NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF ARMENIA

R E P O R T
ON MAJOR RESEARCH OUTCOMES
FOR 2018

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INTRODUCTION

The National Academy of Sciences of the Republic of Armenia in 2018 celebrated the 75th anniversary of its foundation. The highest scientific center of Armenia, having traveled a long and meaningful path, has gained world recognition and has become the body that coordinates the fundamental science of the republic.

Within the framework of this high-level jubilee a number of events were organized: scientific conferences in various fields of science, an exhibition in the building of the Presidium of the Academy, which demonstrated the scientific achievements of fundamental and applied importance of scientific centers and institutes of NAS, many of which can rightly find application in various economy sectors of the republic. Armenian Prime Minister N.Pashinyan, President of the Republic A.Sarkissian, 32 representatives from 14 foreign countries took part in the anniversary events. In the congratulatory messages and speeches, the undeniable contribution of NAS scientists to world science was emphasized.

The Academy organized and effectively conducted the "Forum of CIS Scientists - 2018". Representatives of the executive bodies of the CIS countries, members of the RA government, researchers of scientific and educational institutions took part in the Forum. In the declaration adopted by the Forum, addressed to the scientists of the CIS countries, science officials, governments, the necessity and the importance of expansion of joint research between scientific organizations of the CIS countries were noted, in particular, in the fields of innovative development of science, training of highly qualified personnel, works carried out with young scientists.

International relations of NAS have expanded. In 2018, a meeting of the Council of the International Association of Academies of Sciences (IAAS) was held, in which representatives of academies of sciences from 10 foreign countries took part, problems of the development of academic science in different countries, modern directions of basic and applied research development were discussed, new ways of further cooperation were marked.

In 2018 NAS scientific organizations carried out researches within the scope of 45 budget-supported, 148 theme-funded and 6 state target programs. Based on the results of these works 156 monographs and collections, 28 manuals, 2140 articles (including 853 abroad), 508 theses (including 231 abroad) were issued.

President of NAS RA, academician R.M.Martirosyan

DIVISION OF MATHEMATICAL AND TECHNICAL SCIENCES

Academician-Secretary – academician L.Aghalovyan
Scientific Secretary – L.Martirosyan

The Division of Mathematical and Technical Sciences includes the Institutes of Mathematics, Mechanics, for Informatics and Automation Problems, as well as the Department of Hydromechanics and Vibrotechnics.

The Division includes 13 academicians, 9 corresponding members, 26 foreign members, 5 honorary doctors.

During the reporting year 2 general meetings of the Division were held.

At the annual general meeting held on 16 April the report of the academician-secretary L.Aghalovyan "On the main scientific and scientific-and-organizational results of the Division for 2017" was approved. Scientific reports of DSc(phys.-math.) G.Karagulyan (Institute of Mathematics), corr. memb. A.Avetisyan (Institute of Mechanics), cand. (tech.) G.Ascatryan (Institute for Informatics and Automation Problems), as well as foreign members of NAS RA L.Petrosyan (RF), F.Mkrtchyan (RF), H.Shahgolian (Sweden) were presented at the meeting.

At the annual general meeting held on 16 November the candidacy of cand. (phys.-math.) H.Ascatryan for the vacancy of the director of the Institute for Informatics and Automation Problems was discussed and approved.

9 meetings of the Bureau of the Division were held. The following issues were considered and approved: the working plan of the Division for 2018; the number of the postgraduate vacancies and their distribution among the Institutes for 2018-2019 academic year; the results of admission to the postgraduate school, research advisers and scientific topics of the postgraduate students; the decision project of the general meeting for the reporting year; applications on maintaining of scientific objects of national value for 2019 on state target programs, the reports of the institutions of the Division for the year 2018, including the programs of basic funding; as well as new staff of the editorial boards and website of the journal and new electronic order of papers publication of the Armenian Journal of Mathematics. The elections of the candidacy for the editor-in-chief of the scientific journal "Proceedings of NAS RA. Technical sciences" were held, corr. memb. V.Melikyan was elected as the candidacy for the editor-in-chief of the journal.

Scientific-and-organizational issues of the events and exhibition topics dedicated to the 75th anniversary of the foundation of NAS RA, the cooperation of the Division Institutes with the Academy of Sciences, universities and other scientific organizations of Russian Federation and other countries, the main results of the scientific organizations of the Division, the results of the international and local conferences, organized by the Division Institutes, possible interdisciplinary investigation between institutions of the Division, issues on provision and on the results of the scientific trips as well as some other scientific-and-organizational issues were discussed.

The following scientific journals have been published on the Division specialities: "Proceedings of NAS RA. Mathematics" (6 numbers), "Proceedings of NAS RA. Mechanics" (4 numbers), "Proceedings of NAS RA. Technical sciences" (4 numbers), "Mathematical Problems of Computer Science" (2 numbers), as well as the electronic "Armenian mathematical journal".

271 scientific articles (including 105 abroad) and 45 conference abstracts (including 3 abroad) were published in 2018 by the researchers of the Institutes of the Division, as well as 2 monographs and 1 collection of scientific articles.

The Institutes of the Division have organized 12 international and republican scientific conferences. 5 projects on international grants have been implemented in the Institutes of the Division (Institute for Informatics and Automation Problems).

3 Doctoral and 10 Candidates dissertations were defended by the researchers of the Institutes. 2 Doctoral and 8 Candidates dissertations were defended at the Scientific Councils of the Institutes of the Division.

In December of the reporting year annual report meetings of the Institutes were held, the reports of the Institutes for 2018 year were discussed and approved.

Institute of Mathematics

Major achievements

A generalization of the well-known theorem of V.S.Vladimirov-Ya.I.Volovich on the existence of inter-vacuum solutions in Dynamic theory of p-adic strings has been obtained. The uniqueness of the solution in the class of bounded functions has also been proved. As a consequence, from the proved results, a theorem of L.Zhukovskaya on rolling solutions has been obtained (Sup.: DSc(phys.math.) Kh.Khachatryan, DSc(phys.math.) N.Engibaryan).

Institute of Mechanics

Major achievements

A method of investigation of exact and approximate controllability of linear and nonlinear control system has been developed on the basis of the well-known method of Green's function for solving boundary-value problems. A heuristic method has been developed for explicit determination of resolving controls from (in general, nonlinear) controllability conditions, allowing to reduce the conditions of exact controllability to a system of (nonlinear) algebraic equations, and the conditions of approximate controllability – to inequalities. Applying Green's function and heuristic methods the following problems have been investigated: exact and approximate controllability of linear heat equation in unbounded domains in finite time, approximate controllability of bending vibrations of a sandwich beam with an uncertainty in finite time, exact and approximate controllability of Janus particles (Langevin equation) by external electric field in finite time, exact and approximate controllability of nonlinear equations in infinite time, exact and approximate controllability of Burgers' viscous equation in finite time (Sup.: corr. member A.Avetisyan, cand.(phys.-math.) A.Khurshudyan).

Outcomes of applied developments

Without the use of traditional binders (cement, lime, liquid glass) by the method of autoclave processing, a method of obtaining new building composite materials with controlled properties has been developed. On the basis of developed materials, it is advisable to manufacture building bricks, partition plates and blocks (Sup.: DSc(tech.) K.Karapetyan, cand.(chem.) N.Gurgenyan, A.Arakelyan, DSc (tech.) A.Avanesyan).

Institute for Informatics and Automation Problems

Major achievments

In the quantitative association rule mining model where the attributes are monotonous, an algorithm has been developed that introduces the concept of "cube-splitting", and in this manner, reduces the problem to the case of binary attributes. Although the problem remains computationally hard, it acquires a simple model description that allows to obtain mining rules by additional restrictions on the problem, such as the small left-side of the rule, access-type restrictions, and others. The scope of the application is extremely wide, such as detecting network intrusions by mining computer LOG files (Sup.: corr. member L.Aslanyan).

