

NATIONAL ACADEMY OF SCIENCES OF UKRAINE

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Main Results



B. E. Paton,
President of the Academy

The 2010 was a year of arduous intellectual endeavour for scientists of the National Academy of Sciences (NAS) of Ukraine. They made a significant contribution to the advancement of many cutting-edge areas of science and technology, to solving urgent problems of the national scope.

Last year saw important organizational and legislative activities of scientific and R&D policy. The State Agency for Science, Innovation and Information was founded within the system of central executive power bodies. Its principal tasks were defined as the formation and implementation of the state policy in the sphere of research, S&T activities, technology transfer, creating conditions for the development of information-oriented society.

On 9 September 2010, the Verkhovna Rada of Ukraine passed the Law of Ukraine "On Amendments to the Law of Ukraine 'On Priority Areas of Advancing Science and Technology'". This law established new principles of forming and implementing the system of priority measures to advance science and technology in Ukraine and approved those measures for a long-term period, namely out to 2020. Of great importance is the fact that one of its priorities is "fundamental research in the most important spheres of developing S&T, socio-economic, socio-political, and human potential to ensure Ukraine's competitiveness in the world and sustainable development of the society and the state". Academy institutions intensified their work towards updating their research subjects to follow this important direction of activities, as well as applied lines assigned by the law. Those cover information and communication technologies, power engineering and energy efficiency, rational nature management, advanced technologies of preventing and treating the most common diseases, novel substances and materials.

In the year under review, Academy's scientists obtained new results in many state-of-the-art areas of mathematics, information science, mechanics, physics, astronomy and radio physics, Earth sciences, materials studies, physics and technology problems of power engineering, chemistry and biology, in nuclear and radiation technologies. Institutions of social studies and humanities focused on issues of improving the efficiency of structural transformations in the economy, its integration to the international economic processes, overcoming crisis phenomena, formation of the civil society, national and cultural progress of the nation.

Of great importance for ensuring high scientific

standards of research were NAS targeted integrative programs. As of today, Academy institutions are carrying out 18 programs covering up-to-date areas of fundamental research and important applied spheres that are of high relevance for Ukraine. It should be emphasized that they enabled scientists to obtain truly significant research results which were instrumental in implementing top-priority lines of science and technology advancement, solving important national economy tasks. This concerns, first and foremost, such integrated programs as 'Fundamental Problems of Nanostructure Systems, Nanomaterials, Nanotechnologies', 'Problems of Operation Life and Safe Exploitation of Structures, Buildings and Facilities', 'Fundamental Problems of Hydrogen Energy', 'Strategic Mineral Resources of Ukraine', 'Fundamentals of Molecular and Cell Biotechnologies'.

Last year, scientists started to implement a new targeted interdisciplinary scientific program on sustainable development, regional nature management and environment conservation. The outcomes of integrated research under this program will also be of great importance for tackling such major problem as overcoming the impacts of the Chernobyl disaster, whose 25th anniversary will be marked this April. To commemorate this tragic date, the National Academy of Sciences planned and carried out a number of activities including international conferences, publication of monographs, honoring of people who participated in liquidating accident impacts, etc.

Among important lines of Academy's activities was improving research coordination in Ukraine, updating its subjects. A joint session of the Presidium of the National Academy of Sciences of Ukraine and the National Academy of Medical Sciences of Ukraine, and the Board of the Health Ministry of Ukraine determined the main lines of developing and deepening their collaboration, strengthening R&D potential, employing advanced organizational and economic mechanisms to introduce promising research outcomes in medicine.

A lot of attention was given to ensuring high standards of expert assessment of fundamental research subjects to be carried out by country's scientific institutions with state-budget allocations. A positive effect on the quality of this work was produced by the measures taken by the Academy to implement the Resolution of the Cabinet of Ministers of Ukraine of 28 October 2009, # 1182 'Improving the Efficiency of Coordinating Fundamental Scientific Research'.

A leading role in NAS activities was played by scientific backup to progressive transformations in the nation, the innovative development of its economy. Academy's specialists prepared the National Report 'New Course: Reforms in Ukraine 2010–2015', where they proposed a vision of strategy, ways and concrete mechanisms of implementing top-priority transformations, overcoming systemic crisis and leading the country towards the guidelines of dynamic growth. A joint session of the Presidium of the National Academy of Sciences of Ukraine and the Board of the State Agency of Ukraine for Investments and Inno-

vations, which was held in the January of 2010, identified the principal lines of advancing and deepening collaboration in the sphere of investments and innovative activities, creating a national innovation system to accelerate the shift of Ukrainian economy to innovative development principles. 8 state targeted programs that are important for updating nation's economy were carried out, the Academy being the governmental contractor for them. Significant results were achieved in implementing 58 R&D projects selected through competition. They aimed at developing information, nano- and biotechnologies, novel materials, methods of their joining and treatment, projects promising for use in machine building and instrument-making industries, fuel-and-energy sector, in the rational use of natural-resource potential.

No doubt, the availability of great intellectual potential and significant research achievements at Academy institutions calls forth their active involvement in the successful implementation of the economic reforms program scheduled for 2010–2014 'Prosperous Society, Competitive Economy, Efficient State' in general, and strategically important national projects in particular.

In this connection, the National Academy of Sciences of Ukraine has prepared analytical materials and concrete proposals on highly relevant issues of technologically upgrading some economy branches and fulfilling a number of major S&T projects to this end; those are to be considered by state authorities. The projects are concerned with employing information technologies, some elements of electronic government included; meeting economy's needs for novel materials; improving energy efficiency; advancing nuclear power engineering; developing fuel-and-energy and mineral-resource base; renovating the chemical sphere of the economy; technologies of health protection, including biotechnologies to produce up-to-date medical substances; providing the people with high-quality drinking water; modernizing and developing agri-business production; scientific backup to socio-economic modernization; using efficient humanitarian technologies in the spheres of public administration and social life.

Summarizing the innovative activities of the previous year, I would mention that Academy institutions fulfilled 4.5 thousand projects under contracts aimed at improving the engineering and technological standards of domestic manufacture. Nearly 1700 novel developments were produced and commercialized, among them being novel technologies, devices, equipment, materials, medicines, methods of disease diagnostics, prevention and treatment, technologies for intensive cultivation of agricultural crops, methods and agents for pest control, measures for conservation, reproduction and rational management of Ukrainian flora and fauna.

Yet, one has to point out that the quantitative characteristics of fulfilling orders of outside customers and commercializing novel developments are still below the pre-crisis level, so the NAS sections, departments and institutions have to improve their work towards practical use of research results.

Among positive achievements of the previous year

one should point out a rather high level of publishing activities of Academy institutions. They published over 870 academic books, including 650 monographs. Of those, 55 scientific monographs were issued by foreign publishers, and that was the best result in the last 15 years. Relying on their research outcomes, scholars presented nearly 26 thousand papers in specialized academic journals, 5 thousand of them being published in foreign ones. Issued were the first publications under new NAS projects 'Ukrainian Academic Books in Foreign Languages' and 'Academic Book. Young Scholars'.

The presentation of Academy's journals in leading international databases has also increased. All in all, current research works of our scholars were published in 86 academic journals, 1 popular-science magazine and 41 NAS proceedings. 19 Academy journals were published in English.

Still, a lot of problems remain to be solved in this sphere. Very urgent is the issue of broader representation of Academy's publications in the electronic medium, alongside with its cataloguing and unification in accordance with international standards. Primarily, this concerns periodicals and their electronic subscription.

Furthering international academic ties took an important place in NAS activities. Besides effective 109 (as of 1 January 2010) agreements, memoranda and protocols that had been concluded by the NAS of Ukraine with organizations of 48 countries, new ones were added – those with some research centers of Spain, China, Russia and Kazakhstan. In particular, the agreement on collaboration of the National Academy of Sciences of Ukraine and 'Kurchatov Institute' Russian Science Center was signed. It gave a boost to close co-operation in such top-priority areas as information-computing systems and networks; systems analysis and systems programming; optimization methods for tasks of trans-computational complexity; software for computing machines, databanks and databases; scientific fundamentals and use of information technologies in biology and medicine; nuclear physics and power engineering; plasma physics and controlled thermonuclear fusion; nanotechnologies. Regular competitions of research projects were organized jointly with Ukrainian Science and Technology Center, the Russian Foundation for Basic Research and the Russian Foundation for Humanities.

The demand of foreign enterprises, corporations and firms for applied developments of Academy institutions remains stable and high. In 2010 nearly 300 orders were fulfilled under their orders covering the development of information systems, manufacturing of magnetometric instruments, thermoelectric optical and radio physical equipment, application of welding technologies, development of thermal emission materials, development of technologies to obtain titanium powder products, supplies of hard alloy products, producing single crystals of synthetic corundum, scintillation materials and sensors on their basis, development of technologies and equipment for metallurgy, nuclear power engineering, organic compounds synthesis, polymer materials etc.

In the reporting year, the NAS of Ukraine gave

much effort to events related to the activities of the International Association of the Academies of Sciences (IAAS). The V Forum of Artistic and Scholarly Intellectuals of CIS member states was held on 14–15 October 2010 in Moscow with the active participation of IAAS, NAS of Ukraine in particular. Fruitful collaboration with the Russian Academy of Sciences (RAS) was going on. 2010 saw the start of the international scientific program 'Astronomy in the Elbrus Area. 2010–2014', initiated by the RAS and the NAS of Ukraine. The program involves 42 projects of fundamental, applied and prospecting studies that are carried out by 38 leading astronomy institutions of CIS countries.

The ties of Academy scholars with education workers were strengthened, the integration of research work with education process was given further impetus. About 30 new joint research-and-education structures – university departments, laboratories, branches, chairs – were set up on the basis of both Academy institutions and universities. Now as many as 120 such structures are functioning. The publication of over 70 collaborative academic monographs is another evidence of efficient intellectual collaboration.

The co-operation with the Taras Shevchenko Kyiv National University was furthered. A lot of work was done to find and support talented and gifted children; the Ukrainian State Center 'Junior Academy of Sciences' was organized jointly with the Ministry of Education and Science of Ukraine. Later, a Decree of the President of Ukraine awarded it the national institution status.

With a view to training specialists of new technology waves, it is necessary to found an education-and-research establishment of the academy university type. This establishment is to function within the NAS structure and provide training for master students in the state-of-the-art areas of science and technology on the basis of leading NAS institutions. It is worth mentioning that academy universities have been established and operate within the system of the Russian Academy of Sciences and the Academy of Sciences of Moldova. The efficient work of such an establishment in the Academy will, undoubtedly, facilitate the improvement in providing science workforce for the Academy, involving young people in research activities.

In general, the backup of young researchers has been taking an important place in Academy's activities. Through NAS initiative and efforts, a branched system of addressed state support to talented young people was set up, consisting in prizes, grants and scholarships of the President of Ukraine, the Verkhovna Rada and the Cabinet of Ministers. Nearly 350 young researchers of the Academy won those awards in 2010. Besides the all-Academy measures similar to the aforementioned ones, NAS institutions have also established prizes and scholarships named after outstanding scientists who had been their research associates in the past. Last year those prizes were awarded to nearly 100 young scholars.

It is to be pointed out that all these and other measures had their positive effect on the number of young

researchers employed by the Academy. This is seen in the follow-up analysis provided by the NAS Presidium since 1999. Over the period, the number of young researchers employed by the NAS of Ukraine has increased by 2.6 times, and there was a 2-fold rise in the number of young candidates of science. As of today, nearly every fifth NAS research worker is a young scholar, and every sixth candidate of science is under the age of 35. At the end of 1999 those indices were much worse – twice as low.

In the reporting period, permanent and persistent efforts were given to financial and logistical provision of scientific research. The 2010 results show that the general fund of the State budget allocated UAH 2.1 bn for the Academy, which is somewhat more than the 2010 budget, though those payments only amounted to 96.6% of the annual projections approved.

In the previous year, the salaries of Academy research workers were increased in accordance with the rise in minimal wages, the integrated research programs and studies under joint competitions were carried on, funds for new R&D projects and promising applied studies were allocated, and the purchase of unique import research equipment (though in somewhat smaller amounts) was continued.

In the year under review the amount of money spent by the Academy for purchasing instruments, equipment and materials rose, but it only amounted to 70% of that allocated in 2008. We were able to buy 5 sets of facilities for centers of shared use of research equipment. Now 90 such centers are hosted by 66 Academy institutions.

Unfortunately, as in the previous years, the funds for purchasing equipment were scarce. It is worth noting that 81% of all Academy's spending from the general fund of the state budget went to salaries and payroll tax. So, NAS institutions are to do all they can to attract extra-budgetary earnings, primarily those from contracted research.

Some steps were taken to upgrade the network of Academy's research institutions and organizations. NAS sections and departments analyzed the work of R&D institutions of the Academy, taking into account the amounts of their budgetary finance and the commercialization of their research results. In accordance with the results of this analysis, the NAS Presidium made concrete decisions on reorganizing a number of institutions whose personnel was small, and on mergers of institutions doing similar research, on liquidating institutions whose research subjects did not meet the modern trends in science advancement. Yet, it is too early to think that this work is over.

Summing up the activities of the National Academy of Sciences in the previous year, one can state that its creative teams did much for science advancement and pursuing research lines that are of high relevance for our nation. I am sure that the National Academy of Sciences of Ukraine will do everything it can for promoting research and S&T activities in Ukraine, for ensuring positive change in the life of our people.

Targeted-Program Framework for Solving Important Integrated Problems. International Collaboration



**A. P. Shpak,
First Vice-President of the
Academy**

Alongside with the traditional activities of the National Academy of Sciences of Ukraine, which aim at producing new knowledge and getting new insights into ways of nature, humans and society, its main statutory task is defined as the strengthening the effect of scientific results on the innovative development of the economy, education and culture in Ukraine. The latter, primarily, relies on problem-oriented approach to forming subject areas of research, its integration to international scientific programs and projects.

As of today, the development and implementation of novel science-intensive technologies is only possible through the adoption of targeted-program and interdisciplinary research. Interdisciplinary research employs a wide range of approaches: from mere information exchange to concept integration and interpenetration for addressing problems that are beyond the scope of any one research field.

The National Academy of Sciences has accumulated a positive many-year experience in forming and implementing both state and Academy programs in different areas. Here the top-priority is attached to implementing state targeted programs to ensure innovative development and deal with the major challenges facing the country. In 2010, NAS institutions were engaged in carrying out eight state targeted R&D programs; the Academy was assigned as their specifier. Quite a lot of significant results were produced.

Thus, the fulfillment of the tasks of the 'State Program of Fundamental and Applied Research into Using Nuclear Materials, Nuclear and Radiation Technologies in Economy Branches', planned for 2004–2010, resulted in developing and commissioning novel nuclear-physics equipment, advanced materials with the optimum ratio of strength and ductility. Scientists have acquired new knowledge that will be a major contribution to gaining the experience in developing new-generation nuclear reactors. Of great importance is the fact that they have already developed a technology that enables them to process solid radioactive waste into chemically stable insoluble matrix materials.

