NATIONAL ACADEMY OF SCIENCES OF UKRAINE BRIEF ANNUAL REPORT

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Main Results



B. E. Paton, President of the Academy

2008 was a momentous year for the National Academy of Sciences of Ukraine (NAS). The whole nation celebrated its 90-th anniversary.

International conferences, academic readings, exhibitions, grand meetings in the Regional Science Centers, sessions of the General Meeting of the Academy's Departments demonstrated outstanding achievements of its scholars, their significant contribution to the progress of independent Ukraine. The annual All-Ukraine Science Festival was also devosted to this event; it contributed to informing the public at large about scientific research, increased the social prestige of science.

Respective Presidential decrees, decisions of the Verkhovna Rada and the Cabinet of Ministers of Ukraine played an important role in celebrating the Academy's jubilee at the all-Ukraine level, promoting its research and R&D activities, increasing its role in dealing with major challenges for Ukraine. We are grateful to the leaders of the nation, ministries, agencies, organizations, businesses and individuals for their assistance and participation in organizing the celebration, for numerous greetings on this occasion.

The Academy's jubilee provided a good opportunity for scientists to look back, summarize the things done and pose new tasks. And the main conclusion is that the Academy principles and organizational forms of research, the concept which was put into its basis by the outstanding scientist V. I. Vernadsky, its first President, has withstood the test of time.

The results of the previous year convincingly show that scholars of the Academy marked its 90-th anniversary with major achievements, they did not spare efforts to ensure a dynamic socio-economic, R&D and cultural progress of Ukraine. Of great importance is also the fact that early in 2009 NAS membership was replenished with 30 academicians and 73 corresponding members.

Academy's research teams fruitfully worked towards fulfilling its principal statute task – that of advancing fundamental research. In the period under review, research was done under 2209 assignments of other agencies, 122 pilot studies and 1071 tasks of target programs and competitive works. Significant results of fundamental and applied nature were produced in many advanced research areas. E. g., new qualitative methods of non-linear mechanics were worked out, alongside with their application for the analysis of multi-frequency oscillations. A technology was developed and production started of titanium alloys whose mechanical properties exceed those that exist in the current world practice. Of major importance for manufacturing effective low-temperature fuel cells was the production of novel bifunctional nanocomposite electrocatalysts. A number of winter wheat lines with protein content of up to 17.5% were obtained through controlled mutational selection.

Economists made prognostic and analytical estimates of the development of Ukrainian economy in 2009-2015, they produced a basic energy-supply scenario and energy balance of Ukraine.

Of the utmost significance for the socio-humanitarian sphere in 2008 was the start of research to forecast and model social and socio-cultural transformations of the Ukrainian society in the XXI century, study the impacts of integration to the world community and strategic challenges for Ukraine.

Much effort was given to improving the coordination of fundamental research in the country, updating its subjects. The Inter-Agency Board on Coordinating Fundamental Research was operating actively and it supported NAS measures towards setting up an efficient system for coordinating fundamental research in natural, engineering sciences and humanities. The Council of the Presidents of the Academies of Sciences of Ukraine sought to advance the collaboration of NAS and branch academies with ministries and agencies, form an efficient mechanism of the interaction between science and state power structures, refine legal, organizational and financial principles of R&D functioning and progress, improve its provision with qualified personnel, provide the certification of high-level research and research-and-educationalist personnel, improve the social security of research workers.

To implement the Law of Ukraine 'On research and R&D activities', the NAS Expert Board has appraised over 700 subjects of fundamental research done by NAS institutions under 11 executive administrators to estimate the feasibility of financing those studies from the general fund of the State budget of Ukraine. Such estimates have been done for 3 years running and have already produced positive results.

It should be noted that last year a broad network of scholarly associations worked in the Academy, including over 140 councils, commissions and societies. Efforts of these public organizations were focused on coordinating research, preparing draft normative and legal documents, programs, analytical data for state administration bodies, on organizing and holding seminars, conferences, symposia on relevant scientific issues.

The collaboration of researchers and educationalists was going on, its result being the implementation of 250 joint research projects, publication of about 80 collective monographs and over 160 textbooks and study manuals for universities. The activities of nearly 200 joint research-and-educational complexes, centers, laboratories, chair branches etc. are good

examples of the true integration of science and higher education.

NAS international ties continued to extend. The traditional collaboration with the Russian Academy of Sciences (RAS) was furthered, in particular, that with RAS Siberian Branch, the Russian Foundation for Humanitarian Studies. A competition of Ukrainian-Russian projects was held jointly with the Russian Fundamental Research Foundation. Agreements were concluded and collaboration in energy started with organizations of Canada and the Republic of South Africa. Successful interaction with the International Institute of Applied Systems Analysis was going on. The Academy did its utmost to advance IAAS activities. A scheduled meeting of IAAS Council was held to mark the 15-th anniversary of this organization and the 90-th NAS anniversary. It summarized the IAAS activities and set a series of tasks for the near future

In 2008 the creative intellectual potential of the Academy was directed towards positive changes in the Ukrainian economy. Those were facilitated by extending close NAS collaboration with the Government. One of the lines of this collaboration was advncing 10 jointly selected top-priority R&D areas that can significantly accelerate the socio-economic progress of the nation, provide a qualitative increase in national economy's competitiveness. Among those areas are nanomaterials and nanotechnologies; energy supply and energy efficiency; information technologies and resources; new materials, methods of their joining and treatment; the rational use of natural-resource potential; novel biotechnologies for medicine, environment and agriculture.

The efficient use of Academy's potential was facilitated by government-authorized appointment of its leading scholars and specialists to boards and R&D councils of nearly 50 ministries and agencies.

The top priority was assigned to scientific and technological backup to the innovative development of economy branches. Academy institutions implemented a number of state target programs and initiated new ones, aimed, in particular at developing an environment-friendly nuclear-fuel cycle, setting up chemical metallurgy to produce pure silicon, advancing nanotechnologies, commercializing energy-efficient LED illumination systems, developing and introducing grid-technologies etc. A significant contribution to dealing with important for Ukraine problems was made by Academy's programs of applied research. We witnessed a rise in the number of implemented R&D works that laid foundations for major innovative projects.

In total, over 2000 various technologies, techniques, instruments and devices were commercialized at enterprises of various industries last year. I'll cite just a few examples. Intelligent microelectronic equipment of the new generation, a unique magnetron for radar stations, high-reliability rail frogs and diamonds for railways were referred to manufacturing. Automobile and tractor plants widely use vibration- and noise-absorbing materials, which are 30% cheaper than their foreign analogs. A technological process to control chemical composition and defect-production was developed for 'Aviant' aircraft-building state company; its cost and analysis duration are an order of magnitude lower as compared to other methods. 6 metallurgy and construction enterprises have adopted on a broad scale a new system of firing diversified furnaces.

Last year, the Academy persistently worked with young people to involve them in research activities. One should note that today every fifth researcher and every sixth candidate of sciences of the total number of Academy's research workers is a young scholar. At the end of 2008, NAS had 8 doctors of science under the age of 35.

These figures are a result of our permanent efforts towards overcoming the lingering crisis in the personnel sphere, yet, they in no way meet the needs of current, and all the more so, of future science progress. The solution of this problem demands effective measures, primarily, at the national level. So, of the utmost importance is the fact that last-year initiatives of NAS and its Commission on the work with young researchers to start new forms of support to young researchers and further the existing ones were taken into account in the Presidential decrees of May 16, 2008 # 444 'On extra measures to develop science sphere' and of September 11, 2008 #827 'On extra measures to advance research and R&D activities in the National Academy of Sciences of Ukraine' and in respective instructions to the Government.

The Academy developed further the existing forms of support to young scholars. Monthly NAS scholarships for young researchers were increased three times. The practice of listening to their research presentations at NAS Presidium meetings and providing addressed support to their studies was continued. Their participation in the national competitions for prizes, scholarships, grants was encouraged in every way. As a result, in 2008 young NAS scholars won over 40% of the total number of those prizes and scholarships.

No doubt, various measures to support young talents bring positive results, yet replenishing research institutions with youth is a very difficult problem and demands an integral approach. It is quite natural that talented young people will only be interested in research work if decent salaries and appropriate accommodation could be guaranteed and, by and large, if the social prestige of scientific research increases.

Anchoring of able youth at NAS research institutions and organizations, reducing the brain drain to leading science centers of the world is not possible if such an important problem as providing research with the state-of-the-art scientific equipment and facilities is not properly dealt with. Unfortunately, now mere 15 - 20% of Academy's research instruments and devices meet the requirements of the present-day experimental work, another 30 - 35% are obsolescent or need continuous repairs, the remaining 45 - 55% can only reproduce scientific experiments that are no longer relevant.

Due to governmental support, in the recent years NAS has been renovating its research equipment and

facilities. In total, 124 unique scientific instruments and complexes have been purchased from leading foreign manufacturers. Relying on those, a network of 67 centers for shared use of research facilities has been set up. Last year, as before, the consolidated procurement of costly import research equipment continued. Nearly UAH 81m was spent for that. In 2008, however, in contrast to the previous years, the Academy made those purchases through bidding procedures and without exemption from taxes, which, in fact, reduced the money by more than 30%.

In research provision, of major importance is its information component, in particular, publishing academic and popular-science books, dictionaries, reference and encyclopedic editions. 82 academic journals and 38 periodic collections of scholarly writings were issued.

Still, the absence of Academy's own high-capacity printing facilities, which could provide a complete publishing cycle, is a major obstacle to such activities. This situation must be dealt with.

Now, I'd like to dwell on the issue of introducing information technologies to science. It should be stressed that in the recent years the Academy and its research institutions have made a significant step forward in that direction. This involves not only an access to global resources of R&D information and creating their own electronic databases. Of no less importance is using cutting-edge supercomputer systems and grid-technologies in scientific research. Now, through implementing a special academy program, computing capacities of 16 research institutions are pooled, and Ukraine has become a member of the world-largest international grid-project. This enabled our scientists to achieve major progress in solving advanced problems of physics, astronomy and biology. And the work towards extending the grid-network, creating a data-exchange network which would integrate all our regional science centers must be assigned a top priority. This will be facilitated by implementing a state target R&D program on introducing and using grid technologies. Its concept was proposed by the Academy and approved by the Cabinet of Ministers of Ukraine.

Regrettably, according to the 2008 results, NAS underfunding amounted to UAH 36.1m, which prevented critically important budget-financed programs from being implemented in full. First and foremost, the lack of finance had a bad impact on providing housing for NAS researchers. The Academy received 70% less money for the purpose than had been planned. The procurement of unique import equipment was also underfunded. It should be noted that planned 2009 state-budget allocations for providing NAS activities have been reduced considerably (by 11% against the previous year).

Taking these factors into account, the immediate task of NAS institutions, alongside with sparing and rational use of money, is to step up work to increase revenues to the specialized funds of their budgets. The Academy has identified the principal lines of such work and measures towards their implementation.

In the immediate future, NAS Departments, in order to improve the efficiency of their research, are

to specify the research subjects of subordinate institutions, revise their network and prepare proposals on its optimization, take measures for channeling maximum possible assets of institutes' specialized funds to paying membership fees to international scientific organizations, holding science forums and R&D exhibitions, settling utility bills. It was decided as necessary to make a basic list of individual effectiveness factors of research activities of NAS employees; those are to be taken into account when determining encouraging allowances and bonuses.

The rise in revenues to the specialized funds is to be stimulated by setting target figures of contractual works, increasing the amounts of paid services, leasing floor space and laboratories, training post-graduate and doctorate students on a contract basis, using pilot-production facilities to organize manufacturing of institutes' own innovative products, etc.

Important new priorities in NAS activities are measures aiming at more active involvement of its institutions in overcoming the crisis in nation's economy and its financial sphere. These are, primarily, the accelerated development and introduction of energyefficient technologies, a better efficiency of using energy, developing alternative energy sources, extracting nation's own mineral resources. Of great significance is the active participation of leading NAS scientists in the recent conferences on these and other issues, held by Yu. V. Timoshenko, the Prime Minister of Ukraine. Today, a major task of the Academy is scientific and R&D backup to anti-crisis programs and projects of the ministries and agencies, local self-government bodies, unions and organizations, as well as broader co-operation with them for more extensive introduction of research results to practice.

Though the crisis brings about major socio-economic hardships, still it gives the nation a chance to accomplish quick and efficient structural reforms in its economy, implement a real strategy of innovative development. We are sure that scientific and R&D potential of the Academy can and must serve the renovation of the Ukrainian economy.

New Challenges

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



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

In the reporting year, NAS Presidium focused its activities on advancing research in cutting-edge areas of science and technology, implementing the major R&D results, co-operating with central bodies of the state power, promoting international scientific collaboration and facilitating the integration of Ukrainian scholars to the international academic community.