Outcomes of applied developments

An algorithm for image blur assessment has been proposed and it has been experimentally shown that it may be successfully used for many other types of image distortion (Sup.: DSc (tech.) D.Asatryan).

Cloud infrastructures and services have been studied, which can provide cloud computing resources, applications and storages for solving scientific problems through the network. The main

cloud infrastructure has been developed using the OpenStack environment. Storage (Swift), network (Neutron) and processing (Nova) services have been studied. The Keystone Identity Management service has been implemented. The cloud storage service has been developed to store the data received from experiments and different calculations. Implementation of scientific metadata storage was run on the basis of iRODS (Integrated Rule-Oriented Data System), open source data management system.

An Interactive Data Visualization Platform has been developed for molecular dynamics modelling. The suggested Platform is an integrated environment to analyse, process and visualize the scientific data (Sup.: cand. (tech.) H.Astsatryan).

A pilot software package for the study of self-organized dynamic processes described by the abelian sandpile model has been developed and implemented. The software package is intended to calculate various physical and informational characteristics, also to simultaneous scanning of joint research in two-dimensional and three-dimensional spaces; making changes; maintaining; receiving and transmitting the models' states in a multiuser environment.

The known problem of reducing energy consumption in computer networks has been reformulated in built-up models. New algorithms for optimal distribution of users' programs (tasks) have been developed and implemented to answer specific problems.

The software package designed and developed by our parallel programming methods (MPI, OpenMP, CUDA) can be successfully adapted to high performance computing clusters and supercomputers (Sup.: acad. Yu.Shoukourian).

Methods and software for identification, recognition and positioning of objects of interest in video have been developed. A high-performance software system for detecting, recognizing and managing cadres of various types of objects has been developed using neural networks (Sup.: DSc (phys.-math.) H.Sarukhanyan).

A multifunctional info-communicational resource UniMail, based on network and SMS technologies, has been developed, tested and released for production. It is designed to replace some of already existing separate info-communicational services of ASNET-AM. UniMail is an independent, info-communicational, network-based, multifunctional resource designed to send SMS notifications about incoming messages of email by initiative of sender or receiver. It provides also an ability to send SMS messages by email and some other services (Sup.: DSc (tech.) A.Nanassian).

The following eduroam wireless access has been carried out: to ensure a secure connection the automatic configuration system eduroam CAT (Configuration Assistant Tool) has been set up, configuration management tools for describing eduroam coverage on the map and its presentation on the eduroam.am site have been developed and implemented; eduroam Managed IdP pilot system has been implemented in ASNET-AM network; eduroam/AFIRE services password recovery mechanism has been developed and implemented; Email and webmail interface protection mechanisms based on the package Fail2Ban have been developed and implemented. The integration of UNIMail system with ASNET-AM mail servers has been done. A system for monitoring mail queues and SMS-notification of exceeding the number of messages in the queue through the UNIMail system has been implemented (Sup. cand. (tech.) A.Petrosyan).

To verify the accuracy of data and weather forecast in Armenia, a cloud service has been developed that collects atmospheric components, such as air temperature, relative humidity, atmospheric pressure, wind and air, from ground stations, satellite images and weather forecasting models, and enabling interactive visualization to conduct a comparative analysis (Sup.: cand. (tech.) H.Astsatryan).

Integration of the modern programming languages and environments (JaveScript, Node js) with the cluster environment has been developed. A sip calling application for ASNET sip has been developed based on CSipSimple open source project (Sup.: cand. (tech.) M.Gyurjyan

Department of Hydromechanics and Vibrotechnics

Outcomes of applied developments

Based on the study results a multi-mode regulator of pressure and flow fluctuations has been developed to eliminate and reduce pressure pulsations and vibration levels in pipelines of a hydrocracking unit (Sup.: cand. (tech.) G.Avetisyan).

DIVISION OF PHYSICS AND ASTROPHYSICS

Academician-Secretary – academician R.Kostanyan
Scientific Secretary – N. Davidyan

The Division of Physics and Astrophysics includes the Byurakan Astrophysical Observatory after V.Ambartsumian, the Institute for Physical Research, the Institute of Applied Problems of Physics, the Institute of Radiophysics and Electronics, the International Center for Relativistic Astrophysics Network –Armenia and "Galaktika" CJSC.

The Division includes 9 academicians, 12 corresponding members and 29 foreign members.

During the reporting year 1 general meeting was held.

At the annual general meeting held on March 27 the academician-secretary of the Division R.Kostanyan presented the main results of the scientific and organizational activities of the Division for 2017. Scientific reports were made by NAS RA foreign member A.Sedrakian (Germany), cand.(phys.-math.) A.Mikaelian, cand.(phys.-math.) Zh.Kafadaryan, cand.(phys.-math.) A.Yesayan, cand.(phys.-math.) V.Qocharyan and A.Movsisyan.

During the 9 sessions of the Bureau of the Division the following issues were discussed and approved: the applications of the subdivisions for "Maintenance and Development Projects for the Base Financing Infrastructure of the Scientific and Technological Activity" for the year of 2019, postgraduate applications, a list of authorized representatives elected at the scientific councils of the Division organizations. The organizational issues related to the renaming of the IPR, the exhibition devoted to the 75th anniversary of the NAS and issues concerning the second forum of CIS were discussed. The debates on increasing the efficiency of scientific research, on the expansion of applied research and the evaluation of the scientific organizations works were a subject of discussion.

Interdepartmental programs have been developed, the reports of subdivisions on implementation of the recommendations of the staff evaluation commissions have been discussed.

During the reporting year a number of national and international scientific events has been held, international cooperation in the scientific organizations of the Division has expanded, new agreements have been signed, cooperation between scientific and educational institutions has been ongoing.

6 employees of institutions of the Division got their PhDs.

Institutions of the Division have received 8 licenses, 216 articles (including 118 abroad), 141 theses (65), 5 monographs and 4 manuals have been published.

In December of the reporting year annual reporting meetings were held in the scientific organizations of the Division, the reports on scientific and organizational activity in 2018 were discussed and approved.

The Division publishes the following scientific journals: "Proceedings of NAS RA. Physics", "Astrophysics" and the electronic "Armenian Journal of Physics".

Byurakan Astrophysical Observatory after V.Ambartsumyan

Major achievements

For more than 200 X-ray ROSAT galaxies spectral studies have been conducted and the types of their activity have been first determined. About 50 hidden candidates for AGN (active galactic nuclei) are weak galaxies, but with no signs of activity in the optical range nevertheless represent powerful X-ray sources. From all IRAS PSC/FSC point sources, 55 new ultra-bright infrared (IR) galaxies (ULIRG) have been identified and, as a result, the largest sample of IR galaxies has been created (Sup.: cand.(phys.-math.) A.Mikaelian).

A detailed spectral and photometric study of the eruptive star V1318 Cyg has been conducted. It has been revealed that this star belongs to the HAEBE type, and has been at the maximum luminosity for more than three years. Such behaviour is not typical for HAEBE type stars and, with high probability, this object is a new subtype of eruptive stellar objects (Sup.: DSc (phys.-math.) T.Magakian).

The study of the kinematics of a young (~ 2-3 mil. years) stellar cluster IC 348, using the database of Gaia DR2 survey, has shown that this cluster is in a superviral state and is a gravitationally unbound system (Sup.: cand.(phys.-math.) A.Harutyunyan).