Research under the state targeted S&T program 'Development and Production of Sensor-Based Science-Intensive Products' permitted novel materials for sensor and detector devices to be produced. Technologies for manufacturing sensors, prevention and treatment of common diseases, developing analytical and information systems were perfected; diagnostic and monitoring complexes were produced.

The state targeted R&D program for implementing and using grid technologies, which was started in the reporting year, has yielded some results. The national grid infrastructure produced has combined over 3200 processor cores and more than 500 terabytes for information storage. It should be emphasized that grid technologies in the NAS of Ukraine are becoming a necessary instrument for solving scientific and applied problems in physics and astrophysics, nanotechnologies, biology and medicine, geophysics and economics. According to the results of the first competition within the state targeted R&D program 'Nanotechnologies and Nanomaterials', also started in 2010, financing will be provided for 120 projects which cover a wide range of studies that are relevant for advancing nanoindustry in Ukraine.

The participation of Academy institutions in other targeted programs is determined by the importance of those in terms of Ukraine transition to the principles of sustainable development, elaboration of the national strategy and methodology of environment conservation, determining the degree of man-induced damage to natural systems, the rational use of natural-resource potential at the national, regional, and local levels, providing the natural basis for human life. Important research was done under the State targeted program for integrated anti-flood protection in the basins of the Dnister, Prut and Siret rivers, the state program for sustainable development of the region of uranium ore mining and primary processing, the state 2003–2012 program for radiation protection and social security of the population of Zhovti Vody town, and the program for disposal of solid household waste. In this connection, I would stress that the involvement of Academy's specialists in a number of managerial activities that are within the competence of the NAS Academic Council for Environment and Sustainable Development was advantageous for the efficient coordination of respective research efforts.

Last year, the targeted-program approach to solving integrated and applied problems was also used for dealing with tasks of 18 NAS research programs. For example, new approaches to controlling the most common and the most dangerous human and animal diseases were developed within targeted integrated interdisciplinary program 'Fundamental Principles of Molecular and Cell Biotechnologies' due to employing advanced methods of molecular physiology, biochemistry and gene engineering; scientific fundamentals for formulating novel medical preparations, their therapeutic use, and effective systems of their delivery into the body are being developed. The implementation of another NAS targeted integrated program of fundamental research resulted in new knowledge in physics and chemistry of nano-sized systems, it helped develop cutting-edge technologies for producing nanomaterials and study their effects on living organisms and biological systems. Through the initiative of the NAS Academic Council for Environment and Sustainable Development, the NAS targeted integrated interdisciplinary program for sustainable development, rational nature management

and environment conservation has been started. During its implementation a concept of heavy-weight waste disposal has been elaborated, a system for collection and treatment of dump biogas for its further use has been worked out, and the possibility of intensifying the processes of water biological self-purification have been studied experimentally.

In 2010, some NAS targeted research programs were completed. Their outcomes were thoroughly analyzed at NAS Presidium meetings. In particular, this concerns the programs 'Problems and Prospects of Socio-Economic, Political and Legal Progress of Ukraine' and 'The Development of Intellectual and Spiritual Potential and Modernization of Science, Education, Culture and Government Spheres', whose results are implemented in the activities of state authorities of Ukraine, the Committee for Economic Reforms under the President of Ukraine, economic ministries and agencies.

The NAS targeted integrated research program 'Fundamental Problems of Hydrogen Energy', which was carried out in 2006–2010 and involved 28 Academy institutions, covered three main areas: hydrogen generation, hydrogen storage and utilization. It permitted scientists to solve a number of fundamental and applied problems of today's hydrogen energy and open up new prospects for further advancement of research, in particular that into scientific fundamentals of technologies, equipment and materials in this area.

The experience gained, including the achievements of the year under review, shows the high efficiency of research organization according to the targeted-program principle, demonstrates the advantages of focusing efforts on integrative interdisciplinary programs aimed at obtaining and introducing significant practical results – the development of technologies, recommendations, legal and normative documents.

NAS scientists took part in preparing scientifically validated proposals and observations towards solving numerous nature-conservation problems in Ukraine, in particular: observations and proposals to the draft National survey of technological emissions and their absorption by greenhouse gas sinks in Ukraine in 1990–2008, data on fulfilling the National plan of measures for implementing the Kyoto Protocol to the UN Framework Convention on Climate Change, proposals concerning the integrative approach to forecasting, preventing and minimizing possible losses, and alleviating the impacts of natural disasters.

The international collaboration organized by the National Committee of Ukraine for 'Man and Biosphere' (MAB) UNESCO Program has become an important element of those activities. NAS scientists took part in the 22nd session of the International Coordination Council on MAB Program, in preparing and holding the International Conference 'Global and Regional Climate Change'. Steps were taken to carry out in Ukraine the second stage of UNESCO project 'Studying the effect of climate change on the biodiversity structure in the Polissia region' as exemplified by

the 'Western Polissia' transborder biosphere reserve. Joint research of Ukrainian specialists with their Polish, Romanian, Slovak, Russian, Byelorussian and Moldavian colleagues for biodiversity conservation and sustainable development in transborder regions of the Eastern Carpathians, the Danube Delta, Western Polissia, the basin of the Desna River, the Ukrainian steppe zone enabled them to get deeper insights into those valuable natural landscapes and develop new approaches to their conservation.

Competitive projects fulfilled under joint programs with foreign and international organizations, namely, the Russian Foundation for Basic Research, French National Centre for Scientific Research, Scientific and Technological Center of Ukraine are implemented in the same areas as Academy's targeted programs. In that way they permit scientists to supplement and support studies in the defined top-priority areas.

It should be emphasized that annual extension of the regulatory framework of Academy's scientific ties enables our scholars to take part in numerous bilateral and multilateral projects, and involve new partners in joint research. Last year, agreements were concluded with some science centers of Russia, Kazakhstan, Spain, and the People's Republic of China. To further scientific and R&D collaboration with the Turkish Republic, a respective NAS Committee was set up after the visit of NAS delegation to Turkey, and lines of its activities were defined.

The year 2010 was rather fruitful in terms of extending Ukrainian–Iranian scientific and R&D ties. NAS representatives participated in the Week of Iranian Culture in Ukraine and identified priority spheres of joint research, as well as ways to enhance them in many science areas in the future.

The agreement on collaboration between the NAS of Ukraine and 'Kurchatov Institute' Russian Science Center, and setting up the International Innovation Center for Nanotechnologies of CIS Countries provides for joint applied research projects, with a view to commercializing their results and entering the common nanoindustry market, training highly qualified research personnel in the sphere of nanotechnologies. This, undoubtedly, is an important basis for successful implementation of respective state and NAS targeted programs in Ukraine.

Implementation of NAS Applied Developments: a Way to Renovating National Economy



**A. G. Naumovets,
Vice-President
of the Academy**

Scientists of the NAS Section of Physical, Engineering, and Mathematical Sciences carry out a wide range of scientific research aimed at developing and introducing new technologies and, ultimately, at enhancing the competitiveness of Ukrainian economy. Yet, insufficient financing of the NAS of Ukraine in recent years demands that the available resources should be concentrated in the most promising areas of research and developments, whose implementation would allow a real short-term or medium-term economic effect. With that end in view, the Academy, in parallel with implementing its own targeted scientific research programs, has initiated a number of state-supported targeted R&D programs. The ultimate goal is to organize the manufacture of hi-tech production, which would produce a positive impact on the Ukrainian economy by reducing its dependence on import supplies, creating new jobs, and enhancing Ukraine's export potential.

In particular, NAS researchers have been fulfilling the state targeted R&D program 'Development and Commercialization of Energy-Saving Light-Emitting Diode Sources and Lighting Systems on their Basis' since 2009. The main task of the program is to develop and organize the manufacture of light-emitting diode sources, whose energy consumption can boast a 8–12-fold reduction as compared to that of incandescent lamps. The application of light-emitting diodes would provide a considerable economic effect and give a boost to some branches in mechanical engineering, chemical and electronic industries. When implementing the program in 2009–2010, specialists of NAS research institutions and those of numerous industrial enterprises developed the principal mechanic, optic, and electronic units. A pilot batch of first Ukrainian light-emitting diode lamps was produced. Their manufacture, however, still needs imported elements. The construction of a Ukrainian factory that would produce powerful light-emitting diodes for lighting equipment with the participation of foreign partners is under consideration now.

Among the top-priority programs fulfilled by NAS scientists also is the state targeted R&D program 'Start of Chemical-Metallurgy Production of Pure Silicon in 2009–2012'. The program aims at creating an integrated S&T infrastructure for the fabrication of pure silicon to manufacture hi-tech produce on the basis of domestic mineral and raw-material resources. In 2010, the main efforts were given to the development of an industrial technology for concentration of quartz raw materials, the development of technologies for

producing pure silicon, smelting of polycrystalline ingots, growing single crystals, and fabrication of solar energy cells. Future promise of the program is confirmed by the active interest that private investors are showing to it. In particular, private investments of about UAH 879 million have already been involved in the program to resume manufacturing at the 'Zavod Napivprovodnykiv' ('Semiconductor Plant') PLC in Zaporizhzhia.

One of the major interdisciplinary research areas at Academy's institutions is R&D activities in nanotechnologies and nanomaterials. Since 2010, scientists of 40 NAS institutes have been engaged in 120 scientific projects to fulfill tasks and plans set by the state-financed targeted R&D program 'Nanotechnologies and nanomaterials' for 2010–2014. The purpose of the program, which is carried out in collaboration with the institutions of the Ministry for Education and Science, Youth, and Sports of Ukraine, is the creation of nanoindustry through developing its industrial and technological infrastructure, applying the research results obtained, and training skilled personnel. Even in the first year of program implementation, promising results were obtained, which may form the basis for state-of-the-art technologies that keep good promise of commercialization.

Besides, scientists of the NAS of Ukraine purposefully work at preparing major innovative projects. In particular, Academy's researchers developed a number of ready-to-use projects to manufacture boiler units that burn high-ash coal; fabricate sapphire single-crystal substrates for light-emitting diodes; develop multi-purpose neutron source based on a subcritical assembly driven by an electron accelerator; implement technologies of drilling super-deep and directional boreholes for degasification of mine fields, methane and shale-gas recovery; direct iron production; obtaining radio isotope-based products; manufacturing portable equipment for early diagnostics of tumors and inflammatory diseases, relying on contact digital thermography; and mobile x-ray fluorographic units. The implementation of the abovementioned large-scale tasks is to become an important factor on the way to modernizing the Ukrainian economy.

Targeted-Program Planning of Research in Cutting-Edge Areas of Biology



**V. D. Pokhodenko,
Vice-President
of the Academy**

Over the past 10 years, the National Academy of Sciences of Ukraine has been making wide use of targeted-program planning of research projects under targeted integrative programs tackling problems in highly relevant areas of modern science and technology.

One of the first such programs was the integrated program of fundamental research 'Studies in the Field of Sensory Systems and Technologies' (approved by the resolution of the NAS Presidium of 1 July 2003, # 404), which was worked out by the NAS Section of Chemistry and Biology. Due to their high sensitivity, selectivity and usability, sensory systems are extensively used in nearly all spheres of human activities. Research towards the development of biosensors for medical diagnostics, ecology, and food industry played an important part in that project.

Due to joint efforts of biologists, chemists, and physicists, some fundamental problems were solved, namely: the search for promising novel biological and chemical structures to be used as sensitive elements of biosensors; improvements of physical converters which transform a signal generated by the selective element into an electrical one; the development of effective ways to combine biological/chemical structures with the abovementioned converters; and, finally, highly sensitive recording of the generated signals. During the implementation of projects under that program, certain laboratory prototypes of biosensor and chemosensor devices were developed, as well as optimal algorithms for analyzing the results obtained.

The program was continued in 2007, this time under a more concrete title: 'Sensor Systems for Medical, Ecological, Industrial and Technological Needs' (the NAS Presidium resolution of 31 January 2007, # 23). The primary task of this program was to select sensor prototypes (among those developed earlier), which were in the highest demand and met the requirements of practical use. Besides, working prototypes of devices were to be developed, which would be ready for practical application in express analysis in biotechnology, medicine, ecology, and in the control of industrial technological processes. The Academic Council for this program determined its top-priority targets up to 2012: special attention was to be focused on testing the devices developed under real conditions and on providing their metrological maintenance and standardization.

In parallel with implementing those programs, the integrated project of fundamental research 'Novel Medico-Biological Problems and Human Environ-

ment' was started in 2004 (the NAS Presidium resolution of 21 January 2004, # 6); this project was completed at the end of 2009.

The aforementioned program yielded a number of major scientific and applied results. For example, *Corvitin* and *Flokalin* cardioprotectors were introduced to medical practice; the *Metovitan* hepatoprotector was developed and preclinically tested; a commercial prototype technology was worked out for producing vitamins of the *Kalmivid* group (applicable in the treatment of bone tissue diseases); biologically inert polymeric stent coatings (used for the treatment of cardiovascular system pathologies) were also developed.

In general, this program allowed researchers to address and solve a wide range of urgent medicobiological and ecological problems, to get deeper insights into fundamental issues, and to provide preconditions for advancing novel technologies in important areas of human life.

So, in order to combine research efforts of leading NAS institutions, ensure the mutual enrichment of their achievements and exchange of experience, the NAS Presidium, taking into account the top priority of studies in novel biotechnologies and the importance of technological innovations for industrial practice, approved the target integrative interdisciplinary research program 'Fundamental Principles of Molecular and Cellular Biotechnologies' (the NAS Presidium resolution of 7 July 2010, # 222). The program was developed by the NAS Section of Chemistry and Biology. Among its principal objectives are the intensification of fundamental research in molecular and cellular biotechnologies, consolidation of efforts of scientists working in this field, efficient use of material and financial resources, and improved coordination of research activities.

The implementation of this program is to ensure further progress of Ukrainian biology in accordance with international trends in science advancement and be instrumental in the practical use of innovative biotechnologies to meet the needs of today's medicine, agriculture, pharmaceutical and food industries, and to preserve genetic resources.

To summarize, the many-year experience of implementing the above mentioned targeted programs proved the advantages and high efficiency of the targeted-program research planning as the method that allows personnel, material, and financial resources to be accumulated for solving problems of the highest scientific relevance.

Modernization and Reforms: Contribution of Academy's Socio-Humanities to Dealing with Major Challenges for State and Society



**V. M. Heyets,
Vice-President
of the Academy**

In the life of this country, 2010 was marked with a decisive launch of systemic reforms designed to radically upgrade the country and put it into the circle of most developed countries in the future. Academy's Socio-Humanities do not stand aside those processes. Based on the new, modernizing and reforming paradigm of country's development, NAS Socio-Humanities Section in 2010 focused its efforts on elaborating the conceptual vision of a fundamentally new course of urgent modernization in Ukraine, its specific targets and mechanisms.

