

New Requirements to Science and Technology in the Context of the Sustainable Development : A Response of Scientific Community of Siberia("Peoples and Nature in Northeast Asia: For the Symbiosis of Human and Nature")

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New Requirements to Science and Technology in the Context of the Sustainable Development: A Response of Scientific Community of Siberia

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On the threshold of the XXI century the mankind met a set of global problems that cannot be solved without cardinal revision of the paradigm of development. The most important global problems are:

Extremely large social discrepancies

Explosive-like increase of the world population in the XX century

Threatening scale of the environment degradation.

Mr. Maurice Strong, Secretary General of the United Nations Conference on Environment and Development (Rio de Janeiro, June 1992) stressed in the Statement at the opening of the Conference: "The same progress of economic growth which have produced such unprecedented level and power for rich minority have also given rise to the risk and imbalances that threaten the future of rich and poor alike. This growth model, and the pattern of production and consumption that have accompanied it, is not sustainable for reach, nor can it be replicated by the poor. To continue along this pathway could lead to the end of our civilization."

To bring the living standards of the poor (80% of the world population) to the level of rich using existing models of development and today's technologies it is necessary to increase consumption of raw materials and energy by 30-40 times.

This is impossible in view of exhaustability of non-renewable resources and the danger of complete degradation of the environment. On the other hand, elaboration and realization of new technologies that requires 30-40 times less raw materials and energy per unit of production also cannot be done quickly.

Therefore the people are obliged to use a new way of development that is well balanced from social, economical points of view and ensures sustainability of the development.

* Academician Valentin A.Koptug, President of Siberian Branch Russian Academy of Science, was invited to present a lecture at the science session devoted to inauguration of new organization of Tohoku University-Center for North East Studies. Due to pressing assignments in Russia he was not able to come. His lecture was delivered by member of SB RAS academician F.A. Kuznetsov. Acad. V. Koptug was working on the text of his lecture for this publication. Because he passed away on January 12 1997, preparation of the text was completed by acad. F.A. Kuznetsov. Illustration are prepared by Dr. Leopold Chernyavski and Dr. E.V. Dvornikov.

At this turning point of human civilization when the mankind must find a way out of the global crisis the role and responsibility of science sharply increases. In the changing world the goals and organization of scientific communities will also suffer changes in order to take up challenges of our time. Scientific efforts for solving global problems of mankind must be more goal-oriented, multidisciplinary and international.

These problems of reorganization of science were discussed in details at international seminar in Novosibirsk in 1993 " Science policy: new mechanisms of cooperation between East and West" ⁽¹⁾.

It was clearly indicated that increased goal-orientation of science is necessary to find ways to solve global problems which appear by the end of XX century in development of the world civilization. In application to Russia orientation on priority directions which will provide overcoming the country's system crisis is also unavoidable. In framework of general problems of civilization development an accent on fundamental aspects and a wide international cooperation is required. In Russia strengthening of "realization component" of scientific activity: designing, pilot production, technology transfer and other application are very essential. One should not think that this type of activity undermines sphere of fundamental research. It is required to overcome certain gap between basic studies and applied research and implementation of results in industry and agriculture. So, considering present situation in the country, priority has to be given to most urgent needs. However, due to big scale and significance of national problems, progress in their solving will certainly have international impact.

The second aspect which has to be taken in to account in reforming of science is the requirement of multidisciplinary. This requirement arises from extreme complexity of global problems of mankind. Close cooperation of different scientific and technical disciplines becomes imperative. Role of science leaders continues to be very essential. However due to complexity and scale of problems, wide variety of scientific methods and instruments required in research preferential support of individual scientists, which is pronounced tendency in Russia now in practice on national and international agencies responsible for support of science, can not be considered as optimal. Main results will undoubtedly be generated in framework of coordinated collective efforts. It is natural that complex teams have to be united by obvious leaders-generators of ideas and organizers of science. The coordination should, wherever it is possible, be on international level.

Another aspect of science at the threshold of XXI century is unavoidability of formation of new scientific disciplines being oriented on complexity of approaches to global problems of mankind. For example, necessity to achieve most economic mode of use of natural resources, maximization of technological efforts in decreasing materials and energy consumption in course of production, realization by the society urgent need for reasonable rationalization of consumption (in a wide meaning of the term) will require to take into account in estimation of general results of human activity not only capital, created by people but also a loss of the "natural capital." Loss direct as well as indirect. A new discipline that is required to solve this

type of problems is ecological economics.

It has to be also noted that the requirement of multidisciplinary of approaches used in domain of science and its applications as well as requirement for leaders and decision makers of the society to be competent and broad-minded lead to imperative demand to improve systems of education and professional training to realize the principle "to teach individuals to be able to learn all the life". Very perspective in this respect developed in last decades so called "of phys-tech system"⁽²⁾, based on integration of science and higher education.