The distribution in the galactic plane of the signs of the measure of rotation of pulsars endowed with large Faraday rotation (| RM |> 300 rad/m2) shows that in a ring bounded by radii of 5 and 7 kilo parsecs from the centre of the Galaxy, the large-scale magnetic field is counterclockwise (Sup.: cand.(phys.-math.) R.Andreasyan).

For the first time, two-dimensional composition groups have been introduced into the theory of radiation transfer. The groups relate to non-stationary problems of light scattering, as well as to problems in which the scattering medium is turbulent (Sup.: DSc (phys.-math.) A.Nikogosyan).

It has been concluded that one-sided use of linear models of radiating fields can lead to an overestimation of the values of diffuse radiation fields and optical parameters of the medium (Sup.: cand.(phys.-math.) O.Pikichyan).

For the first time, 2000 M-type variables have been classified and their distances have been determined (Sup.: cand.(phys.-math.) K.Gigoyan).

Outcomes of applied developments

At the joint Armenian-Russian station 420000 measurements have been performed altogether and 630 orbits of artificial satellites have been restored during 210 observational nights (Sup.: cand.(phys.-math.) H.Harutyunian).

The analysis of the possibilities of improving the 2.6 m telescope of the Byurakan Astrophysical Observatory and of the influence of the central coverage of the telescope on the efficiency of its work has been carried out (Sup.: A.Hakobyan).

Institute for Physical Research

Major achievements

The behavior of transitions of the atomic D_2 line has been studied in the high-temperature potassium nanocell with 50–1500 nm thickness depending on the vapor density. An unusual behavior of atomic transition frequencies is obtained for the cell thickness in the vicinity of $L = \lambda/2 = 380$ nm: the increase of density results in a “blue shift”, while for $L < 100$ nm, the shift is “red” as expected. This result has been attributed to the collective Lamb shift phenomenon. A theoretical model has been developed; very good agreement with experimental results has been obtained (Sup.: DSc(phys.-math.) D.Sarkisyan).

In order to develop Q-switched lasers on Yb:$LuAlO_3$ and Yb:$YAlO_3$ single crystals, the effect of crystallization conditions by the Czochralski and Bridgman methods on the optical characteristics of crystals has been studied, and crystals with different activator concentrations (1.5-8 at.%) have been obtained. The mechanisms of formation of color centers have been considered. The optimum concentration of Yb ions for the diode-pumped Q-switched generation in $YAlO_3$:Yb crystals has been determined (2-3 at.%). The conditions for the growth of $CaYAlO_4$:Yb crystals having promising spectroscopic and lasing properties have been also studied (Sup.: DSc(phys.-math.) A.Petrosyan).

Outcomes of applied developments

An optical magnetometer scheme has been developed for measuring the magnetic field in the range of 0–5000 Gs with an accuracy of ≤ 5%. In the laboratory prototype device, a Rb nanocell of 400 nm thickness was excited by a 50 μW circularly-polarized radiation of a laser diode tunable in the region of the atomic D_2 line. In the measurement procedure, a selective reflection spectrum for Zeeman-split transitions of the hyperfine structure is recorded, which is compared with the spectra calculated by the theoretical model. In case of coincidence, the measurement result is displayed. The system works autonomously based on the available Arduino and Raspberry-pi3 devices, with dedicated software support. The measurement time is about 1 s (Sup.: corr. member A.Papoyan).

A new method for registering nuclear reactions, based on the registration of the type and amount of product chemicals, has been patented. In the experiment performed, the phenomenon of discharge in a double electrical layer formed between the surface of immersed metal electrodes and contacting water was used as a source of neutrons (Sup.: acad. R.Kostanyan).

A fundamentally new method for local diffusion doping of ZnO films with donor (Ga) or acceptor (Li) impurities has been developed to create films with topological image of the dopant. The electrophysical and photoelectric properties of diffusely doped samples of planar metal-insulator-metal structures have been investigated. Based on this technology, nonlinear electronic elements for transparent electronics have been created, i.e. field transistors and diodes; their electric and photoelectric characteristics have been studied (Sup.:cand.(phys.-math.) R.Hovsepyan).

In the M/n-ZnO1Li/LaB_6 (M=Ag,Al,Au) structures bipolar switching (BS) without electroforming has been obtained, in which the writing and erasing voltages increase while increasing the work function of the electrode. In the M/p-ZnO_{10}Li/LaB_6 (M=Al,Ag) structures unipolar switching (US) has been obtained, which depends on the polarity of the applied voltage. With a negative bias, these structures behave like a diode and with a positive bias like a memory element. At the p-n junction of ZnO_{10}Li / ZnO_1Li, a stable memristor BS has been registered. In the Au/p-Li_{10}ZnO/FTO structures, a BS with 10^3 switching cycles has been obtained. In the M/p-ZnO_{10}Li/Pt structures, a US has been registered with a resistance ratio of 5×10^2 and switching voltages of 0.8 / 0.4 V. The obtained results are promising for creating memristor elements and systems with specified characteristics (Sup.: cand.(phys.-math.) Y.Kafadaryan).

On the basis of a single-layer flat-coil generator, a new type of magnetic field sensor has been developed jointly with PSI LTD, that is capable to detect magnetic field of ≤ 1 μG. A laboratory prototype of the new magnetometer has been created, studies of its applicability for measuring biomagnetic fields have been initiated (Sup.: DSc(phys.-math.) S.Gevorgyan).

Institute of Applied problems of Physics

Major achievements

The radiation of the train of bunches of charged particles moving rectilinearly and uniformly has been studied when it passes through the center of a dielectric ball in a vacuum. It has been shown that for certain values of the parameters of the problem in a narrow range of frequencies an intensive radiation can be produced when the radiation energy is proportional to the square of the number of bunches in the train (Sup.: acad. A.Mkrtchyan).

The possibility of separation of an X-ray beam of certain angular and spectral width from a white beam by applying a vertical point temperature gradient to the atomic planes of a quartz single crystal and its two dimensional focusing has been shown experimentally (Sup.: cand.(phys.-math.) V.Kocharyan).

Outcomes of applied developments

In acoustoplasma state by means of ionoplasma evaporation method, utilizing refractory metals and other materials media with various relative density and degree of order have been synthesized, which can be used in the development of wide range of electromagnetic waves absorber-convertor devices.

A new method to detect super weak acoustic waves has been developed, which is based on the registration of acoustic echoes from biological objects by means of acoustophysics methods (Sup.: corr. member A.Mkrtchyan).

A method for obtaining deformation distribution maps along different axes caused by acoustic waves presence in crystals has been elaborated (modeling method) in programming environment "COMSOL MULTIPHYSICS".

An electromagnetic signal amplifier for 0.1÷1 MHz range has been designed and created (Sup.: cand.(phys.-math.) V.Kocharyan).

A laboratory specimen of a new type of high productivity hydrogen generator has been developed by applying various acoustophysics methods (Sup.: cand.(phys.-math.) V.Nalbandyan).

Institute of Radiophysics and Electronics

Major achievements

In the millimeter wavelength range (MMW), the guiding properties of phased array antennas (PAR) with the Fresnel dielectric lenses previously proposed by us as elementary emitters have been investigated. A 4x4 HEADLIGHT has been made, the element of which is a parallelepiped lens with dimensions of 2λ x 2λ x113λ from a dielectric with ε = 1,6. Each of the lenses in the focal spot with a radius of λ / 4 provides an intensity increase by 16 dB compared to the density of the incident radiation. With the cross-lens distance $\Delta \geq \lambda/4$, the mutual decoupling of the PAR elements exceeds L = -23 dB. On the basis of the developed PAR, it is proposed to build a radio imager for systems of unmanned car traffic in the range of 70 GHz.

