

Information

General meeting of the Division of Chemistry and Materials Science of the Russian Academy of Sciences

The General meeting of the Division of Chemistry and Materials Science of the Russian Academy of Sciences was held on May 17, 2010, at the N. D. Zelinsky Institute of Organic Chemistry of the RAS.

The report concerning the Division's activity in 2009 was delivered by Academician Secretary of the Division Academician *V. A. Tartakovsky*. He noted the most important scientific achievements in the field of chemistry and materials sciences.

The report about the science organization activity, the staff policy, and issues of financing of the Institutes of the Division was presented by the Head of the Department of Chemistry and Materials Science, Deputy Academician Secretary of the Division for Science Organization Issues *A. E. Chalykh*.

Also, Vice President of the Russian Academy of Sciences Academician *S. M. Aldoshin* presented a report considering some most important points of the communication of the RAS with the legislative and executive state authorities in the field of innovation activity in 2009–2010. Academician *S. M. Aldoshin* discussed the

key lines of research carried out at the Russian Academy of Sciences that could be efficient for implementation of innovative projects and modernization of the national economy and the aspects related to efficient use and management of the land property of the RAS and the problems of building accommodations for employees of the RAS.

The General meeting considered and approved the report on the Division's activity of 2009.

The General meeting approved Corresponding Member of the RAS *Yu. M. Mikhailov* as a member of the Bureau of the Division.

The scientific report entitled "Supramolecular Systems as a Bridge between Nonliving and Living Matter" was presented by Academician *A. I. Konovalov*.

Academician *A. I. Rusanov* spoke in the discussion of the report.

In the General meeting of the Division, Diplomas of V. N. Ipat'ev Prize winners of 2009 were presented to *V. V. Lunin*, *S. N. Tkachenko*, and *E. Z. Golosman* for the work "Physicochemical Grounds of the Industrial Production of Water-Resistant Catalysts of Gas Purification from Ozone".

General meeting of the Russian Academy of Sciences

The General meeting of the Russian Academy of Sciences was held on May 18, 2010, in the Great Hall of the Russian Academy of Sciences in Moscow. The meeting was attended by about 1300 participants including 329 Full Members of the RAS, 550 Corresponding Members of the RAS, 240 research fellows delegated as members of the General meeting by scientific institutions of the RAS,

heads of other state academies, scientific societies and associations, responsible representatives of the Presidium of the RAS and its divisions, and members of the press. Chairman of the Russian Federation Government *V. V. Putin* took part in the meeting.

The meeting considered and approved the report about the activity of the Russian Academy of Sciences in 2009

and took the decision to create the Division of Global Problems and International Relations of the RAS within the Academy. In addition, M. V. Lomonosov Big Gold Medals of the RAS and the Gold Medals of the RAS named after outstanding Russian scientists of 2009 were presented.

Prime Minister Vladimir Putin addressed the General meeting of the Russian Academy of Sciences.*

"The General meeting of the Russian Academy of Sciences is traditionally an important event for the entire academic community and our country as a whole. This is understandable, if we consider the Academy's prestige and its place in Russian public life.

Today, you will sum up the Academy's performance and that of its organisations throughout 2009. This was a difficult period for the Academy and for all of us. Nevertheless, we did not revise our strategic goals even in the face of the global financial and economic crisis. Obviously, we are not abandoning our goals today, when the peak of the crisis, hopefully, has passed and when sustained economic growth is resuming. But we realise that leading global economies and our neighbors in the European Union still face many problems.

The government plans to overhaul key sectors of the Russian industry and the social system on a large scale. In the long run, this large-scale modernisation should improve basic living standards and increase the efficiency of the economy. Major projects in the fields of energy conservation, space, nuclear power, medicine, and information technology are currently being launched in Russia.

For 2010, we allocated nearly 1.1 trillion roubles, or over 10% of the federal budget, on fundamental and applied science, higher education and other federal innovation programmes involving, among others, organisations of the Russian Academy of Sciences.

The Academy will receive 49.3 billion roubles in 2010, just as much as was received in 2008, in the successful time... This sum, however, is slightly lower than the funding from 2009, as we used the so-called anti-crisis funds last year. Despite some problems, we manage to maintain the Academy's pre-crisis levels of funding.

Moreover, the Academy's extra-budgetary earnings totalled about 27 billion roubles in 2009.

As you would expect, the Russian Academy of Sciences and national science as a whole cannot shy away from the modernisation agenda. The Academy has always been and must remain a key institution of national and social development - both as a generator of new fundamental knowledge turned toward the future and as an instrument for selecting and promoting Russia's intellectual elite.

And, finally, the reliable, long-term prediction of scientific and technological priorities is only possible with the involvement of the research community.

Certainly, a primitive and utilitarian understanding of science's role is unacceptable. Fundamental research is not a commercial project based on investment volumes or profit-making.

At the same time, the field of science in the modern world is based on a principle of encouraging tough competition and is characterised by a serious struggle for superiority. Leading states invest heavily in R&D projects in order to remain predominant in science. This concerns not only technology but also the humanities, politics and ideology.

Strengthening fundamental science and furthering its development are important in making an impression in the world and attracting investment, innovative business and intellectual resources.

In view of its global role, Russia cannot remain aloof from such competition, including competition in the field of fundamental knowledge, for this would mean lagging behind and occupying a place on the periphery of global development.

I want to emphasise that we have a high opinion of the academy's achievements. By way of example, I would like to mention serious results in medicine: a new process facilitating the biological production of genetically engineered human insulin has been developed.

The Kvazar-KVO complex of the Russian Academy of Sciences has contributed to the qualitative development of our Global Navigation Satellite System (GLONASS). I think we can be proud of how this project is turning out. We launched the project together with our European partners. I even proposed cooperation from the beginning. They declined and are working independently. We now have 25 satellites in orbit, and this will increase to 29–30 before the year is out. This improves global coverage. To the best of my knowledge, the Europeans partners still have only two satellites. But they have some advantages, which are linked to electronics and scientific support. We need your assistance here.

Russian specialists are also actively involved in major international research projects.