The annual session of NAS General Meeting, held in April 2008 and attended by V. A. Yushchenko, the President of Ukraine, top-level state officials, heads of ministries and agencies, of Kyiv City State Administration, representatives of research institutions of NAS and other state-supported academies of sciences, NGOs, foreign guests and mass media, summarized NAS activities in 2007, highlighted the most significant research results obtained by NAS scientists in the period under review, and determined priority tasks for the immediate future.

The annual report of the NAS President academician B. E. Paton, the address of the President of Ukraine to the participants of the session, speeches of the representatives of the Verkhovna Rada of Ukraine, state power bodies and research institutions emphasized that further positive changes could be seen in the activities of the leading research organization of Ukraine, both in research management and provision, and in its stronger influence on the scientific and R&D progress of the nation. Yet, the major NAS tasks include increasing its role in the scholarly backup to progressive reforms, identifying the ways and means of accelerated science development in line with the innovative model, forming and realizing national priorities in the science sphere, preserving and advancing leading academic schools, involving talented young people in research.

The recognition of scholarly achievements and the important role of socio-humanitarian research was demonstrated by presenting at the session of NAS General Meeting of V. I. Vernadsky Gold Medal to NAS academician M. V. Popovich for his outstanding accomplishments in philosophy and to George Nivas, the founding chancellor of the Russian Humanitarian University in Geneva, for his prominent achievements in Slavic studies.

In October 2008, the participants of the session of NAS General Meeting celebrated the 100-th birthday anniversary of NAS academician P. M. Serkov, a renowned Ukrainian scientist, one of the founders of the world-known school of Ukrainian physiologists, a talented science manager and educationalist.

Late in 2008, the whole nation celebrated an outstanding event - the 90-th anniversary of the foundation of the National Academy of Sciences of Ukraine. On that occasion, on December 1, 2008 the Jubilee session of the NAS General Meeting was held in the 'Ukraina' National Palace. It was attended by V. A. Yushchenko, the President of Ukraine, the Prime Minister Yu. V. Timoshenko, the Minister of Education and Science I. O. Vakarchuk, the head of Verkhovna Rada Committee on science and education V. I. Polokhalo, presidents of the branch academies of sciences of Ukraine, NAS academicians and corresponding members, foreign NAS members, representatives of the diplomatic corps, Academy's research institutions, executives of governmental, state, public and trade-union organizations, and journalists. Numerous delegations of the academies of sciences and leading research centers of 25 countries of Europe, South-East Asia and Middle East honoured the Academy's jubilee with their participation in the celebration.

The report of the NAS President academician B. E. Paton, greeting addresses and speeches of the President of Ukraine V. A. Yushchenko, Prime Minister Yu. V. Timoshenko, presidents of the Russian Academy of Sciences and the academies of sciences of Azerbaijan, Belorus, Georgia and Kazakhstan stressed, that in the 90 years since its foundation NAS has made a significant contribution to the progress of Ukrainian and international science, has become a major research center of Europe and the whole world, playing the role of a powerful spiritual center of the nation, the symbol of Ukrainian statehood. Academy's scholars have laid the foundation for the advancement of numerous novel research areas in natural, engineering and socio-humanitarian studies, which have always been aimed at achieving economic progress and strengthening the competitiveness of the nation, at raising the intellectual and cultural level of the society, arming it with the analysis of the past experience, constructive understanding of today's situation and reliable forecasts of the future.

As before, NAS Presidium attached major importance to the scientific backup to dealing with major national challenges in the economic, socio-political and humanitarian progress of the nation. E. g., open sessions of NAS Presidium and its Bureau, attended by members of the Cabinet of Ministers, discussed drafts of governmental policy documents, approved the list of respective tasks for Academy research institutions to pursue the most important R&D lines. The top priority in NAS activities was a closer co-operation with executive bodies and broad involvement of Academy's representatives in the activities of boards and R&D councils of those bodies, where over 60 NAS researchers took part.

A number of Presidential Decrees issued in 2008 gave evidence of the state's recognition of NAS authority. They supported numerous Academy initiatives, in particular, those on setting up the National Science Foundation and the Ukrainian Humanitarian Foundation, holding annual All-Ukraine Science Festivals, fixing expenditures in local budgets for R&D and

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innovative progress, on developing academic publishing in Ukraine, raising the prestige of research work and recruiting talented young people to it.

Much consideration was given to the progress of fundamental studies and developments in natural, engineering sciences and in socio-humanities, especially those which had been approved by joint NAS Presidium sittings with the Government and were aimed at accelerating the socio-economic progress of the nation, ensuring a qualitative rise in the competitiveness of its economy, and determining the ways to overcome the economic crisis in Ukraine. Meetings of NAS Presidium considered, for example, measures towards implementing the State target R&D program 'Development and commercialization of energy-efficient LED light sources and illumination systems on their basis', discussed the concept of the State R&D program of furthering nanotechnologies for 2009-2013, announced competitions for draft target programs of NAS research 'Integration to the international community and strategic challenges for Ukraine' and 'Forecasts and models of social and socio-cultural transformation of the Ukrainian society in the first quarter of the XXI century' for 2008 - 2012. Presidium meetings listened to scientific presentations on newgeneration grid information technologies, R&D problems of radiation resistance of nuclear-reactor structural materials, up-dating the railway transport, on the place of Ukraine in the world transportation system and the prospects of developing domestic shipping, seismicity and seismic hazards on the territory of Ukraine, fundamental problems of heat power engineering, manufacturing of heat power equipment, problems of aviation and aerospace engineering, purposeful search for and structural design of physiologically active substances, cell mechanisms of ischemic brain damage and the ways of its pharmacological correction, issues of controlling the evelution of ecosystems in Ukraine and preserving them. Scholars in socio-humanities also made their presentations, including those on the present-day European constitutionalism and the advancement of Ukrainian legal system, the status and prospects of archeological studies of early Kyiv, the ways of furthering academic literature studies. With special interest NAS Presidium considered analytical academic presentations, in particular, those on the impacts of financial and economic crisis on R&D and innovation in Ukraine, the role of academy science in overcoming it, on the development of Ukrainian economy and social sphere in the post-crisis period.

Great significance was attached to supporting and promoting research activities of young scholars, improving their work environment and living conditions. Sittings of NAS Presidium listened to the presentations of young researchers, made decisions about providing financial support to their studies. In May, the second All-Ukraine Science Festival was held. During it, young people were given the opportunity to learn about the work of major NAS research institutions, communicate with famous scientists and representatives of leading science schools.

The key role in the work of NAS Presidium belonged to analyzing and assessing the state of research and research-management work of academy institutions. NAS Presidium routinely considered Academy's

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publishing activities. We analyzed their status, determined prospects and directed them towards highlighting the priorities of science and social life. Started was the publication of «Systems Research and Information Technologies» journal and «Eidos» almanac. Publishing a 5-volume «History of Ukrainian Culture» and providing the Academy with advanced printing facilities were discussed.

Of special concern for the Academy were issues of advancing international scientific collaboration and integrating Ukrainian scientists to the international academic community. NAS collaborated successfully with numerous international organizations, in particular, with the International Institute of Applied Systems analysis under UNESCO programs.

NAS continued to host the International Association of the Academies of Sciences (IAAS), which marked the 15-th anniversary of its establishment in 2008. The Academy made a significant contribution to preparing the conference of the leaders of state-supported R&D organizations with IAAS participation in Bishkek (Kirghizia), where proposals for promoting collaboration in fundamental and applied science were advanced. Last December, the jubilee session of the IAAS Council deeply appreciated the Association's contribution to resuming, preserving and promoting fruitful scientific collaboration of the scholars of its member academies and organizations. An important result of IAAS activities last year was the signing of the Agreement on setting up the CIS International Innovation Nanotechnology Center in Dubna by IAAS, the Russian Science Center 'Kurchatov Institute' and the Joint Institute for Nuclear Research.

NAS institutions carried on joint research with academy, state research and educational institutions, and companies of 64 countries under more than 100 agreements on scientific and R&D collaboration. Extensive co-operation was carried out under more than 760 direct bilateral agreements between NAS institutions and their partners from Europe, Asia and the Americas. We witnessed a considerable rise in the number of direct contracts between NAS and RAS institutes. Joint projects with the RAS Siberian Branch, the Russian Humanitarian Research Foundation and the Russian Fundamental Research Foundation were implemented successfully.

New collaboration agreements were concluded with the Hungarian Academy of Sciences, the Department for Engineering and Science of the Guangdong Province Government (China), collaboration memoranda were signed with the National Institute for Nuclear Physics of Italy, Canadian state company 'Atomic Energy Canada Ltd', South-African Nuclear Energy Corporation. The agreement on scientific collaboration with the Romanian Academy of Sciences was renewed.

Over 3290 NAS researchers and post-graduate students were sent on missions to research and educational institutions of Austria, Great Britain, Italy, Canada, Germany, Poland, the Russian Federation, Slovakia, the USA, France, Sweden, the Czech Republic and the Republic of South Africa: they got training or worked there.

New Challenges

Innovations Due to Basic Research Done at the Section of Physical, Engineering and Mathematical Sciences



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

Today, research institutions operating under the NAS Section of Physical, Engineering and Mathematical Sciences carry out numerous goal-oriented basic studies, whose results meet current scientific standards and possess a considerable application potential.

The Institute of Mathematics completed the development of the perturbation theory for toroidal invariant manifolds of dynamic systems. This permits efficient studies of the phenomena of resonance transit, various kinds of bifurcations and synchronization processes. The results obtained allowed the development of a method to enhance the radiation emission power of coupled single-mode semiconductor lasers due to their mutual pumping.

With the method of the Riemann-Hilbert inverse problem, solutions of the Camassa-Holm equation were obtained, which describe nonlinear waves in shallow water and in elastic rods. That made a crucial step towards solving an important applied problem which had been a challenge for mathematicians and physicists in the last two decades.

The V. M. Glushkov Institute of Cybernetics developed theoretical fundamentals to accelerate the process of solving involved problems of discrete optimization. A RESTART-technology was elaborated, making the optimizing algorithm probabilistic as much as possible and modifying it to minimize its execution time through a special restart procedure. The technology was used to solve intricate problems with the SKIT supercomputer complex.

The M. S. Polyakov Institute of Geotechnical Mechanics, relying on basic research into physicomechanical properties of ultimate-strained rocks and patterns of geo-mechanical processes around mine tunnels, validated a pioneering technology of mine tunnel anchoring, tested it under operating conditions and introduced it into practice as a normative document. The implementation of this technology improved safety in mines and reduced the cost of timber materials by UAH 1m per 1 km of mine tunnel.

Relying on new acousto-electronic effects revealed in semiconductor nanostructures, scientists of V. E. Lashkarev Institute for Semiconductors Physics and Nottingham University (Great Britain) collaboratively produced a terahertz acoustic laser. The device opens up novel ways for light modulation, generation of terahertz electromagnetic radiation, diagnostics and testing of materials and structures, nanostructures included. Researchers of M. M. Bogolyubov Institute for Theoretical Physics predicted high conductivity of a novel carbon material – graphene. This material offers promise for a substantial operational improvement in semiconductor-based electronics.

A complex of economic, informative and express techniques for geoecological studies, structural mappings and predictive estimates of hydrocarbon deposits was developed at the Institute of Geological Sciences. These methods are now used to analyze hydrocarbon resource potential in Ukraine and to scientifically validate the prospects of future increase in domestic raw-material resources.

Last year, scientists of the E. O. Paton Institute of Electric Welding continued to improve their methods of welding living tissues. They investigated the postsurgery properties of tissues in various human organs and developed new welding equipment and methods to control the welding process. The durability of welded joints was determined experimentally. New equipment prototypes were successfully tested at various medical institutions in Ukraine and Russia, and above 30 thousand surgical procedures were carried out. Now, similar testing is being performed in far-abroad countries.

Specialists of the Institute of Electrodynamics created an international-level information technology for automated control of high-voltage objects of electric supply mains. The first such system was put into operation in 2008 to control the newly-constructed 750 kV 'Kyivska' sub-station in the united electric mains of Ukraine.

Scientists of the National Science Centre 'Kharkiv Institute of Physics and Technology' discovered that the effect of radiation-induced penetration of impurities into the crystal lattice of steel can dramatically change the scenario of phase transformation under irradiation, as well as the mechanical properties of steel. Their results are of importance for validating the feasibility of extending the lifetime of reactor vessels at Ukrainian nuclear power plants. Those are also important in terms of choosing the materials for new nuclear reactor vessels. Jointly with scientists from Argonne National Laboratory (USA), a project of subcritical nuclear installation was developed. The chain reaction in such an installation can only proceed under stimulation by an external ion source. The installation will be used to produce medical radioisotopes and in studies towards constructing safe nuclear reactors.