In the X range, the combination of the proposed microlens with a microstrip antenna of the "patch" type with the directivity factor G = 7 dBc has been studied. The use of a microlens has allowed to increase the directivity by 12 dB, reaching a total directivity G = 19 dBc, inaccessible to a single microstrip antenna. At the same time, the mutual isolation between the microstrip antenna elements has significantly increased, reaching L = -42dB. The obtained characteristics of the studied microlens – microstrip antenna structures make their use highly promising in radar and telecommunication systems (Sup.: corr. member A.Hakhoumian).

Dynamical Hall conductivity $\sigma_H(\omega)$ of a 2Delectron gas with impurities in the perpendicular magnetic field has been analyzed. Plateau-like behavior at low frequencies as well as at high frequencies provided by the complete filling of Landau levels is predicted. The broadening of a Landau level separates two frequency regions with different behaviour. Imaginary part of dynamical Hall conductivity reveals oscillations in the localized states region. Comparison with the experiment has been carried out.

Light transport in a dilute photonic crystal has been considered. Analytical expression for transmission coefficient has been derived. Straightening of light under certain conditions in one-dimensional photonic crystal has been predicted and experimentally observed in the microwave region. Such a behavior is caused by suppression of photon mobility in the dielectric permittivity inhomogeneity direction. The reason is the appearance of localized and low energy states. In both cases the mobility is suppressed in transverse direction and therefore photon is forced to straighten. Straightening of light in the optical region along with small reflection make these systems very promising for use in solar cells (Sup.: DSc(phys.-math.) Zh.Gevorkyan).

Outcomes of applied developments

The theory of the longitudinal photovoltaic effect arising in a p-InSb/n-CdTe based on the infrared photodiode in the case of a «pin-cushion» -type photoactive surface has been constructed. The optimal structure of working surface of such a coordinate-sensitive photodetector and the dimensions of characteristics linearity region have been found.

Work has begun on the synthesis of a new type ceramic substances with a colossal dielectric permittivity, which have good prospects in obtaining small-sized and highly efficient electric accumulators and capacitors with a capacity reaching the order of farad.

A special furnace has been manufactured that allows annealing of samples to a temperature of 1500 ° C. The technological mode of sample production has been worked out. Nb_2O_5 (99.5%), Al_2O_3 (99.9%), and TiO_2 (98.9%) were used as initial components. Using a press, ceramic samples with a diameter of 10 mm and a thickness of 1-2 mm were obtained under a pressure of 250-600 MPa. The obtained samples were annealed at a temperature of 1350-1500 ° C for 4 hours, then their surface was polished, and silver contacts were deposited using vacuum deposition and conductive silver glue. The dependence of the capacity of the structure obtained on temperature (30–170 ° C) and frequency (up to 1 GHz) was measured. Initial results have shown that it is possible to observe a significant increase in the dielectric constant of a given substance (Sup.: corr. member S.Petrosyan).

The mechanism of current flow through the p-InSb/n-CdTe ideal heterostructure in the presence of an inversion layer at the interface has been investigated. It has been shown that a power (3/2) low can be observed in the direct part of the current-voltage characteristic. A theoretical model of the phenomenon has been constructed and compared with the experiment.

Works on the development of laboratory layout based on the heterojunction photodiode p-InSb/n-CdTe for tracking the position of infrared radiation source have been continued. The photodiode is placed in a closed cycle SRI 401 Stirling cryocooler with the infrared optical-mechanical system. The analog part of the system has been developed and implemented, which allows detecting the modulated signal from the photodiode (Sup.: cand.(phys.-math.) K.Avjyan).

Studies of water molecule clusters and quantity of ions and silver nanoparticles obtained by laser ablation, with the help of changes of the intensity of surface plasmon polaritons have been carried out. The dependence of the density of ions and silver nanoparticles on temperature has been studied (Sup.: cand(phys.-math.) R.Khachatryan).

Within the framework of cooperation with the Institute of Applied Astronomy of the Russian Academy of Sciences (IAA RAS) a program-method has been developed. The program anticipates for focusing and measuring characteristics of "RT-13 IAA RAS" radio telescope of GLONASS system and uses Cassiopeia – A space radio source. The measuring is done in the following frequency ranges: S–(2, 2–2, 6) *GHz*, X–(7, 0–9, 5) *GHz and* Ka–(28–34) *GHz.* The developed method is targeted to provide measure parameters with high accuracy and operability in GLONASS system (Sup.: DSc(tech.) H.Piroumyan).

A biomedical tissues device which is used for the purpose of diagnosis and investigation in body's different parts has been developed and implemented. It can externally affect on the different points of the skin of human body with different types of currents (i.e. constant, alternate, pulse etc.) and measure bioimpedance suspended by temperature. Several electrotherapies can be done to diagnose the presence of some diseases. The LabView software code is also provided with the device (Sup.: acad. A.Ghulyan).

ICRAnet Armenia

Major achivements

By combing the data from multiple telescopes, it has been shown that very-high-energy neutrino event IceCube-170922A observed by IceCube at the South Pole most likely originate from the distant blazar TXS 0506+056 (Sup.: cand.(phys.-math.) N.Sahakyan).

DIVISION OF NATURAL SCIENCES

Academician-Secretary – corresponding member R.Aroutiounian
Scientific Secretary – S.Atshemyan

The Division includes the Scientific and Production Centre (SPC) "Armbiotechnology", the Scientific Centre of Zoology and Hydroecology, the Institute of Botany after A.Takhtajian, the Centre for Ecological-Noosphere Studies, the Institute of Biochemistry after H.Buniatyan, the Institute of Hydroponics after G.Davtyan, the Institute of Molecular Biology, the Institute of Physiology after L.Orbeli.

The Division includes 7 academicians, 11 corresponding members, 27 foreign members as well as 12 honorary doctors.

1 general meeting, 27 Bureau meetings of the Division were held during the reporting year.

At the annual meeting of the Division held on 27 March the report of the Academician-Secretary R.Aroutiounian on the scientific and scientific-organizational activities of the Division in 2017 was heard. The main fundamental and applied results of the Institutes, the involvement of young researchers in science, the activities of the organizations in the upcoming 75th anniversary of the National Academy of Sciences were discussed. Scientific reports of the following leading scientists of the Division were heard: NAS RA foreign member G.Tavartkiladze "Modern perspectives of cochlear implantation", NAS RA foreign member H.Sarukhanyan "The role of informational-telecommunicational technologies in the improvement of medical-social help", DSc(biol.) N.Ayvazyan "The biological effects and application of natural toxins", cand.(biol.) H.Zakaryan "Natural compounds as medicine for the african swine fever", cand.(biol.) V.Muradyan "The role of remote monitoring systems in the study of mountain ecosystems".

At 27 meetings of Bureau the following issues were discussed and approved: the 2018 working plan of the Division; the reports of the institutions of the Division on 2017 and 2018 base funding, on the maintenance and development of the infrastructure, on the maintenance of the scientific objects of national importance and scientific and scientific-technical state projects of target programs; the applications for the positions of postgraduate studies and doctoral candidacy for 2018-2019; the applications of the Institutes for new appliances; the reports of the Institutes on the scientific-organizational activity in 2018. The candidacy of A.Arakelyan was elected to the post of the director of the Institute of Molecular Biology.

During the reporting period the Division has organized the following round tables: "Perspectives of the development of fundamental science" supervised by the Academician-Secretary of the Division R.Aroutiounian for the "CIS scientific forum-2018", "Discussion of the cooperation with Russian Academy of Sciences in the field of biomedicine" with participation of the Vice President of RAS academician V. Chekhonin and "The ecological problems of lake Sevan" jointly with the Expert Commission (NAS RA) on protection of lake Sevan.

The exhibition of the applied developments and products of the organizations of the Division (with participation of high school students) was held during the 75th anniversary of NAS RA.