At the same time, our scientists now are 14th in the ranking defined by a quantitative criterion such as the number of articles published in widely recognised scientific journals.

In this, we are at the same level as the Netherlands and Brazil. Although we are in good company, this is still a downward trend as we were seventh in 1995. Of course, we must jointly rectify the situation.

Today, we are setting forth strict requirements for industry, the business community and other key public and economic institutions. This will require constant renewal and increased effectiveness. To be honest, this involves the issue of our national prospects.

Internal transformations in national science and in the system of the Russian Academy of Sciences are consid-

* <http://premier.gov.ru/eng/events/news>

ered to be a matter of paramount importance. These will enable improved quality of R&D projects, the academic community's active involvement in training modern personnel and the creation of a scientific and technological backlog for the economy and the social sector.

Our plans are absolutely open. They are widely discussed in academic and educational circles. I am referring to the plans for creating a competitive base for science in Russia, for supporting strong and capable scientific schools, and focusing resources on priority areas.

Naturally, these plans should be implemented by identifying the leading institutions through open and transparent proposals, rather than by bureaucratic procedures or by the preference of an official.

In addition, bidding procedure, within the programmes executed by the presidium and various departments of the Academy of Sciences, should also be expanded.

We will also have to introduce independent auditing practices for scientific institutions and to learn how to use these mechanisms efficiently in order to improve Russian science. I believe that the Academy of Sciences should be the first to start using these mechanisms to assess the efficiency of its subordinate institutions.

It goes without saying that assessment criteria should be elaborated by the academic community that will be subjected to public discussion, being both comprehensible and objective.

Most importantly, after completing the audit, the academy should take certain financial and even organisational measures, redistributing funds to the more efficient research teams, and even reorganising some scientific institutions, if necessary.

These measures should all aim at the final result of making those specialists who are working in the Russian Academy of Sciences or in other scientific organisations feel that they are needed and that they can hope to see professional prospects and opportunities to achieve their full potential.

Specialists and young scientists should have the opportunity to work at state-of-the-art research centres where serious scientific activities are conducted and which have all the necessary facilities for them, including educational facilities. It is absolutely unacceptable to make them stagnate at institutions which only generate useless papers and waste budget funds.

As everywhere else in the world, we should facilitate integration between research, education and production activities. In fact, this issue has been very intensely discussed lately. We need to eliminate disagreement and inconsistency. That is another reason why the decisions we are making are meant to encourage scientists to teach and research at higher education institutions.

For example, special grants have been established this year to motivate respected scientists to work in Russian universities. Additional funds have been earmarked to de-

velop innovative infrastructures in higher education institutions and to support research centres. The measures proposed provide for the investment of 39 billion roubles through 2012. I would like to emphasise that these funds have been allocated in addition to what we planned earlier.

Another document is currently being formulated that immediately relates to the academic community. In 2010 and 2011, we intend to spend 3 billion roubles on supporting jointly implemented projects between leading research organisations and higher education institutions.

We also expect the Russian Academy of Sciences to take an active part in the work of federal and national research universities. We need to ensure that research at these centres will be carried out at the proper level.

The government is maintaining an ongoing dialogue with the management of the Russian Academy of Sciences. Together we are searching for ways to resolve the pressing concerns of the scholarly community and the academy's employees...

As you know, the pilot project pertaining to salaries in the system of the Russian Academy of Sciences has been completed. Just as we planned, the average salary now exceeds 30,000 roubles, and leading research institutes pay substantially higher salaries.

Unfortunately, we failed to carry out some of our plans related to the material and technical aspects of these projects, establishing shared centres and purchasing certain devices and equipment.

Mr Osipov has asked us to address this issue and we will keep in touch with him about this. We have agreed to keep this issue in mind and return to it when our budget situation improves. And I am sure it will improve.

Another pressing issue is the provision of housing. I believe that one way to settle this issue, and we have discussed it already, is to use the plots of land managed by the academy for the construction of new housing... Especially given that the academy currently has more than 330,000 hectares of land. And these are rather good plots of land.

The government has instructed the relevant authorities to study the issue and introduce the necessary amendments to the legislation. These amendments will stipulate the future developers' obligation to sell a portion of the flats to the academy's employees at affordable prices. I would estimate the price at 30,000 roubles per square metre.

Colleagues, in conclusion I would like to thank the management and the staff of the Academy of Sciences for the large contribution they have made to the development of Russia. I hope we will continue our cooperative and constructive work.

As far as I can see, my words about the housing issue sparked some interest. We can discuss this issue more thoroughly, both during this meeting and later, with Mr Osipov. The numbers I mentioned are rough estimates. Both subsidies and financial aid are possible. I believe that in

some special cases the academy, as supported by the government, can provide certain subsidies. All these possibilities can be discussed. The main thing is to begin the process."

In his report, President of the RAS Academician *Yu. S. Osipov* spoke about some important scientific results obtained in 2009, in particular, within the framework of all-Academy programs of fundamental research. He also considered problems and tasks of the Academy aimed at implementation of its innovative potential.

"In the field of **mathematical science**, fundamental results concerning major mathematical problems in extremal combinatorial theory and inverse problems of geometry were obtained at the V. A. Steklov Institute of Mathematics of the RAS and its St.-Petersburg Department.

At the S. L. Sobolev Institute of Mathematics of the Siberian Branch of the RAS, the J Seidel hypothesis on the volume of a hyperbolic tetrahedron formulated almost 25 years ago was proved. Although the explicit formula for determining the volume of this tetrahedron has been known since N. I. Lobachevsky's time, the problem resisted solution for long.

A unified positional control concept that couples the apparatus of the mathematical theory of optimal control and differential games with the classical methods of mathematical physics equations and generalized solution of the Hamilton—Jacobi type equations, and functional and non-smooth analysis constructions, was elaborated at the Institute of Mathematics and Mechanics of the Ural Branch of the RAS. This opens up new prospects for the construction of effective navigation and control algorithms in complex systems.

A new representation for discrete functions of variables (tensors) was created at the Institute of Computing Mathematics of the RAS. This served as the basis for unique methods of high-precision calculation of many-dimensional integrals and solution of elliptic equations with up to several thousand independent variables.

