



The Scientific Revolution of the 21st Century as a Fundamental Base of the Progress of Civilizations

1. Four Gulfs of the Global Crisis of Science.

The world science in the late 20th — early 21st century is experiencing a deep financial crisis, the like of which has never been observed for several centuries. The main signs of this crisis may be formulated as four deepening gulfs in the dynamics of the world knowledge.

The first gulf: the speed and depth of changes in society and nature are far ahead than consciousness of the essence and implications of these changes by the world science. The prevailing industrial scientific paradigm reflects the regularities and trends of the industrial world civilization completing its life cycle. But the post-industrial, humanistic-noospheric civilization is coming replacing it. Science received a powerful development effort in the industrial society has turned out to be unable either to foresee the rising ninth wave of global crises or to show the reliable guides to move towards the post-industrial civilization. The prevailing science loses its primary function of the «looking forward» in the stormy sea of changes that increases the risks in choosing a strategic course by the leaders of humanity. As the pace and radical changes grow, this gulf expands threatening by global catastrophes.

The second gulf — between science and society: the weakening of the ability of science to foresee crises and changes and to show the effective way of movement to the future has led to a drop in the prestige of science, weakening of attention to the scientific knowledge of society, by the government and business, explosion

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of seemingly long gone in the past anti-scientific false teachings and beliefs. Faith typical for the industrial age in the limitless possibilities of science gave way to skepticism about its achievements, a lack of confidence in its abilities. From the beloved firstborn science is turning into all persecuted stepson. The power — at the national and international levels — and business leaders less and less listen to the voice in formulating strategic decisions that determines their not far horizon, increases the gulf between science and society. The gap weakens them both.

The third gulf: a discrepancy between the growing investment in science and its results. Between growing from year to year as a whole over the world and most countries investments in science (they have reached, according to the World Bank, 2.21% of world GDP, for countries with high income 2.47%, USA — 2.67%, Japan — 3.45%) and the number of epochal scientific discoveries and major inventions similar to those that were observed during the scientific revolution of the late 19th — early 20th centuries. This gap

is explained by the fact that the prevailing current industrial scientific paradigm has largely exhausted its creative potential, and the post-industrial paradigm at the establishment stage has not yet received the necessary support and achieved not to fullest its creative potential.

The fourth gulf: super concentration of scientific potential in rich countries of the «golden billion» practically the minimum level in poor countries where most of the world population resides. This can be seen from Table 1.

In the countries of the «golden billion» where 16% of the world population resides a half of the researchers is concentrated, 80% of R&D costs; 74% of patent applications from residents, it not a wonder that they get 98% of income from royalties and license sales, the bulk of the world technological quasi-rent. At the same time countries with low income science and technology and innovation potential is negligibly small, where 15% of the world population resides, the assimilation of achievements of scientific and technological revolutions

Table 1. *The Distribution of Scientific Potential by Countries with Different Income Levels*

Country Groups	Population Size, 2008		Number of Researchers		R&D Costs		Applications for Patents from Residents		Proceeds from Sale of Licenses	
	Mln. People	% of world	Thous. people	% of world	Bln. USD	% of world	thous.	% of world	Bln. USD	% of world
World	6697	100	8505	100	1337.5	100	988.5	100	181.3	100
Countries with income: High	1069	16.0	4220	49.6	1068.9	79.9	796.6	74.5	177.4	97.8
Above average	949	14.2	1180	13.9	68.4	5.1	40.9	4.1	2.3	1.2
Below average	3703	55.3	1774	20.9	101.8	7.6	134.1	13.6	1.4	0.7
Lower	978	14.6	594	7.0

Source: *World Development Indicators 2010. Washington: The World Bank, 2010. p. 342.*

of the 21st century and doomed to poverty, backwardness. Gross national income per capita in 2008 in low-income countries was 76 times lower according to the current exchange rate and 30 times lower by purchasing power parity than in high-income countries.

Thus, the world science being in the state of deep crisis at the final stage of its industrial cycle happens to be unable to effectively perform its essential functions — the cognitive, creative and predictive. And this is just at a time when civilization has entered into the era of radical changes, chaotic fluctuations.

2. The End of the Century of Science or a New Scientific Revolution?

Several years ago American science journalist John Horgan, after interviewing a number of prominent scientists, including Nobel laureates, concluded that that all the major scientific discoveries had been made and that all that remained was the working out of minor details, the end of the century of science comes¹.

