NATIONAL ACADEMY OF SCIENCES OF UKRAINE BRIEF ANNUAL REPORT 2006

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Contents

Main Results



B. E. Paton, President of the Academy

In 2006, institutions of the National Academy of Sciences of Ukraine (NAS) carried out extensive fundamental and applied research in top-priority fields of science and technology.

New results were obtained in many advanced areas of mathematics, information science, mechanics, physics, astronomy and radio astronomy, Earth sciences, materials science, physical and technical studies of energy, nuclear and radiation technolo-gies, in the area of chemistry and biology. Institutions of socio-humanitarian research studied issues of improving the efficiency of restructuring the economy, its integration to the international economic processes, overcoming demographic crisis, forming civil society, and national and cultural revival of the country. Last year, Academy scholars published over 800 academic books, including 561 monographic writings. Its researchers published over 24 thousand papers, 4.5 thousand of those being published in leading foreign journals. A large number of textbooks, reference and popular science publications were prepared for educational establishments – almost 400 books in total.

Of great significance for ensuring high scholarly level of research were target NAS programs, which were formed on competitive principles. At present the Academy is implementing 30 programs that cover both advanced areas of fundamental research and important applied studies that are of high relevance for Ukraine. It should be emphasized that their number rose each year due to integrated programs where research is done at the interfaces between several study areas. It was on these principles that 5 new integrated programs of applied nature were started. They addressed energy efficiency and energy provision, the creation of domestic super powerful computing machines, study of mementoes of historical and cultural heritage and their re-introduction to the spiritual life of modern Ukrainian society. The total number of integrated programs amounted to 17, with almost 50% more money than in 2005 being allocated to finance them.

Last year, the majority of the programs were to be completed, so NAS Presidium reviewed their results and determined prospects of further research in respective areas. One should point out that the implementation of those programs brought about truly significant achievements that contributed to the progress in priority trends of science and technology, the solution of important tasks in national economy. This concerns, first and foremost, such integrated programs as 'Service life and safety of structures, facilities and machines', 'Nanostructure systems, nanomaterials, nanotechnologies', 'Research into sensor systems and technologies', 'Novel medico-biological problems and human environment', 'Socio-economic and humanitarian factors of the innovative development of Ukraine'.

A high priority in the NAS activities was given to dealing with strategic challenges of R&D and innovative progress of the nation. Academy specialists took an active part in analyzing the situation in the R&D sphere and the activities towards innovative development of Ukraine; the results were considered by the Council for National Security and Defense (CNSD) of Ukraine. The respective CNSD decision provides for a broad range of measures for improving the efficiency of management in R&D and innovative activities, ensuring the growth of the national economy and competitiveness of Ukrainian products due to innovations. Of great importance is the fact that the Decree of the President of Ukraine, that puts into effect this CNSD decision, sets as a priority task the all-round support to fundamental research aiming at the innovative development of Ukraine.

Major issues of the progress in science and R&D sphere were discussed at a joint meeting of NAS Presidium and Verkhovna Rada Committee on Science and Education, held on November 1, 2006. NAS Sections and Departments take an active part in this work. In particular, predictive studies of R&D and innovative progress are done, analytical reports and research information materials are prepared for state power bodies and respective Verkhovna Rada committees. Those cover highly relevant issues of economic, socio-political, social, R&D, innovative, cultural progress.

Much attention is given to establishing efficient co-operation with specialized ministries and major state-owned companies in order to determine priorities in technological renovation of domestic industry and with a view to joint implementation of such tasks. A visiting session of NAS Presidium was held at O.K.Antonov Aviation R&D Corporation, which resulted in signing a general agreement on collaboration. The purpose of this agreement is R&D backup for ensuring high competitiveness of Ukrainian aircraft. In the framework of co-operation with the National Space Agency of Ukraine and under the National space program for 2003-2007, joint research was done to develop polymer materials resistant to bio-corrosion in space. One should also stress that in the year under review the National Academy of Sciences ordered and implemented 9 state target programs addressing major challenges in microelectronics, nuclear power, food industry, reliability and safe exploitation of structures, facilities and engineering service networks, the development of global satellite navigation systems.

Last year, the total number of works performed under commercial agreements increased by 15%, these were aimed at improving the engineering and technological level of domestic production. In particular, devices for remote sensing of liquid level in deep narrow water and oil wells found application at 15 plants in various industries. 'Zaporizky Aluminium Plant' joint-stock company commercialized a system for burning shaft-furnace limestone, which saves about 680 thousand cubic meters of natural gas per year. Academy specialists produced substances that selectively bind and extract the most dangerous elements of spent nuclear fuel with the efficiency 2-3 orders-of-magnitude higher than available industrial extractors. Automotive transport enterprises employed a technology of tribotechnical reconditioning of diesel and gasoline engines, which significantly increases their power, reduces fuel and lubricant consumption and improves environment safety. Developed and commercialized were technologies for producing novel medical preparations, vitamins, alongside with methods for disease diagnostics, prevention and treatment; obtained were intensive technologies of growing crops, methods and means of pest control; elaborated were measures for protection, reproduction and rational use of Ukrainian flora and fauna.

Extensive innovative work of Academy scientists resulted in submitting 626 applications for patents and obtaining 602 patents for inventions and utility models. In the reporting year, NAS institutions concluded 64 license agreements and contracts both in Ukraine and abroad. Significant results were achieved in implementing R&D (innovative) projects selected through competition.

Important steps were also taken towards more intensive innovation activities in the regions. Regional science centers operating under NAS and the Ministry of Education and Science (MES) worked out and sent to local authorities scientifically substantiated proposals adapted to local conditions on ways and specific measures to build up in each region an innovation infrastructure that would combine the available research potential, production capacities of its enterprises and administrative capabilities of its power bodies. A joint resolution of NAS and MES approved a renewed model statute of a regional science center. According to it, the centers are to organize work on forming data banks of high-efficiency R&D results and innovations that are of importance for the regions, for preparing and substantiating projects and business plans to attract investments for innovative activities, ensuring intellectual property protection. A new version of the agreement between NAS and Kyiv City State Administration, signed in 2006, opens up new opportunities for their fruitful co-operation.

Promoting collaboration with education sphere was a top priority in NAS work. Results and future areas of integration were discussed on November 22, 2006 by a joint session of MES Board and NAS Presidium. Its resolution, adopted after the discussion, identified co-operation areas, approved measures to develop collaboration, set up a joint NAS and MES Commission on integrating research and education. No doubt, such integration facilitates the involvement of young people to research activities, promotes the level of education and science in Ukraine, the solution of urgent problems in its economy and state development, the parallel incorporation of Academy and university scholars to the international academic community.

Academy's international ties were extending, as well as participation of Ukrainian scholars in international research programs, especially European ones. Their collaboration with foreign colleagues under numerous UNESCO research programs was going on. Active inter-academy contacts were continued in the framework of the International Association of the Academies of Sciences, primarily, in shared use of unique research facilities, establishing and furthering ties with international organizations - UNESCO, Organization, World Intellectual Property International Science Council, in particular. Deeper became the collaboration with the academies of arts and sciences of Poland, the Czech Republic, Slovakia and the European Organization for Nuclear Research

Developed further was the practice of holding joint competitions with foreign research organizations with on par financing. E.g., competitions of integrated projects were started jointly with the Siberian Branch of the Russian Academy of Sciences (RAS). According to the collaboration agreement between NAS and Russian Humanitarian Academic Foundation (RHAF), projects selected through competition were implemented and a second competition of research projects was organized. Fruitful collaboration with Ukrainian Center of Science and Technologies was carried on. Thus, according to the results of two competitions held under the program 'Target research and the development of initiatives', 17 projects were realized, with nearly 30 NAS institutions participating.

The Academy worked persistently at perfecting its activities, implementing the proposals of the Commission on further improving NAS efficiency, in particular, in such spheres as improving its research management, achieving a better perception of science in the society, dealing with social issues. State certification of Academy research institutions was held, which was to estimate the efficiency of their work, the compliance of the results obtained with nation's R&D priorities and tasks of R&D progress, alongside with their need for the support from the state.

NAS gave permanent attention to a most important issue - improving the quality of its personnel, involving young people to research activities. NAS Presidium, in collaboration with the Commission on work with young researchers, held competitions of young scholars for state prizes, grants and scholarships. Young researchers won 11 annual prizes of the President of Ukraine for young scholars and 2 prizes of the Cabinet of Ministers of Ukraine for special achievements of youth in the development of Ukraine, obtained 29 grants of the President of Ukraine to support the research done by young scholars and 9 grants of the President of Ukraine for gifted young people. In the year under review, 96 research projects, supported with NAS grants, were completed quite successfully. For three years running, NAS institutions and departments have been selecting the best young scholars to present their research results at NAS Presidium meetings.

Measures to stimulate young researchers bore fruit. Last year, as compared to 2005, the number of

young researchers and the number of candidates of sciences under 35 rose by 6.7 and 8.3 % respectively. It should also be emphasized that in the recent years positive changes have been noticed in the personnel structure and quality of research institutions. The number of research personnel is on the rise, as well as the number of doctors and candidates of sciences. Now NAS employs 16813 researchers (42.7% of the total number of its workers), with 2493 doctors of science and 7996 candidates of science being among them.

Persistent efforts towards providing financial and logistical support to research were continued. The Law of Ukraine 'On the State Budget of Ukraine for 2006' provided total target expenditures for NAS at UAH 1,196.8m, which is 23.4% more than in 2005. The budget finance target was met in full. That enabled us to increase in 2006 salaries of Academy's workers by 21.4%, as compared to the rise in the minimum wages, to carry on the implementation of integrated research programs and projects started earlier under joint competitions and to continue the import of unique science equipment. In addition to the state-budget allocations in 2006, budget-financed institutions and organizations of the Academy earned on their own UAH 322.5m (the special fund of the budget), which amounted to 21.2% of the total revenues.

The rise in the state-budget expenditures permitted a significant improvement in scientific research maintenance in 2006. In total, NAS institutions spent UAH 186.839m for purchasing instruments, equipment and materials, with UAH 55.0m of that money being earned by themselves and the total Academy's spending for that purpose increasing by 11.5% against the respective figures of 2005. The amount of money used for centralized import of research equipment also rose. The Academy imported 26 novel devices at a cost of UAH 50m. Now they are being commissioned, forming the basis for new centers of shared use of equipment. It should be mentioned that 31 such centers already function, having been set up on the basis of expensive imported facilities purchased by the Academy in 2004-2005.

Last year, NAS did not spare efforts for fulfilling one of its major statute tasks – that of better fundamental-research coordination in science institutions and organizations. In pursuance of article 41 of the Law of Ukraine 'On the State Budget of Ukraine for 2007', the Academy did an expert assessment of the fundamental research subjects to be financed from the general fund of the 2007 State budget of Ukraine. The NAS Expert board received 3527 applications from 10 major administrators of budget finance, including 1646 applications for research performed by NAS institutions. In a short time the Academy did a large amount of work on organizing and performing the expert assessment. Necessary methodological documents were produced, registration and preliminary assessment of the submitted projects - done, the analysis of those by qualified experts - organized. The principal assessment work was centered in NAS Departments, where sections of the Expert board were set up. At the same time, NAS academic councils and committees were broadly involved. Over 200 leading university academics, representatives of state-financed specialized academies and respective ministries participated in the work. Such an approach ensured objectivity and transparency in the analysis of research subjects. In general, the expert assessment demonstrated a high scholarly level of fundamental research done by institutions subordinated to different agencies.

The results of the fundamental-research assessment are to become a significant factor in identifying the list of priority areas and major challenges in fundamental research, the so-called 'coordination plans', being prepared by the National Academy of Sciences of Ukraine in pursuance of the Presidential Decree 'On the resolution of the Council for National Security and Defense of April 6, 2006'. The results of the work to be done, after their generalization and analysis, will be discussed at a meeting of the Inter-Agency Board on Fundamental Research Coordination. One should stress that NAS initiated changes to the Board statutes, with a view to extending its authority and tasks.

Summing up the NAS activities in 2006, one can say with confidence that its institutions and creative teams worked fruitfully, they achieved significant research results and will not spare efforts for further progress of science in Ukraine, scientific backup to technological, socio-economic, and cultural renewal of the nation.

Activities of NAS General Meeting and Presidium. Furthering of International Ties



A. P. Shpak, First Vice-President — Chief Scientific Secretary of the Academy

In the year under review, the activities of NAS General Meeting and Presidium were focused on promoting cutting-edge research, backup to dealing with major national challenges, on improving the efficiency of Academy's activities, integrating NAS scholars to the international scientific community.