A version of the REACTOR package for the end-to-end calculation of the REACTOR+PROTECTION system on supercomputers was developed at the M. V. Keldysh Institute of Applied Mathematics of the RAS. Full-scale deterministic calculations for a fundamentally new innovative project of a LBFR (lead-bismuth cooled fast nuclear power reactor) reactor were carried out for the first time. The exposure dose rates for personnel residence areas were estimated, the activities of primary and secondary coolants were calculated, the gas evolution and radiation damage levels in the structure elements and in radiation protection were determined.

A banking system model was constructed and its parameters were evaluated using the data from RF Central Bank within the framework of the program "Intellectual information technology, mathematical simulation, system analysis, and automation" implemented at the

A. A. Dorodnitsyn Computer Center of the RAS. The model adequately reflects the response of Russian commercial banks to variations of the money demand, interests on credits and deposits. The calculations showed that by manipulating the Central bank credits and hard currency deposits, banks can make stimulating of the credits for manufacturers inefficient. It was found that under real economy conditions, for making rational decisions, banks need not accurately predict the future but need only know the current behavior.

A scheme of distributed interaction of highway telecommunication computer networks of science and education for Russia and Europe was designed and implemented, as a part of the all-Europe project GEANT, at the interdisciplinary supercomputer center of the RAS. The scheme ensures highly reliable information exchange between Russian and foreign scientific networks at a rate of 10 Gbps, which is especially important for the participants of the Large Hadron Collider project.

In the field of **physical science**, an outstanding result was achieved at the A. F. Ioffe Physical Technical Institute of the RAS. It was discovered at large red shifts that 12 billion years ago, there existed a cold rarefied gas cloud containing deuterium and hydrogen molecules. The new method was thus used to determine the ratio of the isotopes formed upon the primary nucleosynthesis: $D/H = 3.4 \cdot 10^{-5}$ and, on this basis, an independent estimate of the baryon density in the nucleosynthesis age and in the modern age was obtained. According to the obtained estimate, the matter that constitutes the visible portion of the Universe amounts to only about 4% of its critical density. Hence, the predominant part of the Universe is formed by "dark" matter and "dark" energy, which determine the global geometric properties and evolution of the Universe.

The highly important problem concerning the behavior of high-energy hydrogen isotope ions and α -particles in the fusion plasma was solved at the same Institute. An original gamma-ray spectrometric diagnostics of nuclear reactions involving high-energy particles was developed and successfully employed. The method was approved on the largest tokamak, JET (Euroatom), with active participation of the Institute. This diagnostics was included in the list of priority ones for the international fusion-type reactors.

A new concept of quantum glasses was proposed and the experimentally observed low-temperature anomaly of solid helium-4 rotation was interpreted at the P. L. Kapitza Institute of Physical Problems of the RAS. This phenomenon is due to so-called quantum effect of momentum deficit for two-level systems in a moving solid.

At the Institute of High-Current Electronics of the Siberian Branch of the RAS, experiments on generation of high-current relativistic electron beams in a plasma-filled rod pinch diode were performed on a multipurpose terawatt pulse generator in order to produce a radiographic

X-ray source. The attained parameters markedly exceed the parameters of analogs of X-ray sources based on vacuum diodes existing in the world. The key applications of the sources of powerful hard X-ray pulses are the radiography of explosion processes and testing of electronic facilities for radiation stability.

The generation mode of stimulated emission at the second stage of the free-electron laser, which is a unique source of coherent electromagnetic radiation with a rated range of wavelengths of 5 to 240 μm , was determined at the G. I. Budker Nuclear Physics Institute of the Siberian Branch of the RAS. As regards the average emission power, it markedly surpasses similar foreign facilities. Launching of its second stage considerably extended the range of multidisciplinary research carried out using unique laser emission.

Using the big alt-azimuth telescope of the Special Astrophysical Observatory of the RAS, an image of accretion white dwarf in the unusual symbiotic Cygnus supernova binary system was obtained for the first time. The system consists of a red giant and a hot companion, which is an accretion white dwarf. The orbital period (15.6 years) and the component masses (2.0 solar masses for the red giant and 0.7 solar masses for white dwarf) were determined. It was found that collimated gas outflow from the system does not coincide with the normal line to the binary star orbit plane.

The generation of toroidal magnetic field in accretion disks of semidetached binary stars due to the differential gas rotation was studied for the first time by numerical 3D-simulation at the Institute of Astronomy of the RAS.

The non-adiabatic resonance acceleration of ions in the area of closed magnetic field lines of the current sheath of the Earth magnetospheric tail was predicted theoretically and detected experimentally with the Cluster (European project) and Geotail (Japanese project) satellites at the Institute of Space Research of the RAS. Early acceleration of plasma particles was traditionally attributed to magnetic field reconnection. It was demonstrated in satellite experiments that several spatially localized sources of non-adiabatic ion acceleration may exist in the current sheath during quiescent geomagnetic periods. The accelerated ions form energy collimated and space-localized beamlets, which may be observable for as long as 20 min. The European Space Agency presented this result among the most important results within the bounds of the Cluster project.

At the P. N. Lebedev Institute of Physics of the RAS, N. V. Pushkov Institute of Earth Magnetism, Ionosphere, and Radiowave Propagation of the RAS, and the Polar Geophysical Institute of the Kola Scientific Center of the RAS, continuous observation of galactic cosmic ray fluxes by surface and stratosphere instruments resulted in the detection of the highest particle fluxes over more than the 50-year history of observations. In 2009, the previously

established highest level of cosmic ray fluxes was exceeded by 3% according to the ground-based data, while according to stratosphere-based measurements, the galactic flux of more than 100-MeV cosmic rays increased by 20%. The increase in the galactic cosmic ray intensity is related to the exceptionally low level of solar activity observed during the last three years. The discovered effect may be directly related to the climatic cooling probably expected in the near decades.

The scientists of physical institutes actively participate in launching of the LHC with support from the program "Experimental and Theoretical Investigations of Fundamental Interactions Related to the CERN Acceleration Complex."