This work was carried out by the Section under NAS targeted integrated research programs 'Problems and Prospects of Socio-Economic and Political-and-Legal Development of Ukraine', 'Development of Intellectual and Spiritual Potential and Modernization of Science, Education, Culture, and Administration Spheres' (both programs were completed last year), as well as 'Projections and Models of Social and Socio-Cultural Transformation of the Ukrainian Society in the First Quarter of the 21st Century' and 'Integration into the Global Community and Strategic Challenges for Ukraine'.

Due to the implementation of those programs, significant theoretical and applied results for a number of scientifically and socially relevant problems were obtained. In particular, the NAS National Report 'New Course: Reforms in Ukraine. 2010–2015' (2010) was prepared. This report is both a strategic and practice-oriented document that outlines principal trends and mechanisms of reforms in political, economic and cultural spheres.

As a part of the tasks and measures of the State Program of Economic and Social Development of Ukraine for 2010, the Section organized its work towards drawing up the Concept of Humanitarian Development of Ukraine till 2020 as a strategic document that is to define basic objectives of state policy in respective spheres of human development in Ukraine and ways to fulfill them in relation to global trends of human development.

Significant results were achieved in scientific backup to socio-economic changes. The NAS Department of Economics analyzed the causes and effects of financial crisis in Ukraine; its major trends in public finances, banking, stock market and foreign trade; the lines of state policy to stabilize the economy in 2010–2011, based on strengthening the banking system, improving tax and expenditure rationalization. A series of analytic materials on tax reform and the development of Tax and Budget Codes were pre-

pared for the Administration of the President of Ukraine and the Cabinet of Ministers of Ukraine. General principles of working out and implementing pension reform measures were elaborated, their possible negative impacts were determined, a series of steps for their prevention or mitigation were proposed. Scholars worked out the draft Law of Ukraine 'On Introducing the Cumulative System of State Pension Insurance' and amendments to the Law of Ukraine 'On Living Wage'.

A considerable success was achieved in scholarly maintenance of political and public-law reforms. The NAS Department of History, Philosophy and Law validated the necessity, trends and specific ways to modernize the political system in Ukraine, relying on systemic internal and external factors of political change. A political-prediction analysis of the political situation in Ukraine was made. Conclusions and proposals for further deepening of the conceptual foundations of developing the state and law were formulated and validated, as well as those for adapting sources of law in Ukraine to the EU legislation. Department's scholars elaborated the draft Law of Ukraine 'On the Verkhovna Rada of Ukraine' and a bill providing legal regulations of lawmaking by the Cabinet of Ministers of Ukraine; they defined the concepts, content, types of legal guarantees of rights and lawful interests of Ukrainian citizens, as well as mechanisms for their implementation.

Important results were obtained in providing the backup to the upgrading of socio-humanitarian space of Ukraine. The NAS Department of Literature, Language and Art Studies revealed the crucial role of culture, science and education in shaping a personality with innovative thinking, who can deal with the most difficult today's challenges. Its scholars produced methodological recommendations to work out state and public programs for enhancing the society's intellectual and spiritual potential in the formulation and implementation of projects aimed at socio-economic and cultural progress. The 'LEXICA-SLAVICA' computer distributed system of the all-Slavic lexicography was created.

The research results obtained are extensively introduced in the practical work of higher authorities of Ukraine, the Committee on Reforms under the President of Ukraine, socio-economic ministries and departments, and in the social, educational, informational spheres.

In the future, the Section will continue its in-depth studies of the major challenges for the state and society within the new NAS targeted integrative research programs in socio-humanities: 'Modernization of Ukrainian Society and Economy in the Context of 21st-Century Challenges' and 'Humanitarian Technologies as a Factor of Social Transformations in Ukraine'.

Activities of NAS General Meeting and Presidium



**A. G. Zagorodny,
Chief Scientific Secretary of
the Academy**

In 2010, the General Meeting and Presidium of the National Academy of Sciences of Ukraine focused their work on ensuring the advancement of research and its efficient coordination in top-priority areas of science and technology, more active involvement of Academy's scholars in dealing with important challenges of the national scope, their further integration to education and the international scientific community.

The annual session of the NAS General Meeting was held on 13 May 2010 and attended by the Prime Minister of Ukraine M. Ya. Azarov, the Vice-Premier V. P. Semynozhenko, the Minister of Education and Science D. V. Tabachnyk, presidents of the national specialized academies of sciences, heads of ministries and agencies, representatives of Academy institutions, scholarly community, mass media and foreign guests. It summarized Academy's work in 2009 and outlined top priorities in enhancing the efficiency of its further activities.

The report of B. E. Paton, Academy President, and its discussion showed that despite problems caused by the world financial and economic crisis, scholars worked hard for science advancement, deepening its influence on positive transformations in socio-political, socio-economic, scientific and technological spheres, and achieved significant research results of fundamental and applied nature. M. Ya. Azarov, the Prime Minister of Ukraine, read the address of V. F. Yanukovych, the President of Ukraine, to participants of the NAS General Meeting. He also made a speech, where he outlined the socio-economic situation in the country, Government's work towards solving the most urgent problems and called scientists and scholars for active cooperation in implementing the program of structural reforms.

The Academy's President NAS Academician B. E. Paton presented the highest award of the Academy – the V. I. Vernadsky Gold Medal – to NAS Academician V. O. Marchenko for his outstanding achievements in functional analysis and mathematical physics, declared that professor Jean Bourgain, a foreign scientist, was honoured with this award for his breakthroughs in the theory of harmonic analysis, ergodic theory, and the theory of numbers. He also handed diplomas to winners of prizes named after outstanding scientists of Ukraine.

Before the reporting session of the Academy General Meeting, NAS academicians and corresponding members were elected by the Department of Earth Sciences, as were new members of the Academy Presidium.

Last year, two sessions of the NAS General Meeting were held to mark the jubilees of prominent NAS scientists. At the jubilee session of 12 October 2010, the scientific community commemorated the 80th anniversary of V. I. Trefilov, an outstanding scientist in physics and materials science, research organizer, a statesman and public figure. A session of the NAS General Meeting was also held on 12 November 2010 to honour the 100th anniversary of G. S. Pisarenko – a famous scientist in mechanics and strength of materials, science manager and education leader.

In the year under review, the NAS Presidium, as before, attached great significance to the current status and development prospects of fundamental and applied research. Thus, it heard scientific presentations on advanced mathematical methods of moving objects control; issues of developing software for supercomputer systems; methodological foundations for analyzing the state and controlling the integrity of main pipelines; regional climate change in Ukraine; analysis of primary pain mechanisms and their pharmacology; studies of the genes of the most common hereditary human diseases; current issues of studying medieval landmarks in Ukraine. The NAS Presidium summed up the implementation of some integrative research programs and outlined prospects of further studies in respective areas.

The NAS Presidium attached top priority to improving scientific research coordination. Measures were taken to ensure the efficient work of the Inter-Agency Council for Assessment of Fundamental Research Subjects and the Council of the Presidents of Academies of Sciences. The joint session of the Presidiums of the NAS, the National Academy of Medical Sciences, the Board of the Health Ministry was an important event that determined principal lines of collaboration, more active joint use of S&T potential.

In the reporting period, the NAS Presidium placed an emphasis on scientific backup to progressive transformations in the state, and innovative development of the economy. It considered the principal points of the National Report 'A New Course: Reforms in Ukraine in 2010–2015', prepared by scholars of the NAS. The document proposes a new vision of the strategy, ways and mechanisms of transformations aimed at overcoming the systemic crisis and leading the nation towards guidelines of dynamic growth.

The NAS Presidium also considered issues of strengthening ties of Academy's scientists with education workers, training the young generation of scientists and their anchoring in at Academy institutions. A collaboration agreement was signed with Taras Shevchenko Kyiv National University; the Ukrainian State Center 'Junior Academy of Sciences of Ukraine' was set up jointly with the Ministry of Education and Science of Ukraine.

The NAS Presidium and its Bureau took persistent steps to improve the network of Academy institutions and organizations. State certification of all its research institutions was carried out, and a number of inefficient institutions, organizations and production facilities were liquidated or reorganized.

Mathematics

A. M. Samoilenko,
Academician-Secretary
of the Department

In 2010, scientists of the institutions of the NAS Department of Mathematics carried out important fundamental research and obtained a series of whole new results in major branches of mathematical sciences.

Experts in differential equations and dynamic systems investigated the behavior of solutions of the equivariant autonomous system of differential equations under external perturbation. Parameters were described, for which the synchronization of the external force frequencies and modulated wave solutions of the perturbed system occurs. Criteria for the absolute stability of solutions of a broad class of discontinuous dynamical systems were obtained. Conditions were established for the unique solvability of boundary-value problems with mixed boundary conditions for linear and weakly nonlinear hyperbolic equations with variable coefficients. The fractal dimension of global attractor was determined for the Kirchhoff wave model with nonlinear stiffness. The equation of evolution of thin capillary films with nonlinear reverse diffusion was investigated.

In the field of mathematical physics and functional analysis, the construction of the theory of the strong Hamburger moment problem was completed. Researchers obtained estimates that characterize the accuracy of the reconstruction of generalized eigenfunctions of the Schrödinger operator in the case where scattering data or the spectral function are known only on a finite interval of values. The existence of global weak solutions was proved for initial boundary-value problems for the Navier–Stokes–Fokker–Planck system of equations that describes the dynamics of the strongly dispersed suspension of solid particles in a viscous incompressible liquid. The theory of analytic semi-groups of linear operators in the Banach space was developed, and solutions of deterministic evolution systems at singular points were described on its basis. A solution of the Dirac equation was obtained for the neutron that moves in the electromagnetic field induced by a charged wire with direct current. Properties of orthoscalar systems of subspaces and configurations of subspaces in the Hilbert space were studied.

In the field of the theory of functions, scientists proved that, for a function analytic in a bounded domain and continuous in its closure, the moduli of continuity on the boundary of the domain and in its closure coincide. Theorems on the existence of homeomorphic solutions of the degenerate Beltrami equation with integral restrictions on the complex characteristic were proved. The convergence of Fourier–Jacobi

series in the spaces of functions integrable with weight was established in the case of unbounded Lebesgue constants.

In probability theory and mathematical statistics, the problem of large deviations was solved for random evolutions with independent increments in the scheme of asymptotically small diffusion. Algorithms were constructed for calculating the exponential generator of large deviations for Markov random evolutions. A limit theorem was proved for the number of crossings of an arbitrary level by a sequence of diffusion processes in the case where the local limit theorem is not true. Central limit theorems were proved for matrix elements of functions of random matrices that belong to Gaussian orthogonal and unitary ensembles for differentiable test functions with bounded derivative.

In geometry and topology, the values of global Morse numbers for non-simply connected cobordisms were calculated. A comparison theorem was proved for the angles between normals to the hypersurface and geodesic lines that enter a point of the hypersurface.

Algebraists described cubic rings over a discrete valuation ring and nodal Noetherian algebras. Groups that are not generated by primary non-normal subgroups were described. Cell-triangular and cell-diagonal factorizations of cell matrices over the rings of principal ideals were described.

In the field of mathematical problems of mechanics, expressions were obtained for hydrodynamic coefficients of the mathematical model of nonlinear oscillations of liquid in tanks shaped as truncated circular cones; their numerical realization was carried out. In the theory of motion stability, the separation of coordinates into stable, asymptotically stable, and unstable ones was proposed, and the theorem on separation of unstable variables was proved. For an axisymmetric stationary temperature field, exact solutions of boundary integral equations were found in the case where the right-hand sides are polynomials. The optimal control and an algorithm for the solution of a two-dimensional problem on heating a parallelepiped under the deformation of material were found.

In the field of mathematical modeling and computational and applied mathematics, a method was constructed for an approximate solution of the two-point nonlocal problem for an evolution equation with unbounded operator coefficient in the Banach space. The complete system of equations of the nonlocal gradient-type model of mechanical, heat, and electromagnetic processes was obtained.

Under the supervision of scientists of Department's institutions, 12 doctoral-degree theses and 39 candidate-degree theses were defended. 12 monographs and 14 textbooks were published (including four monographs issued by foreign publishers). 767 scientific papers were published (more than a third of them were issued abroad). Institutions of the Department were organizers and co-organizers of 21 international and all-Ukrainian scientific forums.

Information Science



A. O. Morozov,
Acting Academician-Secretary of the Department

In 2010, scientists of the NAS Department of Information Science obtained a number of new important research results. In particular, they developed methods for mathematical modelling of dangers to the security of humans, society and the state as decompositions of the general problem of multifactor-risk analysis. Principles of interactions and relations among elements of the national security system were determined.

A classification of systems with repeated calls was proposed alongside with methods to investigate conditions of their durability under general laws of distribution of their main time performances.

For information-analysis systems of the 'situational centers' type, new models were proposed as well as methods to solve problems of environment improvement by forecasting the emergence and development of social, technotronic and environmental hazards.

Relying on the results of supercomputer analysis of spatial groundwater dynamics in 1942–2009, scientists estimated groundwater resources in the Kyiv industrial-and-urban agglomeration.

A modelling system was developed, and real-time modelling of spring floods in the Dnieper reservoir system was performed.

Relying on the difference inclusions apparatus for describing dynamics of a family of nonlinear discrete systems, scientists constructed a discrete analog of Lyapunov theorems and obtained constructive sufficient conditions of asymptotic durability 'in the domain' of the family of wide-class nonlinear systems.

Principles of designing laser stations for superdense recording were proposed.

A mathematical model was produced to investigate filtration consolidation processes in deformed saturated porous environments under the action of geochemical factors of underground leaching.

A prototype of trace generator capable of generating text scenarios in the MSC engineering modelling language and tools for specifying test objectives were developed.

A formalized ontological model of expert profile was proposed, as well as a method of using organization ontologies, to form the specialist assessment domain.

Mathematical models and software were produced for evaluating characteristic vectors of video and photo images to solve problems of classifying mimic expressions and emotional states of the human face.

Scientists developed models of sustainable deve-

lopment processes in the context of human life quality and safety. Systems of evaluating sustainable development indices were formed, alongside with methods to assess countries' vulnerability to the impacts of aggregate global threats.

A new variational method was developed to solve the problem of estimating states of dynamic systems, relying on approximate and incomplete data over the sliding interval.

Conditions of the convergence of standard algorithm of non-cumulative learning of neuro-grid models with one buried layer in nonstochastic environment were determined.

Researchers worked out a formal-algorithm model of synthesizing key-domain design of SQL-like database for an arbitrary knowledge domain. A multi-criterion method for analyzing risks of information security violation was developed.

To prepare a space experiment onboard the Russian Segment of the International Space Station, theoretical research of transient phenomena during directional crystallization was carried out. A mathematical model of impurity segregation process was developed, as well as respective software that enables scientists to study transient crystallization of binary alloys.