In fact, the global crisis of science is not the end of the century of science but the crisis of the industrial scientific paradigm prevailed for more than two centuries that largely does not meet the requirements of development of society in the 21st century and is a forerunner of the postindustrial paradigm. Its establishment will be the main content of the scientific revolution of the second quarter of the 21st century.

This is a naturally determined process. The accumulation of knowledge is not smooth and continuous. It occurs under the regularities of cyclic-genetic dynamics. Along with the change of historical epochs

a change of general scientific paradigms occurs — the amount of knowledge that underpins strategic decisions and actions. Such change is accompanied by crisis of the passing paradigm and the rise of new, innovative updating of the accumulated amount of knowledge. At the same time a set of the leading area of knowledge and centers of scientific creativity change. The general trend, from age to age, the role of scientific knowledge increases in addressing the increasingly complex challenges humanity faces to be solved with the will of the epochal and basic innovations. This is more so correct for the 21st century when it stands to overcome the cluster of global crises and to build a post-industrial, humanistic-noospheric integral society.

The school of the Russian cyclism rejects the point of the end of the century of science and foresees the completion of the modern crisis of knowledge by a new scientific revolution, the peak of which will likely be in the second quarter of the 21st century.

3. Will the New Scientific Revolution be Great?

The history of scientific knowledge, investigated in depth in his time by V.I. Vernadsky² and John Bernal³ distinguishes several general scientific revolutions. I distinguish four scientific turns over the past five millennia.

The first of them occurred in the 3rd millennium B. C., when the accumulated amount of knowledge made possible to create sophisticated irrigation systems, to build the pyramids, palaces, religious buildings in the valleys of the great historic rivers (Nile, Tigris and Euphrates, the Indus) and

at the crossroads of sea trade routes (Minoan civilization on Crete). This became the basis of the technological revolution, many times increased the labor productivity.

The second scientific revolution began in the second half of the last millennium B. C., when in ancient Greece it was completed a science building by abstract and fundamental knowledge, established system of sciences still existing, Plato's Academy founded, Aristotle's Lyceum, Library of Alexandria, numerous schools of philosophers. This scientific revolution may be viewed indeed as Great because it laid the foundations of scientific knowledge at the millennia ahead.

The next scientific revolution refers to the period of the 15th–17th centuries, when due to the great geographical and scientific discoveries the picture of the world radically changed. John Bernal not without reason called this revolution Great. The explosion of scientific creativity had its epicenter in Europe. It became the fundamental base of the industrial revolution, establishment of the industrial world civilization.

Scientific revolution took place in the period of maturity of the industrial world civilization and was adequate to its content. There were assimilated electricity, liquid and gaseous fuels, development of air space began. Since the end of the 19th century the recent revolution in science evolved in natural sciences opening the way to knowledge and use of atomic energy and space exploration. Many discoveries were made in biology, medicine, science of society. However, despite the significance of these discoveries, it could hardly be called this Revolution Great: it took place within and on the basis of the industrial universal scientific paradigm.

Since the end of the 20th century it becomes increasingly clear that this paradigm has largely exhausted its creative and prognostic potential. The time of new «universal scientific revolution» is coming which may be viewed as Great.

What is the basis of such a bold statement, and in respect of the coming scientific revolution?

First, the first half of this century is a change of historical epochs: the decline of industrial and establishment of post-industrial, integral by its nature, world civilization, change of the fourth generation of local civilizations with the fifth more differentiated; transition from the second (millennium and a half) historical super cycle in the dynamics of the global civilization to the third. All the components of the genotype of civilization: nature of demographic dynamics, energy-ecological, technological and economic modes of production, architecture of geopolitical world order, socio-cultural system are radically changing. Such avalanche of radical changes does not fit into the «Procrustean bed» of the industrial scientific paradigm. The rapidly changing world requires the updating of the entire system of knowledge. The magnitude of changes defines the nature of scientific revolution.

Second, the growing gap between the rate of changes in society and its relationship with nature, their too late and incomplete awareness is the source of many erroneous strategic decisions and a phenomenon which Alvin Toffler called «future shock» — a fear of the future that leads to an inadequate response to new challenges and threats. This has the potential to call into question the very existence of the species Homo Sapiens. The scientific revolution must clean the Augean stables of accumu-

lated knowledge, free them from the outdated dogmas and fill with new knowledge adequate to the modern age. It is in power by the great scientific revolution only.

Third, the building of science by its architecture, the ratio of elements that reflect the priorities of the passing era, in many respects does not meet the priorities of the new era. A grand transformation of the whole knowledge of science is coming, change of leaders that is only possible as a result of the great scientific revolution. The leadership goes to the social sciences, sciences about life and ecology.