It is clear now that described requirements to science of XXI century, which look quite obvious now, were used in building up facilities and formation of human potential of academic science in east part of our country.

Almost fifty years ago the Government of the USSR accepted a very impressive plan of serious improvement of educational and scientific level of the Siberian and Far Eastern communities, assuming this to be very important conditions for the rapid development of these regions. In the framework of the plan the Siberian Branches of the USSR (now Russian Federation) Academy of Sciences, Academy of Agricultural Sciences and Academy of Medical Sciences were established.

Each branch is organized as a network of scientific centers placed in or near largest cities of Siberia and Far East (Figure 1)**. It can be seen that in many cities organizations of all these "three Academies" are present. From the beginning the Academy has established close cooperation. It would be interesting to analyze results of this cooperation. However in this paper we will give facts related to the Siberian Branch of the Russian Academy of Sciences (SB RAS) only.

At present the Scientific Research Centers of SB RAS are in Tyumen, Omsk, Novosibirsk, Tomsk, Kemerovo, Krasnoyarsk, Irkutsk, Ulan-Ude and Yakutsk, which all together comprise more than one hundred research and technological institutes. The human potential of SB RAS is demonstrated by Figure 2.

The largest scientific Center of SB RAS (50% of SB RAS potential) is placed near Novosibirsk (30 km) and partly in the city (Figure 3).

In period 1960-90 potential of SB RAS in basic sciences and different applications was used very efficiently by USSR Government, local authorities in Siberia, industry and agriculture, the system of higher education, etc. However during the political and economic crisis in Russia the interest in science has dropped. So, realizing that without science the rebirth of Russia and its movement to sustainable development are impossible, we start to think how we should modify the system of SB RAS in order to compensate for a very large (by 7 times) decrease of governmental support of our basic and applied research. The modification of the SB RAS system should also take into account some additional requirements to the science and technology that follow from global problems encountered on the threshold of

** For figures attached to this article, see pp.135-141 of this volume.

the third millennium: to make all science activity more goal-oriented, multidisciplinary and international.

Let us consider the second requirement – multidisciplinary.

As it was already mentioned earlier, the campuses of the SB RAS were organized from the beginning as multidisciplinary Scientific Centers (Proportions of different disciplines in the science centers of SB RAS are illustrated by the right part of Fig. 1). Therefore the Scientific Centers, being essentially multidisciplinary formations, are well prepared for tackling global problems of the mankind. Many Institutes of SB RAS have experience in solution of rather large scale problems in application to Siberia (the area of Siberia totals 10 million km², 1/15 of the world land). The problems are related to forest, rivers and lakes, mineral resources, industry-nature interaction and so on.

In order to use these build in advantages of Scientific Centers and SB RAS as whole for entering more efficiently into global problems and to stimulate the involvement of our scientific schools in broader international collaboration the Presidium of the SB RAS launched a special Program on the Development of International Research Centers in Siberia. During last five years we have created 15 Centers (Fig. 4) which are acting as non-governmental international organizations where scientists from various countries can work together with scientists from Siberia and other parts of Russia using sophisticated and diverse facilities and expertise of the institutes of the SB RAS.

The joint research of the International Research Centers in Siberia is concentrated on the most important natural objects of Siberia (such as Lake Baikal, Siberian forests, Altai Mountains region, etc.).

Scientific projects are approved periodically by the International Scientific Council of each center. One of the examples is the Baikal Drilling Projects (Fig. 5 and 6); the Lake Baikal sediments have thickness up to 7 km and contain “records” on evolution of living organisms and climate changes for 20 million of years.

SB RAS always paid serious attention to organization of international science meetings. In spite of economical difficulties of the last period we continue to organize meetings of different scale. Table 1 shows titles of some international of meetings held recently in different Scientific Centers of SB RAS. Selected meetings are related to global or big regional problems. Most of them are actually a part of internationally coordinated scientific activity of SB RAS.

Foreign scientists take an active part in various field missions in Siberia on the basis field station's network of SB RAS (Figure 7). Now we have some difficulties (mainly financial) with their maintenance of the network, but in some cases it is the international collaboration that helps us to open up even some new stations (Fig. 8 shows a new international biosphere station established recently in the mouth of the Siberian river Lena).

The ratio of basic and applied research in the organizations of the SB RAS is approximately equal 1:1. This circumstance always allowed us to find additional financial resources through contracts with industrial and agricultural companies (mainly at national level in the past and at international level now). The priorities of basic and applied research cover

broad scope of problems. For example, in the area of energy production and consumption specialized institutes work out a strategy of development of oil and gas industry of Siberia for XXI century (Figure 9) and conduct investigations on thermonuclear generation of energy (Figure 10), on using slightly warm sewage as a source of energy etc. In relation to energy production and saving very interesting are investigations of Institutes of SB RAS related to establishing of new major production of semiconductor silicon in Russia for needs of electronic and electrotechnic industry and complex investigations of natural gases hydrates, which are considered to become very essential source of energy in XXI century. Substantial program exists in SB RAS related to development and application of new materials for different applications. Fig. 11 shows original crystal growing unit for production of crystal of oxide materials and an example of x-ray luminescence BGO crystal.