Models and technologies for balanced development of domestic electronic learning technologies were worked out.

Department's scientists proposed a class of unifying models that integrate the capabilities of intelligent information technologies for recognizing biological and physiological signals with those of image-based thinking. These enable them to develop efficient electronic technologies for wide clinical use in medical diagnostics and treatment.

Methods were worked out to identify point contamination sources as isotope mixture in porous environments, taking into account their age structure and inhomogeneity of the study area.

Specialists developed and prepared to industrial use novel intelligent technologies for recognizing images and continuous speech, for processing textual knowledge.

A concept, architecture and software algorithm for high-end intelligent parallel computer based on graphic processors was worked out.

A method of linear spatial transformation of multi-user system was proposed and a scheme was developed to optimize transmission power of multi-antenna transmitter.

The state R&D program 'Image Computer' was completed. It resulted in the development and commercialization of numerous unique devices and systems.

On Department's initiative, the basic discipline 'Technology of distributed systems and parallel computations' was included in the branch standard of higher education; it provides an insight into supercomputer technologies.

Mechanics

A. F. Bulat,
Academician-Secretary of
the Department

In 2010, scientists of the NAS Mechanics Department obtained a number of new important results.

Researchers of the NAS S. P. Timoshenko Institute of Mechanics discovered the effect of physical and mechanical parameters of skins and the piecewise homogeneous filler on the stress-strain state of sandwich shells of revolution under nonstationary loading. Within the framework of piecewise-homogeneous body model, the effect of structural, geometrical and physico-mechanical characteristics of laminated coatings on the stability of their equilibrium state was studied under biaxial loading.

The investigation of elastic deformation of thin and non-thin anisotropic non-homogeneous shell structures was carried out; it relied on discrete-continual approaches based on classical, refined and spatial theories. The results obtained (displacements, stress fields, and dynamic characteristics) can be used to estimate the strength and reliability of structure elements.

Numerical methods were elaborated to solve boundary-value problems of thermoplasticity on the basis of constitutive equations that take into account the kind of stress state; the experimental verification of similar thermo-visco-plasticity equations was carried out.

Time continuous-discrete nonlinear systems were investigated. The instability conditions of unperturbed motion were found, and conditions of exponential stability of dynamic equations on time scales established.

Peculiarities of nonlinear dynamic deformations of cylindrical shells with flowing liquid under external periodic radial loading were revealed.

The Institute of Technical Mechanics, operating under the NAS of Ukraine and the National Space Agency of Ukraine, relying on the outcomes of its experimental and theoretical studies, developed and manufactured pilot versions of burners for effective coal-water fuel combustion in heat-and-power engineering facilities and tested them; stable and effective flare burning of coal-water fuel was achieved.

An experimental-calculation procedure was developed to predict electric power losses in spacecraft silicon solar batteries due to long-term effect of near-satellite environment factors in circular orbits in the polar ionosphere and magnetosphere of the Earth. Integral dependences of spacecraft solar battery power decrease in the geosynchronous and solar synchronous orbits were obtained, taking into

account the synergetic effect of individual factors of the near-satellite environment.

Scientists of the G. S. Pisarenko Institute for Problems of Strength of the NAS of Ukraine revealed the mechanism of the effect of violated identity in contact interactions between similar elements of mechanical systems with construction regularity. Recommendations and means were developed to ensure the reliable operation of shrouded-blade assemblies of turbomachine rotors; those permit a more precise determination of their static and dynamic states, with account being taken of structural, technological and in-service factors. A numerical procedure was developed to determine the characteristics of brittle fracture resistance of NPP reactor pressure vessels, taking into account thermomechanical loading history, nonlinear behaviour of the material, and the presence of defects of different shapes; the procedure is based on the G-integral "crack-closure" concept. Its efficiency for evaluating the operation life of WWER reactor pressure vessels was shown.

Researchers of the NAS N.S. Polyakov Institute of Geotechnical Mechanics proved that when rocks transfer from uniformly stressed state into the non-uniformly stressed one, gas permeability increases with the increased degree of non-uniformity of principal stresses that are perpendicular to the filtrating gas flow. The process is accounted for by the activation of deformations that structure the filtration system of non-uniformly stressed gas-saturated environment. A wide range of new-generation mining and processing equipment based on dynamically active band sieves has been introduced in mining industry.

The NAS Institute of Hydromechanics theoretically validated and proposed methods for calculating technological and structural parameters of facilities for the treatment of water containing various impurities.

Scientists of the NAS Institute of Transport Systems and Technologies, investigating a system of nonlinear differential equations with varying delays, found sufficient (and for some cases, necessary) conditions for exponential stability, which are invariant in respect to delays. For a stationary linear system with constant or arbitrary varying delays, the necessary and sufficient stability conditions, expressed in the eigenvalues of the corresponding matrix and maximal delay value, were obtained. A 20 kW self contained vertical-axis wind turbine with the H-rotor Dar'e in conjunction with an energy accumulation system based on VESTA ISIC accumulators were developed and manufactured. Now they are being installed and tested.

In 2011, Department's scientists will work towards providing R&D support to relevant industries of the country.

Physics and Astronomy



V. M. Loktev,
Academician-Secretary of
the Department

2010 was a year when scientists of the NAS Department of Physics and Astronomy endeavoured to strengthen their stand in the most topical areas of the development of physical science. They continued working in a number of high-potential international collaboration projects, moreover, in the largest and, probably, most important area (in terms of major expectations), i.e. at the Large Hadron Collider in CERN, Department's scientists became co-authors of pioneering scientific publications, being respectable representatives of Ukraine in this prestigious cutting-edge project. A lot of effort went to building and upgrading the Ukrainian Giant Radio Telescope, constructed not merely as an individual high-capacity measuring facility, but also as an important link in the group of European radio telescopes integrated into a single system, which is to substantially enhance the possibilities of specialists in investigating the most challenging problems of the near and deep space. Of great significance is also the fact that telescopes, accelerators and other large and expensive facilities are the backbone of modern fundamental physics, which are created jointly with industry and foreign partners by the NAS of Ukraine (rather than by universities, which, by the way, is the case in other countries).

Besides, it should be noted that one of the major today's challenges, to the developed countries in particular, is their role as leaders in the field of high-tech products whose manufacture often requires large-scale computations. So, the scientists of the Department, in collaboration with the NAS Department of Nuclear Physics and Power Engineering and NAS Department of Information Science, made a great stride toward upgrading and boosting the potential of Academy's GRID-system, which, in turn, increased computational capabilities of specialists in different disciplines, such as mathematics, physics, chemistry, biology etc., for solving fundamental and applied interdisciplinary problems. Now universities started training relevant and highly required specialists in parallel programming. This shows promise that industry will eventually start introducing such computations, and that the so-called "scientific forecasting" will become a priority in nation's development. Meanwhile, GRID-computations are used, primarily, by theoretical physicists to address problems related to the structure of micro- and macrocosm.

To mention briefly the most important results, first of all it should be emphasized that the 2010 Nobel Prize in Physics was awarded for groundbreaking

experiments in the development and investigation of a new physical material – the two-dimensional graphene crystal. It is pleasant to note that Ukrainian theorists rank high in the world in studying graphene, and are among the key players in developing new notions and elaborating the theory of the so-called relativistic-like condensed media, which are now associated with well-grounded expectations for the initiation and formation of a new stage in micro- and nano-electronics – production of devices and cells of smaller sizes and quicker responses as compared to the available ones. In general, achievements of Ukrainian physicists, both theorists and experimenters, in nanophysics and nanotechnologies are quite reputable, being the result of two R&D programs – the Ukrainian program and the joint program implemented in collaboration with Russian colleagues. Besides, scientists of the Department obtained a number of major results, in particular: they proposed mechanisms of origination and propagation of giant atmospheric vortices, i.e. cyclones, typhoons and tornados; determined factors that control the ability of structural materials to resist brittle fracture; investigated unusual glass-like properties of solid helium; developed and patented the scheme of transporting magnetic particles on film surfaces; discovered a new planet in one of extrasolar galactic systems; improved the performances of the world-largest YTP-2 radio telescope, etc.

Yet, it must be admitted that there are a lot of problems to be solved. In particular, despite all the efforts of the NAS Presidium, the problem of scientific personnel ageing remains practically unsolved. In fact, the main cause of this situation is low salaries of scientists and lecturers. Another pressing problem is accommodation, especially that for young scientists.

In spite of the well-known difficulties, physicists were working devotedly and won acknowledgements of their achievements both in our country and abroad. The most prominent among them were conferring the honorary title of the Hero of Ukraine to NAS Academician V.G. Baryakhtar and awarding him with the Order of State, as well as awarding the State Prize of Ukraine in Science and Technology to a team of astronomers who had proposed, developed and implemented fine polarimetric methods and procedures for measuring physical properties of celestial bodies of various natures. These developments were not only duly appreciated by the international scientific community, but also penetrated into the spheres that are rather remote from astronomy. The monograph published on the basis of these results ranked first in the international competition of books on astrophysics.

In general, the last year was difficult, but it did not shatter the hope for revival of the Ukrainian science, which remains at the world level owing to the work of the enthusiasts who are convinced that the destiny of science in Ukraine is the destiny of Ukraine itself.

Earth Sciences

V. M. Shestopalov,
Academician-Secretary of
the Department

In 2010, researchers of the NAS Department of Geosciences produced a number of major fundamental and applied results; some of those won various awards and prizes. The most important research outcomes are as follows.

Main patterns of gas occurrence in shale pelitomorphic rocks (as compared to other non-conventional gas sources) were revealed and prospects for producing shale gas in Ukraine described. A new direction in developing non-conventional and alternative sources of hydrocarbons was proposed and validated; that was associated with creating man-made oil and gas deposits.

A thorough analysis of the composition of thick molten impactite mass within the Boltys structure was made. Its mineralogy and solidification conditions were studied in detail. Data on the melt interaction with the enclosing environment were obtained. Chondritic composition of the crater-generating impact structure was proved for the Boltys crater.

An integral model of diamondiferous structures formation within the Ukrainian Shield was developed to study diamond-bearing structures, including both conventional kimberlitic ones and those related genetically to associations of alkali-ultrabasic rocks – komatiite-picrite and lamprophyre ones.

The intensity of bottom gas flows in the Black Sea was estimated as 6.9 km³/year. The calculations showed that about 1.0 km³/year of gas (mostly methane) enter the atmosphere.

On the basis of a 3D density model for the Dnieper–Donets depression (DDD) and Donbas basin, the thicknesses of Earth crust layers ('granite', 'diorite' and 'basalt' ones) were calculated. The ratio of each layer thickness to the total thickness of the Earth crust enabled scientists to predict the material constitution of the crystalline part of the Earth crust in the DDD and Donbas basin.

An integrated interpretation of magnetic, gravity and thermal fields, as well as seismic tomographic data for the Black Sea, was performed for the first time ever. A detailed map of faults in the consolidated crust was compiled.

A program was developed and used for numerical simulation of geo-block formation in structured geological environment.

A structural tectonic-physics map of the Ukrainian Shield was drawn in the scale range of 1:200 000–1:500 000.

A mathematical model of high-performance program package was developed, which simulated dynamic processes in coastal zones of the Azov–Black Sea basin.

An information system was produced to forecast catastrophic changes in the Black Sea level, and the most complete (as of today) database was formed, which covered 25 historical events and involved 14 parameters.

Relying on remote Earth-sensing data, scientists validated time–space transformations of Eurasia vegetation massifs as a major regulator of global and regional carbon cycling in the land–atmosphere system.

The concept of the Atlas of Natural, Technological and Social Hazards and Emergency Risks in Ukraine was elaborated; principles and levels of cartographic modeling of emergency situations were proposed as well.

Novel recommendations for organizing and conducting integrated environment monitoring in mining regions were developed. These take into account structural, geologic, landscape, climatic, ecological and economic conditions of their functioning.

N. A. Dykan, a scientist of the Institute of Geological Sciences, was awarded the NAS P. A. Tutkivsky Prize for his study «The System of Quaternary Ostracodes of Ukraine (Identification Guide)».

Ye. O. Maruniak, a research associate of the Institute of Geography, won the Prize of the President of Ukraine for Young Scientists for his research work «Globalization and its Impact on the Development of Ukrainian Regions».

In the framework of international co-operation, scientific collaboration is carried out under bilateral agreements with academies, institutes, geological, geophysical, oceanographic institutions of CIS and far-abroad countries. Leading scientists of the Department are members of many international committees, organizations, editorial boards, etc., they take an active part in international meetings and symposia of different ranks, present their works in specialized international publications.

The Ukrainian Embassy in Slovakia awarded a special diploma to the NAS S. I. Subbotin Institute of Geophysics for its contribution to the Slovak–Ukrainian cooperation in science.

In 2011 the efforts of Department's scientists will be focused on further fundamental and applied research into scientific fundamentals for integrated approach to and evaluation of mineral deposits, development of mineral resources, advancing the technological issues of exploration for promising mineral resources, promoting geo-ecological studies, with the aim of stabilizing and improving the environment in Ukraine.

Physical-and-Technical Problems of Materials Science



**I. K. Pokhodnya,
Academician-Secretary of
the Department**

In 2010, scientists of the NAS Department of Physics and Technology Problems of Materials Science addressed new important tasks in various areas of modern materials studies. A number of significant research results were obtained.

A new-generation power supply unit was developed for high-frequency (HF) welding of live tissues. Full-scale tests were carried out on animals by performing surgeries on different organs. A basis was provided for mass production of such power supply units at the NAS E. O. Paton Electric Welding Institute. An electrosurgical instrument for mass production was developed and tested. Studies were carried out by fixing electrical parameters in HF welding of live tissues and analyzing the effect of the process control parameters and algorithms on the quality of welded joints, including those done directly in clinics. The results obtained serve as a framework for further development of new equipment and process control systems.

A mathematical model was developed to describe formation and growth of non-metallic inclusions under conditions of high-gradient temperature and concentration fields. An algorithm was proposed to solve the system of diffusion kinetic equations for evaluating the kinetics of non-equilibrium chemical metallurgy reactions. Basic software modules were developed to predict the number and composition of non-metallic inclusions in the weld metal.

Department's researchers worked out scientific fundamentals of hydrogen technology for synthesizing functional nanostructural composite materials based on titanium hydride in reactions of destructive hydrogenation of titanium-containing intermetallics. They proved the possibility of recombining the products of destructive hydrogenation of titanium-based intermetallics in hydrogen medium, which provides inverse hydrogen accumulation in destructive hydrogenation-recombination cycles. Destructive hydrogenation of TiCu and TiNi intermetallics was used to synthesize nanostructural titanium-based composite materials with a 2-3 times higher hydrogen capacity. The resulting composite materials were used in hydride accumulators recommended for integration into commercial units for producing hydrogen by water electrolysis.