The travel expenses for scientific visits of researchers from the Division Institutes were discussed and 26 travel grants were provided from NAS RA funds preappointed for the scientific visits.

16 local and international events were organized by the Institutes of the Division including seminars, conferences, scientific expeditions, a total of 904 participants, 232 of which were from abroad.

284 articles (107 – in local and 177 – in foreign journals) and 144 abstracts (48 – in materials of local and 96 – in materials of foreign conferences), 12 monographs, 4 educational tutorials and 2 patents were published by the Institutes of the Division.

3 candidates' dissertations were defended by the researchers from the Institutes at the specialized councils of the Division.

Institute of Botany

Major achievements

In the field of biotaxonomical research of Armenian flora new species for Armenia *Persicaria orientalis (Polygonaceae)* and *Valerianella pumila (Valerianaceae)*, as well as *Bupleurum papilloides (Apiaceae)* for Caucasus have been discovered (Sup.: DSc.(biol.) M.Hovanisyan).

In the field of paleobotanical research, for the first time for the fossil floras of the World, the species *Tanacetum cf. chiliophyllum* was discovered from the Vorotan River basin. The fossil flora from the diatomaceous sediments of coastal sections of the Tolors reservoir was studied in the Syunik region. Around 40 fossil plant imprints have been collected. As a result of the study of Hortun Pyliocene flora based on the plant macroremains, a new for the science fossil species has been described (*Acer hajastana Papikyan*). A list of species from this locality has been composed and a climatic analysis has been done based on those taxa on the basis of the Coexistence Approach method (Sup.: cand.(biol.) I.Gabrielyan).

As a result of monitoring of the Natural monument of Armenia "Salt marshes in the vicinity of the Ararat town", the boundaries of the surviving fragment of the relic wet salt marshes of Ararat valley and the size of the territory of conservation value have been defined. Botanical inventory, ecological and flora-cenotic studies of the habitat have been conducted. The taxonomic composition of dominant and rare and endangered plant species, as well as narrow-local endemics has been clarified, their bio-ecological and phenological parameters and the seasonal rhythm of development have been studied. Based on the received data, a monograph "Natural monument of Armenia "Salt marshes" in the vicinity of Ararat town" (J.Akopian., A.Ghukasyan, J.Hovakimyan, Yerevan, 2018, 120 p., in Russian & English) was published (Sup.: DSc(biol.) J.Akopian).

Centre for Ecological-Noosphere Studies

Major achievements

The outcomes of researches aimed at detecting correlations between spectral indices (NDVI, VCI, TCI, VHI) and climatic factors (air temperature, precipitation) point to the presence of correlation between climatic data and data of spectral indices of assessment of general status of ecosystems between 1984 and 2017. Investigations of space-and-time series of cosmic imagery in conditions of climatic change across Armenia point to an increase in productivity of mountain ecosystems (Sup.: cand.(geogr.) Sh.Asmaryan).

Outcomes of applied developments

Works on assessment of chemical hazards and associated risks of food products have been continued. No pesticides were detected in the studied fruits and vegetables, whereas nitrite contents did not exceed the allowable level. It has been established that in animal-based food marketplaces N1(GUM) and Malatia the quantity of high risk pavilions has decreased significantly up to 10%, that of low risk pavilions reaching 50%. Practically in all the cheese and sausage samples collected from the marketplaces and salad samples taken from different trade outlets microbiological risks were identified and non-compliance with food safety requirements was detected. A survey was completed with the population regarding frequencies of fish, chicken meat and honey consumption. A database has been produced to be used to assess exposure to chemical hazards and health risk assessment (Sup.: DSc(food.sci.) D.Pipoyan).

A database of monitoring studies of Yerevan park and street tree species has been completed. In the frames of a special commission established by Yerevan City Council in order to improve health of green areas consultations were held and expert opinions were expressed (Sup.: cand.(biol.) H.Hovhannisyan).

Expert maps of distribution of a- and b- activities of radionuclides in soils and respective hazard indices of gamma radiation on the territories of Armenia's largest cities (Yerevan, Gyumri, Vanadzor) and mining centers (Kajaran, Kapan) have been developed. Maps are an essential information basis for an early warning system in radiation protection (Sup.: cand.(biol.) O.Belyaeva).

Scientific Centre of Zoology and Hydroecology

Major achievements

11 new species and 1 new genus of insects have been identified for the Armenian fauna. Based on the scientific collections of foreign museums, 11 new species of beetles from the Palearctic and Eastern Zoogeographic regions have been described (Sup.: cand.(biol.) M.Kalashyan).

For the first time, karyotypes of 8 species of longhorn beetles from the genus *Dorcadion* and 4 species of Damon blue butterflies from the genus *Agrodiaetus* have been described. For the purpose of phylogenetic analysis, DNA tests were carried out for 18 species of longhorn beetles *Dorcadion*, 4 subspecies of *Carabus* beetles from the genus *Carabus* (*Procerus*) and flower chafer beetles from the genus *Cetoniinae* from different populations of Armenia (Sup.: cand. (biol.) G.Karagyan).

On the territories neighboring the middle reaches of the Hrazdan River, 10 species of mammals, 4 species of amphibians, 28 species of reptiles have been recorded. 8 species of reptiles are listed in the Red Data Book of Armenia. Due to the fact that the left banks of the river are more urbanized and occupied by agricultural lands, the avian fauna is less rich (62 species) than on the right banks (87 species) (Sup.: cand. (biol.) M.Kasabyan).

The cytogenetic studies of the frog *Pelophylax ridibundus* and of the toad *Bufo variabilis* have shown a relatively lower extent of water pollution in the middle reaches of the Hrazdan river (Sup.: cand. (biol.) I.Stepanyan).

The identification and morphometric treatment of bone material from excavation of various archaeological sites of the Early Bronze Age have revealed a significant predominance of domestic animals over wild ones, the secondary role of hunting, where the red deer was the main object, has been identified (Sup.: DSc(biol.) N.Manaseryan).

The succession processes of Lake Sevan as well as the changes in dominant complexes under the conditions of the lake's water level change have been studied. Main factors affecting the sustainability of the lymnosystem and the tendencies of ongoing processes in the ecosystem have been revealed. In July 2018 algal bloom in the lake was registered due to the intense growth of cyanobacteria of the genus *Anabaena*. Dominant species were *Anabaena flos-aquae and A. spiroides.* The effects of fish hatcheries installed in the lake aiming at development of fish farming in Lake Sevan have been assessed. It has been shown that near the hatcheries some level of organic pollution is present, but it has had a local effect yet and does not impact significantly the processes ongoing in the broader scale(Sup.: DSc(biol.) B.Gabrielyan).

The collection and analyses of the hydrological, hydrochemical and meteorological monthly data of Lake Sevan's deep-water sites have been implemented. Lake Sevan's one-dimensional (1D) model for the assessment of thermal regime has been developed, by which the dynamics of the vertical distribution of the lake temperature over the past decade has been assessed (Sup.: cand. (biol.) G.Gevorgyan).

Outcomes of applied developments

The species composition of parasites of wild and domestic animals as well as of the plant nematodes has been identified. Their infestation of various species of animals and plants as well as paths of helminth circulation in the pasture biocenoses have been revealed in the middle reaches of the Razdan river. The collected data can be used to assess the environmental contamination caused by parasites in order to prevent parasitic diseases in animals and plants and to organize effective control of parasites causing these infestations (Sup.: acad. S.Movsesyan).

24 species of bloodsucking dipterous insects have been recorded, the research results have great economic importance in the fields of animal husbandry and public health (Sup.: DSc(biol.) V.Oganesyan).