The abovementioned results, as well as many others, were widely demonstrated at the exhibition of R&D achievements, organized on the occasion of the 90-th anniversary of NAS establishment. The exhibition convincingly showed that the basic research carried out by Academy institutions and aimed at developing various innovative technologies has grown considerably. A top priority for the Academy scientists is their active participation in major large-scale projects, which will help our country deal with challenges of the current economic crisis.

Upgrading Academy's Research Facilities



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

New Challenges

Nowadays, in times of accelerated science progress, it is rather problematic and sometimes even impossible to produce valid research results without modern scientific facilities. This applies to many science areas, but is especially crucial and essential to the very development and progress of cutting-edge research in physics, chemistry, biology, materials and engineering sciences.

In the early 21st century, NAS is faced with the situation, when due to its meagre budget in recent years, the major part of existing facilities, dating back to 1970-ies and 1980-ies at the best, has become very much outdated. It is a universal fact, however, that leading world laboratories update and upgrade their scientific equipment every five years. Obsolete research facilities prevented our scientists from putting their theoretical ideas to practical use and hindered the up-scaling of research.

Being fully aware of such dramatic situation, NAS authorities have repeatedly appealed to Ukrainian leaders for financial support, with the purpose of resolving this most urgent problem, vital for science and its future in Ukraine. Finally, for the first time in the history of independent Ukraine, Article 104 of the Law of Ukraine 'On the 2004 State Budget of Ukraine', allocated UAH 40 million to purchasing unique stateof-the-art research equipment from leading world producers.

With a view to upgrading scientific facilities, NAS Presidium formed the Committee on upgrading NAS scientific facilities (hereinafter – the Committee). Later it approved two documents proposed by the Committee. The first one, 'Regulations on the mechanism of applying to the Committee for updating research instruments and equipment through consolidated purchases of imported scientific instruments and equipment with NAS budgetary finance' assigned the key role in applying to the Committee to the Bureaus of Science Departments which analyzed the requests of their subordinate institutes and sent summarized proposals to the Committee. The other of the documents approved was 'Model provisions for the Center for shared use of scientific equipment/facilities in various research/R&D areas'.

A special emphasis should be placed on the fact that providing NAS with ear-marked finance to purchase costly scientific equipment continued in the following years as well. Over the five-year period, from 2004 through 2008, NAS received UAH 280 million, though a rather substantial part of the money (over 20%) was spent as import tax and VAT payments, as well as payments for bidding procedures.

In 2004 – 2008 the Committee examined more than 400 applications from NAS institutions, submitted through Science Departments. Taking into account Academy's limited budgetary funds, the best applicants were selected and 124 foreign-made research modules were purchased in the consolidated way, to be distributed among 67 NAS institutions. This allowed us to organize several dozens of Centers for shared use of scientific facilities. All the relevant information about the activities of those centers can be found at the Internet site of NAS Presidium: http://www.nas.gov.ua.

Among the equipment and instruments procured were: femto-second laser complex by Coherent (USA); NMR and EPR spectrometers, X-ray diffractometers and IR Fourier-spectrometers by Bruker (Germany); scanning and transmission electron microscopes by JEOL Ltd (Japan); mass-spectrometric and chromato-mass-spectrometric modules by Thermo Electron GmbH (Germany), Bruker (Germany) and Agilent Technologies (CLUA); testing modules by INSTRON Ltd (Great Britain) and MTS (USA); light and confocal microscopes by Olympus (Japan) and Carl Zeiss (Germany), as well as many other cutting-edge equipment by world-known producers.

The analysis performed showed that the system of distributing research equipment among NAS institutes, based on the normative documents of NAS Presidium, through competitive selection of applicants at the Science Departments with further discussion and approval by the Committee ensures the fair and unbiased distribution of finance and equipment among NAS Science Departments and all the way down to subordinate institutions, irrespective of their location.

No doubt, all those measures resulted in a significant renovation and upgrading of NAS research equipment and facilities base. Still, these efforts should be considered as a mere beginning of further concerted effort towards continuous upgrading of scientific facilities. State-of-the-art instruments and equipment would update institutes' projects in line with the current trends in global science, promote international co-operation, facilitate the recruitment of gifted young researchers to NAS and preservation of its research-personnel potential.

New Challenges

Socio-Humanities: Contribution to Priorities of Social Progress



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

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Scholars of NAS Socio-Humanities Section persistently work towards interpreting intricate processes and changes which occur in the Ukrainian society, producing forecasts and optimal models of social, economic and political development, searching for ways to overcome the crisis phenomena born by recent realities and challenges of the XXI century.

Scholars in socio-humanities focus their research efforts on a broad spectrum of practical issues to produce and implement novel technologies of economic and social management, advance social and humanitarian spheres, increase nation's demographic and labour potential, improve its education system, all those being fundamentals of economic and social progress of Ukraine.

NAS researchers implemented the following integrated target programs: 'Problems and prospects of socio-economic, political and legal progress of Ukraine', 'Forecasts and models of social and socio-cultural transformations of the Ukrainian society in the first quarter of the XXI century', 'Development of intel-lectual and spiritual potential and modernization of science, education, culture and administration', 'Integration to the international community and strategic challenges for Ukraine', 'Studying mementoes of na-tional historical and cultural heritage and their adaptation to the spiritual life of the present-day Ukrainian society'. Scholars carried out research aiming at the analysis of socio-economic, political, legal, spiritual, cultural and world-view transformations in Ukraine, at determining vectors of changes in civilizational and cultural norms and values in the Ukrainian society, at forming current economic, social, regional, linguistic, research, educational, spiritual, cultural and information policy, alongside with studies of socio-economic phenomena that influence the competitiveness of the country in the system of international relations, at modelling possible strategies of humanitarian, eco-nomic, political and legal participation of Ukraine in the European and global co-operation.

Series of profound works in economy, sociology, political science, law, global studies, and contemporary history were published. They analyzed conditions and prospects of the Ukrainian society advancement. The publication of three-volume editions «Civilizational Structure of Today's World» and «Financial and Monetary Instruments of Economic Development» was completed. Fundamental writings «Political System for Ukraine: Historical Experience and Present-Day Challenges», «Security of Ukraine's Regions and Strategy to Ensure it» were published.

The Section had significant achievements in humanitarian studies to analyze and re-introduce nation's centuries-old cultural heritage to the spiritual life of the present-day Ukrainian society. Its researchers published four volumes of the «History of Ukrainian Culture», «History of XIX-Century Ukrainian Arts» and «History of XX-Century Ukrainian Arts». Seven volumes of «Ćomplete Works by Taras Shevchenko in 12 volumes» were issued. The work on preparing academic «Collected Works by Ivan Franko in 100 Volumes» was started. The writing of the «History of Ukrainian Literature in 12 volumes» is coming to an end. The preparation and publication of multi-volume encyclopedic works is carried on; among those are: «Encyclopedia of Present-Day Ukraine», «Encyclope-dia of the History of Ukraine», «Ukrainian Literary Encyclopedia», «Shevchenko Encyclopedia», «Franko Encyclopedia», «Musical Encyclopedia», a corpus of dictionaries of the Ukrainian language. The concept of the «Ukrainian Universal Encyclopedia» was developed.

To celebrate the 90-th NAS anniversary, our scholars published numerous works generalizing the richest experience of Ukrainian science progress. Among them were: «The National Academy of Sciences of Ukraine. 1918–2008: to the 90-th Anniversary of its Establishment», «The National Academy of Sciences of Ukraine: Development and Integration to the European Science Area», «Socio-Humanities in the National Academy of Sciences of Ukraine. 2004–2008», «History of V. I. Vernadsky National Library of Ukraine. 1965–1992».

Research workers of the Section focus their efforts on making their achievements the basis for the Ukrainian project of XXI century: a cardinal breakthrough in the development of 'knowledge-based' society, where intellectual potential becomes a powerful productive force ensuring the progress of a strong and prosperous state – a rightful participant in the global and European civilizational processes; an improvement in the well-being of Ukrainian people; the strengthening of cohesion and mutual understanding in the society.



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

Mathematics

In 2008, scientists of the institutions under NAS Department of Mathematics carried out important fundamental research and achieved a number of whole new results in major areas of mathematical science.

Progress in Research Areas

Experts in the field of differential equations and dynamical systems determined conditions for the global existence, uniqueness and controllability of weak solutions of neutral-type stochastic functional differential equations in a separable Hilbert space. They showed that boundary-value problems for piecewise-linear partial differential equations with linear boundary conditions can have chaotic solutions. All solutions on a semiaxis were described for differential equations of elliptic type in a Banach space. The well-posedness of local and nonlocal problems for almost linear hyperbolic systems of the first order was investigated. A broad class of impulsive differential inclusions in Banach spaces was studied.

Specialists in mathematical physics and functional analysis studied nonlinear difference equations of the Toda-chain type. In the finite and tame configurations of subspaces of a Hilbert space, they gave a description of irreducible nonequivalent systems of subspaces. Characteristic properties of scattering data for direct and inverse multichannel scattering problems were obtained. Investigated was the asymptotic behavior of solutions of a system of equations that describe the motion of the viscous incompressible liquid perturbed by small rotating solid particles.

In the field of theory of functions, new contoursolid theorems for holomorphic functions were established. Denjoy problems with respect to analytic functions with perfect sets of singular points were solved. Estimates were found for generalized Lebesgue constants for partial sums of Fourier–Jacobi series in spaces of integrable functions.

In probability theory and mathematical statistics, the Poisson and Levy approximations were studied for stochastic processes in Markov and semi-Markov random media. A new class of boundary-value problems for mathematical expectations of functionals of diffusion processes was constructed and theorems on the form of their solutions were obtained. Central limit theorems were proved for multivariate statistics and von Mises statistics of eigenvalues of random matrices of high dimension.

Researchers in the field of geometry and topology calculated the exact values of global Morse numbers for a broad class of nonsimply connected manifolds. They studied curvature flows for a broad class of Riemann spaces, in particular in the case of mean curvature flows with Gaussian density.

Algebraists developed a deformation technique in bimodule categories and, on its basis, obtained a description of unitary general-position maps of linear groups over Euclidean algebras.

Specialists in mathematical problems of mechanics studied force interaction of an ideal liquid with the walls of a movable cylindrical tank. For systems satisfying the Barbashin–Krasovskii theorem, they constructed two types of additional functions,;relying on them Lyapunov functions were obtained. The problems of stationary heat conduction and thermoelasticity were solved for infinite and semi-infinite bodies with heat release in circular and elliptic domains. They derived a system of equations to describe interrelated electromagnetic, heat and mechanical processes in chemically inert electroconductive nonferromagnetic polarized media.

In the field of mathematical modeling and computational and applied mathematics, a new class of interpolation integral fractions was investigated and interpolation integral operator fractions in a Banach space were constructed. An algorithm was developed to solve the problem of terminal control of the ingot surface temperature. A mathematical model of gas transmission system was constructed.

In the course of implementing the targeted research program 'Mathematical modeling of physical and mechanical processes in strongly inhomogeneous media', researchers proposed integral criteria to estimate the detail level of digital photographs of the space optical system, with an allowance for the signal distortion due to the motion of the spacecraft, atmospheric effects (turbulence, haze), inaccurate lens focusing, discreteness of information representation, and random fluctuations. They also substantiated requirements to precision and information characteristics of the target efficiency of space systems for optoelectronic observation of the Earth.

The State Prize of Ukraine in Science and Technology was awarded to researchers of the NAS Institute of Mathematics, NAS Institute of Applied Mathematics and Mechanics, and NAS Ya. S. Pidstryhach Institute of Applied Problems in Mechanics and Mathematics for the series of works «New Qualitative Methods of Nonlinear Mechanics and Their Application to the Analysis of Multifrequency Oscillations, Stability, and Control Problems».

Under the supervision of Department's scientists, 14 doctor-of-science degree theses and 35 candidate-of-science degree ones were defended. 23 monographs and 10 textbooks were published. The institutions of the Department organized and held 16 international scientific events and were co-organizers of 11 international scientific forums, attended by prominent scientists from the USA, China, European and CIS countries.

Progress in Research Areas

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

Information Science

In 2008, scientists of NAS Informatics Department achieved new major results.

An algorithm of global equilibrium search for the solution to quadratic assignment problem was developed and investigated.

Mathematical models of the self-regulation of body's functional systems relative to the stabilization of its state in conflict and stressed situations of life were constructed.

A software complex, implementing the Bayes procedure of recognizing pairs (triplets) of the states for pairs (triplets) of adjacent amino acids on Markov chains of different order was developed for conducting experiments to forecast albumen secondary structure on the SCIT cluster computer complex. An expert system was built to analyze the progress of cerebral gliomas.