A novel joining technology based on adhesive brazing of numerous individual size-limited elements of cubic boron nitride was developed. Monolithic macro-hardware was produced to be used in various structures with BN/BN friction surfaces: shafts, sliding bearings, thrust bearings, bearing plates etc. This

started a new area of applying such structural superhard materials as cubic boron nitride.

Studies of the mechanical properties of the stishovite single crystal (high-pressure SiO_2 phase) were carried out by the nanoindentation method. They showed that stishovite hardness is 38 GPa, whereas sapphire hardness under the same testing conditions is 29 GPa. The abnormal nature of elastic-plastic transition was discovered in the stishovite single crystal for deformation localization in the submicron region, namely, the deformation jump under the pressure of 35 GPa, which was the first observation of the second-kind phase transition in hardness tests.

New methods were proposed for evaluating contact durability of tribo-coupling elements; they allow for the tear and shear cyclic crack-resistance characteristics of materials.

Methods were developed for direct doping of iron-carbon alloys with chromium and vanadium contained in dump steel-making slag, concentrates and ash waste of heat power stations. The technologies proposed allow the reduction of nearly 95 % of chromium and 90 % of vanadium contained in oxide melts.

Scientists determined and optimized thermal parameters for growing mono-block large-sized r-oriented crystals of high optical quality and structural perfection by the horizontal DS method, using the 'Horizont-5' facility. Large-scale production and commercialization of sapphire billets up to 350x500x40 mm in size were organized to meet the needs of the aerospace engineering industry.

Novel scintillation single crystals based on gadolinium and lanthanum pyrosilicate – $\text{La}_{2x}\text{Gd}_{2-2x}\text{Si}_2\text{O}_7:\text{Ce}$ (LaGPS:Ce) – were produced. They demonstrate the luminescence efficiency that is 10–12 times higher as compared to that of $\text{Gd}_2\text{SiO}_5:\text{Ce}$ (GSO:Ce), over 50 % of their luminescence intensity being retained to the temperatures of up to 450–500 K.

Mathematical description of the procedures for measuring electrical conductivity, thermal conductivity and thermo-EMF coefficient of thermoelectric materials was completed. Computer methods were developed to investigate the distribution of temperature and electric potential in specimens. The distribution of electric potential and temperature in samples of the materials was determined by computer modelling during measuring their parameters. The results obtained serve as a basis for designing high-precision equipment to measure parameters of thermoelectric materials over the temperature range of 30–500°C and developing nits for express measurements.

B. E. Paton, NAS Academician and President, was awarded the 'Global Energy' International Prize. V. P. Semynozhenko, NAS Academician, and V. L. Mazur, NAS Corresponding Member, were awarded the Orders of Yaroslav the Wise V Class, and G. G. Efimenko, NAS Corresponding Member, was awarded the Order 'For Merits' III Class.

Physical-and-Technical Problems of Power Engineering

B. S. Stogniy,
Academician-Secretary of
the Department

In 2010, efforts of scientists of the NAS Department of Physics-and-Technology Problems of Power Engineering were aimed at improving the level of Ukrainian power engineering, in particular, at meeting the guidelines and requirements of the European Power Union, whose member Ukraine became last year.

The implementation of the NAS integrated research program 'R&D Problems of Integrating the Ukrainian Power System to the European Power System' ('Association') was started. The programs 'Problems of Operation Life and Safety of Exploiting Structures, Buildings and Facilities' ('Operation Life'), 'Biofuel' and 'Fundamental Problems of Hydrogen Energy' were continued.

In 2010, scientists of the Department obtained a number of major fundamental and applied results.

New approaches to solving inverse problems of heat exchange were generalized, and a new approximate analytical method to solve direct and inverse three-dimensional problems of heat conductivity was developed on the basis of joint application of dominant spectral functions, finite integral transformations and structural-variation method.

A mathematical model of coupled non-stationary electromagnetic and mechanical processes in linear-coaxial drivers with massive magnetic conductors was developed. It relies on a system of integral and differential equations for the density of vortical currents and magnetization currents.

Scientists studied in detail processes in the systems of frequency and power adjustment in interconnected grids on the basis of electro-thermal regulator users; determined the most effective adjustment laws which provide minimization of duration and non-periodical nature of transient processes in a power grid, developed relations for determining the necessary parameters of adjustment laws.

Thermodynamic conditions of possible carbon-dioxide gas-hydrate formation processes were determined, and it was proved that their stability considerably exceeds that of the methane gas-hydrate. The possibility of depositing greenhouse CO_2 as its gas-hydrate at biologically unproductive depths of the Black Sea was shown.

Scientists developed mathematical and computer methods of modeling continuous dynamic systems that are described by integro-differential equations with operators of fractional orders, relying on operational approaches based on the method of finite elements.

A closed multi-channel system for control of the external magnetic field of engineering facilities was synthesized for the first time ever. It employs magnetic executive devices of the surface-distributed type, which provides an optimal control on the basis of integral-quadratic quality criterion.

A 70 MW thermal power gas-ring with thermo-chemical fuel preparation was put to experimental operation in a boiler of TPP-210-A type of Trypilska thermal power plant.

Three-dimensional CFD models were developed and calculations made to verify the feasibility of the design of the ventilation system for the arch of the new safe confinement over the 'Shelter' facility at Chornobyl NPP. They relied on the analysis of the heat-humid state of the arch under set conditions of ventilation system exploitation.

Researchers solved the applied-science problem of controlling operation modes of power systems with flexible transmissions of alternating current, taking into account the characteristics of Ukrainian UPS. The results obtained were used in developing the updating project for the 'Simferopol-330 kV' substation.

Theoretical and experimental studies of specific performances of wind and solar energy were carried out in different regions of Ukraine; that enabled scientists to adjust integral potentials of these sources and produce a more exact version of the «Atlas of Power Potential of Renewable Energy Sources of Ukraine».

Studies of nuclear-physics parameters within the risk zones of the 'Shelter' facility showed that in the super-damp meltdown area of the reactor cavity bed-plate a critical mass of fuel still persists; the mass became super-critical when the reactor cavity was filled with water in June 1990. It was shown that a rise of temperature and 'Shelter' facility dehydration after the construction of a new safe confinement can result in reverse criticality.

A number of works produced by Department's scientists were duly appreciated.

NAS Corresponding Member A. A. Shcherba, I. P. Kondratenko, M. M. Rezinkina were awarded the NAS V. M. Khrushchov Prize for a series of scientific publications «Modelling and Analysis of Electromagnetic Processes in Power and Technological Systems».

NAS Academician Yu. M. Matsevyti and NAS Corresponding Member A. A. Khalatov were awarded the O. V. Lykov Prize of the NAS of Belarus for a series of scientific works «Studies of Burning and Heat-and-Mass Transfer Processes under Difficult Heat-Gas Dynamics Conditions through their Modelling and Identification».

NAS Corresponding Member N. M. Fialko, G. O. Presich, R. O. Navrodska won the Prize of the presidents of the academies of sciences of Ukraine, Belarus, and Moldova as co-authors of the work «Development of High-Efficiency Technologies for Utilizing Heat Emissions of Municipal and Industrial Power Facilities».

Nuclear Physics and Power Engineering



I. M. Nekludov,
Academician-Secretary of
the Department

In 2010, scientists of the Department of Nuclear Physics and Power Engineering of NASU obtained new important scientific results.

For the first time, isomeric ratios were determined experimentally for the ^{84}Br , ^{90}Rb , ^{134}I and ^{135}Xe nuclei during photofission of ^{240}Pu and ^{241}Am by bremsstrahlung γ -quanta.

The theory of collective band structure of the levels in odd-odd nuclei was proposed to describe the contraction of rotational-band lower energy levels in the case of conflict odd proton-neutron coupling.

The dynamics of the nuclear convergence process in fusion-fission reactions was investigated for the first time. The shell structure of the interacting nuclei was shown to exert influence not only on the fusion process as a whole, but also on the processes that occur in each nucleus.

A new approach was experimentally realized for the first time ever to determine the excited-state energy of atomic nuclei. It consists in reference transition energy measurements by precision β - and γ -spectroscopy methods, followed by calculations of the level energy and the energy of all γ -quanta.

Scientists simulated the process of fast electron bunching, using the model of a subpicosecond bunch source. A technique was developed for experimental detection of ^{235}U , ^{238}U nuclei and ^{14}N , ^{16}O , ^{12}C light nuclei in the volume under study.

Relying on the experimental data obtained from the studies by the CMS collaboration at the Great Hadron Collider, researchers first studied the processes of K_S^0 -meson nucleation at the proton collision energy of 900 GeV.

They also constructed a relativistic theory of resonances associated with the virtual particle transition to the mass shell for the processes of spontaneous electron bremsstrahlung in the nuclear field and electron-electron (positron, muon) scattering in a pulsed laser field.

A new mechanism was discovered for the temporal evolution of oscillation frequency in plasma, namely, the Doppler shift variation resulting from the variation in the plasma rotation frequency during instability development.

A nonlinear nonstationary multimode theory of coaxial gyrotron (a powerful microwave radiation source for thermonuclear fusion and practical applications) was proposed.

A plasma diagnostics test bench was produced on the basis of a magnetic-plasma compressor, with the

output plasma stream velocity reaching $\sim 10^7$ cm/s.

An essential ($\sim 40\%$) reduction in irradiation hardening of vessel steel 15Kh2NMFA exposed to low ($\sim 10^{-4}$ dpa) and over-designed (~ 1 dpa) doses, subjected to magnetic treatment, and also, in the process of irradiation, was demonstrated for the first time. This was attributed to relaxation processes of several types, occurring due to the interaction between lattice imperfections and magnetic subsystem defects.

A convection loop with supercriticality water under external electron radiation was designed for simulation test of promising reactor materials of the 4-th generation.

Equipment was developed for remote investigation of the base metal and welded joints of the nuclear reactor vessel with the spherical indenter technique. Integrated eddy-current control data were organized for the steam-generator pipe stills of Pivdenno-Ukrainska and Zaporizka NPP power supply units.

With the participation of the Department's specialists, the four-year pilot-production test of the first batch of Westinghaus-produced fuel assemblies was completed. This permitted the 'Energoatom' National Nuclear Energy Generating Company to enter into a contract for the delivery of the Westinghouse pilot nuclear fuel to three blocks of WWER-1000 reactors.

The implementation of a novel technology for reconstructing irradiated check test pieces of WWER-type reactor vessel metal and the determination of radiation load of in-vessel reactor components have become the basis for validating the prolongation of safe operation life of the reactor vessel at the Pivdenno-Ukrainska NPP power supply unit №1 till 2025.

A programmed-analytical system was developed for certification of ore occurrences and raw material deposits for nuclear engineering needs, as well as for control of technological and environmental safety of mining and concentrating facilities. Geo-cartographic software block and the resource database on uranium were compiled.

Conceptual principles were developed for long-lived radioactive waste disposal in a deep-seated storage in reference to the geological conditions of the Chernobyl exclusion zone.

Fundamental differences were discovered in the behavior of stable and radioactive components of radioactive hydrogen (H-D-T) and carbon (^{12}C - ^{13}C - ^{14}C) isotope triads in different biological systems.

The Third International Consultation Workshop 'Advancement of Nuclear Power Engineering as a Factor of Permanent Interstate Cooperation' was held; it was attended by representatives of academy and industrial institutions, design organizations and manufacturing plants of Ukraine, Russia and Armenia. Collaboration with international and national S&T centers and organizations, CERN (Switzerland), Euroatom, the United Kingdom Closed Nuclear Centres Programme in particular, is being furthered.

Chemistry



V. V. Goncharuk,
Academician-Secretary of
the Department

Scientific research in chemistry is carried out at 11 institutes and 2 their divisions by nearly one thousand highly skilled scientists. Among them, there are 11 NAS Academicians and 27 NAS Corresponding Members.

A number of significant fundamental results of the international scope were obtained in 2010.

It was found that nanocomposite electrodes produced by mechanic-and-chemical means on the basis of electroconductive polymers and transition metal oxides of the host-guest type are much superior to the nucleus-shell nanocomposites in lithium accumulators in terms of charge-discharge cycling stability. This is due to pillaring of electroconductive polymers of oxide layers by macromolecules, which can ensure a more rapid transport of lithium ions and redox processes at higher potentials (NAS Academician V. D. Pokhodenko).

The possibility of synthesizing C, Sn, Te, Si nanostructures on the optical-needle point during short-term (less than 100 s) laser irradiation was proved. It would allow scientists to use short-range field for placing nanostructures in local areas, for achieving photo-transformations and photo-destructions of chemical compounds (NAS Academician S. V. Volkov).

Researchers synthesized a number of new alkox-yaminopropanol derivatives which contain aliphatic, aromatic and polycyclic radicals as their alkox-ygroup. Some of the compounds synthesized were sent to 'Pharmacology and Toxicology' State Institution to investigate their antimicrobial activity. A certain 'structure – action' dependence was found during studies of antimicrobial action of the compounds produced (NAS Academician [M. O. Lozinsky]).

The electroconductivity level of organo-inorganic polymers within 7–10 orders of magnitude can be regulated by the chemical structure of clusters generated by inorganic fragments (NAS Academician E. V. Lebedev).

Organized nanodimensional systems based on dimeric surfactants functionalized with hydroxyl groups were proposed. They are characterized with the abnormally low concentration of micelle formation, which allows researchers to achieve the necessary rates of organophosphorous compounds decomposition with detergent concentrations of almost 1/100 of those of their monomer analogs (NAS Academician A. F. Popov).

Scientists carried out large-scale monitoring of the density of thermal neutrons stream near the Earth sur-

face in the European part of Russia, in the Atlantic, on the North Pole, and in the troposphere during high-altitude air flights. Zones of forced emission of thermal neutrons of up to 300 n/(sm²) were detected in the Atlantic; they are 20–30 times in excess of the background level and their localization coincides with ocean fronts and zones of increased phytoplankton concentration. The role of kinetic capture of background neutrons in the formation of abnormally high corpuscular radiation of the biomass was revealed.

Data on physical and chemical properties of protium water were obtained. The mechanism of their significant differences as compared to the water of normal isotope composition, which is due to the formation of supramolecular density irregularities in water – huge deuterium-stabilized heterophase clusters (NAS Academician V. V. Goncharuk).

It was shown that the condensation of 1,4-benzodiazepin-2-ons with aromatic aldehydes under Knevenagel reaction conditions occurs with the participation of an active methylene group in position 3 and a methyl group in position 5, with forming previously unknown 5-substituted 1,4-benzodiazepin-2-ons.

Successful clinical studies of the *Cinnazepam* innovative medical preparation were completed. The preparation was registered as a hypnotic and anxiolytic medicine by the Pharmacological Center of the Ministry of Health of Ukraine (NAS Academician S. A. Andronati).