The annual session of NAS General Meeting, held in May, 2006 and attended by the President of Ukraine, Verkhovna Rada Speaker and the Prime-Minister of Ukraine, as well as heads of ministries and agencies, Academy scholars, representatives of mass media, NGOs, guests from abroad, summarized the Academy's activities in 2005 and determined the prospects of its future development. The annual report, the address of the President of Ukraine to those present at the session, presentations of General Meeting participants emphasized that NAS scientists obtained significant results in many advanced research areas in natural, technical sciences and socio-humanitarian studies. Still, attention was called to the necessity of promoting science progress in Ukraine, forming national priorities in research, strengthening innovative activities.

An important event at the session of General awarding NAS academician Meeting was V.V.Skopenko, President of the National T.Shevchenko University, with V.I.Vernadsky Gold Medal for his outstanding contribution to coordination chemistry and RAS academician M.A.Plate, NAS foreign member, for his prominent achievements in polymer physics and chemistry. Polish Foundation for Materials Science Development awarded NAS academician B.E.Paton with Prof. Jan Czochralsky Gold Medal for his research activities and achievements in materials science.

The General Meeting session elected new NAS academicians and corresponding members, a NAS Vice-President – the head of the Section of Social and Humanitarian Studies (NAS academician V.M.Litvin) and approved the academician-secretary of NAS Mathematics Department (NAS academician A.M.Samoylenko).

At its May session, NAS General Meeting also approved proposals of the Commission on further improving the efficiency of NAS activities. In accordance with those proposals, Academy Presidium has already adopted a number of resolutions towards improving research management, achieving a better perception of science in the society, solving social problems; jointly with the Board of the Ministry of Education, it adopted resolutions towards deeper integration of research and education.

The session of NAS General Meeting, held in the April of 2006 to commemorate the 20th anniversary of Chornobyl disaster, was attended by people's deputies of Ukraine, scientists and guests from Belarus and Russia, representatives of ministries and agencies, scientific community and mass media. NAS academician B.Paton presented Academy scientists who took part in clearing the impacts of the Chornobyl catastrophe with honorary NAS decorations. Those present listened to the report 'Chornobyl Lessons. From the Past into a Future' and were shown a documentary 'A Mistake for Millennia' about NAS participation in liquidating the impacts of the disaster at Chornobyl NPP. In discussing the report and film, an emphasis was made on an important contribution made by Academy researchers to overcoming the impact of this major disaster. The session also stressed that due to the efforts of NAS specialists, catastrophic effects were significantly alleviated.

As in the previous years, NAS Presidium gave much attention to the scientific backup to dealing with major national challenges, primarily those of R&D and innovation progress. In the March of 2006, the President of Ukraine, at a meeting with Academy authorities, scientists and directors of leading industrial enterprises in Kharkiv, discussed the present status and development prospects of domestic science, commercialization of advanced research results and technologies. A joint meeting of NAS Presidium and Verkhovna Rada Committee on science and education in November made a comprehensive analysis of current R&D progress in Ukraine and of its legislative provision.

A visiting meeting of NAS Presidium, held last September at O.K.Antonov R&D Concern, aimed at a more active creative collaboration of the Academy and the R&D concern, with a view to ensuring high competitiveness of Ukrainian next-generation aircraft.

The assessment of the current status and development prospects of advanced research areas and of solving some highly relevant science problems played an important role in the activities of NAS Presidium in 2006. In particular, scientific presentations were made on fundamental problems of non-linear dynamics, novel methods and off-the-shelf means for personalizing computer, telecommunications and other sophisticated engineering systems, the status and prospects of Ukrainian research into coherent quantum optics, plasma physics and controlled thermonuclear fusion, compilation of the National Atlas of Ukraine, on-line oceanography and new technologies of studying the World Öcean, of scintillation crystals and detectors for digital radiography and tomography, high-strength and heat-resistant titanium alloys, advanced cryobiology achievements for agricultural needs, academic aspects of constructing a new system of inter-state competitive relations, Constitution's role and significance in state- and law-formation in Ukraine etc.

NAS Presidium also discussed the results of imple-

menting target integrated research programs that were to be completed last year and determined prospects of further scientific research in respective areas.

On the instructions of NAS Presidium, a special Expert panel carried out expert assessment of the subjects of fundamental studies done at Ukrainian institutions.

Great significance was attached to discussing research and research-organizing activities of Academy institutions. In 2006, 13 institutions reported on those issues at Presidium meetings; the results of Academy institutions certification were affirmed.

Last year, NAS Presidium gave much attention to publishing activities. A book series "Presidents of the Academy of Sciences of Ukraine" was started; the participation of the NAS Institute of Encyclopedic Studies in publishing a 35-volume works by P.Kulish was considered; a decision concerning the preparation and publication of Ukrainian Universal and I.Franko encyclopedias, as well as a new academic "History of the Ukrainian Literature" was made; targets were approved for the Academy publishers to issue academic books under government orders.

In the period under review, a special emphasis was placed on supporting and promoting studies of young scientists. In particular, in 2006 Academy Presidium discussed the results of implementing research projects by young scholars financed by NAS grants and the organization of yet another competition, awarded NAS prizes for young scholars and students for the best studies and provided addressed financial support to young scholars who made academic presentations at NAS Presidium meetings.

NAS Presidium Bureau dealt with important issues of allocating target finance to maintain basic assets in a proper condition, providing priority research areas with state-of-the-art instruments and devices, securing land plots for NAS institutions, attracting investors for cooperative construction and renovation of buildings; issues of energy consumption and payments for the utility services consumed, leasing policy, use of hostels, acquiring and allotting apartments to provide Academy workers, young specialists in particular, with job-related accommodations etc.

In total, NAS Presidium and its Bureau held 32 meetings, adopted 364 resolutions and issued 807 orders.

In the reporting period, NAS Presidium did not spare efforts for promoting international collaboration in science, further integration of Academy scholars to the international academic community. It continued the implementation of long-term agreements and programs of research co-operation with numerous foreign Academies, foreign and international organizations, the work under joint research programs, studies financed by international grants and scholarships, participation in activities under the aegis of IAAS, UNESCO, NATO, EU, OBSEC etc. Foreign delegations were received; the exchange of scientists and specialists, academic literature and research information was going on.

In 2006, there were 94 effective collaboration agreements with 45 foreign academic centers. Nearly 150 NAS institutions had established 570 direct

agreements and contracts with partners from 50 countries. New agreements with Polish, Serbian, Montenegrin academies of sciences and arts, the European Nuclear Research Organization, agreements with academies of sciences of Mongolia and Tajikistan were renewed, as well as a protocol with the Austrian Academy of Sciences. 107 joint research projects were implemented under inter-academy agreements with countries of Eastern Europe.

Academy scholars participated on competitive basis and with on par financing in joint research projects with the Russian Humanitarian Academic Foundation, RAS Siberian Branch, the International Institute of Applied Systems Analysis, Ukrainian R&D Center, the French National Center of Scientific Research, the Council of R&D Studies of the Turkish Republic etc.

During Science Days of the Macedonian Republic conference Ukraine, academic in an 'Ukrainian-Macedonian Parallels in History and Today' was held, hosted by the Crimea Science Center under NAS and the Ministry of Education and Science. Collaboration of NAS institutions with research organizations of France, Italy, Germany and Austria gained momentum. The agreements of some Academy institutions in the framework of European Research Association were implemented fruitfully. Lately, co-operation with US research institution and firms has become more active. The role of East-Asian countries in Academy's international collaboration increased significantly. In particular, a long-term collaboration in technology transfer and commercialization of NAS R&D results is now under way at Vietnamese-Ukrainian and Ukrainian-Korean technology transfer centers, as well as the International Technology Transfer Center that was set up in 2006 with Ukrainian contribution in Tziasin (Zetsian province, China).

New Challenges

Contribution of the Institutions under NAS Section of Physical, Technical and Mathematical Sciences to NAS Target Integral Research Programs



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

With a view to promoting interdisciplinary top-priority studies at NAS institutions and strengthening their innovative orientation toward challenges of the economic and social development of the nation, in 2003 the National Academy of Sciences of Ukraine introduced a new mechanism of addressed support to high-priority areas of fundamental and applied research in natural and technical sciences as well as social and humanitarian studies, namely the target integral research programs.

In 2006, the term of financing of five such programs expired. Those were mainly implemented by the institutions under the NAS Section of Physical-and-Technical and Mathematical Sciences. The Programs concerned:

1. Service life and operation safety of structures, buildings and machines ('Service Life');

2. Nanostructure systems, nanomaterials, nanotechnologies;

3. Development of effective intellectual information technologies for high-efficiency computers and means of information protection ('Intellect');

4. Mineral resources in Ukraine and their mining;

5. Studies of the phase state and amount of methane in fossil coal, intended for improving operation safety.

Due to the implementation of the programs, major fundamental and applied scientific results were obtained and introduced to industrial practice. In particular, under the 'Resource' program, procedural approaches to estimating the probabilistic characteristics of defects in existing pipelines were developed and used in solving risk-analysis problems; efficient systems for monitoring the state of crucial facilities were proposed; a new corrosion-resistant coating for pipelines was produced and tested; a system to control the properties of metal of the nuclear reactor vessel in power block No.4 of Rivnenska NPP was developed and installed; a new technology for automated welding of elements of the main circulation pipe, aimed at extending the service life of the NPP, was developed, certified and used in replacing steam generators; a technology to extend the service life of boiler equipment elements for decentralized heat-and-power generation was proposed; methods were developed for renewing large-sized structures of ore-processing equipment operating under heavy-duty conditions.

In implementing the target integral program 'Nanostructure systems, nanomaterials, nanotechnologies', a wide range of high-priority problems were tackled by joined efforts of 33 NAS institutions, namely: structure-forming of nanodots, nanowires, nanofilms, multilayer systems of quantum dots, hetand polyerostructures composites of mer-nanoparticle type were studied alongside with their anomalous optic, electric, magnetic and emission properties with regard for quantization effects, specific features of charge carrier transport and memory effect; investigated were patterns of the energy spectrum of carriers in quantum wells and electron processes that occur in light-emitting structures based on nanoinclusions of Si in an oxide matrix; technologies to produce numerous multifunctional materials were developed; parameters of the synthesis of nanostructurized bioactive ceramic composites and coatings were optimized and their biological properties were studied, with a view to creating efficient implants.

In the framework of 'Intellect' program, several cluster-type supercomputers integrated in a single complex were assembled and put into trial operation; methods for preliminary processing of 3D pictures and implemented; were developed a Grid-infrastructure for integrating computational resources was adjusted; a new approach to producing an intellectual system for the information support of efficient managerial decisions was developed; new mathematical methods and software were elaborated for forecasting the development of natural and technogenic processes in the atmosphere.

Due to the implementation of 'Mineral resources of Ukraine and their mining' program, the latest data on the mineral resources of Ukraine were generalized; new technologies were developed for the search and intense extraction of oil and gas; computer-based methodological and technical means to control marine environment were produced; efficient technologies for integral development of coal deposits were upgraded.

Under the program 'Studies of the phase state and the amount of methane in fossil coal to improve operation safety', a physical model of the coal-gas system was developed, and patterns of the transformation of closed pores into open ones were clarified; a method to determine the time of the accumulation of dangerous methane concentrations in development workings was approbated; and a procedure for acoustic probing of a coal-containing massif to determine the size of the active gas-release zone was proposed and approbated.

In December 2006, meetings of NAS Presidium discussed the results of implementing 'Resource' and 'Nanostructure systems, nanomaterials, nanotechnologies' programs. In view of the high scientific quality of the results obtained and prospects for their introduction to industry, the Presidium made a decision to extend those programs for 2007-2009.

In general, one can state that the beginning of target financing of priority studies at the NAS of Ukraine facilitates a more efficient use of budgetary funds and the involvement of the best research personnel to dealing with the most urgent problems, due to the emergence of competitiveness and that is a most efficient way to reorganize Ukrainian science.

Integrated Programs for Fundamental Research into Medico-Biological Problems and Sensorics



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

In recent years, the target-oriented method of planning research has become a common practice at the NAS of Ukraine.