As a part of the program "Extremal Light Fields and their Applications" for the GLONASS system, the Laser Physics Institute of the Siberian Branch of the RAS and the P. N. Lebedev Institute of Physics of the RAS optimized the parameters of the developed universal femtosecond optical clock, which allow working with any main optical frequency standards. This essentially enhanced the stability and reliability of clock operation.

In 2009, the institutes of the Division of **Nanotechnologies and Information Technologies** focused attention on the development of nanostructures with specified optical, electric, and mechanical properties; elaboration of the elemental base of optoelectronics by producing complex light-emitting structures by means of nanophotonic techniques; development of nanotechnology methods based on manufacture of integrated hybrid biocompatible nanostructures.

Thus a series of research and design works dealing with the development of the basic industrial process for the synthesis of semiconductor nanoheterostructures of compounds A₃B₅ (InGaAs/AlGaAs/GaAs on the GaAs surface) for the manufacture of discrete heterojunction microwave instruments and monolithic integrated circuits based on them were carried out at the St. Petersburg Science and Education Center of Physical Technology. These instruments are basic components for a broad range of modern super-high-frequency devices having enhanced radiation stability as compared with silicon-based devices.

According to the program "Grounds of Fundamental Research into Nanotechnologies and Nanomaterials", the Fiber Optics Scientific Center developed and studied for the first time bismuth-doped phosphogermanosilicate fiber light guides. Their optical gain spectrum covers the wavelength range of 1280–1550 nm; this is necessary for next-generation fiber-optics communication systems. These light waveguides underlay the design of an optical amplifier whose characteristics satisfy the application conditions in real communication lines and continuous fiber lasers with an output power of up to 10 W and efficiency of up to 50%.

The possibility of dislocation-free growth of III—V (or A3B5) whisker nanocrystals (WNC) (InAs, GaAs, AlGaAs, GaN) on the silicon surface was demonstrated for the first time at the St.-Petersburg Academic University, a scientific and educational center for nanotechnologies. Heterostructured whisker nanocrystals in a number of systems were designed (GaAs/AlGaAs, GaN/AlN и InAsP/InP). Intense photoluminescence (from the InAsP/InP WNC) with a uniquely narrow linewidth (0.12 MeV) was obtained. New theoretical models of the coherent growth of whisker nanocrystals and nanoneedles were constructed. The applications of WNC include light-emitting diodes and lasers, single-photon devices and nanosensors. The practical value is in the possibility of integrating WNC on the silicon surface with uniquely low number of dislocations.

Efforts of the Institute of Program Systems of the RAS, Scientific Research Computation Center of Moscow State University, and Tomsk State University produced a geographically distributed computing Grid system SKIF-Polygon, which combines a number of high-productivity cluster computer installations of major Russian universities.

Optimization of the topology of high-speed blocks of simultaneous and serial channels for the use in 64-bit microprocessors was carried out at the Research Institute of System Studies of the RAS. The topology of the electronic chip of a 8-channel switch RapidIO for the manufacture of unified multiprocessor systems was optimized. The results of simulation showed that exchange rates close to limiting rates can be attained and that the developed electronic chip can be used to design high-performance computing systems, including supercomputers.

Power engineering, mechanical engineering, mechanical science, and control processes. Aluminum microdoping followed by thermodeformation treatment gave high-performance anodes used as fuel in the air aluminum—air batteries. The anodes contain a twice lower amount of indium (0.3%), which reduces the cost of electric power generated in electrochemical generators by 25%. In some characteristics (polarization and corrosion), they surpass the best foreign analogs. This is the work of the Joint Institute of High Temperatures of the RAS.

The development of an effective power technology plant for cogeneration of electric power and synthetic liquid fuel from natural gas using a 1 MW gas-turbine generator set was completed at the same Institute. This plant substantially reduces the expenditure for the manufacture of synthetic liquid fuel as compared with traditional processes; the atmospheric emission of toxic nitrogen oxides was markedly reduced; the cost of the generated power decreased severalfold and hazardous emission was eliminated.

The G. M. Krzhizhanovsky Energetic Institute in collaboration with the Moscow Aviation Institute, the Institute of Cable Industry, the Joint Institute of High Tem-

peratures of the RAS, and the JSC Science and Technology Center of Electric Power Industry manufactured the first Russian and the longest European 200 m-long superconducting cable. Thus, Russia has overcome more than a 15-year lag from leading countries along this line and has now the third longest cable in the world. The superconducting power lines are cost-effective even today, and in the future, they may crucially change the structure of power engineering.

At the Institute of Continuum Mechanics of the Ural Branch of the RAS and the Southern Scientific Center of the RAS, a geomonitoring mechanics for disastrous geomechanical phenomena was developed. An automated monitoring system for the deformation behavior of vital engineering and building structures suitable for recording the state parameters of the structure was designed. The system is used for monitoring of a five-story apartment building in a risky karstic region.

New mathematical models for dispersion, precipitation, and size variation of particles of disperse phase were developed at the Institute of Problems of Safe Development of Nuclear Power Engineering of the RAS. They basically simplify and accelerate the simulation of these processes and analysis of the discharge of radioactive aerosols upon nuclear reactor accidents as compared with traditional methods.

Chemistry and materials sciences. The discovery of a new fundamental natural phenomenon — magnetic isotope effect — at the N. N. Semenov Institute of Chemical Physics of the RAS and the Institute of Problems of Chemical Physics of the RAS was an important event in world chemistry. The new isotope effect separates the isotope nuclei according to their magnetism rather than the weights. The magnetic isotope effect makes a large contribution to the isotope science in chemistry and related branches of science — geochemistry, cosmochemistry, molecular biology, biochemistry, and ecological chemistry. Great (differing by an order of magnitude) magnetic isotope effects have now been discovered in the enzymatic synthesis of adenosine triphosphate (ATP), the main molecular energy carrier in living organisms. New drugs stimulating the ATP synthesis in the cardiac muscle and special nanocontainers for the accurate targeted delivery of these molecular stimulants to the cardiac muscle were proposed. The ATP production in a living organism is doubled in the presence of the magnesium-25 magnetic isotope.