A new method to synthesize fluorine-containing aminobisphosphonic acids, which are promising as inhibitors of proteintyrosinephosphatase, was developed. The method is based on bonding of functionalized amines to tetrakis(trimethylsilyl)methylenbisphosphonate. The advantage of the method is the ease of silyl esters transformation into biologically active functionalized bisphosphonic acids and their salts (NAS Academician V. P. Kukhar).

Novel methods of doping activated carbon with nitrogen heteroatoms were developed. High sorption ability of these materials for greenhouse gases alongside with prospects of their use in supercondensers was shown (NAS Academician V. V. Strelko).

Fundamentals of the effect of the electron structure of reagents, the nature of the medium and background salts on the course of essentially new processes of producing fluorine-containing amino acids by electron-induced introduction of carbon dioxide into fluorine-containing aromatic imines were discovered. This provides opportunities for synthesizing important amino acids with high yields (NAS Academician V. G. Koshechko).

To optimize its network of research institutions, the Department reorganized the NAS 'AKSO' R&D Center by joining it to the NAS Institute of Bioorganic Chemistry and Petrochemistry.

In the coming years the efforts of Department's scientists will be aimed at advancing fundamental research within the framework of its targeted research program 'Development Strategy for Top-Priority Areas of Chemistry'.

Biochemistry, Physiology and Molecular Biology



S. V. Komisarenko,
Academician-Secretary of
the Department

In 2010, researchers of the NAS Department of Biochemistry, Physiology and Molecular Biology obtained significant results in studying fundamental problems of biology, medicine and ecology. They gave a lot of attention to the development of novel biotechnologies, to issues of fundamental and practical medicine. A number of important scientific results of the international level were produced.

Researchers of the O. V. Palladin Institute of Biochemistry obtained different recombinant derivatives of heparin-binding epidermal growth factor (HB EGF) and determined their interaction with various ligands, diphtheria toxin in particular. The ability of HB EGF derivatives coupled to enhanced green fluorescent protein to interact specifically with the surface of cells of different types and origin was discovered; differences in dynamics of intracellular transportation of these derivatives were studied.

Using methods of RNA-interference, scientists of the O. O. Bohomolets Institute of Physiology determined positive effects of inhibition of lipoxygenase and ubiquitin genes, of proteasome subunits, which proved the involvement of these molecules in pathogenesis of heart ischemic injuries and the possibility of employing the RNA-interference method with specific micro-RNAs in the therapy of such injuries.

Researchers of the D. K. Zabolotny Institute of Microbiology and Virology established the ability of bacterial strains of the *Dietzia*, *Gordonia* and *Rhodococcus* genera to destruct petroleum oils – a petroleum fraction that is very difficult to oxidize. The highest destruction activity in respect of those oils was found in the strains of *G. rubripinctincta* UKM AC-179, *R. erythropolis* UKM AC-50 and *D. maris* UKM AC-205. It was shown that the process of oil hydrocarbons assimilation by actinobacteria is accompanied by a considerable improvement of cell surface hydrophobic property and by the synthesis of surfactants.

Scientists of the Institute of Molecular Biology and Genetics demonstrated that the editing of norvalin by leucyl-tRNA synthetase obtained from *Thermus thermophilus* proceeded mainly through the post-transfer way. They proved the availability of tRNA-independent pre-transfer editing in the editing domain, which can supplement the post-transfer editing since its share only is 7–8 %.

Researchers of the R. E. Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology validated the advantages of using nanotechnologies in oncology. Optical physico-chemical conditions of synthesis were developed and nanoferrospinel

(CuFe_2O_4 , CoFe_2O_4) were obtained. Scientists studied their influence on the processes of *in vitro* free-radical oxidation in phospholipid model medium. A biochemical model system was developed and used to study the effects of CuFe_2O_4 and CoFe_2O_4 nanodimensional structures on peroxidation of blood serum lipids *in vitro*, with a view to improving the selectivity of antitumour drug action.

Researchers of the NAS Institute for Problems of Cryobiology and Cryomedicine found that in late terms of gestation fetal liver cryopreserved cells with a high level of expression of genes of proliferation and differentiation of stem cells compartment can possess high therapeutic efficiency. The mechanism of such action consists in stimulating the hemopoietic activity of recipients and regulatory T-cells pool.

Scientists of the NAS Institute of Cell Biology conducted research to optimize the synthesis of gold, silver and ferromagnetic nanoparticles, their functionalization and covalent conjugation with respective enzymes, using as models alcoholoxidase and recombinant enzymes – yeast L-lactate: cytochrome c-oxidoreductase (flavocytochrome b2) and yeast methylaminoxidase modified by histidine cluster (-His)6-tag, and tegated human arginase I. Structures of the bio-nanodimensional products obtained and their physico-chemical and catalytic properties with conjugated enzymes were investigated.

In the field of medicine new methods were developed to correct cardiac and vascular insufficiency, as well as those to prevent myocardial infarction soon after coronary bypassing. Comparative evaluation of lead toxicity was carried out. Criteria of larynx cancer diagnostics were defined and the efficiency of radiotherapy and combined therapy of such patients was determined. New methods for treatment of patients with malignant tumors of thoracic cavity organs were worked out. The role of antigen-independent factors in the pathogenesis of kidney allotransplant dysfunction was revealed.

A new targeted NAS interdisciplinary program 'Fundamentals of Molecular and Cell Biotechnologies' for 2010–2014 was started. Projects under the targeted state R&D program 'Nanotechnologies and Nanomaterials' were carried out as well as the tasks of targeted NAS research programs: 'Fundamentals of Genomics and Proteomics'; 'Fundamental Problems of Nanostructural Systems, Nanomaterials and Nanotechnologies'; 'Sensor Systems for Medical, Ecological, Industrial and Technological Needs'; 'Biomass as Raw Material for Fuel'; 'Fundamental Problems of Hydrogen Energy'; the NAS interdisciplinary targeted research program on sustainable development, rational nature management and environment conservation. Summarizing conferences were held to present programs results.

The international conference 'On Biosafety and Biosecurity: Implementing the Recommendations of the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction' also was a success.

General Biology



V. V. Morgun,
Academician-Secretary of
the Department

In 2010 the efforts of scientists of the NAS Department of General Biology were focused on top-priority fundamental issues of biology and on improving the competitiveness of applied research.

For the first time, using the test for chromosomal aberrations in cells of winter wheat, scientists investigated the mutagenic activity of a new class of chemical compounds – chiral nitrosoalkyl ureas, which are promising for the development of new crop varieties. Theoretical principles of risk assessment for the cultivation of genetically modified plants in Ukraine were elaborated. Using molecular DNA markers and chromosomal analysis, scientists showed that preservation of the plant genome with methods of cell biotechnology is ensured in direct plant regeneration from explants, while genetic differences appear in regenerants derived from tissue cultures.

On the basis of biotechnologies, researchers created transgenic lines of barley producing human lactoferrin, and lines of rape that, in addition to resistance to the glufosinate ammonium herbicide, also have a higher rate of total soluble protein and modified lipid composition. Cellular mechanisms of plant adaptation to microgravity were revealed.

A draft catalogue of the *Gli-Mb1* allele locus of *Aegilops lorentii* was compiled, and catalogues for alleles of loci of macromolecular subunits of *Glu-U1*, *Glu-Mb1* gluteins were complemented with new alleles. It was shown that the use of silicon-containing analcime mineral reduces by 30–80% the content of phenol compounds in soil, which are the main factor of soil fatigue.

Highly efficient weed control technologies for principal crops were developed and implemented, which ensure the environmental safety of agrophytocenoses.

It was found that in the Chornobyl NPP exclusion zone, under radioactive pollution, the risks of emergence of new highly virulent forms of phytopathogenic organisms increase. Scientists showed, in particular, that the chronic exposure of cereal crops to low doses of ionizing radiation reduces their phytoimmune potential.

Considerable success was achieved in biodiversity studies and conservation. For example, 108 new species of lower and higher plants, fungi and invertebrates were described as new for science. With the active participation of Department's scientists, regional Red Books were prepared and published; these include rare species of Ukrainian flora. Novel quantitative landscape characteristics and an integral dimensionless index of landscape diversity were pro-

posed; a classification scheme was developed for the vegetation of Ukraine. Criteria were determined and mechanisms clarified for self-restoration in populations of rare, endemic and relict plant species in high-mountain ecosystems. New approaches to designing biopositive flood-control measures in the Carpathians were proposed; they can minimize changes in the structure of biotic communities under the impact of catastrophic floods.

Scientists validated principles for assessing the risk of alien species penetration through aquatic ecosystems of Ukraine. A methodology for monitoring vegetation stands in ancient parks was developed, and landscape-based principles of forming plant collections in botanical gardens and arboreturns of Ukraine were proposed.

Studies of contour (marginal) habitats of the Black Sea and their biotic communities allowed the principles of topo-ecological classification of the marine biota to be formulated. For the first time, researchers investigated the structure and vertical distribution of the deepwater fauna of the Bosphorus region under hypoxia and anoxia in the zone of interacting oxygen and hydrogen-sulfide water masses, where high quantitative and qualitative development of meiobenthos was observed. It was found that the productivity of methanotrophic chemosynthesis in the fields of gas discharge on the Black Sea bottom can exceed the productivity of phytoplankton.

Mechanisms of elytra action in beetles were revealed; these results can be used for designing airborne micromachines. Scientists proposed a new concept of cell mechanisms of remodeling and mechanic transduction in mammal bone tissues under the removal of static load.

Significant achievements were obtained in genetic improvement of plants. 32 new varieties and hybrids of fruit, industrial, ornamental and cereal crops were produced and listed in the State Register of Plant Varieties Suitable for Cultivation in Ukraine. For example, cultivars of winter wheat and maize hybrids with high productivity, grain quality, and high resistance to extreme environmental conditions were recognized as new achievements in plant breeding and recommended for use in all climate zones of Ukraine. Active and efficient work of Department's scientists won 26 inventor's certificates and 38 patents. All in all, 2062 licensing agreements were issued and implemented for the use of plant varieties in production, which is a significant contribution to strengthening food security of the country.

Leading scientists of the Department were honoured with the State Prizes of Ukraine and Academy awards for their significant scientific achievements; young scientists won awards and prizes of the President of Ukraine and the Verkhovna Rada of Ukraine.

In the near future, the efforts of Department's scientists will be focused on the advancement of novel areas of biological science and their practical implementation, with a view to the development and updating of respective sectors of Ukrainian economy.

Economics



E. M. Libanova,
Academician-Secretary of
the Department

In the reporting period, the efforts of researchers of the NAS Department of Economics were aimed at investigating issues of projecting and strategic planning of the national economy development; issues of sustainable and spatial development of territories, the development of human potential, as well as issues of economic integration in the context of global recession challenges; determining priority areas of economic policy modernization in the national and regional dimensions, elimination of structural disproportions in particular.

Some important results were obtained. Typical features of the systems of values were determined in terms of their adequacy for and identity to different civilizations; fundamental correlations between socio-cultural bases of certain civilization structures and their ability to develop under globalization and postindustrial transition of the most developed countries were revealed; the concept of forming and functioning of the modern global macro-civilization system was developed, especially regarding the place of Ukraine in this system.

For the first time ever, criteria for periodization of historical development of the institute of confidence were determined; a direct correlation between the main stages of development of commodity-money relations and forms of confidence was found. It was proved that basic economic categories of market economy can be regarded as forms of confidence display, while confidence – as a basic institute of market economy.

Peculiarities of the genesis of the current systemic crisis were determined, and its social and demographic manifestations and effects were investigated. Conceptual fundamentals for studying problems of social exclusion and marginalization of population were worked out in the context of human development; approaches to regulating the contradictions between economic efficiency and social integration were identified.

The specificity of sectoral interrelations between factors of macroeconomic instability was defined, determined and revealed relying on the system approach; it was found that the process of the national economy recovery, which started in 2010, still has the features of “growth without development”; characteristics of anti-crisis programs and certain antirecession proposals for the Ukrainian economy were summarized; macroeconomic projections were worked out, and estimates of development scenarios for macroeconomic situation in Ukraine for 2010–2015 were made.

Mechanisms of Ukrainian financial system destabilization were revealed under conditions of a high level of external debts and prevalence of the “contamination effects” on the financial market of Ukraine due to action of trade shocks, general shocks, information effects and financial shocks; ways to reforming the state support for Ukrainian enterprises were proposed.

In close cooperation with institutions of the NAS Department of Information Science in the framework of interdisciplinary project ‘Automated Intellectual Information-Analytic System for Supporting Budgetary Process on the Basis of the National Electronic Computing Super-Machine’, an information-analytic system for supporting budgetary process at the regional level was created for 12 oblasts; an updated version of software and analytic instruments of projecting basic macroeconomic indicators ‘Macro-Projection of the Ukrainian Economy’ was developed, which allows projections of basic indices of nation’s development for 2010–2012.

The definition of the “quality of labour life” category was validated, as well as its place in the system of economic categories. Bilateral correlations between quality of labour life and competitiveness of the national economy, quality of labour force and economic growth, productivity, work organization and conditions were revealed.

Preconditions of the development and specific features of the systemic crisis in Ukraine were revealed; theoretical fundamentals of estimating the impact of the crisis in socio-humanitarian and economic spheres on population’s living standards were developed.

Principles of forming funding mechanisms for technological development of industrial production were validated. Models were developed to calculate mutual benefits of leasing agreements during up-dating of industrial enterprises. Methods were developed to select the procedure of calculating the amortization and adjustment of the primary costs of fixed assets.

Global trends and patterns in technological projecting and technological development were revealed; methods to estimate the technological level of economy and models of technological projections were worked out; a target model was constructed to determine strategic national priorities (including technological ones) of socio-economic development; recommendations towards forecasting of promising and critical technologies were worked out to implement strategic priorities of socio-economic development of the nation.

Scientists also determined ways of reforming the Ukrainian financial sector, with a view to improving its competitive preferences under crisis; elaborated theoretical and practical approaches to international monetary and financial policy of the state for ensuring adaptation of the Ukrainian financial market to global integration processes.

History, Philosophy and Law



O. S. Onyschenko,
Academician-Secretary of
the Department

In the year under review, research institutions of the Department achieved substantial theoretical and practical progress in the comprehension of historical experience, of the development of modern Ukrainian society and the prospects of socio-political, socio-economic and cultural progress of Ukraine. Scholars of Department's institutions prepared the socio-humanities part of the fundamental document 'New Course: Reforms in Ukraine. 2010–2015. National Report' (NAS Acad. O. S. Onyschenko, Yu. A. Levenets, V. M. Vorona, M. V. Popovych, Yu. S. Shemshuchenko et al.).

The NAS Institute of the History of Ukraine published academic writings: «History of Civil Service in Ukraine. In 5 Volumes» (by NAS Acad. V. A. Smolii, S. V. Kulchytskyi), «History of Ukrainian Parliamentarism. In 3 Volumes» (by NAS Acad. V. M. Lytvyn, V. A. Smolii), «Essays on Martial Arts of Old Rus» (by NAS Corr. Memb. M. F. Kotliar).