In particular, the NAS Section of Chemical and Biological Sciences initiated an integrated fundamental research programs 'Studies in the field of sensor systems and technologies' (NAS Presidium directive of July 1, 2003 № 404) and in 2004 – an integrated fundamental research program 'Current medico-biological issues and human environment' (NAS Presidium directive of January 21, 2004 № 6). Their term of implementation expired at the end of 2006, so some conclusions could be drawn.

Under each program, academic boards were set up, which developed concepts, priority research areas and formulated principal tasks of the programs.

Scientists of 24 institutions of 6 NAS Departments of Academy, namely, those of Chemistry, Molecular Biology, Biochemistry, Experimental and Clinical Physiology, Physics and Astronomy, Physical-and-Technical Problems Power of Engineering, Informatics, Physical-and-Technical Problems of Materials Science were involved in the former. In total, 46 projects were implemented, 20 of them being of integral (inter-institute) nature. This allowed the efforts of specialists in different fields to be combined for addressing fundamental and applied problems and a number of majot results to be obtained.

For example, fundamental patterns were discovered in the formation of organized biomolecular layers, and ways for optimum combination of bioselective material with surfaces of physical transformers were found; new basic electronic information-and-measuring systems were proposed for sensors and electronic optical devices with computer procession.

Physical and technological principles were developed for producing sensors and sensory arrays on the basis of microelectronic materials, alongside with theoretical and technological principles for developing fundamentally new selective elements on the basis of biomimics.

Besides, physicochemical principles were developed to obtain sensitive layers for sensory and multi-sensory systems on the basis of nanocomposite materials; new materials were produced for high-sensitivity sensors and intellectual sensory systems, highly-selective synthetic receptors for ions and molecules. The results produced by scientists during the program implementation are significant – 256 research papers and abstracts of 421 presentations at conferences were published. 45 patent certificates were obtained and patent applications were made. In addition, a summarizing scientific conference was held and 2 books of scientific proceedings published.

Participating in the implementation of the 96 projects under the latter of the abovementioned programs were researchers of 27 institutions from 5 NAS Departments: those of Molecular Biology, Biochemistry, Experimental and Clinical Physiology; General Biology; Chemistry; Physics and Astronomy; Earth Science. This allowed them to cover and to solve a wide range of medico-biological and ecological problems of the day.

For instance, cellular mechanisms of the origin of metabolic pain syndromes in diabetes were studied; a new method for early diagnostics of myocardium pathologies was offered; high-activity cultures – producers of new anti-carcinogenic antibiotic landomicine E were obtained.

Potentially promising medical preparations, including anti-carcinogenic ones, were studied; inhibitors of non-specific phosphatases and fluorine-containing activators of ATP- dependent potassium channels were synthesized.

Besides, determination of typical conventional components in some objects was made; scientific methodology was worked out for environment monitoring and prediction of emergencies on the facilities with high environmental hazards etc.

The implementation of the program resulted in 3 monographs, 152 papers, the abstracts of 99 presentations at conferences being published. A total of 16 patents were obtained and patent applications were submitted; 2 final scientific conferences were held.

In general, the implementation of the abovementioned programs allowed scientists to expand fundamental knowledge and create prerequisites for the development of cutting-edge technologies in important areas of human vital activities.

In view of the importance and promise of the research results obtained, NAS Presidium decided to extend works under both abovementioned programs within the limits of a new stage in 2007-2009.

The experience gained in the research done within integrated programs allows us to conclude that they are an effective instrument in integrating scientific teams from various NAS institutions, who are specialists in different fields, in advanced promising interdisciplinary areas of science progress.

Socio-Humanitarian Studies as a Factor of Accelerating Ukraine's Innovative Development



V. M. Litvin, Vice-President of the Academy

2006 was the time of completing an important stage of work and determining new research trends and objectives. The General Meeting of the NAS Section of Social and Humanitarian Sciences, held in December, 2006, summarized the implementation of the integral research program 'Socio-economic and humanitarian factors of innovative development of Ukraine', alongside with a number of research programs implemented by the Departments. They were centered at realizing the innovative potential of socio-humanitarian studies, for the future of Ukraine can only be ensured by a rapid and effective breakthrough to dynamic innovative high-tech-based growth in both manufacturing and management, education, culture, information.

Completed were works aimed at theoretical elaboration of ways and models of improving the efficiency of innovative, investment, social and ethno-cultural development, in particular, of that in regions; upgrading the legal regulation of innovative progress; a better methodological support to the activities of state-power and local self-government bodies, a deeper Ukraine's involvement in international, primarily European, economic, political, R&D, cultural and educational institutions. Under the supervision of NAS academician V.M. Heyets, a system analysis of Ukraine's competitiveness was made: that of strengths and weaknesses of its domestic economy, priorities of its innovative development, its structural harmonization at micro-, mezo- and macro- levels. Studied were issues of developing network economy, ensuring the entrepreneur environment, improving its labour-market and taxation as well as the participation of Ukraine in international integration processes.

Significant theoretical, prognostic, methodological and practical results were obtained due to imple-NAS integral menting research program 'Demography and human development'. The NAS Institute of Demography and Social Studies prepared and sent to the Government the concept and strategy of demographic development till 2015, where the projections of demographic situation were made out to mid-XXI century, as well as tasks and ways of forming the social-and-demographic policy of the country were determined, with a view to a significant improvement in the human and labour potential of Ukraine, ensuring the solution of dynamic innovative-development problems in conditions of real reduction of the population and changes in its age structure.

Scholars in philosophy, sociology, politics and law

found irrefutable proofs that social progress, and the development of domestic economic, R&D and innovative potential in particular, will increasingly rely on a general improvement in education and culture, the solution of social problems, rather than the other way round, which had been believed before. The research covered a wide range of social, political-and-juridical, ethno-cultural, ideological and religious aspects of modern Ukrainian society. Significant attention was given to generalizing integral studies, doing conceptual, prognostic, comparative, monitorexpert research into socio-political, ina. socio-economical, cultural and civilization processes. Scholarly data were obtained to work out measures towards improving the efficiency of the present-day Ukrainian academy research, increasing its role in dealing with new challenges of socio-political, socio-economic and cultural progress, ensuring the nation's transition to dynamic innovative development.

Truly innovative were the studies of linguistic institutions, which are aimed at developing and efficient implementation of novel linguistic technologies. A linguistic corpus of over 42m word usages was compiled, which facilitated a number of fundamental linguistic studies that would otherwise had been impossible. The collaboration of NAS Ukrainian Linguistic Information Fund and the NAS O.O. Potebnia Institute of Linguistics allowed a seven-volume Ukrainian Etymology Dictionary to be completed.

In the future, the efforts of social scholars will be focused on studying the problems and prospects of socio-economic and political-and-legal progress of Ukraine, as well as on increasing its intellectual and spiritual potential and updating its science, education, culture, management. Those issues will be addressed in the framework of NAS target integral research programs for 2007-2010. At the same time, Departments under NAS Section of Socio-Humanitarian Studies will implement projects under target research programs 'Ukraine XXI century: strategic priorities of socio-economic development', 'Dialogue of cultures and civilizations: Ukraine integration to international community' and 'Language, literature and culture in Ukraine: integrated studies within the context of current globalization processes'. The results of this research is to facilitate a deeper insight into the experience, patterns, driving forces, objectives and prospects of nation's progress in the coming decades, which is of utmost importance for forming an integral strategy of socio-economic and cultural rise of the nation, for the consolidation of democratic principles of civil society.

Mathematics



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

In 2006, scientists of the institutions under the NAS Department of Mathematics carried out advanced fundamental research and obtained a number of whole new results in major branches of mathematics.

Experts in the theory of functions and functional analysis constructed a closed theory of orthogonal polynomials of a complex variable, which is similar to the classical theory of orthogonal polynomials of a real variable. The behavior at infinity of weak solutions of abstract parabolic and elliptic equations in Banach space was studied. It was found that all Schur quadruples of (transitive) spaces in finite-dimensional space are generated by irreducible representations of a quadruple of orthoprojectors whose sum is a multiple of the unity. New results were obtained in the study of extreme problems in the theory of univalent conformal mappings that generate multipole quadratic differentials. A theorem on an implicit function with singularities was proved. A new method was constructed for estimating a one-sided approximation of cutoff degrees by algebraic polynomials in the integral metric.

In the field of differential equations, the problem of dynamics of traveling waves of the phenomenological equation of spin combustion was solved. Mathematical models were proposed for information processing (storage and sequential retrieval), based on the application of heteroclinic trajectories of intermixing attractors of dynamical systems. The existence of weak global solutions of initial boundary-value problems for а system of Navier-Stokes-Vlasov-Poisson equations was proved. Conditions for the unique solvability of the problem for linear typeless systems of partial differential equations with non-local conditions with respect to a selected variable were determined. A new method was proposed for investigating weakly nonlinear periodic systems of differential equations in the case where the corresponding linear homogeneous system has a family of periodic solutions.

In mathematical physics, states and the spectrum of the BCS Hamiltonian with sources were constructed. The direct and inverse problems of the theory of multi-channel scattering were studied and solved. The central limit theorem was proved for linear statistics of eigenvalues of deformed unitarily invariant ensembles of random matrices.

In geometry and topology, it was proved that 2-step nilpotent groups with left-invariant metric do not admit isometric immersion into a Euclidean space of small co-dimension. The exact value of the minimum number of closed orbits for Morse–Smale flows on differentiable manifolds was determined. Gromov hypothesis was disproved in the case of Riemannian manifolds of dimension n > 3.

In probability theory and mathematical statistics, the asymptotic behavior of stochastic functionals that determine the sojourn measures in the states of Markov and semi-Markov processes in the scheme of averaging and diffusion approximation was studied. Investigated was the structure of filtration for which there exists a Wiener process consistent with this filtration and is such that every martingale with respect to this filtration can be represented as a stochastic integral with respect to this Wiener process.

In algebra, a complete description of indecomposable finite-dimensional representations of the Euclidean group for vector fields was given and a method for factorization of polynomial matrices over various fields and matrices over adequate rings was developed.

In the field of mathematical problems in mechanics, a solution was found for the problem of viscosity effect on the value of the main vector of hydrodynamic forces and on specific features of the behavior of boundaries of stability domains of plane and space motions of the free surface of a liquid. For asymptotically pendular motions of a solid, a new scenario of the switch from regular to chaotic motion was determined. Mathematical models and methods were developed to investigate thermomechanical contact of structures with sub-boundary and interface cracks and boundary pits. An energy-based approach and methods were proposed for model description of formation of sub-boundary phenomena in thermoelastic bodies in transition from a natural homogeneous thermodynamic state to a locally gradient stationary state. A mathematical apparatus of motion decomposition was developed.

In mathematical modeling and computational and applied mathematics, an exponentially convergent method was constructed for solving Cauchy problem for an abstract quasilinear differential equation with strongly positive operator coefficient in Banach space. A complete system of relations was formulated for describing the initial stage of drying a porous elastic layer, with account being taken of the dispersion of pore sizes of and their cohesion.

In implementing the targeted research program 'Mathematical modeling of physical and mechanical processes in strongly inhomogeneous media', methods were developed for mathematical modeling of images transmission via video channels of a space system with regard for signal deflection due to spacecraft motion. The stability of spatially homogeneous solutions was analyzed for basic reaction-diffusion models of the general form, that are used for mathematical modeling of self-organization phenomena in physical, chemical, environmental and other systems.

Information Science



I. V. Sergiyenko, Academician-Secretary of the Department

In 2006, scientists of NAS Information Science Department carried out a number of important fundamental and applied studies in information science, mathematical modeling, intellectual information technologies and systems, management theory, development and application of super-power computer engineering devices, in solving computation problems of super-high dimensions, artificial intelligence elements, systems and means for transmission, processing and storage of large amounts of information.

A sufficient condition of asymptotic stability of discontinuous linear nonstationary systems and of some special nonlinear nonstationary system classes was obtained and has been constructively verified.

'NADRA 3D' information technology for dynamic analysis of the formation of subterranean waters regimes in large soil ranges was developed and implemented on the basis of SKIT cluster complex.

A new asymptotic analysis method was developed to analyze principal reliability indices of major multiplex systems whose behaviour is described by a strong regenerative process. Developed were procedures for testing parameters of key certification centre for systems of electronic documents circulation and electronic digital signature.

New efficient methods were developed to formalize demands and specifications of distributed systems, relying on basic protocols alongside with methods of abstracting sophisticated system models.

A methodology was proposed for producing future scenarios of sophisticated systems as well as methodological and mathematical approaches to implementing technological prediction and methods of its modeling.