Mathematical models and algorithms were proposed to solve the reverse problem of magnetostatics for the field source as a three-dimensional package, every layer of which is a magnetic-field source of twodimensional structure of currents, distributed in a plane that is parallel to the plane of measurements. The analytical solution of the reverse problem for such a layered field source was obtained for the first time, using tools of Fourier transformations.

Mathematical models and methods for the optimum service of foreign national debt were proposed and investigated, taking into account a number of major economic, investment and social characteristics of the existing loans.

Algorithms were developed to regulate the work of a management unit with documents and control their life cycle. Algorithms of personalized service-oriented computational architectures, interfaces of personalized-service user were developed.

The update multiplatform Java-version of the European radiation-safety decision-support system RODOS was developed and sent for introduction in the emergency centers of EU countries.

A new method was proposed for information crypting in IP-networks, alongside with mechanisms of interaction with diverse methods of information transmission, including transmission of ciphered vocal messages to mobile telephones.

An operating model of biometrical personality authentication system, relying on finger-prints and images, was created. The 'Arkan' comprehensive system of information protection was developed for the integrated interagency information-telecommunication system of control over migration processes. Components of the system for monitoring the above-water situation on state borders of Ukraine were developed and introduced, as well as an information-telecommunication system for registering travelers from the states supporting visa-free entrance and for checking the duration of their stay in Ukraine.

A methodology was worked out to design information-analytical systems for real-time monitoring of a set of dynamic objects; it consisted of techniques and methods allowing one to design the architecture of software-hardware complex, information support etc.

A dynamic-information approach to forecasting space weather on the basis of Dst-index was proposed for the first time. The feasibility of forecasting the state of 'space weather' was proved and mathematical models of 6–9-hour forecasting built.

A cascade of hydrometeorological models to determine parameters of vegetation and soil for monitoring droughts and vegetation condition was created, optimized and verified.

A system of dynamic and temporal characteristics of some macroeconomic and social processes was proposed as a basis of their typification, which, in turn, became the basis for systemic methodology to study the evolution of social processes.

Under the National program of informatization in Ukraine, 18 national standards were developed, concerning methods and techniques to ensure the security of information technologies, computer technologies of teaching and electronic commerce, rules of documenting software, digital signature etc.

A model of electronic teaching technologies was proposed, which in a balanced way takes into account principles of economy, unrestricted accessibility, high quality and life-time education. The results obtained were duly appreciated by experts at the Third International Conference 'New Information Technologies in Education for All: Electronic System of Education' as a new priority research trend, conforming to the UNESCO-advanced paradigm of information society development in the 21st century. Whole new types of educational distributed interactions of basic chains of electronic educational environments were tested. The practical results of the tests were implemented in a number of universities of Ukraine.



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

Mechanics

In 2008, scientists of the NAS Department of Mechanics produced quite a number of new important results.

Progress in Research Areas

Researchers of the S.P. Timoshenko Institute of Mechanics discovered patterns of stress and deformation distribution around holes and inclusions in com-posite shells under biaxial loading. Dependences of deformation levels and periods of plate vibrations on the length of edge cut were obtained. Solutions of static and dynamic problems were produced for anisotropic inhomogeneous shells and solids of complex shape under various boundary conditions. Relying on them, specialists found peculiarities of displacement and stress fields in these objects. They derived and experimentally verified constitutive equations describing non-isothermal deformation of solids along small-curvature trajectories, with account being taken of the kind of stressed state. Using specially built experimental facilities, scientists investigated features of dynamical deformations of a partially liquid-filled cylindrical shell with elastic bottom in the presence of local gas-bubble clusters under polyharmonic vibrational excitation.

Researchers of the Institute of Technical Mechanics, operating under NAS and the National Space Agency of Ukraine, theoretically analyzed dynamic performances of the first stage of the liquid-propellant rocket engine and the air-frame design of Taurus-II launcher, custom-built for the Orbital Sciences Corpo-ration (USA). Relying on the theory of longitudinal stability of liquid-propellant launcher, developed at the Institute, they determined the requirements to the gas-liquid damper providing Taurus-II launcher's longitudinal stability on the active segment of flight trajectory. For the first time ever, similarity parameters were formulated for the magneto-hydrodynamic interaction of magnetized bodies with plasma supersonic flows. The effects of the magneto-hydro-dynamic control of heat exchange and deceleration of magnetized bodies (spacecraft) during reentry were determined. Specialists substantiated the most effective model of magneto-hydro-dynamic screening in terms of heat-flow transfer to the surfaces of magnetized bodies.

A general theory of mixed schemes of the finiteelement method was developed at the NAS G. S. Pisarenko Institute for Problems of Strength to solve quasi-static boundary-value problems describing non-isothermal processes of elastoplastic deformation in bodies of complex structural shape. The theory takes into account the loading history. Using specially developed methods of calculation, researchers investigated kinetics of the stress-strain state of the critical elements of NPP equipment under thermomechanical loading during thermal treatment and routine operation modes.

Scientists of the NAS N. S. Polyakov Institute of Geotechnical Mechanics constructed a model of porous-fractured hollows in sandstones and came to the con-clusion that the hollows emerge due to fractures resulting from exceeded maximum permissible tensile deformation of the rocks under the impact of various natural and man-caused agents. The model was verified by numerous gas seeps in sandstones when holes were drilled in mines. On the basis of these investigations, the following methods were developed:

- a method to calculate the most effective sandstone thickness in open positive tectonic structures; it is very promising for further development of geo-physical and geological procedures of exploring naturalgas deposits in open anticline structures of the Dnieper-Donets Depression;

- a method for advanced degassing of rock in the top of highly-loaded longwalls; this method facilitates methane recovery from gas-bearing rocks before the second working in the mining area.

Scientists of the NAS Institute of Hydromechanics developed a model of soil as hard porous multicomponent viscoplastic medium with variable viscosity coefficient, to give an adequate description of wave processes under dynamic loading. New features of the interaction of large-amplitude internal solitary waves with bottom topography were found. This allows a significant improvement in the methods to estimate characteristics of mass and energy transfer in stratified basins. Properties of V-shaped noise-insulating barriers in a wide range of geometries and frequency characteristics were investigated, using analytical methods for calculating acoustical properties of barriers.

Scientists of the NAS Institute of Transport Systems and Technologies found sharp upper bounds for the solution of a system of second-order vector differential equations. They commercialized the technology of dispersion hardening of lead-acid bars for current taping in storage batteries at 'VESTA – Dnepr' plant. It allowed a significant reduction in the duration of technological process (from 7–10 days to 2 – 3 days) and a better quality of storage battery shut.

A scientific discovery 'The phenomenon of changing pepsin proteolytic activity under the action of alternating magnetic field with vortical component' was registered (certificate #356); this allows gastric contents acidity to be changed in patients without using drugs.

The Institute of Machines and Systems, operating under NAS and the Ministry for Industrial Policy of Ukraine, developed a system description and classification of mechanical variable and transformer systems of mobile type.

Progress in Research Areas

Physics and Astronomy



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

The year 2008 was very special for all physicists – it was the year of the 90th anniversary of the National Academy of Sciences of Ukraine and the 90th birthday of B. E. Baton, the many-years leader and President of the Academy.

Research in physics and astronomy was focused on the areas where Ukrainian physicists hold a leading place in the world. In particular, these were the areas of physics of microscopic interactions and physics of the macrocosm; solid-state physics and sott-matter physics; optics and laser physics; low-temperature physics and radio physics; astronomy and radio astronomy. Much consideration was given to the currently topical nanophysics and nanotechnologies, physics of non-linear phenomena and physics of low-dimensional systems.

Experimental and theoretical results produced by Department's scholars, who obtained a lot of those in collaboration with their foreign colleagues, were published in prestigious international scientific editions with a high impact factor.

One can cite examples of the research results of true international level: the NAS Institute of Physics developed a method to produce man-made nanostructures formed by molecules on metal faces and investigated ferromagnetic nanoparticle materials that hold promise for information recording and storing; the V.E. Lashkaryov Institute of Semiconductor Physics worked out a technology for forming efficientluminescent silicon nanoclusters and elaborated a theory of high-field electron transport for semiconductor heterostructures; the G. V. Kurdyumov Institute for Metal Physics put forward a new method of X-ray diagnostics, which allows an in-depth study of nanomaterial structure; the M. M. Bogolyubov Institute for Theoretical Physics worked out a theory of dynamic screening of particles in low-ionized plasma and calculated diode characteristics of macromolecular structures; the Main Astronomical Observatory upgraded their laser observation station and brought its measuring capacity up to the best world standards; the Institute of Magnetism under NAS and MES of Ukraine advanced a new approach to the description of electron structure of normal and superconductor metal systems; the B. I. Verkin Institute for Low Temperature Physics and Engineering discovered the effect of electrostatic field on the absorption of electromagnetic RF waves in superfluid helium; the O. Ya. Usikov Institute of Radio Physics and Electronics developed a method for dielectrometry of strongly absorbing liq-uids; and the Donetsk O. O. Galkin Institute of Physics and Engineering found a broadening of crystalline lattice of nanoparticles with a decrease in their sizes, which raises new exciting questions for physicists.

Applied studies done at a number of institutions were completed with the development of new devices and technologies. E.g., a new type of radar, having a record-making high sensitivity and functional capabilities, was built; an express method to determine the amount and pressure of methane in coal in coal mines was developed; a new technology for digital processing of colour images for publisher's printing systems was worked out; and a technology was developed to produce single-crystal thermoluminophor with the sensitivity to gamma rays that is five times higher than that in the currently available ones. Besides, the Department implemented 14 innovation projects for the total amount of UAH 6.8m. Most of them ended up in engineering devices necessary for a number of industries and medicine.

The Department held nine meetings, which discussed pressing problems of research, research-management and economic activities of its institutions, including a guest meeting of the Bureau at Vasyl Stefanyk Prycarpatsky National University. The Bureau decided it necessary to organize a branch of the NAS G. V. Kurdyumov Institute for Metal Physics in the city of Ivano-Frankivsk.

A joint celebration meeting of the NAS Department of Physics and Astronomy and the Department of Nuclear Physics and Power Engineering was held, to commemorate the 100th anniversary of L. D. Landau, a prominent theorist physicist and Nobel Prize winner, who worked at the Ukrainian Institute of Physics and Engineering in 1932-1937. Besides, a joint grand meeting with the NAS Department of Physical-and-Technical Problems of Materials Science was held, commemorating the 100th anniversaries of two prominent physicists V. N. Gridnyov and A. A. Smirnov, professors, NAS academicians.

Academic sessions of the Department continued their work. Two such sessions were organized, where six papers were presented; those addressed topical physical problems studied both by Academy institutes and by leading universities.

In 2008, six institutions of the Department were able to replenish their laboratories with imported unique equipment.

The results of the creative intellectual activities of Department's scientists were highly appraised and recognized. Three State Prizes of Ukraine went to associates of the Institute of Physics, M. M. Bogolyubov Institute for Theoretical Physics, O. Ya. Usikov Institute of Radio Physics and Electronics, B. I. Verkin Institute for Low Temperature Physics and Engineering, and the Institute of Radio Astronomy. A staff member of the NAS Institute of Physics was awarded the Prize of the Academies of Ukraine, Belarus and Moldova. High state awards were received by 20 scientists of the Department. 42 scientists (including 11 young scientists) won NAS distinctions. **Earth Sciences**

Progress in Research Areas

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

In 2008, researchers of the NAS Department of the Earth Sciences produced a number of significant fundamental and applied results; some of those won awards and prizes.

New principal and auxiliary criteria were developed to identify the boundaries of stratigraphic units according to the International stratigraphic scale; regional stratigraphic schemes (of the Neogene deposits of the Transcarpathian Trough) were modified and specified; changes in stratigraphic schemes of the Phanerozoic deposits in Ukraine were validated.

Clear differences in isotopic and geochemical features of oils in allochtonous and autochthonous complexes were determined, which can dramatically increase the potential of oil and gas content in mixedage formations of the underthrust zones in the Cis-Carpathians.

A petrogenetic model was developed for Oleksandrivska layered intrusion within the Serednyoprydniprovsky (Mid-Dnieper) megablock of the Ukrainian Shield. The anorthosite-diorite-granodiorite-plagiogranite igneous-rock series penetrating ultrabasite and gabbroid rocks was distinguished for the first time. A conclusion was made concerning the potential nickel-bearing capacity of the Oleksandrivska layered intrusion. The results obtained are of major importance for determining the tectonic regime in the Mezo-Archean formations and hold considerable promise for exploration of nickel, chromium and noble metals.

It was discovered that the highest gas releases from the Black Sea bottom are associated with deep subsurface degassing and confined to the activation zones of tectonic structures. As estimated, the rate of gas escape merely in the southwest part of the Black Sea amounts to 30bn m³ annually. Hypothetical reserves of gas-hydrates in the Black Sea are estimated at 25-48trln m³. The possibility of meeting Ukraine's needs by the use of gas-hydrates is of strategic importance.