The photoreversible reactions of retinal-containing proteins triggered by 25-fs pulses were detected for the first time at room temperature. The photochromic properties of these compounds open up the prospects for the design of fast-response data processing devices. These studies were carried out at the N. M. Emanuel Institute for Biochemical Physics, N. N. Semenov Institute of Chemical Physics, and M. M. Shemyakin and Yu. A. Ovchinnikov Institute of Bioorganic Chemistry of the RAS.

The self-organization of acetylene and ketone molecules in the presence of superbases, resulting in the cascade assembly of complex heterocyclic systems, analogs of known insect pheromones, was discovered at the A. E. Favorsky Irkutsk Institute of Chemistry of the Siberian Branch of the RAS, which opens up absolutely new prospects for the organic synthesis of these important bioregulators from simple and readily accessible reactants.

At the N. N. Semenov Institute of Chemical Physics of the RAS together with the Russian Cardiology Scientific and Production complex, the drug oxacom based on iron dinitrosyl complexes was elaborated. This drug has prolonged hypotensive action (more than 1 hour upon single intravenous administration) and is meant for the treatment of hypertensive crisis. The drug has successfully passed pharmacological tests.

A new way of transformation of associated petroleum gas and natural gas to high-quality engine fuel under the action of accelerated electrons was developed at the A. N. Frumkin Institute of Physical Chemistry and Electrochemistry of the RAS within the bounds of the program "Chemical Aspects of Power Engineering". This ensures complete conversion of gaseous alkanes. In addition to the liquid engine fuel, 4 to 6% of hydrogen is formed.

Prominent results were obtained in the field of **biological sciences**. At the Center on Ecology Problems and Forest Productivity of the RAS, the conceptual grounds of the forest policy of the Russian Federation were formulated and the key trends of development of forestry legislation and perfection of the state regulations of forests were defined. The results were taken into account in the development of the "Strategy of the Development of the Forest Complex of the Russian Federation up to 2020". The technology and software for dynamic mapping of surface ecosystems with annual identification of large-scale changes in the structure of the plant cover of Russia were developed. In cooperation with the Institute of Space Research of the RAS, a new map of vegetation of Russia was constructed using the data of Terra-MODIS satellite survey with spatial resolution of about 250 m.

A number of unique peptide nootropic drugs of neuroprotective action having no world analogs were developed at the Institute of Molecular Genetics of the RAS. The innovation production of these drugs corresponding to the Good Manufacturing Practice (GMP) applied to the production of pharmaceutical products was organized. The production capacity fully satisfies the demand of the Russian Federation and currently allows exporting these pharmaceuticals to other countries.

As a part of the program "Fundamental Science for Medicine", a new strategy for selecting highly efficient antitumor agents was proposed at the A. N. Bakh Institute of Biochemistry of the RAS. The strategy is based on the use of the red fluorescent protein discovered in the RAS in 1999 and optical fluorescence tomograph designed at the

Institute of Applied Physics of the RAS. The procedure allows direct observation of the effect of existing or newly developed drugs on human cancer cells.

New mutations in Alzheimer's disease genes were detected and a test system for identification thereof was developed at the N. I. Vavilov Institute of General Genetics of the RAS. A cell model suitable for estimating the contribution of these mutations to development of the disease was proposed. This provides the basis for testing synthetic compounds as potential drugs against the disease suffered by one third of people above 80 years old.

The contribution of viruses to the formation of plankton biomass and their participation in carbon flows of plankton trophic chains were estimated for the first time at the I. D. Papanin Institute of Inland Water Biology of the RAS. The number of virus particles in natural waters amounts to tens of million per milliliter exceeding the number of bacteria by an order of magnitude. It was found, for example, that up to 50% of bacteria present in Volga water reservoirs are infected by viruses, their death rate caused by viruses reaching a half of daily production and, as a result, a considerable number of dissolved organic compounds and biogenic element compounds is evolved to water area. Thus, viruses have a considerable influence on the biogeochemical element cycle and the productivity and biological diversity of water ecosystems.

A unique computer system for planning experiments on the search of functional sites in the spatial structures of proteins was developed at the Institute of Cytology and Genetics of the Siberian Branch of the RAS. The base contains atom coordinates for 150 thousand sites of protein spatial structures. These results may underlie the development of new-generation antituberculous drugs.

In animals with total interruption of the spinal cord, the electric stimulation of the spinal cord below the interruption site combined with administration of agents stimulating the serotonin system can activate locomotor neuronal spinal networks and cause coordinated walking movements of limbs with full support of the body weight. The results obtained at the I. P. Pavlov Institute of Physiology of the RAS open up prospects for creating a new technology for rehabilitation of spinal patients by means of pharmacological and electric epidural stimulation of the spinal cord.

Earth sciences. The efforts of 49 institutes of 6 divisions of the RAS were joint to cover almost all major ore mining and gas and oil producing regions of Russia including the Arctic Region by research within the framework of all-Academy program "Scientific grounds of effective natural management, development of mineral resources, mastering of new sources of natural and industrial raw materials." A number of important results were obtained that considerably extend the raw material base of many scarce metals. A set of new resource-saving processes for recovery of valuable components from non-tradi-

tional types of ores and for industrial waste processing were developed. Some of the processes are already under way for industrial implementation (JSC Severstal, JSC Chelyabinsk Zinc Plant, Kovdor Mining and Concentrating Mill).

At the A. A. Trofimuk Institute of Oil and Gas Geology and Geophysics of the Siberian Branch of the RAS, the free gas, gas condensate, oil and oil-dissolved gas resources were estimated in the Jurassic and Cretaceous deposits of the South-Western part of the Yenisei-Khatanga trough and in adjacent areas. New prospective areas (to the south of the Vankor deposit and at the outskirts of the West Siberian basin geosyncline and the Yenisei-Khatanga trough from the Tanam to Messoyakh gas field). The geological models of the Jurassic and Cretaceous reservoirs were constructed. The structural maps of reservoir thicknesses, predictive sand deposit thicknesses, fluid trap thicknesses, and sand contents at the overlying beds of permeable regional reservoirs were prepared.