Theoretical fundamentals for hyperplane information clusterization were proposed, which are based on fundamental results of perturbing pseudoinverse and projection operators.

A VC-theory for training large amounts of data was developed and a formalized procedure of rational agents' vital activities concerning intellectual system re-training proposed.

Mathematical models of the processes of soil ranges pollution in sewer areas were built, including filtrative consolidation of saline-saturated soils.

A mathematical model of acoustic wave propagation in inhomogeneous environment with impedance border in the form of Schroedinger-type differential equation was developed.

Theoretical principles and algorithms of informa-

tion coding in any calculus with timer series-parallel interpretation were developed and crypt-stable streaming encoding systems produced.

Models, methods and means of semantics-oriented agent technologies were developed to improve the intellectualization level of multi-purpose distributed dynamic information systems.

The efficiency of MGUA as an inductive method for automatic construction of noise-immunity models with minimal prediction-error dispersion under conditions of short sampling of noisy data was proved.

Optimization methods for geometric characteristics of asymmetric cat's eye elements with a microrelief produced on solid and flexible surfaces by means of 'diamond' cutting were developed.

Logical-and-mathematical principles of universal descriptive systems were constructed, and the problem of completeness, consistency and independence of compositional means was solved. On this basis, compositional information technologies were created.

A computer simulation complex was developed for searching balanced options of Ukraine's socio-economic development on the basis of a dynamic model of inter-departmental balance.

'RADA 3 – KYIV' system for providing information services to deputies of Kyiv City Council was developed and implemented.

Polynomial procedures of pattern recognition were proposed, to be used in agriculture in computer selection of new crop varieties.

Mathematical models of brain structures interaction resulted from studies of human brain bioelectric activity, using improved methods of diagnosing its intellectual status on the basis of the new artificial intelligence methods developed.

A magnetic cardiographic system was completed, which is now under medical certification. The system permits early diagnostics and helps decrease mortality due to cardiovascular diseases.

Mechanics



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

In 2006 scientists of NAS Mechanics Department produced a number of new important results.

At the S. P. Timoshenko Institute of Mechanics, the effect of a cross-cut on the deformation of a thin fiberglass plastic plate loaded by a shock wave was studied experimentally. The theory of thin and non-thin orthotropic shells was developed, which took into account nonlinear elastic properties and low shear stiffness of composite materials. Investigations of the mechanical behavior of anisotropic inhomogeneous noncircular cylindrical shells of varying thickness under complicated boundary conditions and various loads were carried out on the basis of discrete-continuous approaches. A theory and methods for determining axisymmetric geometrically nonlinear thermoviscoelastoplastic stress-strain state of both thin and middle-thickness compound shells were elaborated, with account being taken of the material damage and stress state mode. A mathematical approach to solving problems on dynamic interaction of cylindrical shells filled with fluid and submerged into unbounded elastic medium with a vibrating spherical inclusion was developed. Hydrodynamic characteristics of the fluid and the stress-strain state of the shell and external elastic medium were calculated.

The Institute of Technical Mechanics under NAS of Ukraine and the NSA of Ukraine made calculations, did experimental study and determined design parameters and operation conditions of vibration cavitational-pulse generator intended for increasing oil and gas well flow rate by the treatment of the productive stratum bottomhole zone with high-frequency high-amplitude pulses of liquid pressure. On the basis of mathematical modeling in one-dimensional approximation (with the use of finite element method) and in axial-symmetric approximation (with the use of check value technique in the integration of Navier-Stokes equations), specific features of high-frequency high-amplitude vibrations of liquid pressure in hydraulic systems with the cavitational form loss were calculated for the first time ever. Due to results of theoretical studies, a new profile of the railhead cross-section was developed; this profile is intended for curved outer rails at Ukrainian railways.

Scientists of NAS G. S. Pisarenko Institute for Problems of Strength found functional dependences of the main vibration diagnostic parameter, indicating the presence of a crack in an elastic body, on integral characteristics of nonlinearity and damping capacity of a vibrating system in the region of both weak and significant subharmonic resonances; these dependences may be used to develop vibration diagnostic methods for fatigue damages to structural members. Criteria governing the limit states of materials under conditions of deformation instability at cryogenic temperatures, including the cases under the action of high-density current and powerful magnetic fields, were developed, giving rise to methods for detecting dangerous and allowable stresses with an optimum use of low-temperature and strain hardening, with account being taken of the effect of various design and operation factors.

Researchers of the NAS N.S.Polyakov Institute of Geotechnical Mechanics developed scientific principles for designing modular power generation units intended for conversion of methane and ash-rich coal into thermal and electric power at coal mines; the cost of such energy is 2-3 times lower than the current prices and, owing to the co-generation technologies employed, the efficiency of the units can be improved up to 80%. The results of fundamental research were used to develop a wide range of technologically advanced active band screens that can essentially improve the efficiency of mineral dressing at coal, ore and nonmetallic mines.

At the NAS Institute of Hydromechanics, relationships were obtained, describing the formation of wave perturbations localized near the interface in layered waveguide systems. A theory of filtration and migratory processes in advanced porous materials was constructed and methods were developed to estimate the effect of physical and chemical processes, structural changes and deformations on their properties. New patterns in the development and transformation of hydrodynamic fields generated by the motion of a vessel were found, which took into account nonlinear interaction with topographical features of riverbeds and channels.

At the NAS Institute of Transport Systems and Technologies, mathematical models for a wind electric mill with a vertical axis were worked out and numerical analysis of dynamics and aerodynamics of its elements made. Criteria for absolute stability of nonlinear integral and differential equations with a retarded argument were deduced.

The State Enterprise 'Institute of Machines and Systems', operating under the Ministry for Industrial Policy and NAS, worked out the theoretical background for and, for the first time in Ukraine, designed and manufactured an integrated mobile system of modular machines and devices in collaboration with a number of research institutes and enterprises. Those implement a complex of basic high power-saving technologies for disposal of pesticides and other chemically harmful agents.

Physics and Astronomy



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

For the NAS Department of Physics and Astronomy, the year 2006 was a time of further progress in the major areas of basic and applied research carried out at 18 institutions of the Department, a number of universities and some industrial institutions of Ukraine. Much attention was given to developing state-of-the-art technologies which could substantially accelerate or improve production processes.

The efforts of scientists were focused on in-depth analysis of trends in global research, which are the principal research subjects of the Department's institutions and, in one way or another, determine the evolution of human civilization. Those areas relate to physics of fundamental interactions and physics of macrocosm, solid state physics and soft matter physics, the research wherein is very popular now and includes biophysics and living-matter physics, low-temperature physics and plasma physics, radio physics, electronics, laser physics, and physics of low-dimensional systems and non-linear phenomena. The new experimental and theoretical results were reported in leading international and national journals and made a significant contribution to the current concepts of the micro- and macrocosm.

Some examples of the most significant results obtained at the NAS Department of Physics and Astronomy in 2006 will be mentioned here. The Institute of Physics discovered a strong refractive non-linearity of discontinuous metal films in the visible range, which is much in excess of its values in bulk samples. V. E. Lashkarev Institute for Physics of Semiconductors, in collaboration with their British colleagues, suggested and implemented the idea of acoustic laser operating in the terahertz wavelength range, which can be efficiently applied to modulate waves in optoelectronic devices. We are glad to point out that the American Institute of Physics included this result into the list of major international achievements in physics in 2006. M. M. Bogolyubov Institute for Theoretical Physics and G. V. Kurdyumov Institute of Metal Physics were the first to provide an explanation to the experimentally observed high conductivity of a new material - graphene. The G. V. Kurdyumov Institute of Metal Physics also conducted an integrated study of carbon nanotubes and found formation patterns of their physical properties. B. I. Verkin Institute for Low Temperature Physics and Engi-neering discovered the effect of the dipole moment formed in superfluid helium, which is due to the roton excitations present in it. O. Ya. Usikov Institute of

Radio Physics and Electronics predicted the existence of new surface waves in layered superconductors, which makes the production of fundamentally new radio wave detectors possible. O. O. Galkin Donetsk Physico-Technical Institute proposed a method for superconductor treatment, which allows current wire performances to be improved by 60-80%. Institute for Condensed Matter Physics investigated the mechanisms of proteins coagulation occurring in the Alzheimer's disease and revealed their microscopic structure. NAS Institute of Electron Physics calculated differential cross-sections of elastic electrons scattering at Zn atoms. The Institute of Radio Astronomy developed a new method to identify molecules, which allowed the presence of certain molecules in the interstellar space to be discovered using a large radio telescope (USA). The Main Astronomical Observatory obtained an unprecedented deep image of a galaxy that is extremely lean in heavy chemical elements, which proves its being evolutionary young.

The implementation of the target program of the Department performed with the participation of all its institutions brought about significant achievements. Priorities of this program were investigations of nanomaterials with conducting, superconducting, semiconducting and liquid-crystal properties, as well as the development of new functional materials designed for extreme conditions. It should be noted in this connection that the results of applied research carried out under Department target and innovative projects were widely presented at the exhibitions where NAS participated.

The experimental facilities of some physical institutes were improved. They installed new experimental equipment, which is now in active use as a basis for new centers for shared use of equipment.

Academic sessions of the Department carried on their activities. 7 such sessions were held, one of them jointly with the NAS Department of Nuclear Physics and Power Engineering. 35 scientists made presentations on topical physical problems.

Some research achievements were duly appreciated. For example, associates of V. E. Lashkarev Institute for Physics of Semiconductors, M. M. Bogolyubov Institute for Theoretical Physics, B. I. Verkin Institute for Low Temperature Physics and Engineering and O. Ya. Usikov Institute of Radio Physics and Electronics were awarded three State Prizes of Ukraine in Science and Technology. The Prize of the Presidents of the Academies of Sciences of Ukraine, Belarus and Moldova, and the International B. M. Pontecorvo Prize (Italy) were awarded to associates of M. M. Bogolyubov Institute for Theoretical Physics.

Despite the evident advances made by the Department, NAS Presidium poses new major tasks for it. These tasks make us continue the search for new forms and methods for efficient use of the creative potential of our scientists in the interests of both Ukrainian and international science.

Earth Sciences



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

In 2006, researchers of the NAS Department of Earth Sciences focused their attention on further development of fundamental and applied studies in the following areas: scientific principles for complex approach to and evaluation of mineral deposits exploration, prospects of sources of mineral raw materials and their exploration, technological aspects of research into promising minerals types.

Hardware for gas geochemical, emanation and thermometric studies on land and marine area was developed and tested at experimental sites. This facility was designed for siting oil and gas prospecting boreholes, which would improve the efficiency of exploration.

Prospects for further extension of domestic resources of raw hydrocarbons were scientifically grounded, new natural sources determined, zones of intensive oil and gas deposition mapped, a number of priority predictive-prospecting sites were selected for geophysical studies and drilling, with a view to discovering abundant deposits.

Geological interpretation of seismic materials by common depth point within the area of DOBRE-2 profile location was performed jointly with 'Ukrgeofizika' enterprise (the Asov massif and the Crimea, the shelf of the Black and Azov seas). The work done is a preparation for deep seismic sounding along the same profile.

A set of R&D procedures was developed, which provided the integrity of protected sites in case of partial exhausting of protective coal pillars through auger technique, with account being taken of various mining-and-geological and mining-and-technical conditions.

Special software was developed, which allowed the patterns of geophysical field structure to be determined according to parameters of coal-bearing massif, dimensions and type of geological deformation. The results obtained will be commercialized at coal mines for on-line forecasts of mining-and-geological conditions of coal beds occurrence, preparation to and safe execution of operational mining.

According to authoring the 'Classification of mineral waters of Ukraine', available data on the occurrence and formation of various types of mineral waters (including new ones for Ukraine) were summarized and an increase in their sources forecasted.

In co-operation with the National Space Agency of Ukraine, the inter-agency project 'GMES-GEOSS-Ukraine' for International program 'Global Earth Observation System' (GEOSS) and European program 'Global Monitoring of the Environment and Safety' (GMES) was developed. The first stage of the project was implemented.

Variations in large-scale atmospheric air circulation vs global temperature in the 20th century were analyzed. On the basis of this analysis, a scenario for the next decade was made concerning atmospheric air circulation under anthropogenic impact above the Northern hemisphere and Ukraine in particular. Determined were basic synoptic situations which would form the climate of Ukraine in the next 30 years.