The fauna of lepidopterous insect pests of fruit crops and shrubby-tree forests has been studied, 46 species of agricultural pests and 17 species of phytophagous gall midges have been identified (Sup.: cand. (biol.) M Kalashyan).

11 species of parasitic plant mites, 9 species of predatory mites *Phytoseiidae* have been identified and their development traits have been described. In order to control weeds and pests of agricultural crops studies towards identification of prospective biological agents, development of their selection

criteria, reproduction and conservation have been continued. New products with a complex insecticidal effect have been developed (Sup.: DSc(biol.) K.Dilbaryan).

The bioresources of Lake Sevan (fish and crayfish) as well as their states have been assessed. Urgent measures have been proposed to the Ministry of Nature Protection of RA for the efficient use of commercial reserves. The total whitefish reserves have grown by 33%, the reserves of fish have reached 2948.5t. As a result of continuing overfishing the growth of the proportion of commercial reserves of the whitefish has not been registered. The average density of commercial reserves of the whitefish was 6.6kg/ha (SD ±1.1kg/ha) (Sup.: DSc(biol.) B.Gabrielyan).

The studies have shown that the tendency to the reduction of the reserves of crayfish is continuing. The commercial reserves of crayfish in Lake Sevan have decreased by 300t compared with the previous year data and in 2018 was equal to 2600t. The allowed catch has been determined on the level of 350t. The reasons for crayfish reserves depletion are the mismanagement of the catch and the use of wrong devices as well as spreading of the disease led by Septocylindrium astaci fungi. The last harms only crustaceans without harming the fish (Sup.: cand.(biol.) E.Ghukasyan).

Institute of Biochemistry after H.Buniatyan

Major achievements

The opportunity of differentiation of *Bacillus anthracis* from related bacteria on the base of PCR realized by use of primers specific to *B. anthracis pag* and capsule *cap*A, *B. thuringiensis* and *B. anthracis* typical *16S_rRNA* and universal *16S_rRNA* genes has been studied. It has been shown that *pag* gene is characteristic for *B. anthracis*, and in presence of capsule *cap*A gene is also characteristic for this strain. Therefore, in the respective systems the primers of these two genes can be used both in diagnostic purposes and for the study of the effect of cytokines PRP-1 and Gx-NH2 *in vivo*. Using specific primers to the 16S rRNA gene of *B. thuringiensis* and *B. anthracis* these bacteria can be distinguished from the related *B. cereus* (Sup.: DSc(biol.) S.Chailyan).

The anti-cancer effect of galarmin has been confirmed *in vitro* on the mice inoculated with the Ascite Ehrlich carcinoma (in cooperation with the University of Miami, USA). Studies of the action of different doses of galarmin have been performed on 24 and 72-hour cultured Ehrlich ascites carcinoma (EAC) cells in mice inoculated for 7 and 11 days and the cytostatic/antiproliferative, as well as cytotoxic/apoptotic mechanisms of galarmin effect have been revealed. Using the antiserum against galarmin, galarmin-immunoreactive nuclei have been detected in the cancer cells of the 72 hour-cultivated control samples, which suggests the possible synthesis of the endogenous galarmin in EAC cells (Sup.: cand.(biol.) I.Sahakyan).

For the research of targeted binding to transferrin receptors of cancer cells the formation of new photosensitizers based on transferrin and cationic porphyrins has been studied. The non-covalent binding of three cationic porphyrins 1) meso-tetra [4-N-(2'-oxyethtyl) pyridyl] porphyrin (TOEt4PyP) 2) Zn-TOEt4PyP and 3) Zn-meso-tetra [4-N-butyl pyridyl] porphyrin (Zn-TBut4PyP) with human transferrin has been studied. It has been shown that the investigated porphyrins and metalloporphyrins bind firmly with the protein molecule. It has been found that the porphyrins having Zn ion in porphyrin core, as well as the peripheral OH - groups are linked better to the transferrin molecules. The obtained complexes have a rather high level of singlet oxygen formation, which may serve as a basis for their further use in photodynamic therapy of tumors (Sup.: cand.(biol.) A.Gyulkhandanyan).

Outcomes of applied developments

Producion of cromatographic columns has been completed, which allows to offer cost-effective and locally produced columns for study of peptides and proteins (Sup.: DSc(biol.) S.Chailyan).

Adenosine deaminase activity at patients with rheumatoid and septic arthritis has been determined. The activity of the enzyme, the ratio of small and large isoforms and the degree of citrulisation are important from the perspective of diagnostics and treatment of arthritis. The influences of 15 compounds synthesized in STC OPC of NAS RA on the activity of ADA have been studied.

IC50 value of one of the compounds was of 31.1 ±1.2 μg/ml, which may allow recommending this compound for ADA inhibition in enzyme enhancing pathologies (Sup.: cand.(biol.) A.Antonyan).

A hybrid drug system has been developed, which as opposed to the general effect of chemotherapy, has targeted effect only on cancer cells. It is composed of cancer recognition protein - lectin and drug delivery protein - ferritin. This system is tested on Ehrich carcinoma cells and human myeloma culture. A diagnostic test system, with application of anisotropic silver nanoparticles sensitized by oxidized lipoproteins, for detection of antibodies to oxidized lipoproteins has been developed to estimate the risk of infarction (Sup.: cand.(biol.) V.Gasparyan).

Scientific and Production Centre "Armbiotechnology"

Major achievements

Aspartate and aromatic aminotransferases of *P.carotovorum* MDC 8726 strain have been purified and characterized, on the basis of which immobilized biocatalysts have been obtained (Sup.: cand.(biol.) A.Hambardzumyan).

Novel strains of *Bacillus thuringiensis* have been obtained by the method of chemical mutagenesis, the melaninogenic activity of which compared with the initial cultures has increased by 8% (Sup.: cand.(biol.) A.Hovsepyan).

Antimicrobial resistance of 47 strains of phytopathogenic bacteria of the genera *Rhodococcus, Pseudomonas* to various concentrations of kanamycin, chloramphenicol and a number of beta-lactam antibiotics has been revealed (Sup.: cand.(biol.) N.Hovhannisyan).

Antibacterial activity of *Brevibacillus laterosporus* strain against *E. coli* and *Salmonella enteritidis* has been studied and identified. 100% insecticidal action of *B.laterosporus* against the larvae of Colorado potato beetle and imago leaf beetle has been determined (Sup.: P.Tadevosyan).

A nutrient medium for growing *Saccharapolyspora spinosa* has been optimized. The dependence of biosynthesis of bacterial insecticide spinosyn on the concentration of molasses in a nutrient medium has been determined (Sup.: cand.(biol.) V.Ghochikyan).

The fermentation conditions (nutrient medium, cultivation temperature, aeration regimes) of *Brevibacterium flavum* LGS6 have been optimized providing a high yield of histidine – 25 g/l (Sup.: cand.(biol.) S.Keleshyan).

Phytochemical and mineral compositions of extracts of medicinal plants (milk thistle, round-leaved wintergreen, fireweed, red pepper, blackthorn) containing BAS with high antiradical, hepatoprotective activity and being effective in gallbladder diseases have been studied. It has been revealed that the mentioned medicinal raw materials contain 16 and more amino acids, 15-20 minerals, macro- and microelements, flavonolignans, carotins, arbutin, tannins, anthocyanins, organic acids and various vitamins. An extraction technology of BAS (>70%) with the preservation of their initial activities has been developed (Sup.: DSc(chem.) S.Dadayan).

Two peptides (N-tret-butyloxycarbonyl-(*S*)-alanyl-glycyl-(*S*)-β-[4-allyl-3-isobutyl-5-thioxo-1,2,4-triazol-1-yl)-α-alanine) and 5 non-protein amino acids (N-tret-butyloxycarbonylglycyl-(*S*)-propargylglycine) potentially endowed with biological activity have been synthesized by the method of computer modeling (Sup.: cand.(chem.) A.Mkrtchyan).