The total possible diamond reserves of the Siberian platform were evaluated and prospective areas in open primary and placer commercial diamond fields were distinguished at the Institute of Geology and Mineralogy of the Siberian Branch of the RAS. The predictive potential resources were estimated as 145 million cts. The general map of the possible diamond reserves of the Siberian platform was composed.

High-resolution (40×40) bathymetric survey of the Southern and Middle kettle holes of the Baikal lake over the area of 15 thousand km² was first carried out by the Limnological institute of the Siberian Branch of the RAS. An up-to-date bathymetric map with a 4 times higher resolution compared to the existing maps is being composed. A large number of new underwater structures were identified, which shed light on the geology of the lake. Baikal becomes one of the first deepwater lakes with thoroughly studied bathymetry of the depth zone.

At the Research Institute of Comprehensive Exploitation of Mineral Resources of the RAS, the scientific foundations were developed for the formation and functioning of integrated mine engineering systems for comprehensive development of mineral deposits using new integrated geotechnologies and closed cycle of full recovery, processing, and utilization of all types of rock during joint development of natural and technogenic ore deposits.

At the Institute of Earth Cryosphere of the Siberian Branch of the RAS in cooperation with the Institute of Monitoring of Climate and Ecological Systems of the same branch of the RAS, data on high stability of the permafrost zone were obtained and it was shown that full thawing of thick frozen strata as a response to external action may take place only over thousands of years. In the next 50–100 years, the permafrost zone may disappear only near its south border where it is formed by sparse islets, first of all, in the areas of intense technogenesis. The ob-

tained result is important for the design of new installations and estimation of the tolerance of existing installations in the permafrost zone.

The Institute of Geography of the RAS and the Pacific Institute of Geography of the Far-Eastern Branch of the RAS published a fundamental cartographic work — the Atlas of Kuril Islands. This gives for the first time detailed information on the natural-resources potential of the region, conditions of its development and use, population, economy, prospects of development, and on the position of Kuril Islands in the geopolitical and economic coordinates of the Asian-Pacific region.

Deep core drilling at the Elbrus western firn plateau 5150 m above sea level was carried out for the first time by the Institute of Geography of the RAS. A 40-cm layer of pyroclastic material was discovered in the core at 107 m depth, which could correspond to the tephra blowout of one of the Elbrus craters about 2000 years ago, which is consistent with the data obtained by geologists and geophysicists. No thawing on the glacier bed was found. The maximum thickness of ice on the plateau reaches 274 m. Glacier thickness and subglacial bed maps were composed.

The studies in the field of **social sciences** were concentrated on the problems related to the world economic crisis. Specific features, causes, and the size of the global crisis of unprecedented intensity, its signs in the key sectors of the world economy and in various world regions were analyzed almost in all institutes of the Division from different standpoints. Particular attention was paid to evaluation of the challenges and threats created by the world crisis for Russian economy and to elaboration of efficient anticrisis proposals. The development of the fundamental research lines was also in progress.

In the area of international relations, attention was drawn by the formation process of a new polycentric system of the world and strategic stability issues.

The prospects of long-term socio-economic development of Russia were thoroughly analyzed. Modernization problems and formation of innovation economy were the key issues.

Comprehensive investigation of the history and the current state of Russian philosophy were analyzed in the context of the key trends of development of the today's world philosophy. New procedures for measuring the subjective quality of life were elaborated, relationship between the structure of subjective quality of life and psychological weightiness characteristics were established. A large interdisciplinary study of the human rights problem was performed.

I would mention only several most important scientific results obtained in the Division. The scientists of the Far East Institute of the RAS completed publication of the Encyclopedia "Spiritual Culture of China" having no analogs in the world. The fourth volume deals with the historical thought, political and legal culture, and state

structure of traditional and new China. The fifth volume considers science, technological and military achievements of China, health care and education of this great country.

The collective monograph "New Stage of Development of the International Relations" was published. The authors consider the role and position of Russia and the USA in the formation of the polycentric world structure, demonstrate their influence on the current and long-term processes of international security provision, proposed the possible short- and medium-term lines of cooperation in the military and political areas.

The collective monograph "Innovative Development: Economy, Brainpower, Knowledge Management" appeared. Transition to the innovative economy is considered from the standpoints of various branches of knowledge including economy, management, sociology, psychology, jurisprudence, computer science, and computer programming.

At the Institute of Economy and Organization of Industrial Production of the Siberian Branch of the RAS, a scheme was proposed and a model apparatus was created for integrated predictions of the development of a particular region with optimization of its external and internal interrelations. The scheme was embodied for the Krasnoyarsk Territory as an example.

The first nationwide social studies of characteristic features of the mass consciousness and behavior of Russians under the influence of the global financial and economic crisis were performed at the Institute of Sociology of the RAS. The collective monograph "Russian Everyday Life Under the Crisis Conditions" was published.

The Philosophy Day organized by the Institute of Philosophy of the RAS under the aegis of UNESCO had international response. Almost all leading philosophers all over the world participated.

The section of economy played a key role in the organization and successful carrying out of the first Russian economic congress. There are grounds for believing that this will be the crucial event in the overcoming of the split of the Russian economic science.

It is joyful that strengthening of the international position of the social science of the Academy continues. This is indicated, in particular, by the high international rating of the Institute of World Economy and International Relations of the RAS and Institute of USA and Canada of the RAS, which got in the list of leading analytical centers of the world composed out of 5000 nominees.

Historical and philological sciences. A series of works devoted to important international events of the second half of the 1930s: the Sudeten crisis and the Munich conference, and their influence on the subsequent evolution of history appeared at the Institute of General History of the RAS on the occasion of the 70th anniversary of the beginning of the Second World War.

At the Institute of Russian History of the RAS, documents about the military operations of Red Army in West Ukraine and West Belorussia, circumstances of the war with Finland (northern war) were published.

The publication of the unique three-volume "Dictionary of Russian Writers of the XVIII Century" was completed at the Institute of Russian Literature (the Pushkin House) of the RAS. The fundamental value of this dictionary is determined by not only unprecedented coverage of authors (more than 900 articles of which more than 300 articles are in the third volume) but by the degree of detailing of each biography of both outstanding writers and forgotten men of letters.