Recently Russian government made a number of decisions directed to establishment of NOVOSIBIRSK TECHNOPARK. The Technopark has to utilize high scientific and technological potential of Novosibirsk City, the biggest city of Siberia with high concentrations of high tech industry.

SB RAS is one of founders of the technopark. At the first stage of the technopark existing facilities of Institutes will be used as contribution of SB RAS to development of this innovation enterprise. In line with this development SB RAS recently selected about 150 promising technical projects, which are ready for practical implementation. Short description of these projects published as a separate book. During last visit of Japanese team led by Prof. J.I. Nishizawa to Novosibirsk these materials were presented to our Japanese colleagues. By now Japanese translation of the collection is available. It is a possibility that foreign partners will participate in implementation of these projects⁽³⁾.

At present there is a collaboration between the organizations of SB RAS and scientific community and industrial companies of the countries of Asia Pacific region (mainly Japan), but its scale is not large enough. Broadening of this collaboration seems very desirable to us, and I hope that this conference will play an important role in this respect.

It is very essential that the agreement that was signed by Prof. J.I. Nishizawa and Prof. V.A. Koptuyug in 1992 assumes that cooperation between TU and SB RAS will include research not only in natural sciences and technical disciplines but in humanities and social sciences. There are many problems that unite us today and which will become increasingly important in future. Fig. 12 shown front page of famous encyclopedia of Tibetan medicine published in Russian. This cultural treasure of Indian and Tibetan intellectuals was prepared for publication by scientists from Byariatian Science center of SB RAS. It is only a beginning of big work which can be done based on collection of documents which are in possession of SB RAS.

Very interesting discoveries are being made today. Fig. 13 shows reconstruction of young lady head based on remains excavated recently by joint international team in Altai mountains.

I am sure that creation of the new organization, Center for Northeast Asian Studies, which was a subject of our multiple discussions with Prof. Nishizawa and colleagues from

Tohoku University and Siberian Branch of Russian Academy of Sciences, will help in realization our plans and hopes for closer cooperation in solving problems equally essential for Japan and Russia and contribution to the progress of science.

Table 1 : Selected International meetings organized by SB RAS

Title / Organizers / Place & Date
◆ 108 International Advanced research workshop “Science Policy: New Mechanisms for Scientific Collaboration between East and West” /Presidium SB RAS NATO Scientific Affairs Division /Novosibirsk; November 22–25, 1993
◆ International Workshop “Baikal as a natural laboratory for Global change” /Institute of Limnology, SB RAS, Irkutsk International Association for Promotion of Cooperation with Scientists from Independent States of Former Soviet Union (INTAS) /Irkutsk (Russia); May 11–17, 1994
◆ International congress “Education and Science on the threshold of the third millennium” /SB RAS Institute of Philosophy and law, SB RAS UNESCO /Novosibirsk; 4–9 September, 1995
◆ NATO Advanced Research Workshop “Sustainable development of Lake Baikal Region as a Model Territory for World” /SB RAS Federal Agency for Natural Conservation of Germany NATO Scientific and Environmental Affairs Division Government of Republic Buryatia /Ulan-Ude (Russian Federation); September 11–17, 1994
◆ NATO/SCOPE–RADTEST Advanced Research Workshop “Long–Term Consequences of Nuclear Tests for Environmental and Population Health (Semipalatinsk Test site/Altai Case Study”) /SB RAS Scientific Committee on Problems of the Environment SCOPE–RADTEST NATO Scientific and Environmental Affairs Division Altai Regional Administration /Barnaul, Russia; September 5–11, 1994
◆ NATO Advanced Research Workshop “Regional and Global Mercury Cycles: SOURCES, FLUXES and MASS BALANCES” /SB RAS Scientific Committee on Problems of the Environment NATO Scientific and Environmental Affairs Division /Novosibirsk; July 10–14, 1995
◆ NATO Advanced Research Workshop “Management, technology and human resources policy in Arctic (the North)” /SB RAS NATO Scientific and Environmental Affairs Division Ministry of nationalities affairs and regional policy of Russian Federation Copenhagen Business school, Inst. of Economics Sakha Republic /Novosibirsk; June 26–July 2, 1995

References

- 1) Science Policy: New Mechanisms for Scientific Collaboration between East and West. Edited by V.A. Koptug and J. Klerk, NATO ASI Series 4. Science and Technology Policy-Vol.4
- 2) This term is used to describe educational principle of continuous education developed in Moscow Physico-Technical Institute. The system was successfully applied in practice of Siberian Branch of Russian Academy of Sciences from very beginning of its organization.
- 3) Most important completed projects of Institutes of Siberian Branch of Russian Academy of Sciences.

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