Relying on the analysis of NCEP/NCAR global data base for 1948-2006, scientists studied the 10year pattern of year-by-year variations in cyclone statistic parameters (area, depth, frequency, intensity), which is due to global processes in the ocean-atmosphere system – the El Nino.

A hydrogeological model of the Danube fresh groundwater field was developed. For the first time in this region, it was proved that regional exploitable resources of fresh water in the alluvial aquifer amount to 2.4 million m³/day, which shows a unique potential of the western wing of the Black-Sea artesian basin to satisfy the demand of Odessa oblast population (including Keni, Ismail, Chili, Bolgrad and Tatarbunary districts) for fresh water.

The numerical model of weather forecasts (WRF) was adapted to Ukraine's territory. The model relies on the test mode of IA64-48proc. super computer, which outputs data twice a day in the on-line mode. The modeling yields prognostic fields: air temperature, atmospheric pressure, wind velocity and direction, precipitation, air humidity, and cloudiness.

For the first time ever, the basic balance components of the greenhouse effect within Ukrainian borders were determined; those are based on the results of multi-spectral space survey. The purpose of this study was to calculate parameters for determining greenhouse-gases quotas in Ukraine under the Kyoto's Protocol.

In the area of international collaboration, mention should be made of the DOBRE-3 research project along the Debretzen-Mukacheve-Rivne profile, implemented by the NAS Institute of Geophysics. The project continued studies of the lithosphere deep structure in the South and Southwest of Ukraine. The profile length was 645 km. Field experimental studies were conducted by key geophysisists from Western Europe: those from the University of Copenhagen, Denmark; the Technological University of Vienna, Austria; Budapest Geophysical Institute, Hungary; the University of Helsinki, Finland; PAS Geophysical Institute, Warsaw, Poland; the Free University of Amsterdam, the Netherlands.

The high scientific value of these investigations consists in studying patterns of deep structure and geodynamic evolution of the lithosphere in Dobrudja and Folded Carpathians regions, as well as estimating the effect of geodynamic zoning on the formation of consolidated core and sedimentary cover, which is necessary for mineral prospecting and survey within those territories.

In the reporting period, research efforts of the Department were duly recognized. State Prizes of Ukraine in Science and Technology were awarded to the works performed by specialists of the Ukrainian State R&D Institute of Mining Geology, Rock Mechanics and Mine Survey, as well as the Institute of Problems of Nature Management and Ecology.

In the near future, the activities of Department's institutions will advance research towards extending mineral resources, improving the efficiency of minerals use, developing geoecological studies to stabilize and improve the environment in Ukraine.

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Progress in Research Areas

Physical-and-Technical Problems of Materials Science



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

In 2008, scientists of the NAS Department of Physical-and-Technical Problems of Materials Science produced major research results and developed new materials for various sectors of the economy.

Processes of pulsed flashing and automatic-control algorithms were studied. It was found that the explosive nature of melting breaks up contacts and forms craters on the surface due to momentary voltage values in the gap between the contacting parts. During the explosive breaking-up of contacts, the metal melt is stripped from the surface of the contacting parts and oxide-film defects are formed in these areas. An algorithm was developed to automatically regulate pulsed flashing parameters, which enables sound joints to be produced with minimum power consumption.

A tissue-saving high-frequency electric welding technology for joining live soft-tissue incisions was developed. EK-300 M1 power source with automatic system of adaptive control and monitoring of specialized electric-welding medical tools was developed, and diverse morphological and histological studies were performed on a large group of animals. Health Ministries of Ukraine and Russia, as well as medical institutions of the USA and the European Union, authorized clinical use of the process in surgery. Patents of Ukraine, Russia, USA, European Union, Canada and Australia were secured. Electric-welding medical equipment was developed and certified.

State-of-the-art manufacturing of new-generation flux-cored wires in Ukraine was started. The production of self-shielding flux-cored wire was developed and implemented to weld X80 pipe steels used in the construction of higher-pressure gas pipelines.

Features of diffusion processes in KCl-KBr ion single-crystals at dielectric heating in ultrahigh-frequency (UHF) electromagnetic field in a specialized 24 GHz gyrotron unit were studied. The interdiffusion of ions at UHF heating was shown to occur at a higher speed than that under conventional heating, and the effect of ascending diffusion of CI and Br ions in UHF field was found. The microstructures of the diffusion zone between KCl and KBr single-crystals after UHF and conventional heating were fundamentally different. The features of the microstructure after UHF heating were the formation of chromium-rich local areas in KCl, alongside with the development of periodical banded structures in both crystals. The results obtained are important in terms of determining the interaction mechanisms between UHF field and solids for further development of UHF methods to sinter and synthesize powdered materials.

Within the proposed model for evaluating contact fatigue of rolling bodies, residual fatigue life of a rolling pair was studied in terms of the criterion of pitting development in borderline-lubrication service conditions. Theoretical curves of contact cyclic fatigue lives for rail steels were plotted for the first time.

A pattern of forming metal-polymer composites from superhard materials based on Cu, Sn, and phenol-formaldehyde oligomers was found; metal-frame formation was shown to be the start of intermetallics (Cu₆Sn₅ and Cu₃Sn) formation in the composite. The condition of polymer frame preservation was to limit the sintering temperature to 250°C, above it the destruction of polymer frame starts. This allows one to determine temperature conditions for directional formation of wear-resistant two-frame abrasive metalpolymer composite.

Relying on the processes of interaction of disperse metal and ceramic particles with the melt during its mixing and pouring into the mould, process flowsheets were proposed and optimum modes selected to produce composites from metal suspensions after their deep processing with laser radiation.

Thermal conditions were determined, thermal unit design and technological parameters developed to grow the world's largest rectangular-shaped sapphire crystals (350x500x50 mm) by horizontal directional solidification. Superlarge sapphire crystals grown with the technology developed have no analogs in the world. Products from these crystals are to be used in new-generation units for electroluminescent-structure epitaxy in LED manufacturing, in aerospace engineering and in developing translucent armoring.

Simulation and computer-aided design methods were used to develop durable thermoelectric power sources, which will enable us to provide self-contained power supply and improve operational safety of gas separation stations. Development results were used to build and experimentally verify two types of thermogenerators: the explosion-safe one, based on a vortex tube, and a durable one, using natural-gas fuel. Generator designs were optimized, and design documentation and specifications for the prototypes produced were developed. The generators were proposed for commercialization at Ukrstransgas State Corporation and in Ukrainian coal-mining industry.

The 2008 State Prizes of Ukraine in Science and Technology were awarded to four R&D works with the contribution of scientists of the NAS Department of Physical-and-Technical Problems of Materials Science. Seven researchers won the awards.

Physical-and-Technical Problems of Power Engineering



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

In 2008 the efforts of scientists of the NAS Department of Physical-and-Technical Problems of Power Engineering focused on priority fundamental and applied issues of power engineering.

Progress in Research Areas

Integrated NAS research programs 'R&D fundamentals for energy-saving' ('Energy saving') and 'R&D aspects of integrating the Ukrainian power system to the European power system' ('Integration') were successfully completed.

In 2008, scientists of the Department produced a number of major fundamental and applied research results.

A concept of the State target program of updating Ukrainian municipal heating systems was developed; it was based on respective regional programs. The primary aim of the program was to provide a 30%reduction of natural-gas consumption in heat supply.

The process of accumulating creep damage in the high-temperature area of steam-turbine rotor was first investigated as a 3-dimensional problem. A technology was developed to estimate hazardous vibration failures with increasing turbine vibration; it relied on data from the system of continuous analysis and diagnostics of turbogenerator vibration state.

Methods of optimum choice of type, power and sites of facilities for flexible transmission with alternating current were developed. Their application allows a 2-2.5-time increase in the transfer capability of grid crossings. Recommendations were developed for using flexible transmissions in the United power System of Ukraine.

New mathematical and physical models were developed to analyze non-uniform electric fields and electro-physical processes in super-high voltage cables, allowing for the additive effect of varioussized heterogeneous micro-switchings.

To detect faults in opaque materials, scientists developed and investigated algorithms and programs of generating two-dimensional acoustic pictures in the PC graphic adapter, which has a hardware and software structure of a 64-processor complex. This permits one to use calculating procedures of two-dimensional interpolation and nonlinear filtration for obtaining high-quality images of small-sized defects.

Theoretical fundamentals were developed for the synthesis of large-sized power systems with deep feedbacks, which could be instrumental in incorporating the United Power System of Ukraine to the power grid of the European Union. Specialists studied interrelated structures of power-supply system and those of heat-supply with connected automated frequency control of the electric-power system of powerful heataccumulating systems of electric-and-heat supply, which act as regulator users.

Methods to reduce natural gas consumption by 200 and 300 MW power units burning anthracite and lean coal were developed and refined at Zmiyivska and Starobeshivska thermal power plants. Introducing those methods at 200 MW power units of Zmiyivska power plant permitted a 2–2.5 fold reduction in natural-gas consumption.

A mathematical model of thermophysical processes in the linings of steel-casting ladles was developed, depending on the ladle configuration and lining material, as well as operating schedules of its exploitation.

The results of monitoring the characteristics of radioactive aerosols in sub-reactor space of the 'Ukryttia' ('Shelter') facility were studied. A trend of growing concentration of the small-dispersed fraction of aerosols containing long-lived alpha-radiation sources was discovered.

Mathematical models of dynamic and stationary processes were developed for 'photovoltaic battery – load' systems, with account being taken of their nonlinear nature.

Specialists discovered and studied the basic mechanism of forming hazardous man-induced geomagnetic field distortions in the premises of control units of power plants and distribution substations of the power grid of Ukraine; methods to offset such distortions were proposed.

A number of important developments were commercialized. E.g., the first domestic technology for the automated control of large-sized power facilities was worked out, which is used for information maintenance of powerful 750 kV 'Kyivska' substation. Khorol plant of dairy preserves for babies implemented a technology for the mass production of hypo-allergenic dry baby-product meeting the best international standards. Advanced systems of heating industrial furnaces were introduced in metallurgy, machinebuilding, and construction-materials industry; they save up to 20% of natural gas.

Several works with the contribution of Department's scientists were highly appraised. In particular, eight researchers of the NAS A. M. Pidhorny Institute of Mechanical Engineering Problems won the 2008 State Prize of Ukraine in Science and Technology for the work 'Increasing energy efficiency of operating turbo-installations at thermal power stations through modernization, reconstruction and improvement in their exploitation modes'.

Progress in Research Areas

Nuclear Physics and Power Engineering



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

The NAS Department of Nuclear Physics and Power Engineering incorporates six science institutions and three pilot-production facilities. The total number of their employees is almost 4000, including nearly 1600 scientists. Among them, there are 9 NAS academicians and 19 NAS corresponding members, 150 doctors of science and 562 candidates of science.

In the reporting period, the scientists of the Department produced a number of significant results in fundamental and applied research.

The investigation of elastic ¹⁶O+¹²C scattering at various energies revealed that the short-range repulsion of two nuclei, where nucleon density overlapping and density doubling occurs in a certain volume, is due to a high nuclear-matter compression modulus and to the kinetic energy contribution assigned to the Pauli principle and antisymmetrization.

A theory of low-frequency wave phenomena in toroidal plasma systems of stellarator and tokamak types was constructed, with due regard for the effects of finite diamagnetic frequency and plasma compressibility. Drift-sound characteristic oscillations and a new type of drift-Alfven natural oscillations in toroidal plasma were discovered.

A flow of solar neutrinos from decay of beryllium-7 was first measured in the BOREXINO experiment. The measurements provided new information on oscillations, mass and mixing parameters of neutrinos.

It was found that radiation-stimulated dissolution of interstitial impurities in the crystal lattice of 15Kh2MFA steel (pressure vessel material of WWERtype reactors) can have a significant effect on the development of phase transitions under irradiation, as well as on the change in the mechanical properties of the steel. A theoretical model was proposed for the motion of dislocation kinks in the Peierls relief of the irradiated steel. It accounts for the peculiarities in the behaviour of mechanical characteristics of pressure vessel steel that are observed in through-thickness experiments. Dislocation loops with the Burgers a<100> vector were found to be the main kind of radiation defects in 15X2M Φ A steel under heavy-ion irradiation, which cause metal hardening.

A mechanism of nonuniform defect redistribution by glide dislocations in the bulk of the crystal exposed to radiation, thermal and mechanical actions was proposed.

The strain-stress distributions on five WWER-1000 reactor vessels, 24 steam generators and over 1200 welded joints of NPP turbine piping were analyzed.

The primary causes of pipe conduit rupture were determined; a rapid control technique was proposed; guidelines were elaborated for further operation and additional control of pipe conduits and pipe choking. The safety of Pivdennoukrainska NPP supply unit No 3 with a combined load of various fission materials from alternative suppliers was validated for normal and design-basis accident operating conditions.