A new edition of the "Russian Orthographic Vocabulary" (about 200 thousand words), which includes about 15 thousand of new units, namely, words, fixed collocations, proper nouns, and abbreviations was prepared at the V. V. Vinogradov Institute of Russian Language of the RAS. The new edition retains the former orthographic recommendations and establish the spelling of many new entries and also some known words that have not been included earlier in orthographic vocabularies. All of the words are supplied with marks of accent, grammar information, and, if necessary, indications of the meaning and pronunciation.

The publication of the fundamental work "Peoples of Russia. The Culture and Religion Atlas" by the N. N. Miklukho-Maklay Institute of Ethnology and Anthropology of the RAS was an outstanding event. The book contains up-to-date information about the peoples of Russia, their history, traditional culture, religion. Detailed maps provide the idea of distribution of the ethnoses, the abundances of the major confessions and traditional religions in Russia, which provides versatile knowledge of the diversity of the ethnocultural mosaics of the Russian society. This edition is actively used by the Ministry of Regional Development of the Russian Federation in practical work.

The publication of the three-volume research work "Archeology of the North Russian Village of the X—XIII Centuries: the Medieval Settlements and Burial Grounds at the Kubena Lake" was completed at the Institute of Archeology of the RAS. The paleoecological conditions of existence of a medieval rural settlement at the north of ancient Russia are considered: economy, life support, social organization, and culture of village communities. The results of studies of rural colonization and formation of cultural traditions in various microregions of the European North in the X—XIII centuries are outlined. The interplay of the medieval colonists and the natural environment during exploration of the microregion was restored.

A prominent discovery was made by scientists of the Institute of Archeology and Ethnography of the Siberian Branch of the RAS together with paleontologists of the Max Planck Institute for Evolutionary Anthropology

(Leipzig). A fragment of a finger phalanx of an ancient human was found at the Denisov cave in the Mountain Altai; the fossil mitochondrial DNA of this fragment differed considerably from those of both the contemporary humans and Neanderthals. This suggested the existence of a new human species (or subspecies) called Altai human.

An important achievement of Islam studies in Russia is the edition of the fundamental scientific biography of the prophet Mohammed in Russian.

A more complete list of outstanding scientific achievements of the Academy can be found in the published report of the Presidium of the RAS.

In conclusion, Yu. S. Osipov considered a number of serious problems in the existence of the Academy.

The financial situation has been hard this year. The budgetary funds at the disposal of the Academy were reduced by more than 5.5 billion rubles as compared to 2008. Since the wages and social transfers cannot be reduced (this is certainly right), it was necessary to considerably decrease the expenditures for materiel support of scientific research. In particular, the capability of the Academy to purchase equipment, consumable materials, and spare parts to instruments was reduced on average by 35%. We had to limit the size of financing of the all-Academy fundamental research programs. Of concern is the situation with provision of utility payments. V. V. Putin, who was informed of this situation, entrusted the Minister of Finance and the Minister of Education and Science with the task to propose appropriate measures. The Heads of all subdivisions of the Academy should thoroughly think over once again and correct whenever possible the consumption of budgetary and extra-budgetary funds.

Unfortunately, the financial problem is not the only one. Since autumn of the last year, the Academy has been obdurately and almost permanently attacked. It is repeated time and again that the Academic structure of science organization is inefficient and that the RAS is separated from the world scientific community. As alternatives, it is offered to transfer the fundamental science to higher school, to switch completely to grant financing of the research (by the way, this is not the case anywhere all over the world), to create special conditions for encouraging Russian scientists who live abroad to return here, and so on. The view that only those research groups that work at the highest world level are worthy to be financed has been aggressively peddled to the society. Lately, the stake is placed on opposing the "bureaucratic" highest ranks of the Academy to the "scientific masses" they unmercifully exploit, just as in the class struggle concept. The opponents even started using inadmissible (if not indecent) methods for discrediting some members of the Academy administration. In this situation, I consider it necessary to state the principled position of the RAS on these issues.

1. We are not inclined to whitewash the state of matters in the Russian fundamental science but absolutely do

not agree with the view actively introduced to the society according to which no serious science at all has been left in the country. We are sure that currently Russia still has a high research potential, although it was markedly lowered or even broken along some directions. The future depends on whether we will be able, in the next five to seven years, to remove the disproportion in the age structure of research personnel and ensure the material provision of the research work at the modern level. Unfortunately, the positive trends that formed in the 2000s were blocked by the crisis, I hope, temporarily.

2. All objective facts attest that today RAS remains to be the key scientific organization of the country and occupies a decent position in the world scientific community. This is well known to leading scientific organizations of the country and the world and surely to the key ministries and authorities of Russia. They all show keen interest in the transition to the new level of cooperation with the Academy. Academician A. F. Andreev will speak today about our international cooperation. Note by the way that about 45% of all Russian scientific publications come from employees of the RAS; meanwhile, these employees make only about 14% of all scientific researchers of the country.

3. It becomes more and more evident that the main problems that are to be solved to pass to the innovative economy are related to the demand for the results of scientific activity rather than to the supply of such results. Only in the last 5–6 years, one can clearly see the growing interest of large Russian companies in the cooperation with scientific research teams of the Academy. The last example is the promising beginning of large-scale communication with the company Rosneft.

4. The statement of our opponents that the RAS is too heavy a burden for the country does not stand up to criticism. Even today, which is far from good times, the Academy is quite economically rational as regards the allocated funds. Consider only one example, which seems illustrative (even for those who do not admit the obvious). I mean the discovery of the large Kola platinum metal province. This brought deposits with total palladium, platinum, and gold reserves of more than 350 tons to the state balance. Their cost corresponds to financing of the Academy over a 100-year period.

5. We by no means agree with the statement that fundamental research should be carried out only along the lines where Russian science is at the foremost position. Lagging behind is not a reason for termination of the studies and abolition of so-called inefficient scientific institutions but is the reason for taking measures aimed at overcoming this situation. In view of the strategic goals formulated for the country, fundamental science should cover a rather broad area. Only in this case, will Russia be armed at all points at any changes in the breakthrough avenues in science.