Finally, the *fourth*, while the new architecture of science is only beginning to be built, its foundations had already been laid by outstanding Russian and foreign scientists of the last century, which are far ahead of their time. The new building is not built on sand, not on the fluctuation of random insights, but on the granite foundation of profoundly elaborated theories that makes it possible already now to identify the main outlines of the coming scientific revolution, the post-industrial scientific paradigm.

4. The Main Outlines of the Coming Scientific Revolution.

The main outlines of the coming scientific revolution can already be seen.

First, it will be accompanied by the *rise of science*, overcoming its crisis and enhancing the prestige as the foundation of a knowledge-based society. Young talents will be attracted by science, and the government and businessmen will not save money for researches into new problems.

Second, the content and result of the revolution will be the *establishment of in-*

terdisciplinary scientific paradigm that is adequate to the realities of the 21st century, post-industrial civilization and serves as a reliable guide in dealing with any problems and resolving knots of contradictions.

Third, *humanization of science* will evolve. The priority will be given to the human sciences, medicine, social sciences and humanities. This will help prevent the spread of dangerous diseases, support active life of people under conditions of increasing longevity, prevent and overcome the devastating crises and conflicts, degradation of the moral foundations of society.

Fourth, *noospherization of science* is ahead, the priority of research into problems of interaction between society and nature, and their harmonious co-evolution, formation of environmental sciences system at the boundary between natural and social sciences, bringing environmental issues to the forefront in life of society and in scientific thought.

Since the second half of the 20th century as a result of the rapid jump of the productive forces, the invention of nuclear weapons and other weapons of mass destruction the reason has become not only geological but also the climate power. But concurrently species *Homo Sapiens* have found itself on the brink of self-destruction, according to Pitirim Sorokin — self-cremation in the flames of a thermonuclear war. In the 21st century many types of nonrenewable minerals, primarily fossil fuels will be mainly exhausted, now provide 82% of energy consumption. There is a growing shortage of fresh water, fertile land, tropical forests are felled rapidly — «green lungs» of the planet. It is becoming more and more likely a global ecological catastrophe. But science still can not give

an unambiguous answer to the question: what will happen to humanity the overall warming and the flooding of many coastal cities and countries — or a new ice age? Unusually cold winter of 2009–2010 and hot summer in 2010 have added doubts to science.

Fifth, a complicated process of demilitarization of science is ahead. In the industrial age, human genius has increasingly served to the Moloch of war. The state and corporations generously fueled military researches, the best minds were employed there. It is expected to refocus them on the priority humanitarian and environmental problems, the states should first of all take care of it.

5. The Fundamental Base of the Technological Turn and Progress of Civilizations

The revolution in science becomes the primary source and the driving force of the ninth wave of the epochal and basic innovations⁴ that expect us in the first half of the 21st century and will transform the face of the world. The result of these innovations, a global technology revolution will not only be the formation of the post-industrial, technological mode of production of its first stage — the sixth technological order, noospheric energy-ecological modes of production and consumption, but also the establishment of an integral economic and socio-cultural system, a multi-polar world order based on the partnership of civilizations and transition to a new whorl of the spiral of historical development — to a integral civilization. These epochal innovations can be realized only with goal-directed activity of the humanity and its leaders, with

the defining role of science in shaping the future of society, ways and mechanisms of movement to it. Without it, the chaos of the transitional period will be increasing; the threat of global catastrophe will be growing.

Science is the core of the *synthesis of the three revolutions — scientific, educational and information* as the basis for a radical transformation of society. Science gives a new vision of the world at the next turn of the helix of historical development of society and its interaction with nature, defines the aims of the movement and ways to achieve them. Education is meant for a timely equipping with such new vision of the prevailing generation now and above all — the next generation of the 20s of the 21st century to whom the burden and responsibility of the adoption and implementation of strategic decisions will pass for three decades. The modern information revolution using the Internet, television and other sources of information should help accelerate the rapid assimilation and dissemination of a new paradigm among the present and future generations, improve professional competency, stepping up the transforming activity of hundreds of millions of people. This requires the humanization of information flows, turning them to science and education. An example can be the bilingual science education portal «New Paradigm» (www.newparadigm.ru) created by the Sorokin — Kondratieff International Institute, with more than a dozen and a half of sites on the topical issues of the formation of a new paradigm of social sciences. Similar portals should be created for other branches of knowledge. The Institute in association with the Saint Petersburg State University has proposed the creation

under the auspices of UNESCO the Internet portal «World Scientific Heritage». Three sites have been implemented to this end — «Nikolai Kondratieff,» «Pitirim Sorokin», and «Leonid Kantorovich.» We hope that the UNESCO will respond to this initiative.

