeder reactors and reactors "burning" nuclear waste and non-conventional nuclear fuels such as thorium. Over the medium term, fusion power needs to be developed, and technologies for the large-scale transmutation of elements.

Acknowledging the need for a broad orientation for nuclear energy, the Russian state nuclear energy agency Rosenergatom announced the decision to push ahead with the construction of the fast-neutron reactor BN-800 in the Beloyarsk nuclear power complex, near Yekaterinburg in the Urals region. This 800 MW advanced-design reactor, incorporating a number of significant "inherent safety" features, is designed to burn plutonium processed from the spent fuel of civilian nuclear power plants, as well as weapons-grade plutonium from the former Soviet stockpiles. A smaller breeder-type reactor, the BN-600, has been operating at Beloyarsk since 1981. In both designs, the reactor and the recirculating pumps are immersed in a "bath" of molten sodium coolant. It should be remembered, that the world's first commercial fast-neutron reactor, the BN-300, has been operating in Aktau (formerly Shevchenko) in Kazakstan on the Caspian Sea, providing the city with 80,000 tons of desalinated water every year since 1972!

Small-Scale Nuclear Reactors

Russia is faced with an ongoing depopulation of its northern and eastern territories, in large part as a result of lack of functioning infrastructure and resources to maintain the population in the more remote areas. Every Winter, with increasing frequency, come reports of freezing-over of water systems, collapse of district heating, and exhaustion of fuel supplies in northern towns and settlements. It was with such areas in mind, that Soviet scientists and planners very early recognized the special importance of small-scale nuclear reactors, that could be easily transported and operated without extensive infrastructure.

Back in the 1960s, numerous programs were launched for developing small nuclear reactors as sources of heat and electric power, especially for the Siberian and Far East settlements and adjoining mines and energy-intensive processing industries. For example, a prototype mobile nuclear power station mounted on four Caterpillar trucks and producing 1.5 MW electricity and 11 MW of heat, was constructed and operated. A special reactor called ARBUS (Arctic Modular Reactor System) was developed for Antarctica and for the Far North of Russia, based on an organic chemical coolant. A prototype ARBUS, produced in the form of modular components that could be assembled rapidly on any site, was built and operated in Dmitrovgrad starting 1965. In a first use of multiple small-scale reactors in a permanent installation, four modules of 12 MW(el) were put together in the mid-1970s to form the main power station for Bilibinsk in the Chukotka permafrost area. Unfortunately, although these and other forms of small nuclear reactors were proven to be quite suitable for the northern regions, they did not find a large-scale use in the Soviet period. No doubt the reason lay in an overall shift in strategic priorities by the Soviet leadership, under pressure of the Cold War, away from earlier commitments to comprehensive development of the North. Meanwhile, the exploitation of small nuclear reactors for ships, and especially for submarines, reached a high degree of perfection in the Soviet period. Nuclear-powered icebreakers were key to the maintenance of population and economic activity in the northern coastal areas. The inventiveness and sophistication of Soviet submarine reactors, including extremely high-power liquid-metal-cooled units used to power some of the "monster" submarines, were unmatched in the West.

It is only now, 15 years after the collapse of the Soviet Union, that interest in small nuclear reactors has begun to be revived. The obvious idea, to exploit the dozens of now-unused submarine reactors directly for civilian power production, turns out to be impracticable for various reasons. Instead the know-how and technology of ship and submarine reactors is being applied to the construction of new systems, including above all floating nuclear power plants, which are mounted on barges and can be towed to coastal areas for rapid installation.

The contracts for construction of the world's first floating nuclear power plant have just been signed by Rosenergatom and a consortium of Russian industries. The first plant, to provide both electricity and heat to the northern Russian city of Severodvinsk, should go into operation in 2010. The 70 MW plant, designated ATES-MM, will be powered by two KLT-40 reactors mounted on a single floating platform.

On the eve of the contract signing, the general director of Rosenergatom, Sergei Obozov, proudly announced: "The fact, that Russia—as the first in the world—has initiated the construction of small-scale nuclear plants, signifies a true breakthrough in energy technologies. No one would suggest that such small plants should replace the large nuclear power plants. But it is exactly thanks to their unique characteristics that floating nuclear reactors have the greatest potential for application in a whole array of applications. Thus, the ATES-MM can become the ideal source of electricity and heat for conquering the northern territories, for exploiting new mineral reserves in the extreme North, for developing the northern sea routes—I have in mind the supply of energy to port infrastructure—and for the supply of large navy bases for the Northern and Pacific fleets."

In addition to the Severodvinsk plant, three more floating nuclear plants of the same type are planned, for Dudinka in the Krasnoyarsk region, Viluchinska in Kamchatka, and Peveka in the Chukotsk Autonomous Region. In all, the application of this technology is being studied in 11 regions in Russia. In addition, he noted that several countries of the Asian-Pacific region and the Near East had expressed interest in the Russian floating nuclear plants, above all for the purpose of seawater desalination.