A draft concept of Ukraine transition to the model of sustainable development was worked out. It was based on the principles of 'the comprehensive whole' concerning balanced (economical, ecological, social, humanitarian) development of the country.

A new geomorphologic zoning of Ukraine was produced as a basis for medium-scale geomorphologic mapping in the framework of 'Derzhgeolkarta-200' ('State geological map-200') program.

In the reporting year, the 80th anniversary of the NAS Institute of Geological Sciences was celebrated. To mark the event, a grand session of the Academic council and a scientific conference were held, proceedings and a jubilee issue of Geological Journal were published alongside with profile information on the achievements of Institute's researchers in mass media.

The 100th anniversary of NAS academician S. I. Subbotin was celebrated at the Institute of Geophysics, and an international conference on modern geophysics was held to mark the event.

International conference 'Geology and oil-and-gas occurrence in the Carpathians' was held, to commemorate the 100th anniversary of NAS corresponding member M. R. Ladyzhensky and to mark the 55th anniversary of the Institute of Geology and Geochemistry of Combustible Minerals.

A number of institutes operating under NAS Earth Sciences Department were awarded with NAS Diplomas for their contribution to the national action 'Colorful Ukraine'.

In 2007, the efforts of researchers of the Department's institutions will be directed at further studies towards increased use of mineral resources, improving its efficiency, and towards geo-ecological research for stabilizing and improving the environment in the country.

Physical-and-Technical Problems of Materials Science



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

In 2006, the efforts of scientists of the institutes operating under the NAS Department of Physical-and-Technical Problems of Materials Science were focused on priority fundamental and applied research into advanced materials science and produced a number of major results.

A diagnostic system based on a new method of non-destructive testing, namely electron shearography, was developed. It provides information on the present defects as both interference fringes and 3D images of the deformed state of the test object. The system proved to be highly effective for non-destructive testing of thin-walled aerospace structures – three-layer honeycomb panels and skins of carbon materials.

Peculiarities of hydrogen mass transfer in welded joints were studied, allowing for the effect of external magnetic field and the degree of filling of the interstitial sites with diffusing atoms. Computations were made to determine the dependence of transported hydrogen flow on metal temperature, edge dislocation velocity and concentration of free hydrogen. Patterns of the drop of fracture stress in a sub-microcrack vs the amount of hydrogen transported with an edge dislocation were determined. Software was developed to compute hydrogen diffusivity for a finite-size cylinder.

Ceramic composites based on a volume-coupled metal frame with the maximum impact strength of 200 kJ/m² were produced. Under external static loading, these ceramic materials were found to have an ideal macroelasticity at high fracture energy. The use of volume-woven metal grids in layered metal-ceramic composites resulted in an irregular metal phase distribution in the bulk of layers, mitigated the negative effect of incomplete adhesive contact between the and metal layers ceramic on physical-and-mechanical properties, and substantially improved heat resistance of materials under thermal shock. The hydroxyapatite-stainless grid ceramics is intended for manufacturing bio-implants and the pyroceramics-pinonickel material - for producing thermal-barrier coatings in space vehicles.

A new macrocomposite tool material was developed. It combines diamond grains and a hard-alloy matrix, fully retaining high physical-and-mechanical properties of diamond grains, such as superhardness, wear resistance and impact load resistance. The super strong adhesive-mechanical fixation of diamond grains in the matrix was achieved in this case. The material was used for manufacturing straightening tools and drill bits, whose field tests showed their higher performance as compared to commercial materials; they were tested during exploration work performed by 'Kirovgeologiya' State Enterprise in drilling wells in hard rock.

An algorithm for calculating service life of rail steels, based on the concept of formation of pitting-type surface damages or delaminations, was developed in the context of the theory of fatigue cracks propagating in contacting bodies. Contact service life of a rail was evaluated, depending on such parameters as contact loading intensity, orientation of incipient edge cracks, friction and lubricant presence in the contact.

A mathematical model was developed for the process of laser thermal-deformation sintering of diamond-containing composites. Optimum energy parameters of the laser beam were determined, and a temperature range wherein it is appropriate to use plastic deformation of the diamond-containing composite material was found. Determined were coordinates of the application zone of the deformation force, whose value ranges from 40 to 60 kGs, depending on the laser beam parameters.

An integrated study was conducted to determine thermo-physical and operational peculiarities of liquid-phase reduction melting in electric arc furnace. For the first time ever, it was experimentally shown that the intensity of heat and mass transfer processes occurring when a smelting pellet is in a liquid-phase environment of the melting pool is 2.8 times higher than that in conventional melting. This allowed an analytical formula to be derived to estimate power inputs in liquid-phase melting of oxide materials. Their content of up to 50 % of the charge weight did not deteriorate the quality of the resulting metal.

An efficient technology for growing sapphire crystals in a shielding gas atmosphere of argon under a pressure of 0.1 MPa was developed and applied. The method for decreasing the partial pressure of reduced hydrogen component during crystallization below the critical level was optimized. It permitted a lesser violation of stoichiometry of the melt and growing crystals with improved functional characteristics, which allows their unlimited application in optics and optoelectronics.

Four studies performed by scientists of the NAS Department of Physical and Technical Problems of Materials Science were awarded the 2006 State Prizes in Science and Technology. Thirteen scientists from five institutes of the Department were State Prize winners.

Physical-and-Technical Problems of Power Engineering



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

In 2006, scientists of the Department of Physical-and-Technical Problems of Power Engineering carried out fundamental research and topical applied studies determined primarily by the necessity of modernizing and updating Ukrainian energy industry.

A mathematical model was developed that described the processes of evaporation and growth of liquid drops in overheated steam, taking into account internal and external processes of heat-and-mass exchange and kinetics of phase transitions on liquid-steam interface.

On the basis of R-function theory, a new approach was first developed for automated gridless specification of geometrical information in two- and three-dimensional spaces.

A procedure to calculate gas-rings of existent torch boilers with thermo-chemical coal preparation was proposed due to studies of the process of thermo-chemical low-grade coal preparation.

Mathematical models of hydro-mechanical, electromechanical and energy processes in hydroelectric facilities with varying parameters of water charge and rotation frequency were produced. Their use allows a 10-15% increase in the coefficient of energy transformation of primary hydro-power resources.

A principle of synthesizing structures of power-generating and heat-providing systems with deep feed-back loops was proposed. The principle opens up new possibilities of improving frequency and dynamic stability of a power system alongside with high energy-intensity parameters of a heat-providing system.

A universal method of spatial harmonic analysis was developed, which enabled specialists to conduct spatial harmonic analysis of the magnetic field near the surface of engineering facilities with different correlations of space dimensions.

With a view to solving applied problems of selective radionuclides isolation from various types of fuel-carrying materials (FCM), an extraction technique was developed for selective extraction-column isolation of uranium, plutonium, americium and curium from FCM samples of 'Shelter' facility.

Studies towards upgrading thermal process of 'Vodoliy' technology were carried out, which resulted in increasing its efficiency to 44,5% and power by 14,4%. Commissioning of new ones or re-equipment of operating gas-turbine facilities of compressors systems at 'Ukrtransgaz' state-owned company with 'Vodoliy' technology would allow an annual drop in gas consumption amounting to 2,2 bn m³.

A new method was developed to provide the assurance efficiency of electric-transport power-supply systems with self-contained power sources. Commercialization of such systems permits an 11% reduction in power consumption.

2006 witnessed a significant event in Ukrainian energy industry - a start in implementation of the Energy Strategy of Ukraine out to 2030. Scientists of the NAS Department of Physical-and-Technical Problems of Power Engineering made a major contribution to it. The implementation of the strategy would require considerable efforts of energy scientists to deal with numerous regulative, R&D, environmental and other problems resulting from the Energy Strategy of Ukraine. It is necessary, in particular, to work out and implement over 30 programs of devel-oping FPC industries. NAS Scientists are directly involved in drafting those programs. For example, the NAS Institute of General Energy has already completed a concept of a new Integrated national program for energy efficiency and energy saving, the Institute of Coal Energy Technologies co-operates with the Ministry of Energy of Ukraine at a draft program of developing thermal power plants. The NAS Department of Physical-and-Technical Problems of Power Engineering and all its institutions, jointly with 'Ukrenergo' national company, began to prepare and implement the project for integrating the United Power Systems of Ukraine to the European power system

To ensure the conformity with strategic guidelines in developing power industry of Ukraine, NAS Presidium approved in 2006 two all-academy target R&D programs, namely, 'Energy efficiency' and 'Integration'. Their implementation has already started. The former puts an emphasis on R&D fundamentals for producing and commercializing state-of-the-art technological facilities, processes and systems which could facilitate technological renovation and basic energy efficiency in major industries and social sphere of Ŭkraine. The latter program provides for elaboration and implementation of a complex of R&D projects, measures and facilities aimed at ensuring concurrent operation of United Power Systems of Ukraine with the European power system by developing and introducing novel technologies and facilities at all principal stages of power production, including integral solutions in power generation, transmission, distribution and use. Participating in their implementation are institutions that operate under the NAS Departments of Physics and Astronomy, Information Science, Physical-and-Technical Problems of Power Engineering and Materials Science.

NAS corresponding member Yu. F. Snezhkyn, K. D. Maletska and T.K. Krushnevich were awarded the 2006 State Prize of Ukraine in Science and Technology.

NAS S. O. Lebedev Prize went to NAS corresponding member V. G. Kuznetsov, O. M. Dmitrieva, O.P.

Nuclear Physics and Power Engineering



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

The NAS Department of Nuclear Physics and Power Engineering incorporates

6 research institutions and 2 pilot-production facilities. The total number of their employees is over 4000, including more than 1800 scientists. Among them there are 9 NAS academicians and 19 NAS corresponding members, 141 doctors of science and 553 candidates of science.

the period reviewed, scientists of the Department produced a number of significant fundamental results. Microscopic theory of superfluid systems was developed. It is based on two independent approaches: the method of quasi-average values and the generalization of Landau-Silin's theory for Fermi-liquid to superfluid systems. A new splitting mechanism of isovector and isoscalar collective-mode excitations in isotopically asymmetric nuclei with a considerable excess of neutrons over protons was proposed. The alpha decay of natural europium (151Eu) with the half-period T=5·1018 years was discovered. The investigation of radiation embrittlement of materials with different types of crystal structure under high-energy (e,γ) -irradiation, which was equivalent to reactor irradiation, showed that at any structural level the decrease in the plasticity of the irradiated material was caused by localization effects.

It was found that high-frequency Alfven waves in stellarators were localized on the inside of torus. Different types of superplasticity observed in nonequilibrium systems were found to be due to the presence of liquid at grain boundaries or atoms excited to the liquid state by various factors (radiation included) and located within dynamically active grain or phase boundaries.

Special attention was given to studies and applied R&D works aimed at reliable and safe functioning and further development of the nuclear-power complex in Ukraine.

The technology of uranium extraction from ores in albitites without mass rock mining was substantiated. Identification and studies of promising materials for molten-salt transmutation reactors were carried out. Developed was the description of initiation and evolution of nuclear burning wave in the critical fast reactor. In spite of the great amount of fission products accumulated, this reactor can be automatically sustained in the near-to-critical state for many years.

To control the radiation load on the VVER-440 reactor vessel at the second power unit of Rivnenska Nuclear Power Plant (NPP), state-of-the-art equipment was developed, manufactured and installed. A new criterion was found during the analysis of irradiation effect on VVER-1000 reactor vessels. This criterion shows that new fuel-element columns have a lower neutron yield, which allows a substantial reduction in the fast neutron fluence on the operating reactor vessel. The most stressed sections of reactor vessels and joint welds of power units of Zaporizhska NPP and Pivdennoukrainska NPP were determined. Those sections are exposed to the most severe neutron fluxes and require regular checks of the stress-strained state and mechanical properties of the metal.

A system of computation programs intended for designing reactor cores with mixed nuclear fuel columns was mastered in order to ensure safety of fuel companies at Pivdennoukrainska NPP and Rivnenska NPP, and for dry storage of spent nuclear fuel at Zaporizhska NPP. Physical and designing principles were worked out for developing and employing the neutron source, based on the accelerator-driven sub-critical assembly.

A geological information system for integrated radiation monitoring in the control areas of Ukrainian NPPs was produced. To justify the location of the geological storage for long-life radioactive waste and spent nuclear fuel, experimental ecological & geological studies and projecting calculations were made.