The essentials of techniques to investigate radiation-stimulated transformations in metals and alloys were developed through the use of ellipsometry methods.

Perspective assessment of the Ukrainian territory was made, with a view to discovering new thorium and uranium deposits.

A conceptual design of the neutron source relying on an electron accelerator-controlled subcritical assembly was developed.

The world's first three-beam collinear accelerator that enables a simultaneous irradiation of materials with ions of heavy metals, helium and hydrogen was built to simulate phenomena occurring during nuclear reactor irradiation.

A low-pressure emission spectrometer was first developed and tested with the use of low-pressure inductively coupled plasma in an external magnetic field to improve the efficiency of atomic ionization of the sample under study.

Experimental facilities were produced for preclinical trials of radiopharmaceuticals on laboratory animals.

A concept was developed and approved for building a new multi-purpose research reactor in Ukraine.

Specialists of the Department were engaged in developing drafts of a new Concept of activities in the restricted zone and the zone of unconditional (compulsory) evacuation and of the National ecological target program of radioactive waste management, signed into the Law of Ukraine.

NAS academician E. V. Sobotovich was awarded with the Order 'For Services' II Class, NAS academician V. Yu. Storizhko – with the Order of Prince Yaroslav the Wise V Class. The Honourary Diploma of the Verkhovna Rada of Ukraine was granted to NAS academician I. M. Vyshnevsky. A. A. Valter and O. M. Yegorov were awarded with Diplomas of the Verkhovna Rada of Ukraine. NAS academician Ye. O. Kulish was entitled with the high degree 'Honored Worker in Science and Technology of Ukraine'. NAS O. I. Leipunsky Prize was won by NAS academician V. M. Azhazha, NAS corresponding member O. S. Bakai and NAS corresponding member A. M. Dovbnya – for the series of works 'Simulation experiments on problems of melt-salt reactors'.

The President of Ukraine Prize for young scientists of 2008 went to research fellows of the NAS National Science Center 'Kharkiv Institute of Physics and Technology' O. S. Peletminsky, D. V. Uvarov and S. M. Shulga for their work 'Investigation of spontaneously broken symmetry states in quantum liquids and supersymmetric relativistic objects'.



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

Chemistry

Scientific research in chemistry is carried out at 11 institutes and 2 their divisions by nearly a thousand of highly skilled scientists. Among them, there are 13 NAS academicians and 27 NAS corresponding members, 167 doctors of sciences and 771 candidates of sciences.

Progress in Research Areas

They produced a number of significant fundamental research results that meet international standards.

A method of direct synthesis of manganese-based heterometallic complexes was proposed. It consists in the interaction of metal powder with nonaqueous solution of permanganate which contains a single-charged cation, e.g. that of potassium or tetrabutylammonium, in the presence of ammonium salt, organic ligand and methanol. New mono-, bi- and polynuclear coordination compounds with 3d-, 4f-metals and a uranyl ion were obtained, and the ways of phosphoryl ligands coordination were determined (NAS academician V. V. Skopenko).

It was shown that under spatial restrictions in channels of mesopore matrixes, such as MCM-41, currentconducting polymers could demonstrate an abnormal dependence of the intensity of their luminescence on temperature, which is due to the delayed decay of excitons and switching-off of their temperature-activated jumps.

A technique of cathode electrosedimentation of highly porous nanostructural films of proton-conducting oxide compounds was developed on the basis of tungstic acids with cluster size of \sim 15 nm; such films have a uniquely high colouring contrast and response speed of electrochromic effect as compared to the known films of metal oxides (NAS academician S. V. Volkov).

For the first time ever, new 2-(3,5-diarylpyrazole-4-il)-1H- benzimidazoles were synthesized by cyclocondensation of 2-phenacyl-1H- benzimidazoles with 4-nitro-and 4-methoxybenzoylhydrazines; it was shown that the products obtained exhibit tautomerism with prevailing stabilization of the tautomer in which the electron-donor aryl substituent is in position 5, and electron-acceptor one is in position 3 of pyrazole ring (NAS academician M. O. Lozinsky).

Polymer nanohybrid networks were produced through urethane and epoxy oligomers cure with inorganic compounds in the presence of inorganic functional impurities; that resulted in an improvement of their electric, sorption and physico-mechanical properties (NAS academician Ye. V. Lebedev).

It was discovered that the nucleophility of functional detergents, irrespective of the nature of the main group, is determined by the functional center basicity only up to pKa $\sim 8.5 \div 9.0$, which demands a change in the strategy of further increasing the efficiency of functional detergent action in the processes of ecotoxicants decomposition (NAS academician A. F. Popov).

A new concept of solving the problem of supplying the population of Ukraine with quality drinking water was proposed. It relies on setting up a system of local technological complexes for water treatment at sites of its consumption and on developing essentially new state standards for drinking water, improved-quality drinking water and packaged water; these standards rule out the concept of maximum permissible concentrations of toxicants in water. Scientists proposed changes to the Law of Ukraine 'On drinking water and drinking water supply'; those provide for the replacement of traditional hygiene-based approaches to drinking water quality and new methods for water quality assessment, relying on batteries of test-organisms of various trophic levels and including a number of additional genetic and cytological methods at cellular and subcellular levels (NAŠ academician V. V. Goncharuk).

The synthesized new derivatives of indole[2,3 b]quinoxaline and naphthalimidoacetic acid considerably exceed popular 'Amixin' medicine in terms of their ability to induce interferon, antivirus activity and safety (low toxicity). These compounds were selected for further studies (NAS academician S. A. Andronati).

A simple and effective method was worked out to synthesize novel optically active fluorinated analogs of mevalonic acid – promising inhibitors of cholesterol synthesis (NAS academician V. P. Kukhar).

With the use of natural non-polluting raw materials, original synthesis techniques and fundamentals of technological processes were developed to obtain new enterosorbents and sorbing fodder additives for multiple uses (NAS academician V. V. Strelko).

The possibility of electrochemically-activated introduction of carbon dioxide into fluorine-containing imines was theoretically and experimentally proved for the first time, which opened up new ways for producing important fluorine-containing amino acids; fine details of the mechanisms of such processes were determined (NAS academician V. G. Koshechko).

NAS corresponding member A. G. Bilous (NAS V. I. Vernadsky Institute of General and Inorganic Chemistry) was awarded the 2008 State Prize of Ukraine in Science and Technology as a co-author of the research series 'Intermetallides, hydrides and oxides as a basis of novel energy-efficient materials'.

Doctor of chemistry O. V. Mamchenko and candidate of chemistry <u>V. V. Stavitsky</u>, researchers of the NAS A. V. Dumansky Institute of Colloid and Water Chemistry, won NAS L. V. Pisarzhevsky Prize for a series of scientific works 'Theoretical Validation and Practical Trials of New Resource-Saving Low-Waste Technology of Co-Production of Desalted and Softened Waters'.

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Progress in Research Areas

Biochemistry, Physiology and Molecular Biology



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

In 2008 the efforts of researchers of the NAS Department of Biochemistry, Physiology and Molecular Biology were centered on fundamental problems in biology, medicine and ecology. They also worked towards developing novel biotechnologies, means of diagnostics and medical preparations. A number of significant scientific results of the international level were produced.

Researchers of the NAS O. V. Palladin Institute of Biochemistry, studying the functions of nicotine acetylcholine receptor (nACR) in immune system cells, showed that murine B-lymphocytes produce their own acetylcholine, which auto/paracrinously restrains the proliferation of those cells, caused by the cross-linking of CD40 costimulatory molecules. The acetylcholine affects nACR, some of which contain α 9-subunits. Cross-linking of nACR-specific antibodies leads to the internalization of the antibody-receptor complex and reduces receptor expression both on the cell surface and on the intracellular structures, mitochondria in particular.

The role of intracellular calcium depots in regulating the pulse activity of hippocampus neurons in rats with experimental epilepsy was determined at the NAS O. O. Bohomolets Institute of Physiology. Mitochondria proved to play a significant part in regulating the pulse activity of hippocampus neurons in rats. Blocking their Ca²⁺-accumulating activity stops the generation of pulse activity.

Scientists of the NAS D. K. Zabolotny Institute of Microbiology and Virology discovered that the extracellular lectins of the *B. subtilis* IMVB-7014 strain exist in three isoforms differing in their physico-chemical and biological characteristics. Bacterium lectins inhibit the bacteriostatic activity of mitomycin C antibiotic – an inhibitor of replication processes.

The mechanism of carcinogenic action of RTI-1 oncogen, which consists in inducing the rise in the number of translation errors, was investigated at the NAS Institute of Molecular Biology and Genetics. The mass-spectroscopy method was used to locate the polyethylene-glycol site in interferon molecule, artificially modified for producing a medical drug of prolonged action.

Researchers of the NAS R. Ye. Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology found that considerable changes of micro-RNA profile occur with the formation of medical resistance to anti-tumor preparations. The data obtained prove that the deregulation of micro-RNA expression plays an important role in cell transformation and in the formation of resistance to antitumour preparations that differ in their action mechanism.

Considerable differences in the functional characteristics of the stem hematopoietic and mesenchimal cells of the bone marrow of healthy animals and animals with experimental adjuvant arthritis were determined at the NAS Institute for Problems of Cryobiology and Cryomedicine.

Strains of non-conventional yeast with varied capacity to produce ethanol from xylose were bred at the NAS Institute of Cell Biology. The activity of a several enzymes of xylose utilization, glycolysis and pentosophosphate pathways was determined in the strains obtained.

The NAS International Centre of Molecular Physiology demonstrated that under normal conditions the agonists of μ -opioid receptors inhibit P2X_{2/3}-mediated flows of sensor neurons, activated by ATP, by 50% on the average, through G-protein conjugated mechanisms. The data obtained indicate that opioids affect w or k neuron receptors, causing changes in neuronal activity by the R-type bimodal modulation of potential-regulated calcium channels.

In the field of medicine, researchers developed the algorithm of diagnosis and hormonal therapy of prostate cancer, investigated the regenerative effect of transplants of bone-marrow stem cells, developed optimal protocols of magneto-resonance examination of patients, obtained new data concerning pathogenesis of preeclampsia combined with pyelonephritis, validated new approaches to reducing the risk of cardiovascular complications in patients with essential hypertension, developed efficient methods to improve therapy results and life quality in patients with malignant tumors of the thorax organs, worked out new methods of endoprosthetics of bone-joint defects, developed and introduced new methods of eye microsurgery.

In 2008 the Department's institutions worked at tasks of the 'Nation's Health' inter-agency integrated program for 2002-2001, the 2004-2008 National program for prevention of HIV infection, treatment of HIV-infected patients and those with AIDS. They implemented the following NAS integrated target research programs: 'Novel medico-biological problems and human environment', 'Fundamental principles of genomics and proteomics', 'Nanostructure systems, nanomaterials, nanotechnologies', 'Sensor systems for medicine, ecology, industry and technology', 'Biomass as raw material for fuel', 'Fundamental problems of hydrogen power engineering'. Here important scientific results were obtained, that are promising for introduction in medical, agricultural and industrial practice.



General Biology

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

In 2008, institutions operating under the Department of General Biology studied flora and fauna in Ukraine, biodiversity, molecular-genetic, physiological and biochemical processes to find effective means for environment protection, conservation of animal and plant gene pools, ensuring a better biogeocoenosis stability and developing novel biotechnologies aimed at further diversification of cultural plant varieties.

Progress in Research Areas

Traditionally, a significant number of new-to-science species of algae, lichens, fungi, hexapods, infusorians-suctorians and colembolas were discovered. A new syntaxonomic classification of phytocoenoses and respective prodromus was proposed for a number of plant groupings. The competitive ability of adventive species was studied for continental and sea ecosystems. Special consideration was given to marine invaders that proved powerful competitors of commercial fish. With a view to its effective functioning, studies of biota state in megalopolis were started.

Patterns in changing morphogenetic mechanisms in transition from the cellular level of organization to multicellular metazoans were discovered. The concept of periodic alterations in early ontogenesis of gasteropods was formulated. Phylogenetic studies were extended. The scenario of morphological and functional transformations in bird locomotors from their ancestral form to the current one was described. The role of basic mechanisms of heterozygosis augmentation in plant populations during genetic adaptation to increased levels of ionizing radiation in the environment was estimated.

Researchers found new elicitors isolated from fusarium, which induce systemic stability of plants to biogenic stresses.

Mechanisms of self-repair in populations of rare, endemic and relict species of high-altitude ecosystems were determined.

A significant progress was achieved in the advancement of ecological networks in the Ukrainian Polissia and Steppe zones.