For the first time, the method of membrane filtration has been applied and the optimal technological parameters for the isolation and purification of bacterial melanin have been determined. A chiral HPLC method for determining the optical purity of new non-protein α-amino acids containing alkyne, phenyl and allyl groups in the side radical has been developed (Sup.: cand.(chem.) A.Tsaturyan).

β-Galactosidase activity of 370 strains of lactic acid bacteria has been studied. Prospective strains for the production of galacto-oligosaccharide syrups, sweetening agents, lactose-free milk and probiotics have been selected (Sup.: cand.(biol.) K.Chitchyan).

Genetically identified prospective strains of lactic acid bacteria that can be used as probiotics have been selected. Based on these strains a technology for probiotic dairy products has been developed (Sup.: cand.(biol.) F.Tkhruni).

For the first time, it has been revealed that breast milk of the Armenian women contains 10^4-10^5 CFU/ml of coccal and rod-shaped lactic acid bacteria in the ratio of 3:2. A method for the production of new functional dairy products based on probiotic bacteria of mother's milk has been developed (Sup.: DSc(biol.) H.Hovhannisyan).

The composition of microbial consortia of Kashen copper-molybdenum ore (NKR) has been studied. A stable consortium of iron-oxidizing bacteria has been obtained enabling to increase the leaching of iron 13-15 and 7-8 times, copper – 3 and 5 times from oxidized and non-oxidized ores (Sup.: DSc(biol.) N.Vardanyan).

A stable mutant E10 of purple non-sulfur photosynthesizing bacterium *Rhodobacter azotoformans* MDC 6523 synthesizing 579 mg/l 5-aminolevulinic acid by cultivating in a photobioreactor has been obtained (Sup.: cand.(vet.) V.Goginyan).

Spectrophotometric and chemical methods for detection and quantitative determination of strain-producers of microbial cycloinulofructans (CF) have been developed by computer modeling. As a result of studies on various groups of microorganisms *B. polymyxa* and *B. circulans* have been revealed to be active CF producers (Sup.: cand.(biol.) L.Markosyan).

The resistance of nodule nitrogen-fixing bacteria to high salt concentrations (NaCl, $MgSO_4$, NaHCO, $NaCO_3$) has been revealed and halotolerant strains have been selected. A method of cultivation of leguminous plants, including chickpea, resistant to salt stress in the vegetative test has been developed (Sup.: cand.(biol.) V.Hakobyan).

Outcomes of applied developments

Production and realization in the European market of a number of optically active non-proteinogenic amino acids of great medical, pharmaceutical and diagnostic importance have been continued (Sup.: acad. A.Saghyan).

The production of fermented dairy product "Narine" with the use of lactic acid bacteria Lactobacillus acidophilus MDC 9602 has been continued. The production of fruit and drinkable "Narine" with addition of natural apricot, peach, black mulberry and cherry syrups has been set up. At the same time the production of lyophilized preparation "Narine" has been established. The produced products are realized in leading pharmacy chains and supermarkets of Yerevan (Sup.: R.Hairapetyan).

The production of complex biofertilizers "Ecobiofeed" and "Ecobiofeed+" for agricultural needs has been continued. About 3 tons of biopreparations realized in various farms of the Republic have been produced (Sup.: cand.(biol.) G.Avetisova).

The production of drugs demanded on the Armenian drug market (3% and 30% hydrogen peroxide, boric acid, magnesium sulfate, potassium permanganate, ammonium aqueous solution, castor oil, glycerol, 5% iodine solution) has been continued. On a contractual basis the mentioned preparations are realized in the wholesale network of "Natali-Pharm", "Vaga-Pharm", "Pharm-Dom", "Uni-Pharm", "Sanus", "Armpharmacy", "Alta", etc. (Sup.: cand.(chem.) G.Hovsepyan).

Production of fruit syrups from apricot and peach, black mulberry and cherry, as well as of edible and cosmetic vegetable oils from seeds, stones and fruits of various plants (sea-buckthorn, flax, sesame, almonds, milk thistle, apricot, peach) has been set up (Sup.: DSc(chem.) S.Dadayan).

Institute of Molecular Biology

Major achievements

Using the methods of computational biology it has been shown that the geographic location and population affiliation affect the distribution of genetic variants associated with chronic diseases. In particular, it has been revealed that the Armenian population carries a specific set of genetic variants associated with the immune system, hematological diseases, skin diseases, cancer and diabetes. These results indicate the need for a national genome project (Sup.: cand(biol.) A.Arakelyan).

In chronic lymphocytic leukemia, the expression of CD5 and CD19 markers on neoplastic clones has been shown to correlate positively with the presence of the *IGVH* gene mutations, on the basis of

which a new prognostic classification of the course of chronic lymphocytic leukemia has been developed (Sup.: cand(biol.) G.Manukyan).

Molecular identification and detailed characterization of the genetic resources of the National Grape Collection of the Republic of Armenia has been realized using 9 main and 16 additional microsatellite markers. In the National Grape Collection of the Republic of Armenia numerous synonyms, homonyms, as well as unique genotypes have been identified (Sup.: cand(biol.) K.Margaryan).

Outcomes of applied developments

A database of chromosomal aberrations and clinical syndromes has been developed (jointly with the University of Jena and YSU) (Sup.: cand(biol.) A.Arakelyan).

The bacteriophages active against multidrug resistant clinical strains of Salmonella have been isolated from different sources (natural basins, river, and sewage water) (Sup.: cand(biol.) M.Mkrtchyan).

Molecular identification and detailed characterization of the genetic resources of the National Grape Collection of the Republic of Armenia has been realized, on the basis of which the "Armenian Vitis Database" has been developed (Sup.: cand(biol.) K.Margaryan).

The rapid detection of viral DNA assemblies in infected cell cytoplasm based on methyl green-Y pironin staining has been developed (Sup.: DSc(biol.) Z.Karalyan).

Institute of Hydroponics Problems after G.Davtyan

Major achievements

The regularities of biosynthesis of anthocyanins in medicinal raw material of *Callisia fragrans* have been studied in conditions of open-air hydroponics and soil culture for the first time. According to the preliminary data, in cases of application of selected method and its modification, the content of anthocyanins in fresh lateral sprouts was about 4.7-5.4 mg/100g depending on cultivation conditions.

The output of polysaccharides and water soluble extractive substances in overground dry mass of two years old *Echinacea purpurea* (L.) Moench exceeded the soil plants of the same age 1.1 and 1.3 times, correspondingly. After mineral nourishment optimization it has been revealed that the plants prefer comparatively high content of Potassium (K) for maximum biosynthesis of polysaccharides and tannins, in case of which, however, the decrease of biosynthesis of flavonoids (approximately 30%) and water soluble extractive substances (approximately 40%) has been observed. The different ratios of Sodium (N), Phosphorus (P) and K in nutrient solution did not have significant influence on the accumulation of phenylpropanoids.

Paulownia elongata S.Y.Hu, which is considered the most quickly growing tree in the world, was introduced into hydroponic culture for the first time. From the seeds sowed in spring, saplings with 135 cm medium height and 32 mm root collar depth were received in autumn having the biggest leaf laminae with 30 cm length and 14 cm width. During vegetative active growth period the plant heigth increased on average 14 cm weekly.