Ukrainian State Prizes in Science and Technology were awarded for a cycle of studies 'Geochemistry of technogenesis: toxic elements in the Ukrainian environment' carried out with the participation of scientists of the Institute of Environmental Geochemistry (functioning under NAS and Emergencies Ministry of Ukraine) V. V. Dolin, I. L. Komov, I. F. Shramenko, O. O. Orlov, and for a cycle of works 'Development of devices and control systems, organization of their commercial production and introduction of new radiation safety technologies', co-authored by researchers of NAS Institute for Nuclear Research A. M. Berlizov, O. F. Rudyk.

NAS V. I. Trefilov Prize was awarded to NAS academician I. M. Neklyudov for his studies in materials science.

Orders for Merits III Class were awarded to NAS academician I. M. Vishnevsky and NAS corresponding member G. V. Lisichenko. The Order for Courage III Class was awarded to V. I. Gavrilyuk, a scientist of the Institute for Nuclear Research. T. M. Lashko and V. A. Ageyev, researchers of this institute, and V. P. Ashikhmin from the National Science Center 'Kharkiv Institute of Physics and Technology' under NAS received Diplomas of Verkhovna Rada of Ukraine.

Yu.L. Bolotin and V. O. Cherkasky, scholars of the National Science Center 'Kharkiv Institute of Physics and Technology', were awarded the Prize of Academies of Sciences of Ukraine, Moldova and Belarus for a cycle of works on quantum chaos theory.

Chemistry



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

Scientific research in the field of chemistry is carried out at 11 institutes and 2 their subdivisions by about a thousand of highly skilled scientists. Among them, there are 12 NAS academicians and 24 NAS corresponding members, 172 doctors of sciences and 756 candidates of sciences.

In 2006, scientists of the institutions under NAS Chemistry Department and its Bureau focused attention on promoting fundamental research in advanced areas of chemistry, on applying the results obtained in various branches of the national economy, on improving research-organizing activities and training a young generation of scientists.

A number of major studies in priority trends of modern chemistry, aimed at developing novel high technologies, were carried out:

- formulated was a principal feature of the formation of adsorption mosaic- structure nanolayers in polymer mixes; determined was the feasibility of regulating fractal properties of polymer mix nanolayers on the surface of a solid body during adsorption in variable concentration and kinetic modes;

- for the first time in NAS, R&D Complex 'O. V. Bogatsky Physico-Chemical Institute' carried out a 'total cycle' of developing ready-for-use tablet medical products, in compliance with the requirements of proper industrial practice, adopted in the European union;

- developed were methods of asymmetric synthesis of derivatives of α, α -difluoro- β -aminophosphonate and phosphonic acids, as well as isoelectronic and isosteric analogues of natural biologically active phosphates. Their properties were investigated. It was found that amides of α, α -difluoro- β -aminophosphonic acids are stable in water solutions at physiological pH values and they are potential inhibitors of metalloenzymes;

- a method to obtain asymmetrically functionalized nanotubes was proposed, and for the first time Aviram-Ratner molecular diodes with electrical conductivity of high asymmetry were produced on their basis;

- methods to synthesize whole new substituted condensed pentamerous- and hexamerous nitrogen-, oxygen- and sulfur-containing heterocyclic compounds were developed on the basis of 2-acylmetyl-1H- benzimidazoles and some products of their transformations;

- a mechanism of forming nanocomposite catalysts containing Pd, Cu, Ag was found; interrelation between conditions of their synthesis, physico-chemical and catalytic properties was revealed. The reaction mechanism of nitrate ions reduction in water in the presence of these catalysts was proposed.

Researchers of NAS Institute of Surface Chemistry NAS academician O. O. Chuyko, doctor of science (chemistry) Prof. V. K. Pogorely and doctor of science (chemistry) Prof. V. O. Pokrovsky were awarded O. I. Brodsky NAS Prize for a series of scientific works "Medical chemistry of dispersed silica".

Research associates of the NAS Institute of Organic Chemistry R. V. Rodik, S. O. Cherenok, A. V. Yakovenko were awarded the NAS Prize for young scientists for their work "Synthesis and properties of calyxarenes functionalized with pharmacophore groups".

A. I. Buvaylo, a student of T. Shevchenko Kyiv National University, received the NAS Prize for university students for the work "Synthesis, structure and properties of coordination compounds of Cu (II) and Ni (II) on the basis of oxymno-amide type ligandes".

Researchers of NAS A. V. Dumansky Institute of Colloid and Water Chemistry I. B. Kovban and O.V. Lozovsky were awarded A. T. Pilipenko Prize of NAS Chemistry Department for young scientists for their work "Development of heterogeneous catalysts for oxidizing destruction of dyes and nitrate ions reduction in water".

Since 2006, NAS of Ukraine has been a full member (National Adhering Organization) of IUPAC. NAS academician V.V.Goncharuk is the NAS authorized person for cooperation with IUPAC Secretariat.

In the year under review, the Department program 'Fundamentals of producing novel substances and materials and physicochemical principles of controlling chemical reactions' was successfully completed, and a new program 'Developing strategy of progress in priority areas of chemistry' was approved.

The institutes under the Department take an active part in implementing such NAS programs as 'Nanostructure systems, nanomaterials, nanotechnologies', 'Research into sensor systems and technologies', 'Current medico-biological problems and human environment', 'Mineral resources of Ukraine and their mining', 'Operation life and safety of structures, facilities and machines', 'Fundamental problems of hydrogen energy'. The new NAS program 'Biofuel' has been started by the Department jointly with the Department of General Biology.

The work on purchasing unique equipment and setting up centers of its shared use by the Department institutions was going on. Now all institutions of the Department have been allocated unique equipment.

In pursuance of the NAS Presidium decision of 18.10.06, No270, the work on expert assessment of fundamental research was organized and carried out successfully.

In the near future, the efforts of scientists of the Department will be directed at furthering fundamental and applied studies in priority areas of

Molecular Biology, Biochemistry, Experimental and Clinical Physiology



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

In 2006, the efforts of scientists of the NAS Department of Molecular Biology, Biochemistry, Experimental and Clinical Physiology were directed at fundamental research in biology, medicine and ecology. Due attention was also given to applied studies and developments. Department researchers obtained quite a number of major results with a large potential for commercialization.

Monoclonal antibodies which helped to discover an unknown polymerization centre taking part in formation of 3D fibrin lattice – a frame of any thrombus – were obtained in studying immunochemical structure and function of proteins in the fibrinogen/fibrin system at NAS O. O. Palladin Institute of Biochemistry. The centre is localized in B β 12-46 fragment of fibrin and does not require the splitting of fibrinopeptide B (B β 1-14). It is evident that this centre is a complementary one to the 'c' centre discovered by the Institute and localized in N-terminal section of gamma chain of fibrin D-domain.

NAS O. O. Bohomolets Institute of Physiology developed a method of single-cell polymerization of the chain reaction with inverse transcription (IT-PCR) for simultaneous revealing of the expression of six genes: markers of glutamate-ergic and GABA-ergic neurons – VGuit and GATI/GAD65, respectively, as well as genes of three types of low-threshold calcium channels.

Researchers of NAS D. K. Zabolotny Institute of Microbiology and Virology discovered the capacity of selection strains to synthesize surfactants. It was found that under conditions of alkanotropic metabolism the strains reduced cell surface hydrophobic properties several fold, lowered surface tension of culture liquid and formed stable emulsions.

Formation of a stable complex of tRNAMet deacylated initiator with initiation factor 2 was shown at NAS Institute of Molecular Biology and Genetics, which provides evidence for tRNA channeling mechanism at the stage of translation initiation in higher eukaryotes.

NAS R. E. Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology demonstrated that hyperhomocysteinemia caused by methionine loading intensifies DNA hypomethylation in malignantly transformed cells and plays a significant role in activating genes associated with the development of resistance to anti-tumour drugs. Data were obtained that open up a prospect of preventing the transformation of normal cells to malignant ones and drug resistance at the epigenomic level. The effect of the initial condition of human pre-implantation embryos on their viability after cryoconservation was studied at NAS Institute for Problems of Cryobiology and Cryomedicine. A system for integral estimation of morphological characteristics was developed, which permits the parameters of the degree of blastromer adhesion, the presence of cytoplasmic vacuole fragmentation, the state of zona pellucida to be used as embryo cryosensitivity biomarkers.

The NAS Institute of Cell Biology made an analysis of global transcriptomal response of *H.polymorpha* yeast under conditions of sulphur deficit and incubation with cadmium ions, which revealed the existence of HpMET4-regulon. This regulon included genes of sulphate transport, sulphur metabolism and transcriptional regulation. The absolute necessity of HpMET4 gene in providing cells with cystein – the precursor of GSH – was shown.

In the field of medicine, a combined treatment of kidney cancer with the use of surgery and biotherapy methods was developed; an algorithm for diagnostics and therapy in the treatment of patients with various forms of male sterility was developed; selection criteria were developed and indications determined for operative treatment of patients with the type 2 *diabetes mellitus* and obesity; methods and procedures of intracranial biopsy were developed for functional neurosurgery based on various types of imaging; new methodological approaches in cataract surgery were elaborated; criteria of kidney transplantability were determined; the effect of previous donor's diseases on the further performance of kidney allotransplant was studied.

The implementation of three target integral-research programs was completed. Scientific conferences held to discuss programs results demonstrated a high level of the obtained results, which are of great significance for biology, medicine and ecology. A new target research program 'Fundamental principles of genomics and proteomics' was started, the implementation of the program 'New medico-biological problems and human environment' was continued.

The Department will give due consideration to furthering fundamental and applied studies into high-relevance problems of biology, medicine and ecology, developing advanced biotechnologies to produce new highly efficient medical preparations and biologically active substances.

General Biology



D. M. Grodzinsky, Academician-Secretary of the Department

In 2006, research institutions under the Department of General Biology addressed top-priority subjects in floristics and faunistics, ecology, restoration and preservation of biodiversity in continental and aquatic ecosystems, introduction and acclimation of new plant and animal species, the optimum use of natural resources, genetics and selection, biotechnology, physicochemical mechanisms of vital processes.

Due to progress in biotechnologies, transgenic cell lines and plants capable of producing recombinant proteins as vaccines against tuberculosis were constructed. A new marker system for selecting genetically transformed plant cells was developed on the basis of mutant tubulin. New strains of nodule bacteria of trefoil and peas were produced by hybridization and transposon mutagenesis. Technologies were developed to obtain novel biologically active substances from marine organisms. Those include carotenoids, astaxanthin, fucoxanthin, fucoxanthinol, an immunological stimulator, fodder and food additives. A switch of root gravitational orientation under the effect of magnetic field was discovered. An interrelation between the concentration of reaction centres of photosystems and the efficiency of gross photosynthesis was found. A direct relationship between changes in redox balance caused by abiotic elicitors in cells and formation of anti-fungus resistance in plants was proved. Found was the involvement of systemin in long-distance stress-signal transfer, which results in ontogenetic adaptation in plants.

The feasibility of using the numerical value of energy cumulated in plant mass to assess biotic element in ecosystems was proved. Principles of organizing regional ecological networks in the steppe zone of Ukraine were developed. A pragmatic system of vascular plants in Ukrainian flora was proposed. Substantiated was the establishment of national natural parks 'Velyky Bir' and 'Kremenchuh Plavni'. They are to become nuclei of the National ecological network in Ukraine. A description of species in phyto- and mycobiotas of Ukraine was prepared, with a view to their listing in a new edition of the Red Book of Ukraine. A new concept of the origin of biodiversity in the animal world was formulated, using data on the variability of prenatal ontogenesis. Ecological, faunistic and morpho-biological studies of entomophagous insects in Paleoarctic fauna were made for the first time. Recommendations were made towards preservation of rare bird species in the key territories. Greater emphasis was placed on population genetics of some species in connection with range dynamics under anthropogenic load and migration phenomena. Significant progress was achieved in parasitological studies of ichthyofauna, entomofauna, mammals and marine ecosystems.

Assessments of the current status of plant biodiversity in various water environments were made and principal factors of environmental risks in natural water basins due to punctual pollution were determined. Adsorption capacity of sediments proved to be the major factor influencing water ecosystems. The description of the Black Sea microphytobentos, containing 970 taxons, was made. The negative impact of global climate change on common fish species in the Black Sea pelagic zone was registered. Due to studying trophic chains in the ecosystems of the Black and Azov seas, the causes of wide distribution of stranger species there were determined and their likely effect on autochthon ichthiofauna estimated.