The NAS Institute of Sociology published the monographs: «Ukrainian Society in 1992–2010. Sociological Monitoring» (by NAS Acad. V. M. Vorona), «Trends in Social Changes in Ukraine and Europe» (by Ye. I. Golovakha), «Subcultural Variability of Ukrainian Society» (N. V. Kostenko).

Scholars of the NAS I. F. Kuras Institute of Political and Ethnic Studies published their books: «Problems of Ukrainian Politics. Analytical Reports of the NAS I. F. Kuras Institute of Political and Ethnic Studies» (edited by NAS Acad. Yu. A. Levenets), «Corruption in Ukraine: Political and Philosophical Analysis» (by NAS Corr. Memb. M. I. Mykhalchenko), «Ukraine and Russia: Potential of Interaction and Cooperation» (by O. P. Derhachov).

Scholars of the NAS V. M. Koretsky Institute of State and Law issued: «Sources of Constitutional Law of Ukraine» (by NAS Acad. Yu. S. Shemshuchenko), «Legal Basis of Forming and Developing Gender Environment in Ukraine» (by N. M. Onishchenko), «Political Opposition in Poland and Ukraine. Comparative Analysis» (by O. V. Kukuruz).

Scholars of the NAS H. S. Skovoroda Institute of Philosophy published their books: «Culture: Illustrated Encyclopedia of Ukraine», «Pavel Vasilyevich Kopnin» (by NAS Acad. M. V. Popovych), «Philosophical Discourses of Rationality» (by NAS Corr. Memb. V. S. Pazenok) and «On Sophia, Truth, Sense of Human Existence» (by S. B. Krymskyi).

NAS Acad. L. V. Huberskyi published his writings: «Philosophy: Reading Book (From Origins to the Pres-

ent Day)», «Philosophy: Textbook» (co-authored by NAS Corr. Memb. V. P. Andrushchenko). NAS Acad. V. H. Kremen issued the fundamental monograph «Philosophy of Humanocentrism in Strategies of Educational Space».

Researchers of the NAS M. S. Hrushevsky Institute of Ukrainian Archeography and Source Studies prepared and published their works: «Seals of Podillia (the Late 18th – Mid-20th Centuries)» (by A. B. Zadorozhniuk), «Stalin's "Special Folders" on National-Liberation Struggle in Western Ukraine in 1944–1948» (by Ya. R. Dashkevych).

Researchers of the NAS I. Krypiakevych Institute of Ukrainian Studies issued the books: «Stalin and Western Ukraine. 1939–1941» (by M. R. Lytvyn), «Consolidation of National Pro-State Forces in Western Ukraine (1923–1928)» (by I. Ya. Soliar).

Scholars of the V. I. Vernadsky National Library of Ukraine took part in preparing the book «M. V. Keldysh and Ukrainian Science: to his 100th Anniversary» (by NAS Acad. O. S. Onyschenko and L. M. Yaremenko), submitted for publication a special volume «V. I. Vernadsky and Ukraine» (by NAS Acad. O. S. Onyschenko and NAS Corr. Memb. L. A. Dubrovina) of the all-Academy publication of scholarly writings by V. I. Vernadsky, and the monograph «Academies of Sciences of European Countries» (by NAS Acad. O. S. Onyschenko, L. M. Yaremenko, H. V. Indychenko).

Scholars of the NAS Institute of Archeology prepared and published their writings: «Old Rus Nationality: Imagined or Real?» (by NAS Acad. P. P. Tolochko), «Mesolith of Eastern Europe» (by L. L. Zaluzniak), «Lower City of Olbia. VI Century BC–IV Century AD» (by NAS Corr. Memb. S. D. Kryzhytskyi, in English).

Achievements of leading scholars of Department's institutions were honoured with high awards. H. V. Boriak received the Award of the President of Ukraine – Ivan Mazepa Cross. R. H. Symonenko got the Order 'For Services' II Class, NAS Acad. Yu. S. Shemshuchenko – the Order 'For Services' III Class.

In 2011, the efforts of the Bureau and institutions of the Department will be focused on integrative interdisciplinary research in subjects of primary importance to obtain and implement concrete practical results in public and social life. This would require consolidated efforts of Academy socio-humanities institutions for integrative studies towards developing optimal ways and means to deal with humanitarian challenges facing today's Ukrainian society and take full advantage of humanitarian instruments in social transformations.

Philological Studies, Art Criticism, Ethnology



M. H. Zhulinsky,
Academician-Secretary of
the Department

As before, in the year under review, scholars of the NAS Department of Literature, Language and Art Studies tackled fundamental and applied issues of the development of literature, language, art studies, traditional every-day culture, and computer linguistics; they addressed major challenges of the scholarly backup to the national and cultural revival of Ukraine, provided the unbiased analysis of various stages in the development of Ukrainian spiritual culture in the past and its status at the beginning of the 21st century.

The practical outcome of the abovementioned tasks was the publication of 145 collective and individual works by Department's scholars, including 92 monographs and collections of writings, 14 study textbooks and manuals for university students and schoolchildren, 7 reference books and dictionaries, 32 academically treated and commented belles-lettres texts, nearly 1500 publications in research proceedings and periodicals.

The high academic stand of Department's researchers was proved by awarding O. Ye. Pakhliovska with the 2010 T. H. Shevchenko National Prize of Ukraine for her book «Ave, Europa», and art scholar O. S. Naiden for the work «Folk Icon of the Middle-Dnieper Area in the Context of Peasant Cultural Space». NAS I. Ya. Franko Prize went to literature scholar L. V. Ushkalov for his study «Hryhorii Skovoroda. Complete Academic Collection of Writings»; linguist K. V. Shyrokov won the Verkhovna Rada Prize for Young Scholars for his work «Substantive Inflexions in the Modern Turkish Language». NAS Academician B. I. Oliinyk was honoured with the NAS Award 'For Scholarly Achievements' to mark his outstanding service to the advancement of Ukrainian scholarship.

Literature scholars of the Department carried on their research in literature theory, the history of Ukrainian and foreign literatures, the current state of belles-lettres, prepared encyclopedic academic publications of literary heritage. A number of fundamental studies were published: «Nation. Culture. Literature. National-and-Cultural Myths and Ideological-and-Esthetic Pursuits of the Ukrainian Literature» (by NAS Academician M. H. Zhulynsky), «Socialist Canon in the Ukrainian Literature: Genesis, Development, Modifications» (by V. P. Kharkhun), «Poetics as System: A Literary-Criticism Essay» (by M. P. Kodak), «Issues of Poetics of the Second Volume of "Dead Souls" by Mykola Gogol» (by N. M. Skvira), «Letters and People: Reflections on Epistolary Writings» (M. Kh. Kotsiubynska). Institute's scholars published the 54-th, supplementary, volume to the «Collection

of I. Ya. Franko's Works in 50 Volumes», and the 1-st volume of «Ivan Franko's Library», commented editions of selected writings by I. Franko, V. Vynnychenko, O. Vyshnia, P. Kulish, O. Oles, V. Stus and numerous foreign authors.

To implement the Decree of the President of Ukraine 'On the Development of the National Dictionary Base', Department's linguistics scholars completed the preparation and issued 10 thousand copies of two laser disks «Integrated Lexicographic System "Dictionaries of Ukraine" Version 4.1», with the register of 258 thousand entries and «Ukrainian-Russian-English Welding Dictionary» with the vocabulary of 12,000 S&T terms. They also developed and put to practice the virtual lexicographic laboratory "Thesaurus of the Russian Language" and the technical-system support for the pilot version of the virtual all-Ukrainian biography laboratory. 7 new-generation dictionaries were published, alongside with such fundamental writings as «The Ukrainian Language in the 21st Century: Traditions and Innovations», «Imprints of History and Culture in Word-Formation», «Essays in Sociolinguistics» (L. T. Masenko), «Essays in Conceptual Analysis of Text Linguistics» (T. V. Radziivska), «Conjunctions of Literary Ukrainian Language» (K. H. Horodenska), «Narration in Ukrainian Belles-Lettres Prose» (S. P. Bybyk) etc.

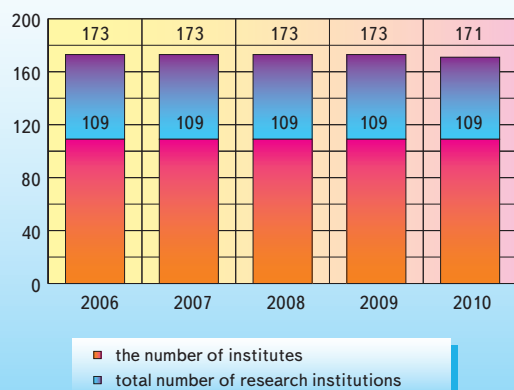
Relying on the outcomes of research into varied phenomena of traditional culture, researchers of arts, folklore and ethnology published 48 collective and individual works: «History of Ukrainian Arts» (vol.2), «History of Ukrainian Theatre» (vol.2), «History of Decorative Arts of Ukraine» (vol.1), «Folk Culture of Ukraine: Traditions and Today», «Ukrainian Theatre on the Eve of the Third Millennium» (N. M. Kornienko), «Fundamentals of Paramusical Studies» (B. O. Siuta), «Traditional Wall Paintings of Podillia in the Late 19th – First Half of the 20th Century» (N. V. Studenets), «Ukrainian Chronicle Songs: Genres and Themes» (O. I. Chikalo), ethnological and artistic works by P. P. Chubynskyi, P. M. Kovzhun, and L. R. Kuzma.

The principal research-management activities of the Department in the reporting year were aimed at developing new scholarly concepts and programs, carrying out state and NAS projects to implement a number of Presidential decrees and Governmental assignments, at preparing and holding 27 international and all-Ukrainian scholarly conferences, as well as promoting international collaboration of Department's institutions with foreign academic centers and strengthening those ties.

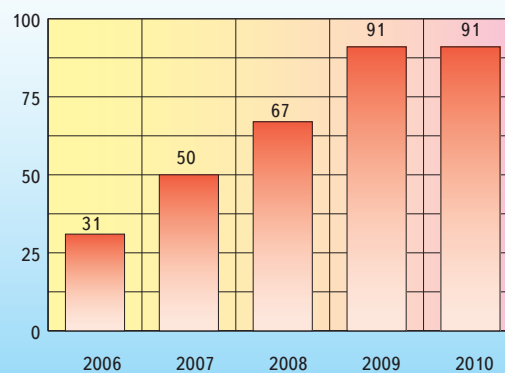
Regional Structure of the National Academy of Sciences of Ukraine



Total number of research institutions

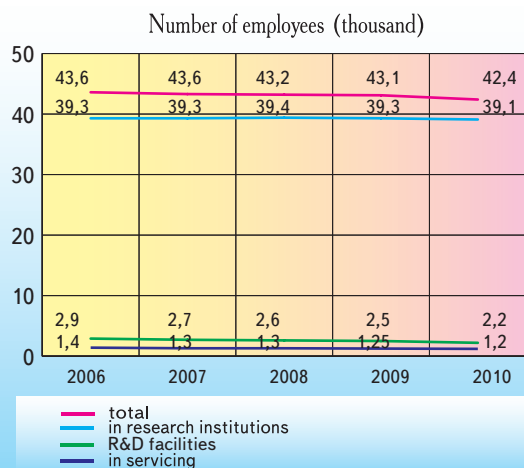


Number of the Centers for shared use of scientific equipment



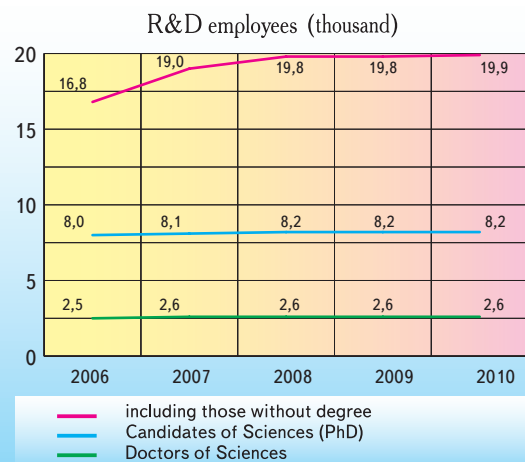
NAS of Ukraine 2010

Total number of employees	42426
including:	
in research institutions	39069
in R&D organizations	2176
in service organizations	1181

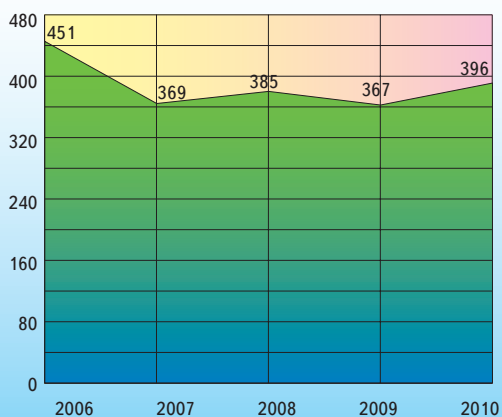


Statistics

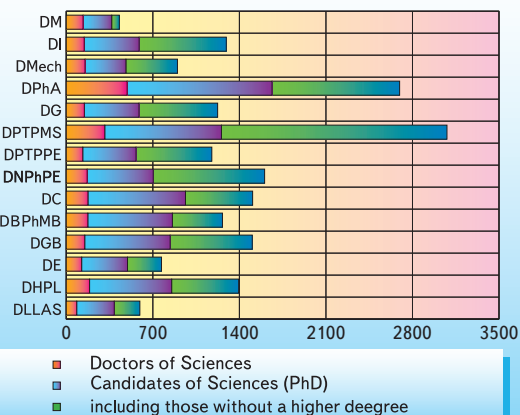
R&D employees	19861
including:	
Doctors of Sciences	2632
Candidates of Sciences (PhD)	8231



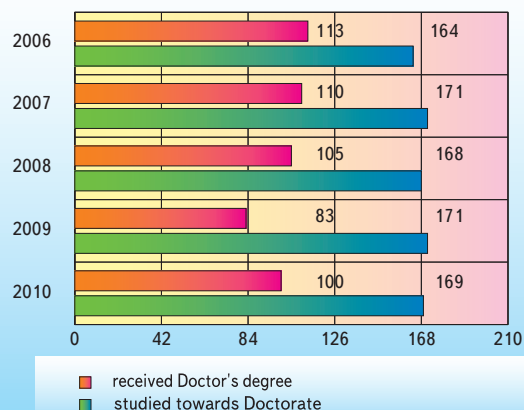
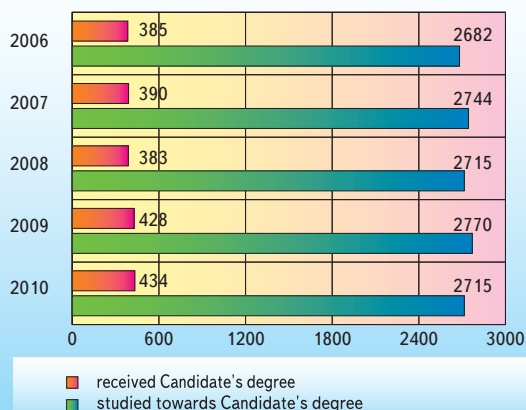
Recruitment of university graduates