An increase in the biomass of medicinal macromycetes under exposure to blue light was found. Techniques to isolate fucoxanthin and astaxanthin carotenoids from sea algae were developed, as well as a new nanobiotechnology for producing a bactericidal biopolymer composition from sea organisms. Gene-modified plants containing recombinant proteins from *Mycobacterium tuberculosis* and interferon were produced. These plants can be used as

"edible vaccines" against tuberculosis and virus diseases in humans and animals.

Basic stages of biodiesel production from unicellular algae with increased lipid contents were developed. A technology to convert vegetable oils to ethyl ethers of adipose acids was worked out. Obtained were gene-modified plants of aboriginal rape varieties for producing biodiesel. Technologies were developed for cultivating some alternative new crops to produce raw materials for biofuel.

New promising lines of winter wheat were originated with mutation selection methods; they have high protein contents and valuable bread-making characteristics. Three winter wheat species and four corn hybrids were introduced to the 2008 Register of Varieties in Ukraine. NAS botanical gardens and arboretums give much consideration to enriching their plant collections, conserving rarity species, introducing new fruit and ornamental plants, identifying the optimal ranges of plants for parks and urban squares, as well as for forestation of rock dumps. Studies in population genetics were in progress.

The analysis of structural-and-functional organization of major components of littoral biocoenoses in the Dnieper reservoirs was done. Population, physiological and biochemical characteristics in water animal adaptation to changing conditions of aquatic environment were determined. Studies of communities in interstitials of the Black Sea sandy beaches under recreational loads were carried out. The trend towards recovery in biocoenoses of the central part of the northwest Black-Sea shelf was confirmed.

An important role of calcium ions in root gravitational response was discovered; the role of gene products of mitochondrial thioredoxine in plant stability to osmotic stress was demonstrated; the specificity of phytohormone combination in monocotyledonous and dicotyledonous plants was determined. Active oxygen forms and calcium-dependent oxidative stress were shown to be modulators of adaptive reactions in mosses. New data on resorption mechanisms in osteal matrix under reduced support load were obtained.

Next year, the research institutions under the NAS Department of General Biology, relying on the results obtained, will aim their activities at extending research in advanced areas of biology. Alongside with classical faunistic and floristic studies, they will focus on molecular-genetics approaches in phylogenetic studies, look into problems of population ecology, stabilizing biodiversity, extending reserved territories, developing novel biotechnologies, selection and acclimatization methods, ensuring enrichment and maintenance of biological natural resources of Ukraine.

Progress in Research Areas



Economics

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

In the reporting year, the efforts of scholars in NAS Economics Department were aimed, primarily, at deepening fundamental and applied research to study present-day global economic processes, determine the sources of the current global financial and economic crisis and ways to mitigate its negative impact on the Ukrainian economy, as well as substantiate the proper economic policy at national and regional levels.

A series of important results were achieved. Our researchers proposed a definition of the potential for endogenous growth as an integrated aggregate of the potentials for endogenous development in all economic spheres, whose interconnections and relationships generate a corresponding synergetic effect for the functioning of Ukraine's economic system with optimization of the action of domestic development factors and minimization of the effect of negative external ones. The Department's institutes corrected the trends of balanced development through the use of efficient economic policy measures optimizing the potential of endogenous growth in the context of conceptual fundamentals of the socio-economic development strategy in Ukraine and made forecasting and analytical calculations of Ukraine's economic development in 2009-2015.

It was proved that the main structural and organizational problem of social development in XXI century is the contradiction between hierarchy and network ties, which becomes apparent at various levels. Department's researchers revealed the form of the contradiction between hierarchy and network and their role in ensuring a balanced socio-economic development.

They described the impact of macro-economic processes on restructuring in the Ukrainian economy and proposed a mechanism to improve the reproductive structure in the real sector through minimizing the disproportions between the structure of the goods and services produced and the structure of banking credits.

The notion of economy 'adaptivity' was proposed as its ability to adequately respond to external disturbances and efficiently reach its optimal functioning parameters in order to resume balanced development. Researchers also proposed a system of adaptivity indicators.

For the first time, the concept of financial provision of investment policy was validated (based on the priority of credit mechanism), which integrates within a single methodological basis the major features of implementation and financial provision of investment policy in a transition economy, with due regard to its priorities, components, objects and agents; this gives such a mechanism the status of a booster of investment-based development.

The Department's institutions elaborated a methodology to formulate the taxation principles, which allows economically predictable effects of their use to be obtained. Researchers developed theoretical and methodological approaches to determine the impact of the state's fiscal policy on oblast's economy and budget system. They simulated a prototype of an integrated system at regional and local levels, which includes forecasts of the indicators of revenue and expenditure parts of the budgets.

Department's institutions investigated the interactions between socio-demographic and socio-economic structures of the Ukrainian society on the labour market and determined the factors of forming differences in the lines and rates of developing sociodemographic structures of urban and rural populations. Besides, they worked out theoretical fundamentals for employment restructuring, determined its factors at macro-, meso- and micro-levels, and substantiated the interrelation between the rates and trends of employment restructuring and the degree of protection of the labor market against the impacts of the world financial crisis.

Our scholars elaborated theoretical fundamentals and practical recommendations to form the system of technological forecasting in the context of implementing the strategy of socio-economic development; they determined the main principles of economic analysis of the cyclic dynamics of technological forecasting, and investigated various problem aspects of Ukraine's technological development in the sphere of protecting industrial property and property rights.

Department's researchers developed theoretical principles of forming and assessed the technological and economic status of the infrastructure facilities and production assets, including the classification of regional infrastructure facilities, the methodology to assess the availability and use of infrastructure and normative regulation of the development of regional infrastructure. They also analyzed the state of the current system of management of regional infrastructure facilities, revealed respective investment risks and developed a system of information provision for regions.

Specialists justified the need of creating, on the basis of large-scale national business, powerful Ukraine-based transnational structures, which would be able to hold the global competition in modern (actually, global) markets of goods and services. The priorities of sectoral integration in the relations within the post-Soviet economic area were recognized.

In the near future, the efforts of economists will be centered on investigating the underlying causes of the current financial and economic crisis, determining the ways to mitigate its negative impacts, on developing scientific funamentals of a future strategy of economic growth and increasing the national economy's competitiveness in the global environment. Progress in Research Areas

NAS of Ukraine 2008

History, Philosophy and Law



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

In the year under review, research institutions of the Department made a noticeable contribution to elaborating the strategy and studying theoretical and practical aspects of socio-economic, political and cultural transformations in Ukraine, alongside with adaptation of the historical experience and spiritual heritage of the past.

NAS Institute of Sociology published academic writings: «Ukrainian Society in 1992 – 2008. Monitoring of Social Changes» (by NAS Acad. V. M. Vorona, M. O. Shulga), «Lifestyles: a Panorama of Changes» (by M. O. Shulga), «Economic Culture of Ukraine's Population» (by NAS Acad. V. M. Vorona, Ye I. Suimenko).

Scholars of NAS I. F. Kuras Institute of Political and Ethnic Studies published the books: «Political Leadership in Persons» (by F. M. Rudych), «Linguistic Situation in Ukraine: Between Conflict and Consensus» (by NAS Corr. Memb. Yu. A. Levenets) and «Cossack Elite of Hetman Rule» (by V. V. Kryvosheya).

NAS Institute of the History of Ukraine published the following monographs: «Political System for Ukraine: Historical Experience and Present-Day Challenges» (by NAS Acads. V. M. Lytvyn, V. A. Smoliy and NAS Corr. Memb. Yu. A. Levenets), «Hetmanate of Pavlo Skoropadsky» (by R. Ya. Pyrih), collected writings «The Great Famine in Ukraine in 1932–1933», in 4 vols., (ed. by S. V. Kulchytsky), «Princely Court of Southern Rus» (by NAS Corr. Memb. M. F. Kotliar, V. M. Rychka), «Political System of Ukrainian Society in the Days of National Revolution of XVII Century» (by NAS Acad. V. A. Smoliy, V. S. Stepankov).

Scholars of NAS V. M. Koretsky Institute of State and Law published their writings: «Constitutional Rights, Freedoms and Duties of Person and Citizen in Ukraine» (by NAS Acad. Yu. S. Shemshuchenko), «Investment in Agriculture» (by NAS Corr. Memb. V. I. Semchyk), «Harmonization of Ukrainian Labour Legislation with Legislation of European Union» (by N. M. Chutorian), «Culture and Law against Evil» (by O. M. Kostenko) and «Criminal Code of Ukraine. Academic and Practical Comments» (by NAS Acad. V. Ya. Tatziy).

NAS Acad. L. V. Gubersky published monographs «Philosophy as Theory and Methodology for Developing Education», «Diplomatic History of Ukraine»; NAS Acad. V. H. Kremen – «Philosophy of National Idea. Person. Education. Society»; NAS Corr. Memb. A. Ye. Konversky – «Logic Traditional and Modern».

Researchers of M. S. Hrushevsky Institute of Ukrai-

nian Archeography and Source Studies prepared and published vols. 11 and 14 of «Complete Works by M. S. Hrushevsky in 50 volumes», «Research and Publishing Activities of T. Shevchenko Scientific Society in Europe» (by O. O. Mavrin, D. V. Burim).

Scholars of NAS H. S. Skovoroda Institute of Philosophy published monographs «Under the Signature of Sophia» (by S. B. Krymsky), «Concepts and Laws of Modern Ecology: a Manual» (by M. M. Kyseliov), «Geniuses against Idiots: Algorithms of Ukrainian History» (by S. I. Hrabovsky), «Ukraine in Search of Identity» (by V. D. Lytvynov), «The Right to be Themselves» (by V. A. Malakhov).

Researchers of NAS I. Krypiakevych Institute of Ukrainian Studies issued the books «Cathedral of Saint Yur in Lviv» (by V. S. Aleksandrovych), «Identities in Austrian Literature of XX Century» (by T. I. Havryliv), «Ukrainian Medicine: History of Names» (by H. M. Dydyk-Meush), «Complete Dictionary of Ukrainian Antonyms. 4-th ed.» (by L. M. Poliuha), «Archaeological Relics of Lviv» (by L. H. Matskevy).

V. I. Vernadsky National Library of Ukraine published its studies «The National Academy of Sciences of Ukraine. 1918–2008: to the 90-th Anniversary of its Establishment» (eds.-in-chief NAS Acad. B. E. Paton, NAS Acad. O. S. Onyschenko), «Socio-Humanities in the National Academy of Sciences of Ukraine. 2004–2008» (by NAS Acads. V. M. Lytvyn, O. S. Onyschenko and V. I. Popyk), «History of V. I. Vernadsky National Library of Ukraine. 1965–1992» (by NAS Acad. O. S. Onyschenko, NAS Corr. Memb. L. A. Dubrovina).

Scholars of NAS Institute of Archeology prepared and published the books «Kyiv and Rus» (by NAS Acad. P. P. Tolochko), «Southern 'Rus Land'» (by NAS Corr. Memb. O. P. Motsia), «The Wends» (by D. N. Kozak), «Trypillia Culture in Ukraine. Vast Settlement of Talianky» (by O. H. Korvin-Piotrovsky).

Achievements of leading scholars of the Department's institutions were honoured with high state awards. They received the distinctions of the President of Ukraine: NAS Acad. O. S. Onyschenko got the Order of Prince Yaroslav the Wise IV Class, NAS Corr. Memb. I. M. Melnykova – the Order of Prince Yaroslav the Wise V Class; NAS Acad. V. A. Smoliy – the Order 'For Services' I Class, NAS Acad. M. V. Popovych – the Order 'For Services' II Class, NAS Acad. V. M. Vorona, V. I. Marochko – the Order 'For Services' III Class; O. M. Veselova, L. I. Krushelnytska – the Orders of Princess Olga III Class. NAS Acad. O. S. Onyschenko and L. Yo. Kostenko won the State Prize in Science and Technology for the study 'Physical methods and hardware for registration, preservation and use of large information bodies' as its coauthors.

In 2009, efforts of the Bureau and institutions of the Department will be focused on further search for new forms and methods to put to better use the creative potential of socio-humanities in the interests of economic, social, spiritual and cultural progress of the Ukrainian society.

Progress in Research Areas

Philological Studies, Art Criticism, Ethnology



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

In the year under review, as before, scholars of the NAS Department of Literature, Language and Art Studies addressed fundamental and applied aspects of the development of literature, language, arts, traditional every-day culture, and computer linguistics. They tackled major issues of the academic backup to the national and cultural revival of Ukraine, providing an unbiased view 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 by the scholars of the Department was the publication of an all-time high – 179 collective and individual writings, including 107 monographic and collective works, 11 study textbooks for university students and schoolchildren, 13 reference books and dictionaries, 48 academically treated and commented belles-lettres texts, over 2000 papers in academic proceedings and periodicals.