A number of plant and animal species were described as new to science. Among them there were 2 fungus species, 19 lichen species, 41 species of entomophagous insects, 13 species of scalewing insects, 3 species of parasitic worms.

In genetics and selection, new data on the role of combinative and mutational variability in grain crop hybrids were obtained alongside with a new generation of winter wheat strains with high environmental plasticity, resistance to diseases, high productivity and early ripeness. Obtained and reproduced were a new sterility fixer and its analogue – a tetraploid pollinator, which provide triploid hybrid seeds in sugar beet.

Much attention was given to studying plant resources and ways of their rational use. E.g., a technology to acclimatize unabi fruit-tree in the forest-steppe zone of Ukraine of was proposed. A collection of 70 species of fast-growing plants was assembled. Their cultivation is promising in terms of phytoenergy resources - producing bioethanol, biodiesel and biopetroleum. Collections of flower plants were enriched, and now they have many species new for floriculture and decorative gardening. Chemical mutagens were applied with appreciable efficiency to obtain new selection forms of decorative flower plants. Emphasis was also placed on studying medicinal plants: chemical description of alkaloid-containing species in Ukrainian flora was made; antioxidant and genome-protective properties were detected in certain cultivated and wild plant species. Resource potential of 23 medicinal plant species growing on the territory of the East Beskidy and Zakarpattya plain was evaluated.

In the future, research institutions of the Department of General Biology are to extend research into genomics, proteomics and discovering regulatory mechanisms in biological systems of various degree of integration – from subcellular structures up to complex biocenoses. They are to promote ecological approaches to enriching biological resources and counteract negative effects of global climate change and growing anthropogenic load on biota. Besides, novel selection methods are to be developed.

Economics



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

In the reporting year, the efforts of the researchers of NAS Economics Department were directed, primarily, towards deepening fundamental and applied economic research to solve urgent scientific problems related to the development and improving the efficiency of transformation mechanisms in the national economy. Considerable attention was given to re-orienting the country's financial system to better possibilities of its financial institutions in providing investments and resources for the real sector; developing nation's R&D potential; constructing and implementing an efficient model of innovative and technological development on a new basis; developing human capital and improving the welfare system in order to overcome the current demographic crisis.

A number of important results were attained. Scholars substantiated government's political measures to improve the efficiency of economic reforms as estimated by humanitarian criteria of knowledge-based economy, evaluated humanitarian factors and indices of endogenous growth, justified the strategy of investment- and innovation-based development concerning determining the signs of modernization project of the economy and society development, features of socio-economic processes during society's transition to knowledge-based economy and innovative and investment activities in Ukraine.

Scientists economimproved the ic-and-mathematical set of tools for comprehensive integrated models of economic forecasting and model-based construction of extended production function with endogenized factors, describing economic development. It is composed of indices of integral indicators specified in accordance with the approaches used in the model of endogenous growth of the Ukrainian economy in order to justify the components of the endogenous growth potential and the guidelines of dynamic development, as well as to search for efficient decisions at the national level concerning sources and mechanisms for implementing the innovation- and investment-based model of Ukraine economic development.

New scientific conclusions and laws were obtained, which enabled the specialists to specify the degree of disproportions in the territorial distribution of real capital, to come to a conclusion on overcoming the disproportions in the territorial distribution of capital as an important capitalization-increasing factor, to reveal the mechanisms of deliberate underestimation of production profitability in the economy and make recommendations towards optimizing the reproductive structure of capital formation and reviving investment- and innovation-related measures to improve the economy's competitiveness.

An economic-and-mathematical model to evaluate the impact of taxes on the functioning of economic system was constructed, which enabled scholars to prove that taxation policy could produce a considerable positive effect on the country's economic development even with a gradual increase in tax payments.

Theoretical-and-methodological approaches were developed to determine economic area, economy's strategic potential and the innovative component of the strategic potential of Ukraine's productive forces. Researchers carried out a comprehensive assessment of rent formation and use and of legal provision of its collection.

Research approaches were systematized in terms of the effect of external economic factors on economic growth. Principles of changing direction of civilization movement and inter-civilization synthesis, in conjunction with the principle of civilization process irrationality, were developed as basic principles in the theory of civilization process. Various economic and institutional inter-relations were found at global, regional and national levels.

A comprehensive analysis and generalization of the practice of normative and information provision were made concerning regulation and assessment of government policy in the system formation of Ukraine's labour market, which permitted basic discoordination between legal and informational provision of those processes to be revealed. Scientists studied the development of the social sphere, improvements in the quality of labour potential, prerequisites and possible consequences of the current demographic crisis, an improvement of migration policy and pension system reform. The Department finalized a Draft strategy of Ukraine's demographic development for 2006-2015 (approved by a Decree of the Cabinet of Ministers of Ukraine of June 24, 2006 Ng879).

In the year under review, the activities of Department's researchers were duly appreciated. NAS corresponding member V.P. Miklovda was awarded with the 'Order for Merits' of III Class. O. M. Boyko, a senior researcher of the NAS Council for Studying Productive Forces, was awarded the Prize of the President of Ukraine for Young Scientists in Science and Technology.

In the near future, the efforts of the Department's scientists will be aimed at studying socio-economic processes in Ukraine, its full integration to the global economy; improving the existing models and producing strategic development forecasts in the context of globalization and emergence of new world-civilization models; providing scientific backup to government's social, innovative, financial, regional, rental, demographic and environmental policies directed towards attaining high competitiveness of the national economy in the global competitive environment.

History, Philosophy and Law



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

In 2006, scholars of the NAS Department of History, Philosophy and Law focused their efforts at studying topical issues of socio-economical, political, cultural and ethno-national development of modern Ukrainian society, the role and importance of historical traditions, formation of whole new political culture and civil society, development of mutually beneficial relations of Ukraine with foreign countries.

NAS Institute of Sociology published "Ukrainian Society of 1992-2006. Sociological Monitoring" (by NAS Acad. V. M. Vorona and M. O. Shulga).

Scholars of NAS I. F. Kuras Institute of Political and Ethno-National Studies issued "Ukrainian Choice. Ukraine in Political Systems of XX-XXI Centuries" (by NAS Corr. Memb. V. F. Soldatenko, M. S. Karmazina, T. A. Bavz, V. I. Kucher), "Destiny as History" (by Yu. I. Shapoval).

NAS Institute of the History of Ukraine published the monographs: "History of Ukrainian Peasantry. In 2 vols." (by NAS Acad. V. A. Smoliy, NAS Corr. Memb. O. P. Reyent, S. V. Kulchytsky, O. Ye Lysenko", "History of Ukrainian Cossacks. In 2 vols. Vol. 1" (by NAS Acad. V. A. Smoliy, NAS Corr. Memb. O. P. Motsia et al.), "Ethnic Minorities in Socio-Political and Cultural Life of USSR. 1920-ths – First Half of 1930-ths" (by L. D. Yakubova).

Specialists of NAS V. M. Koretsky Institute of State and Law published "Constitutions and Constitutional Bills of Ukraine. History and the Present" (edited by NAS Acad. Yu. S. Shemshuchenko), "Interests and Power" (by NAS Corr. Memb. V. F. Sirenko).

NAS Acad. V. M. Lytvyn published the textbook "History of Ukraine", "History of Ukraine: School-Book" and the collection of writings "Ukraine Is to Be".

Published was the 3-rd volume of "Encyclopedia of the History of Ukraine" (by NAS Acads. V. A. Smoliy, P. T. Tronko, NAS Corr. Membs. M. F. Kotliar, O. P. Reyent, V. M. Danylenko, S. V. Kulchytsky etc); prepared and published were the 4-th, 7-th and 8-th volumes of 50-volume collected works by M. S. Hrushevsky. A draft "Environmental Code of Ukraine" was drawn up (NAS Acad. Yu. S. Shemshuchenko).

The following textbooks for universities were published: "Social Philosophy. History, Theory, Methodology" (by NAS Acad. L. V. Hubersky and NAS Corr. Memb. M. I. Mykhalchenko), "Philosophy: Logos. Sophia. Mind" (by NAS Acad. V. H. Kremen), "Philosophy" (by NAS Corr. Memb. V. S. Pazenok), as well as the monograph "Philosophical Ideas in Kyiv Uiversity: History and the Present" (by A. Ye. Konversky). NAS M.S. Hrushevsky Institute of Archaeography and Source Studies prepared and published: "Cathedrals of Lviv Diocese in XVI-XVIII Cent." (by Ya. R. Dashkevych), "History of Religions in Ukraine" (by Ya. R. Dashkevych, A. M. Kolodny).

NAS H. S. Skovoroda Institute of Philosophy published: "Problems of Mentality Theory" (by NAS Acad. M. V. Popovych) and "Explication of Philosophical Senses" (by S. B. Krymsky). The monograph "Hrygory Skovoroda" (by NAS Acad. M. V. Popovych) was prepared to print.

Scholars of NAS I. Krypyakevych Institute of Ukrainian Studies published: "Voluntary Brotherhood: Confraternities of Laymen in Early Modern Ukraine" (by NAS Acad. Ya. D. Isayevych), 1-st vol. of "History of Lviv. In 3 vols." (NAS Acad. Ya. D. Isayevych et al.).

NAS Institute of European Studies prepared to print: "Ethno-Sociology. Ethnic Dynamics of Ukrainian Society" (by NAS Corr. Member V. B. Yevtukh, S. V. Stoyetsky).

V. I. Vernadsky National Library of Ukraine prepared to print: "Libraries of Ukraine in the 20-th century" (by NAS Cor. Memb. L. A. Dubrovina), "Book Sources of Ukrainian Biography Studies in the Stock of V. I. Vernadsky National Library of Ukraine" (by NAS Acad. O. S. Onyshchenko, V. I. Popyk, O. M. Yatsenko).

NAS Institute of Archaeology prepared and issued the interdisciplinary research of NAS Acad. P. P. Tolochko "Old Russian Nationality: Imaginary or Real?" and published "The Oldest Temenos of Pontic Olviya" (by NAS Corr. Memb. S. D. Kryzhytsky, A.S. Rusiayeva).

NAS A. Yu. Krymsky Institute of Oriental Studies published "Epistolary Heritage of A. Yu. Krymsky. Vols. 1, 2" (by L. V. Matveyeva).

The results of leading scholars of Department's institutions were marked with high awards. NAS Acad. Yu. S. Shemshuchenko was awarded with the Order of Ya. the Wise IV Class; NAS Acad. Ya. D. Isayevych, NAS Corr. Memb. H. S. Sokhan, Ya. R. Dashkevych were awarded with the Order of Ya. the Wise V Class; NAS Acad. V. A. Smoliy, V. B. Averyanov, S. V. Kulchytsky were awarded with the Order "For Service" II Class; NAS Corr. Memb. O. P. Reyent, V. F. Verstiuk, R. Ya. Pyrih, Yu. I. Shapoval received the Order "For Service" III Class.

In 2007 the efforts of Bureau and institutions of the Department will be focused on studying new processes of Ukrainian state development, its socio-political and cultural development, integration of Ukraine to the European community, on interpreting transformational processes in Ukrainian society, working out strategic forecasts with a view to constructing a principally new society in Ukraine, which would be able to conceive and realize civilization values, models and development standards, successful and competitive economic, cultural and social life in the conditions of globalization.

Philological Studies, Art Criticism, Ethnology



V. H. Skliarenko, Academician-Secretary of the Department

In the reporting year, as before, scholars of the NAS Department of Literature, Language and Arts Studies addressed fundamental and applied issues in the development of literature, language, arts, traditional every-day culture, computer linguistics, tackled major issues of the academic backup to the national and cultural renaissance of Ukraine, to the unbiased studies of various stages in the progress of Ukrainian spiritual culture in the past and its status at the beginning of the XXI century.

The practical result of those studies was the publication of an all-time high – 149 collective and individual writings, including 62 monographic and collective works, 30 scholarly textbooks and manuals for universities and secondary schools, 15 reference books and dictionaries, 26 academically treated and commented belles-lettres texts, over 1400 papers in academic proceedings and periodicals.