6. We are confident in the vitality of the key principles laid in the foundation of the structure of fundamental sci-

ence. I mean first of all making decisions concerning the priority lines of research and, hence, distribution of the resources allocated by the government for the research by the scientific community itself. Our research institutes are not a financial and economic overstory placed over the departments and laboratories scouring for grants but the key unit of the organization and for the research along the trends of modern science. They make decisions concerning the allocation of resources that they have got as a result of competition within the Academy.

This organization and financing of the scientific process ensures, among other things, most favorable conditions for integration of young people into science, formation and development of powerful scientific schools. We do not share the opinion stating that grant financing is a sign of modern science organization, while cost accounting (that is, a financial plan) is a sign of backwardness. As we know, grants often originate from primitive cutting the funds allocated by the government, while cost accounting may (and must!) provide a financial mechanism for implementing the results of sharp competition of scientific institutes for the assets. Of course, grant financing has its own niche, which is now adequately filled, in our opinion, by state foundations, first of all, the Russian Foundation for Basic Research and the Russian Humanitarian Scientific Foundation. This form imparts additional flexibility to the financing system and is the best for identification and support of both small-scale researches and the initial stages of potentially promising lines of research.

7. We are strongly against the idea of opposing the employees of higher school institutions and the employees of the Academy. We support the intention of the authorities to strengthen the university science but not at the cost of assets allocated to the Academy. The Russian Academy is ready to promote in every way the development of the innovative activity in the country and new forms of science organization. However, we are against the plans to form an alternative science in the country. This is not because we are afraid of competition but because under conditions of very modest financing of scientific research, this would lead to nothing but waste of resources and collapse of the existing effective research teams.

8. The Presidium is far from window dressing for the Academy; the 1990s took their toll: many self-administration mechanisms and competition in the Academy were disturbed or even destroyed. Everyday persevering work is needed to restore the normal system of planning and reporting, control of the efficiency of activity of research teams, strengthening of the labor discipline.

9. The state authorities and the Academy have a lot to do for creating the optimal conditions for implementing the potential of innovative activity of the Academy institutes. The problem of clean-cut delimitation of usages of the financial assets that arrive at the institutes along different channels is still to be solved. Until there is no proper

order in this point, the relations between the administrative authorities and the Academic community would retain some mutual suspiciousness. The authorities will think that we do not pay off the financing we get, and we will think that the authorities expect too much for the money they give. It is even more important to solve this problem because the fractions of off-budget receipts differ very much for different research areas and institutes.

The improvement of the grant system in view of the generally accepted world experience would also be useful. I mean switching to the rules at which grants are used not for paying extra wages to the grant recipient but for purchasing the equipment, materials, and for enlisting students and post-graduates. In this case, grants could become an important support in the development of scheduled projects and there would be no grounds for suspecting that a research fellow wishes to sell the same piece of work to the state several times. We understand that we must further improve the mechanisms of functioning of the Academy with allowance for Russian and world reality but also for the long-standing traditions of Russian science. The special Commission of the Presidium formed for this purpose will present considerations on this topic.

10. Finally, the last but not least. Today, as never before, it is very important to strengthen the corporate solidarity. This does not mean that on the ground of "danger from without", the employees of the Academy should not be free in expressing their opinions or criticizing the activity of the authorities. This means quite different things. Today it is hard for all of us and the temptation to follow the principle "sauve qui peut" is high. But this path can only ruin the Academy and Russian science as a whole. It is necessary to consolidate around common goals and interests. Together we will overcome. There were harder times."

Detailed communications concerning the report about the activity of the Russian Academy of Sciences in 2009 was presented by Chief Academic Secretary of the Presidium of the RAS Academician *V. V. Kostyuk*. After the discussion with participation of Academicians *A. F. Andreev*, *A. L. Aseev*, *V. V. Kozlov*, *A. A. Slavnov*, *V. N. Charushin*, *V. B. Betelin*, and *S. M. Aldoshin*, Corresponding Member of the RAS *A. M. Finkel'shtein*, Doctors of Science (physics and mathematics) *V. F. Vdovin*, the resolution on the Report was approved.

Then the highest award of the RAS, **The M. V. Lomonosov Big Gold Medal**, was presented to Director of the M. M. Shemyakin and Yu. A. Ovchinnikov Institute of Bioorganic Chemistry Academician *V. T. Ivanov* for outstanding contribution to the development of bioorganic chemistry and to Professor of the Nagoya University, a foreign member of the RAS, Noble Prize winner in chemistry *Ryoji Noyori* (Japan) for outstanding contribution to the development of organic chemistry and catalytic asymmetric synthesis. The winners presented scientific reports.

N. N. Bogolyubov Gold Medal was awarded to Academician *S. P. Novikov* for outstanding results in mathematics, theoretical physics, and mechanics.

D. V. Skobel'tsyn Gold Medal was awarded to Doctor of Science (physics and mathematics) *V. N. Gavrin* (Institute of Nuclear Research of the RAS) for outstanding contribution to the investigation of neutrino and to the discovery of neutrino oscillations.

P. L. Kapitsa Gold Medal was awarded to Corresponding Member of the RAS *V. F. Gantmakher* for the series of works "Collective Phenomena in Electronic Systems at Low Temperatures".

D. K. Chernov Gold Medal was awarded to Academician *E. N. Kablov* for the series of works "Heat-Resistant Alloys, Manufacture Technology of Single-Crystal Blades

with Protective Coatings for Aircraft, Power, and Energy Gas Turbine Units".

V. A. Engelhardt Gold Medal was awarded to Academician *G. P. Georgiev* for the series of works "Molecular Biology of a Tumor Cell".

I. M. Sechenov Gold Medal was awarded to Academician *P. G. Kostyuk* (posthumously) for the series of works "Calcium Signaling in a Nerve Cell".

S. M. Solov'ev Gold Medal was awarded to Corresponding Member of the RAS *S. P. Karpov* for the monograph "History of the Empire of Trebizond".

V. I. Dal' Gold Medal was awarded to Academician *N. Yu. Shvedova* (posthumously) for the series of scientific works on the problems of the lexical-grammar system of the Russian literary language and its semantic structure.