The high level of the research done was proved by awarding the 2008 O. P. Dovzhenko State Prize to art scholar S. V. Trymbach for his work «Olexandr Dovzhenko. The Death of Gods» and F. M. Kolessa NAS Prize to art scholar A. I. Ivanitsky for the book «Historical Hotyn Region. Study of Music and Ethnography. Collected Folklore». For their outstanding services to the advancement of Ukrainian science, NAS corresponding member O. B. Tkachenko and art scholar R. T. Kyrchiv were awarded the high title 'Honoured Worker in Science and Technology', art scholar V. I. Volnitska – the title 'Honoured Arts Worker of Ukraine'. NAS academician D. V. Zatonsky was honoured with the Order of Yaroslav the Wise V Class, NAS corresponding member S. P. Pavliuk and art scholar D. V. Stepovyk - with the Order 'For Services' II Class, NAS corresponding member V. A. Shirokov - with the Order 'For Services' III Class, NAS academician H. A. Skrypnyk - with the Order of Princes Olga III Class.

Literature scholars of the Department carried on their studies in literature theory, history of the Ukrainian and foreign literatures, current functioning of belles-lettres, they continued preparation of encyclopedic editions and academic publications of artistic heritage. A number of fundamental works were published: «Taras Shevchenko» (by NAS academician I. M. Dziuba), «Comparative Studies and Literature History» (by NAS corresponding member D. I. Nalivayko), «Themes and Motifs of Taras Shevchenko's Poetry», «Lesia Ukrainka and Today», «Ivan Franko's Philosophical Lyric Poetry: Dialectics of Poetical Reflection» (by B. S. Tikholoz), «Kitsch and Literature: Travesties» by NAS corresponding member T. I. Hundorova. Issued were supplementary volumes 51, 52 and 53 to I. Franko's Collected Works in 50 volumes, commented editions of selected works by T. Shevchenko, Lesia Ukrainka, O. Oles, V. Barka, V. Stus and O. Honchar.

In pursuance of the Presidential Decree 'On the Development of the National Dictionary Base', linguists of the Department completed and issued 10,000copies of the laser disk «'Ukrainian Dictionaries' Integrated Lexicographic System», version 3.2 with the register of 255 thousand entries, they created the virtual lexicographic laboratory 'All-Ukrainian Linguistic Dialogue'. Published were 6 new-generation dictionaries, such fundamental writings as «Language and Linguistics in the Spiritual Life of Society», «Dynamic Processes in Present-Day Ukrainian Lexicon», «Studies in Meryan Language» (by NAS corresponding member O. B. Tkachenko), «Dialect Language: Current Status and Time Dynamics», «Essays on Pra-Slavic Anthroponyms» (V. P. Shulhach).

Relying on their research into versatile phenomena of traditional culture, scholars in arts, folklore and ethnology published 59 collective and individual writings, among them were: «History of Ukrainian Arts» (vol. 1), «History of Ukrainian Culture» (vol. 2, book 1), «Ukrainian Music Encyclopedia», «Painting Legacy of T. H. Shevchenko in the Context of European Art Culture» (by V. A. Ovsiychuk), «Ukrainian Ballet Theatre. History and Today» (by Yu. O. Stanishevsky), «Woman in Traditional Ukrainian Culture (Second Half of XIX – Early XX Century» (by O. R. Kis). Despite financial problems, integral folklore and ethnographic expeditions to 12 Ukrainian regions were organized, where unique mementoes of folk culture and arts were collected.

Major research-organizing activities of the Department in the reporting year were aimed at elaborating new scholarly concepts and programs, implementing national and Academy projects, which were developed by its scholars in pursuance of several Decrees of the President of Ukraine and under government assignments, at preparing and hosting the VII International Congress of Ukrainian Scholars, attended by over 400 leading specialists in Ukrainian studies from 18 countries and 34 international and all-Ukraine academic conferences.

Environment Preservation and Sustainable Development



P. H. Kostiuk, Member of the Academy Presidium

In 2008 research efforts of NAS scientists were aimed at developing scientific fundamentals of the national policy towards environment preservation, sustainable use and management of nature resources and ecosystems at the national, regional and local levels, providing the natural bases of human activities, at validating and studying engineering and technological aspects of Ukraine sustainable development.

Science Organization Activities

Those activities were coordinated by the NAS Academic Council for Environment and Sustainable Development and by the National Committee of Ukraine for UNESCO 'Man and the Biosphere' Program.

In the period under review, research and organization activities were carried out under the 'State program to prevent and control underflooding for 2005-2030', the 'State program of sustainable development for the region of uranium mining and primary processing', the 'State program for radiation protection and social welfare of Zhovti Vody inhabitants for 2003-2012', the 'Program of integral development of the Ukrainian Danube region for 2004-2010'.

NAS scientists took part in developing the draft scheme and the 'Target state program on integrated flood-control measures in the basins of the Dnister, Prut and Siret rivers', concepts of the 'Target state programs on solid domestic waste management for 2010-2019', commissioning and upgrading pollution-free production in Ukraine, as well as nation's transition to sustainable development.

NAS scientists were involved in preparing scientifically validated proposals towards practical solutions of numerous nature-protection problems in Ukraine, in particular, those related to possible emergencies in oil-terminal exploitation in the area of Dzhurdzhuleshti community, the status of fundamental and applied research into anthropogenic and natural security, in producing a long-term climate change forecast and estimating its impact on the national economy and life-support systems of Ukrainian population.

In the reporting period, a number of significant scientific results were produced. Conceptual approaches were developed to upgrade the system of economic instruments for stimulating the efficient use of natural resources, management and economic provision of fuel-and-energy industry modernization in the context of sustainable development of the national economy. Scientists worked out scientific principles of technologies to restore soils damaged by mining activities and use them as green-network elements in mining regions. They developed methodological basics for conceptual model of balanced nature management in economic-and-ecological systems at local and regional levels. The technique for systemic modeling of increasing man-caused environment stresses was substantiated. A procedure was developed for socio-geographic studies of the impact of socio-economic and environmental causes and effects of using the natural-resource potential of Ukraine in its national economy. A new approach to providing the population of the nation with high-quality drinking-water was proposed; it provides for constructing a system of local technological complexes for water treatment at consumption sites.

With respect to international collaboration, NAS scientists contributed to the activities of the Interna-tional Coordinating Council for UNESCO 'Man and the Biosphere' Program, the Inter-agency coordinating council for implementing the principles of the UN Convention on the Environmental Effects Estimates in the transboundary context, the Committee for environment protection and sustainable development in the framework of the joint Ukrainian-Romanian Presidential Commission, the Working group for cooperation with the Romanian party concerning the transboundary effects of economic activities on the environment in the Danube Delta and the implementation of its integrated ecological monitoring. NAS scholars, in collaboration with their Belarussian, Polish, Romanian, Slovak, Moldavian and Russian colleagues, continued joint research towards preserving the biotic and landscape diversity and ensuring sustainable development, the use of nature resource potential in the transboundary regions of the East Carpathians, the Danube Delta, West Polissia and the Desna river basin

In the near future, our research efforts will be aimed at ensuring basic provisions of the documents approved at the World Summit on Sustainable Development in Johannesburg and the Madrid Action Plan for UNESCO Biosphere Reserves. Their implementation will facilitate the achievement of sustainable development goals, along with the preservation of biotic and landscape diversity in various regions of the planet. In this context, studying socio-economic, legal and technological aspects of environment preservation and sustainable development in Ukraine should become a major task.

Science Organization Activities

Certification of Highly-Skilled Researchers as an Important Element in the Development of Academic-Personnel Resources in Ukraine



V. F. Machulin Head of the Supreme Certifying Commission of Ukraine, Acting Member of the Academy Presidium

Nowadays the preservation and further development of academic-personnel potential is among the top priorities in implementing R&D and innovation policy of Ukraine. According to its statute, the Supreme Certifying Commission (SCC) of Ukraine is to perform an important mission in this process, namely, to provide the certification of the senior-rank research and research-and-educationalist cadre, to ensure the functioning of the certification system and improve it, relying on the best domestic achievements and foreign experience.

The backbone of the Ukrainian certification system is formed by over 800 specialized dissertation councils and 43 expert councils of SCC. 220 of those operate in the academy-research sector, 145 functioning in NAS institutions. 30% of the SCC expert council membership consists of the scholars of academy research institutions, 22% being NAS researchers. Of the 22 members of SCC Presidium, 9 represent academy science, with 4 scientists being representatives of the National Academy of Sciences of Ukraine per se.

Leading NAS scholars have the fullest representation in the expert councils on mathematics, physics, mechanics, information science, astronomy, chemistry, biology, geology, geography, instrument-making industry, electronics and energy, engineering science and machine-building, metallurgy, alongside with those on linguistics, philosophy, history, and jurisprudence. In terms of such representation, statesupported branch academies also take leading places in the certification of research and researchand-educationalist personnel.

A noticeable reduction in the age of those awarded with doctor-of-science and candidate-of-science degrees took place in the academic milieu; the principle of gender equality is followed more consistently. I am also glad to stress that academy science plays the leading role in the training of highly-skilled researchers in such important knowledge areas as mathematics, physics, engineering, biology, agriculture, history, economics, medicine and jurisprudence, in pedagogical and political studies.

The Supreme Certifying Commission aims at advancing collaboration with NAS research institutions in order to improve the system of certifying highly- skilled researchers. In 2008 this collaboration was particularly intense. Jointly with Academy institutions, SCC held six large-scale regional meetings with the heads of specialized dissertation councils, their deputies and academic secretaries to improve the certification process and elaborate the draft Law 'On the certification of highly-skilled research and research-and-educationalist personnel'. Nearly all these meetings were hosted or assisted by the Regional Science Centers operating under the National Academy of Sciences and Ministry of Higher Education of Ukraine; the concluding meeting was hosted by NAS Presidium.

In the abovementioned draft law we sought to combine the international and domestic experience in training highly-skilled researchers. So, on the one hand, it was proposed that the autonomy of decisionmaking be significantly greater for those specialized dissertation councils which are well-staffed with their own scholars and, on the other hand, the existing state control be preserved over the activities of the specialized dissertation councils which engage researchers from others educational and research institutions.

On November 12, 2008 the meeting of the Council of the Presidents of the Academies of Sciences of Ukraine was held. This important event made a significant contribution to advancing the collaboration of NAS and branch academies with the Supreme Certifying Commission. The meeting discussed the necessity of regulatory policy in forming research-personnel potential in the major areas of fundamental research and set up an interdepartmental working group on the issue. This group is to provide the interagency coordination of all legal and regulatory draft documents concerning the training of research and educationalist personnel.

In its international activities, the Supreme Certifying Commission shares with NAS its understanding of the ways to upgrade the training of highly-skilled researchers. In particular, this concerns the activities within the framework of the International Association of the Bodies of State Certification (IABSC), founded in 1993 in Almaty by Azerbaijan, Belarus, Kazakhstan, Kyrgyzstan, Moldova, Russia, Turkmenistan, Uzbekistan and Ukraine. It was due to such common with NAS approaches that the Supreme Certifying Commission of Ukraine advocated at IABSS sessions the preservation of the existing system of academic degrees and academic statuses, principles of the mutual recognition of academic-degree diplomas, publication of research results, and coordination of the descriptions of research specializations. The Supreme Certifying Commission is highly interested in continuing its collaboration with NAS in the spheres of mutual concern.



Statistics

Regional Structure of the National Academy of Sciences of Ukraine







26

Total number of employees including: in research institutions



NAS of Ukraine 2008

43211

39378



Statistics

R&D employees	19818
Doctors of Sciences	2599
Candidates of Sciences (PhD)	8171



Distribution of scientists by departments





Statistics

NAS of Ukraine 2008

Budget thou	sand UAH		Target programs subjects
Total expenditures	2509873,1	25	
Basic funding from the State budget	1444802,9	20 -	
Target programs finance	553099,2	15	
Expenditures on personnel trai Expenditures on health protect	ion 18935.7		
Expenditures on capital constr and reconstruction	action 14701,3	10	
Extra-budgetary revenues	470958,5	5 -	
Expenditures on wages	1670444,3	-	
Expenditures on equipment, materials and instruments	185627,8	0	2004 2005 2006 2007 2008 2004 2005 2006 2007 2008
Expenditures on utilities	120560,1		the number of NAS target integral programs financing of NAS target integral programs (million UAH)
Other expenditures	512936,1		 the number of target programs of NAS departments financing of target programs of NAS departments (million UAH)

Distribution of finance by sources







Statistics

130 120 110 90 80 70 60 50 40 30 20 10 0 2008 2007 2006 20 Omect Ò Starting Constraints 2005 N South State O Solution 8 2004 1 800 4 - ON OLAS |

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





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



Foreign Scientists Received in Ukraine



Ukrainian Scientists Sent on Mission Abroad



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