A high level of the research done is attested by awarding the 2006 National T.Shevchenko Prize to arts scholar Z. O. Chehusova for her work "Decorative Arts of Ukraine in XX Century. 200 names" and the State Prize of Ukraine in Science and Technology - to a team of linguists for their 3-volume "Ukrainian" Language Atlas", NAS O. O. Potebnia Prize – to NAS Corr. Memb. O. B. Tkachenko for his writing "Ukrainian Language and World's Linguistic Life" and NAS F. M. Kolessa Prize – to arts scholar T. V. Kara-Vasiliyeva for a series of monographic works. 'Honoured Worker in Science and Technology of Ukraine' title marked outstanding contribution of NAS Corr. Memb. T. I. Hundorova to the development of Ukrainian research; Princess Olga Order III Class went to literature scholar M. Kh. Kotsiubinska, NAS Corr. Memb. H. M. Syvokin received an Honorary Diploma of Verkhovna Rada of Ukraine.

Scholars of the Department carried on their studies in literature theory, history of the Ukrainian and foreign literatures, in today's functioning of belles-lettres, continued preparation of encyclopedic and academic publications of artistic heritage. A number of fundamental works were published: "The History of XIX Century Ukrainian Literature" (in 2 books), "Memories from Old Times" (vol. 1 and 2) and "Shevchenkophobia in Ukraine" (by NAS Acad. I.Dziuba), "Distances" (by NAS Acad. M. Zhulynsky), "Literature Theory and Comparative Studies" (by NAS Corr. Memb. D. S. Nalivayko), "In Perception Dimensions. Theoretical Issues of Belles-Lettres, their History and Functions" (by NAS Corr. Memb. H. M. Syvokin), "Ukrainian Literature Code: a Project of Psychic History of Modern Ukrainian Literature" (by N. V. Zborovska), "Myth Poetry of 'Lisova Pisnia' by Lesia Ukrainka" (by L. I. Skupeyko), "Forbidden Franko Studies: 1885-1988" (by O.B.Lutsyshin and M. O. Moroz), vol.7 (fine arts heritage) of Complete T. H. Shevchenko's works. Scholars are finishing the preparation of vols. 1 and 2 of "Shevchenko Encyclopedia" and of the 12 volumes of "History of the Ukrainian literature".

In pursuance of the Presidential Decree 'On the Development of National Dictionary Base', linguists of the Department prepared for publication vol. IV of fundamental "Etymological Ukrainian Dictionary", issued 10,000 copies of "'Ukrainian Dictionaries' Integrated Lexicographic System", version 1.06 with the register of 252 thousand entries, they produced an updated system of data structures of the Ukrainian National Linguistic Corpus with over 42m usages and introduced an upgraded on-line system "Ukrainian Linguistic Portal" to the Internet, published 6 novel dictionaries and such fundamental works as "XXI Century Linguistics: New Studies and Prospects" (by NAS Research and Education Center for Foreign Languages), "Linguistic Personality of XIX Century Scholar in Humanities" (by I. A. Sinitsya), "History of Ukrainian Speech Etiquette. Addresses" (by O. M. Mironyuk), "Biological Terminology: Formation and Fun-ctioning" L.O.Simonenko), "Linguistic Reality Modeling and Scientific Structure of Language Units" (by S. S. Yermolenko), a reference dictionary "Symbols of Ukrainian Ethnic Culture" (by V. V. Zhayvoronok) and "Studies in Onomastics and Etymology".

Relying on their studies of every-day culture phenomena, scholars in arts, folklore and ethnology published 58 writings, among them were: "History of Ukrainian Arts in XIX Century" (vol. 4), "Ukrainian Music Encyclopedia" (vol.1), "Ethnogenesis and Ethnic History of Population of the Ukrainian Carpathians" (vol.2), "Origins of Ukrainian People in the Context of Traditional Culture" (by NAS Cor. Memb. S. P. Pavliuk), "National Opera of Ukraine. History and Today" (by Yu. O. Stanishevsky), "Ukrainian Arts of XX Century: Ideas, Phenomena, Characters" (by R. M. Yatsiv). Despite financial problems, 11 integral folklore and ethnographic expeditions to 9 Ukrainian regions were held, where unique mementoes of folk culture and arts were collected.

To ensure favourable conditions for preserving Lesia Ukrainka's cultural heritage and coordinating respective studies, Lesia Ukrainka Institute was set up, subordinated to NAS and NES of Ukraine; all-round check-ups of 3 institutions and a state attestation of all Department's institutions were made; 30 international and all-Ukrainian academic conferences were held.

Environment Preservation and Sustainable Development



P. H. Kostiuk, Member of the Academy Presidium

In 2006 scientists aimed their efforts at elaborating scientific fundamentals for the national strategy and methodology of environment preservation and sustainable development, determining the degree of anthropogenic changes in natural systems, at ensuring the efficient use of natural resources at the national, regional and local levels, providing the natural basis for human life, substantiating scientifically and studying technical and technological aspects of sustainable development in Ukraine. The abovementioned activities were coordinated by NAS Academic Council for Environment and Sustainable Development as well as the National Committee of Ukraine for UNESCO Program 'Man and Biosphere'.

Over the period under review, scientific research and management were carried out under the Integrated program towards implementation of the decisions approved by the World Summit on Sustainable Development for 2003-2015, the State program for prevention and control of land underflooding for 2005-2030, the State program on recycling industrial waste and consumption residue up to 2005 (its term had been extended), the State program towards sustainable development for the region of mining and preprocessing of uranium-containing materials, the State program on radiation safety and social security of the population in the city of Źhovti Vody for 2003-2012, the Program of all-round development of Ukrainian Danube region for 2004-2010 and the plan towards 'Measures on Engineering Protection and Development of Tuzla Spit Isle'.

Leading NAS scientists initiated the work on the draft Concept of Ukraine transition to sustainable development. The draft was submitted to Verkhovna Rada of Ukraine and the Cabinet of Ministers of Ukraine for further analysis and approval in accordance with due procedure.

Scientists of the National Academy of Sciences of Ukraine contributed to the preparation of numerous draft laws, namely: 'On the Strategy of Sustainable Development of Ukraine', 'On Ukraine's joining the Stockholm Convention on Persistent Organic Pollutants', 'On Lands Conservation', 'On Organic Production' etc.

NAS scientists prepared and sent to Ukrainian authorities proposals towards restoring the Danube-Black Sea navigation canal and preserving wildlife in the Ukrainian Danube region; on removal of beryllium-production waste from the territory of 'West' state R&D facility, the construction of a special canal in the Lake Kuhurluy district. A Session of NAS General Meeting was prepared and held in the framework of implementing the Action Plan to commemorate the 20-th anniversary of the Chornobyl accident.

A number of significant research results were obtained in the period. Within the framework of studying the nature protection measures in Ukraine, two state standards for waste handling were elaborated and sent for approval to the State Body for Consumer Standards of Ukraine, namely, those for wastes packing, marking, burial and their transportation rules. The feasibility of environment restoration through the use of economic tools was substantiated. A formula was proposed to calculate the ecological rent of the use of environment resources. Scientific substantiation of ecological indicators was made for integral assessment of the compliance of territory's environmental status with sustainable development standards. Scientific principles were worked out for creating the integral Inhuletsky holding alley of Kryvbas ecological network in the mining-disturbed area. To consummate property relations concerning objects of nature resource potential, theoretical fundamentals and recommendations were elaborated for turning contractual relationship into an economic and legal instrument regulating property forms and rights in nature management. Scientific principles for the national concept of starting and developing pollution-free production in Ukraine were worked out. New approaches to the disposal of nuclear waste from the 'Ukryttia' ('Shelter') facility were determined; distribution patterns of radioactive substances in man-disturbed soils of the 'Shelter' local area and neighbouring territories were studied. A procedure was proposed to decontaminate liquid radioactive waste from 'Shelter' facility from organic substances and transuranium elements. The necessity was shown to rationalize regional nature management, restructure production and economy in accordance with the respective nature resource potential and ecological capacity of the territory, meeting human and economic needs, to minimize ecological and economic expenses as well as deal with social challenges. Elaborated was a draft State standard of Ukraine 'Sources of centralized drinking water supply. Hygienic and ecological requirements to water quality and rules of choice'. A technique to assess ecological risks in the areas of punctual pollution sources was developed and employed for the first time.

In the sphere of international cooperation, NAS scientists jointly with their colleagues from Belarus and Poland, conducted research under UNESCO-JFIT project 'Establishment of a Transboundary Biosphere Reserve and a Regional Ecological Network in Polissia' (2006-2007). Last year specialists focused their efforts on building up the national network of UNESCO biosphere reserves in transboundary regions. With a view to coordinating international collaboration, developing unified research methods and data-processing techniques, Shatsk Biosphere Reserve held an international seminar 'The Role of Ecological Network in Polissia for Providing the Sustainable Development in the Region' on September 19-21, 2006. Representatives of Belarus, Poland, Ukraine, the Netherlands, Denmark and UNESCO-MAB Secretariat attended this internation-



Regional Structure of the National Academy of Sciences of Ukraine







NAS of Ukraine 2006

otal number of employees	43613
in research institutions	39344
in R&D organizations	2903
in service organizations	1366



Recruitment of university graduates



Statistics

&D employees	16813
Doctors of Sciences	2493
Candidates of Sciences (PhD)	7996



Distribution of scientists by departments

Budget	ths UAH	
Total amount of expenditures	1519275,5	
Basic funding from the State budget	808600,3	
Target programs finance	341893,1	
Extra-budgetary revenues	322518,1	
Expenditures on wages	933520,1	
Expenditures on equipment, materials and instruments	128958,1	
Expenditures on utilities	62021,7	
Expenditures on capital construct and reconstruction	tion 29900,0	

Target programs subjects

Distribution of finance by sources

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

Publication of Academic Materials

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

Foreign Scientists Received in Ukraine

Ukrainian Scientists Sent on Mission Abroad

The List of the Centers for Shared Use of Scientific Equipment

Name of Centers of Joint Usage by the Scientific Equipment	NAS Institutions
Testing Machine INSTRON 8802	G. S. Pisarenko Institute for Problems of Strength
Laser Femtosecond Complex	Institute of Physics
Diagnostic of Semiconductor Materials, Structures and Devices	V. E. Lashkaryov Institute of Semiconductor Physics
NMR Spectroscopy	G. V. Kurdymov Institute for Metal Physics
Astronomical Spectropolarimeter	Main Astronomical Observatory
EHF Radiospectroscopy	O. Ya. Usikov Institute of Radiophysics and Electronics
Inter-Agency Center for Corporate Use of the RT-22 Radiotelescope	Institute of Radio Astronomy
Complex for Physical Investigations Under Extreme Conditions	Donetsk O. O. Galkin Institute of Physics and Engineering
Center of Solid Phase Mass-Spectrometry, Gas Isotopic and Microelement Analysis Testing Machine MTS	Institute of Geochemistry, Mineralogy and Ore Formation
	E. O. Paton Electric Welding Institute
Laser Interferometric Measuring Complex	E. O. Paton Electric Welding Institute
TEM-SCAN	I. M. Frantsevich Institute of Problems of Materials Science
Molecular and Crystal Structure of Materials	Institute for Scintillation Materials
Gas and Gas-Liquid Chomatography	Gas Institute
Ultra Low Lewel ?-?-Spectrometry	Institute of Environmental Geochemistry under NAS and the MEA of PP from the Consequences of Chornobyl Catastrophe
X-ray Single-Crystal Diffractometry	Institute of Organic Chemistry
FT-IR Spectrometer Tensor 37	Institute of Macromolecular Chemistry
Chromato-Mass-Spectrometry	A. V. Dumansky Institute of Colloid and Water Chemistry
Mass-Spectrometry of Nanosystems	Institute of Surface Chemistry
Laboratory for Analytical Control	Institute for Sorption and Problems of Endoecology
Flow Cytofluorometer COULTER® EPICSTM XLTM ; Mass-Spectrometer Voyager-DE TM PRO; BiospectrometryTM Devices and Equipments of Cellular Biophysics and Physiology	O. V. Palladin Institute of Biochemistry
	O. O. Bogomolets Institute of Physiology
Chromato-Mass-Spectrometrycal System	D. K. Zabolotny Institute of Microbiology and Virology
DNA/RNA Synthesizer	Institute of Molecular Biology and Genetic
Molecular Oncology and Biotechnology	R. E. Kavetsky Institute of Experimental Pathology, Oncology and Badiobiology
Flow Cytofluorometer BD	Institute for Problems of Cryobiology and Cryomedicine
Electron Microscopy of Biological Objects	M. H. Kholodny Institute of Botany
Hydroecological Analytical Centre	Institute of Hydrobiology
GENTEST	Institute of Plant Physiology and Genetics
High-Performance Liquid Chromatography (HPLC)	M. M. Gryshko National Botanical Garden
SPM Centre	Technical Center