The major direction of the coming global scientific revolution will be surmounting the polarization of scientific potential that has reached the extreme limit. It is almost entirely concentrated in the U. S., Western Europe, Japan, China, Russia, and India, the majority of countries and civilizations are devoid of scientific forces that can serve as a basis for the modern transformation and modernization of society.

It will be required the development and implementation under the leadership of the UNESCO a long-term strategy of partnership of civilizations in the field of science. Considerable efforts and resources are necessary of the vanguard nations and civilizations so that to overcome the excessive polarization of a scientific-technological potential and help strengthening it in the lagging countries, failing which it is impossible to bridge the gulf reached critical limits between the «golden billion» and the poorest countries and civilizations.

Thus, the scientific revolution of the 21st century underlies the technological turn, the wave of epochal and basic innovations, transition of the world civilization to a new whorl of historical helix.

6. The Role of Russia in the Scientific Revolution of the 21st Century.

Will Russia be able to join the leaders of the coming scientific revolution, despite the crises shaking it? There are considerable

grounds for a positive answer to this key question to the fates of Russian science

First, it is the Russian scientists already in the first half of 20 century, laid the cornerstones of the post-industrial scientific paradigm. In the field of social sciences — Pitirim Sorokin, Nikolai Kondratieff, Alexander Bogdanov, Nikolai Berdyaev, Wassily Leontieff. In the field of environmental sciences — Vladimir Vernadsky, Alexander Chizhevsky, Nikolai Vavilov, Nikita Moissejev. In the field of life sciences — Ilya Mechnikov, Ivan Pavlov. In the field of astronomy, physics, mathematics — Alexander Friedman, Pyotr Kapitsa, Lev Landau, Leonid Kantorovich, Jaures Alferov and many others. The ideas of these pioneers have been received by the world scientific thought and demanded in the 21st century.

Second, the utmost deep civilizational crisis of the 90s in Russia gave impetus to a new explosion of scientific creativity. Relying on the powerful shoulders of its great predecessors, the modern Russian scientific schools develop the ideas of the post-industrial paradigm of social and ecological sciences. This is particularly true of schools of Russian cyclism, civilization, noosphere, integral macroforecasting, philosophy of economy.

The results of the efforts of these scientific schools are a 7-volume fundamental work «Civilizations: Theory, History, Dialogue and the Future»⁵, a three-volume book «The Philosophy of Economy»⁶. Russian and Kazakhstan scientists under the leadership of the P. Sorokin — N. Kondratieff International Institute elaborated and published in 10 parts, and presented at the Roundtable within the 64th session of the UN General Assembly on 27.10.2009, the Global Forecast «Future of Civiliza-

tions» for 2050 and recommendations to the partnership strategy of civilizations⁷. This ambitious project has become the evidence of the intellectual leadership of Russia in foreseeing the future of civilizations on the basis of the post-industrial scientific paradigm.

Third, Deep and devastating crisis the Russian science pushes to the search for fundamentally new ideas and approaches. According to the World Bank indicators, the number of researchers in Russia accounts for 6% of their total number in the world, and R&D costs — only 1% of the world; the number of patent applications from residents — 2.8% of the world, and Russia's share of royalties and license revenues — 0.24% only of the world and in the export of high technologies — 0.33% only. This indicates a disregard of the government and corporations for science and its low efficiency.

It particularly tells on natural and technical sciences, material and technical base of which is utmost outdated. Industry and corporate science is destroyed, most of the engineering schools are liquidated, which once topped the world. There is a growing aging of scientific personnel — and in fact the scientific revolution is made by daring young talents.

If these trends continue under the inertia-based scenario, then over the next decade, the scientific potential of Russia will be irretrievably undercut, leading to a further decline of the competitiveness of domestic products, and its ousting from the domestic and foreign markets.

However, it is yet realistic an optimistic, innovative-breakthrough scenario, if the positions of supporters of the new paradigm strengthen in the scientific community and they get a real and consid-

erable support from the government and corporations that will become a jumping-off place for tackling the crisis, assimilation of epochal and basic innovations, inclusion of the country into the world leaders in some areas of the formation of a new paradigm. In the field of social and ecological sciences this prospect is clearly visible. But this would require that the current leaders of the state and businesses should become aware of the dead-end movement by the inertia-based path, turn to science, formulate and implement a long-term strategy which will be able to bring Russia to the number of the leaders in a number of areas of the scientific revolution of the 21st century.

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