Distribution of scientists by departments

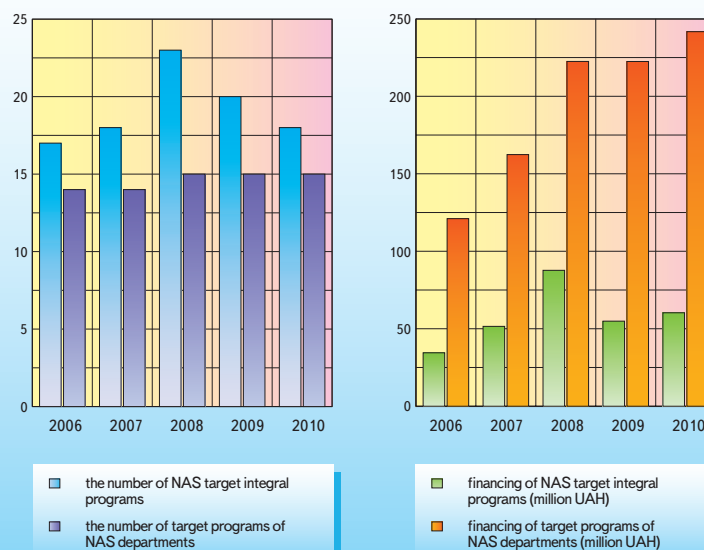


Training of research personnel

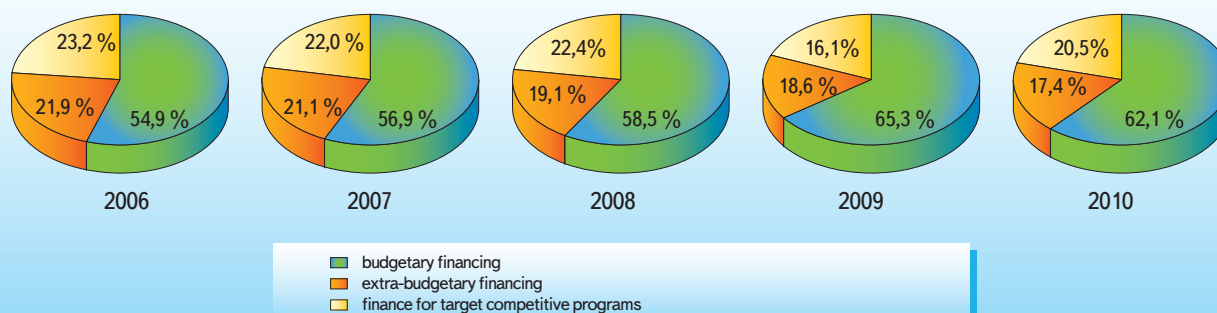


Budget	thousand UAH
Total expenditures	2536381,8
Basic funding from the State budget	1535954,8
Target programs finance	519087,6
Budget finance for personnel training	8890,1
Budget finance for health protection	26126,2
Other	5127,5
Extra-budgetary revenues	441195,6
Expenditures on wages	1846338,6
Expenditures on equipment and instruments	54353,8
Expenditures on capital construction and reconstruction	17226,5
Expenditures on utilities	161797,4
Other expenditures	444027,1

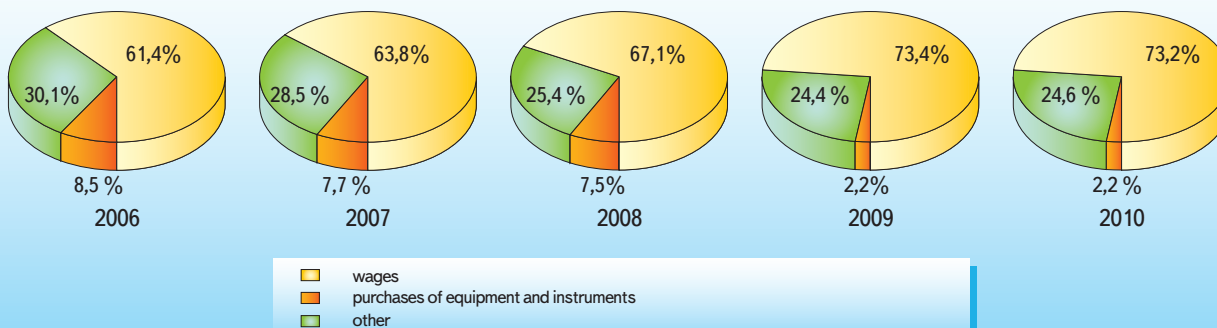
Target programs subjects



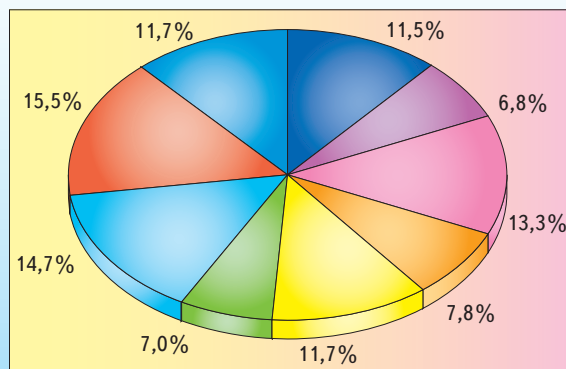
Distribution of finance by sources



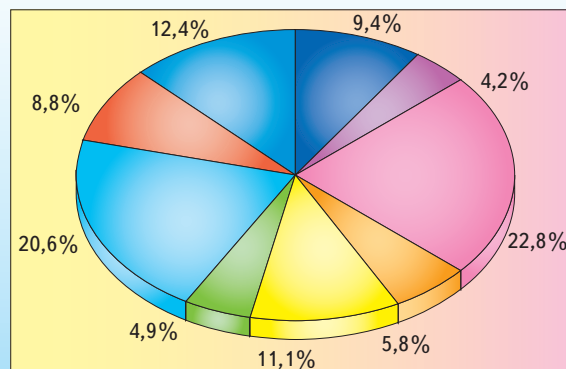
Distribution of expenditures by principal items



Distribution of basic budgetary finance

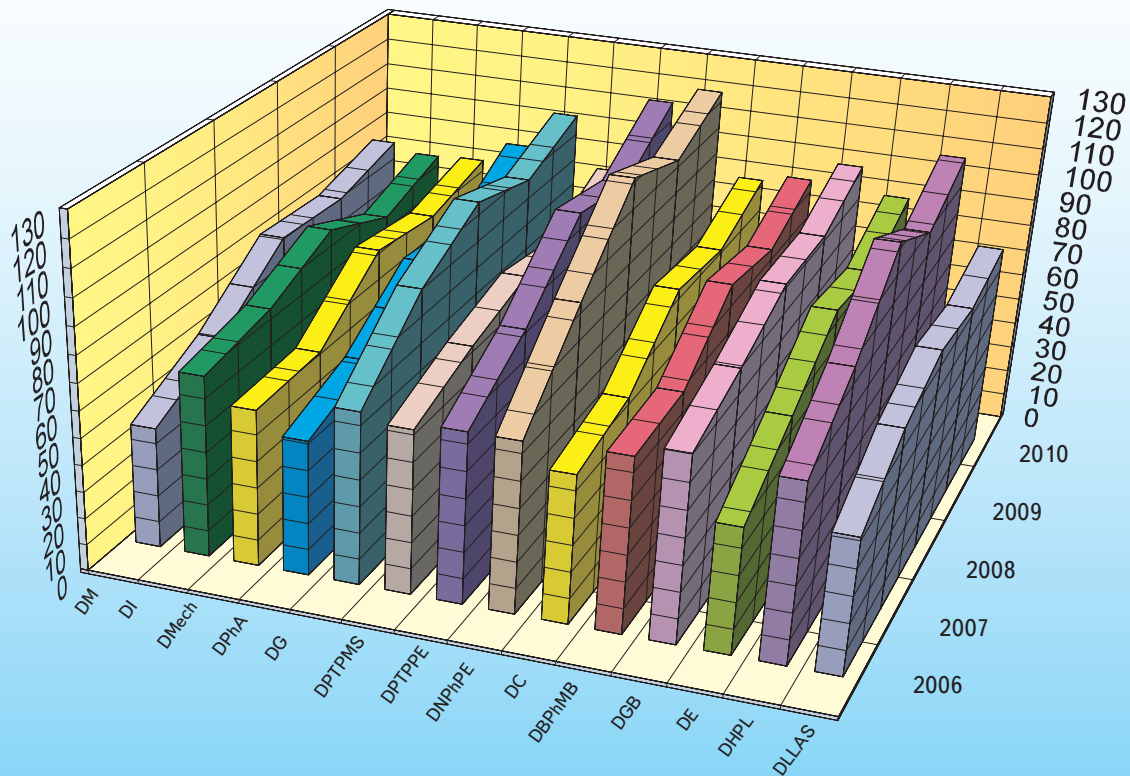


Distribution of extra-budgetary finance



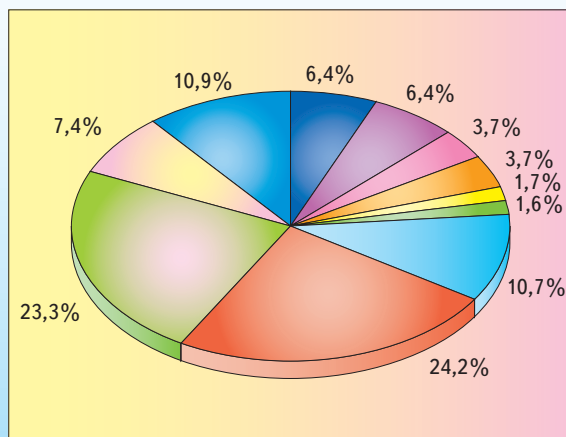
■ Mathematics, Mechanics, Informatics
 ■ Earth Sciences
 ■ Power Engineering
 ■ Chemistry
 ■ Social Sciences and Humanities
■ Physics and Astronomy
 ■ Materials Sciences
 ■ Nuclear Physics and Power Engineering
■ Biological Sciences

Distribution of budget finance per 1 researcher among Departments (thousand UAH)

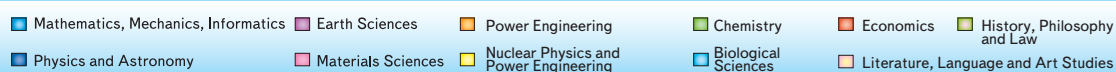
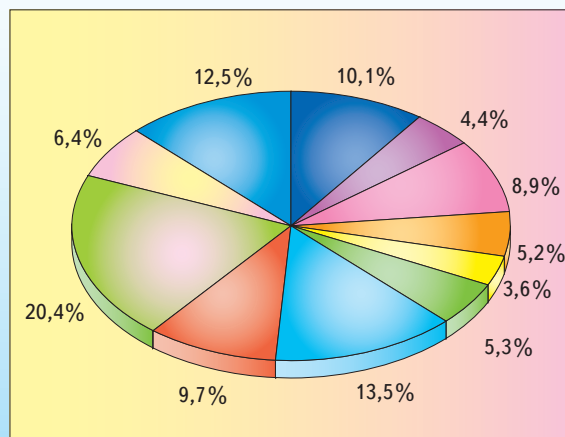


Publication of Academic Materials

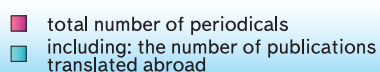
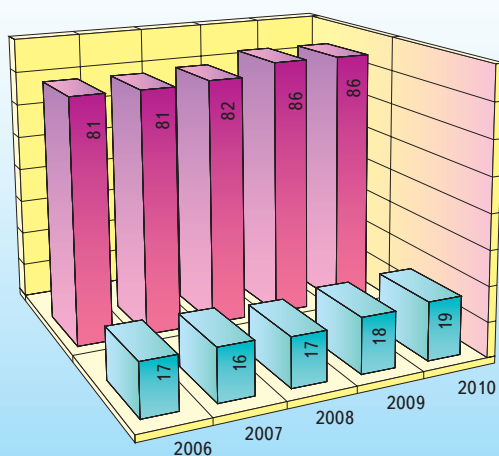
Monographs



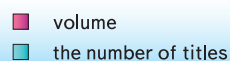
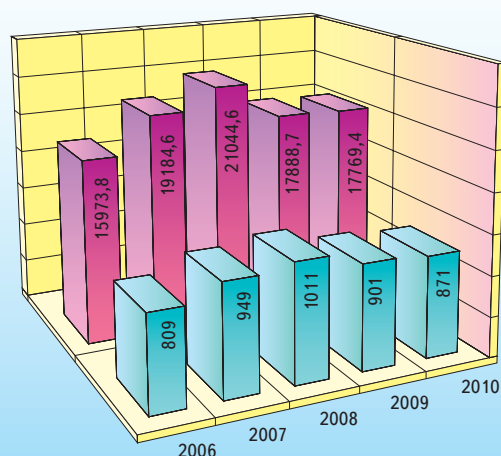
Papers



Academic Periodicals



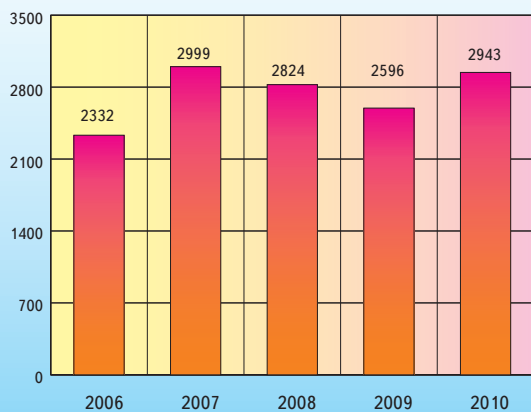
Publication of Academic Books



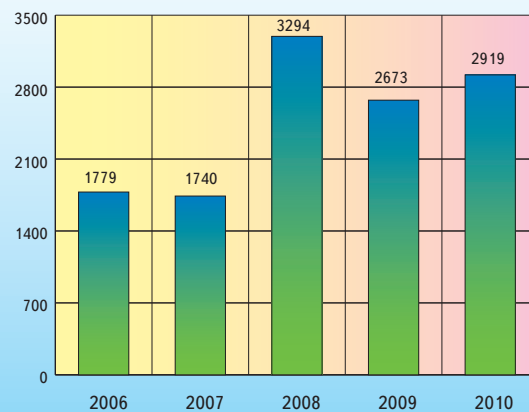
International Contacts of the National Academy of Sciences of Ukraine with Foreign Institutions



Foreign Scientists Received in Ukraine



Ukrainian Scientists Sent on Mission Abroad



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