It has been revealed that in Ararat Valley (in the area of Armenian NPP at 30 km radius) vegetables, grown in hydroponics and in soil, exceeded medicinal plants 1.1-2.8 times by total β-activity. Herewith, in classical hydroponics, the medicinal plants by the total β-activity have made up the following decreasing range: asparagus > lavender > thyme > goji berry> rosemary, and vegetables: red chinese cabbage > chinese cabbage > lettuce > kale. It has also turned out that the hydroponic crops exceeded the plants grown in soil by β-activity (medicinal plants: 1.1-2.1 times and vegetables: 1.1-1.6 times), the quantity of which is generally specified by the amount of K accumulated in plants (due to ^{40}K content). However, hydroponic plants may be considered ecologically safer compared with soil plants, because they were inferior to soil plants by the content of controlled most dangerous ^{90}Sr and ^{137}Cs technogenic radionuclides.

The test of water fraction of *Teucrium polium*'s ethanolic extract in amyloid model of rats at Alzheimer disease has shown positive effect. In experiments related to the influence of *T. polium* on

the brain memory of women in menopause, improvement of their central neural system's dynamic processes and nootropic properties has been noticed (Sup.: corr.member S.Mayrapetyan).

Outcomes of applied developments

For the first time vertical and horizontal NFT hydroponic modules, where several leafy vegetables were grown, have been tested (Sup.: cand.(biol.) A.Tadevosyan).

Practical suggestions on cultivation of technical plants *Lycium barbarum L.* and *Stevia rebaudiana Bertoni* have been done for production in RA and Artsakh. A new variety of *Stevia rebaudiana Bertoni* has been imported from Greece (Sup.: DSc(biol.) M.Babakhanyan).

The RA Patent N 3223 A, 03.09.2018 "Spectrophotometric method of determination of flavonoids total content in medicinal plants" has been received (Sup.: cand.(pharm.) H.Galstyan).

Cooperation agreements have been signed with: a/ the Armenian-Norwegian enterprise "ORWACO" CLSC, to carry out collaborative scientific researches and study the effectiveness of biogenic fertilizers in organic hydroponics; b/ Department of "Pharmacognosy" of Yerevan State Medical University after M. Heratsi to organize students' practical works in the Institute; c/Departments of "Biochemistry, Microbiology and Biotechnology" and "Botany and Mycology" of YSU Faculty of Biology to conduct collaborative scientific researches, for practical classes in the Bachelor's, Master's and PhD students' programs and personnel training; d/ the "Scientific center of vegetable and industrial crops" of MA RA to conduct collaborative scientific research, to exchange seeds, seedlings of a number of valuable and rare plants and to commercialize plant raw material (Sup.: cand.(biol.) Kh.Mayrapetyan).

Proposals were sent to the Municipality of Yerevan and other interested organizations to negotiate economical contracts for realization of saplings received in the result of development of hydroponic growth biotechnology of decorative tree-shrub saplings (thuja pyramidal, plane tree, etc.). 530 tree-shrub saplings were sold of 541500 drams amount (Sup.: cand(biol.) A.Hovsepyan).

Plant raw material (kale, pakchoi, green basil, chamomile, echinacea, mugwort, tea plants, etc.), received during studies of edible plants growth in hydroponic method, were sold, amounting to about 300000 drams (Sup.: cand.(biol.) A.Tadevosyan).

In vitro collection of plants (*Pelargonium roseum Willd., Ginkgo biloba L.,* etc.) has been preserved in tissue culture laboratory (Sup.: cand.(biol.) E.Sargsyan).

Practical radio-protective recommendations will provide the obtaining of ecologically safer plant raw material (Sup.: cand.(agric.) L.Ghalachyan).

Institute of Physiology after L.Orbeli

Major achievements

The Laboratory of Immunology and Tissue Engineering has continued studies on creating a repository of mesenchymal stem cells (MSC) from adipose tissue. The growth properties of AdMSC cultured with human serum persistence have been tested, and the influence of serum on the viability and the rate of reproduction of AdMSC has been investigated. Preliminary results have shown that human serum can be an alternative to fetal bovine serum. Training and improvement of practical skills in isolating mesenchymal stem cells from different source fats has allowed to confirm the presence of a high level of pluripotent mesenchymal cells in the cell culture (Sup.: cand(biol.) Z.Karabekian).

Evaluation of the correlation of NADP oxidase activity and synaptic plasticity in the central nervous system in type II diabetes and phytoterapy to justify the prospects for the development of multi-purpose phytopreparations from native raw materials has been done. The antioxidant activity of Stevia rebaudiana leaves and Goji berry fruits in the central nervous system is accomplished through selective stabilization, which enhances the possibilities of antioxidant therapy (Sup.: DSc(biol.) V.Chavushyan-Papyan).

As a result of immunization of rabbits and oven, an antidote has been obtained from the venom poisoning of the snake Macrovipera lebetina obtusa, and several types of testing by various

experimental in vivo and in vitro approaches have been performed to evaluate the effectiveness of the serum (Sup.: DSc(biol.) N.Ayvazyan).

A new class of SFCO sensors has been developed, intended for creation of a new type of magnetometer (SFCO magnetometer) that can find out, detect and study the characteristics of extremely weak magnetic fields (Sup.: cand(biol.) A.Khachunts).

Outcomes of applied developments

A new class of SFCO sensors has been developed, intended for creation of a new type of magnetometer (SFCO magnetometer) that can find out, detect and study the characteristics of extremely weak magnetic fields (≤ 1 μGauss) (Sup.: cand(biol.) A.Khachunts).

The integrated modified system of psycho-physiological determination of the types of the character of athletes with application of polygraph has been developed, adapted to the specifics of sports. Complex psycho-physiological survey using a polygraph allows to identify individual biological features, functional disorders of the nervous system and to form positive psychophysical mobilization readiness of athletes. Cooperation of polygraph registration of nonspecific physiological reactions of the organism with a psycho-physiological definition of the types of character of athletes serves as a universal means of decoding subconscious nonverbal elements of the psyche of athletes (Sup.: cand(biol.) K.Panchulazyan).

The staff of Immunology and Tissue Engineering laboratory has mastered modern tissue culture techniques and some tissue engineering methods. In parallel, decellularized scaffolds of different organs, specifically skin, have been created for future use in 3D-tissue engineering. As a result of these experiments, the collection of AdMSC of different haplotypes typical of local gene variations has been enlarged in an effort to generate repository of potential donor stem cells. Such collection of cells will serve for preservation of biodiversity, toxicology and drug development, and establishment of collection of cells that can be differentiated into cells of multiple solid organs. In addition, members of the laboratory have acquired methods of decellularisation of different organs to obtain viable natural scaffolds for reconstruction of functional tissues (Sup.: cand(biol.) Z.Karabekian).

DIVISION OF CHEMISTRY AND EARTH SCIENCE

Academician-Secretary – academician L.Tavadyan
Scientific Secretary – cand.(techn.) L.Gasparyan

The Division includes the Scientific Technological Center of Organic and Pharmaceutical Chemistry, the Institute of Chemical Physics, the Institute of General and Inorganic Chemistry, the Institute of Geological Sciences, the Institute of Geophysics and Engineering Seismology after A.Nazarov.

The division includes 9 academicians, 6 corresponding members and 21 foreign members of NAS RA.

4 general meetings of the Division were held during the reporting year.

At the general meeting of the Division held on 31 January annual reports on International secondments participation, editoral boards of the journals "Proceeding of NAS RA. Earth Sciences" and "Chemical journal of Armenia" were heard and approved.

At the general meeting of the Division held on 1 March the report of the head of the laboratory of geodynamics and geological hazards of IGS, DSc(geol.) A.Avagyan on "The basin of Sevan lake is on focus of the geological hazards in according modern researches results" was heard and approved.

At the annual general meeting of the Division held on 27 March the reports of the Academician-Secretary, academician L.Tavadyan, directors of the research Institutes, as well as foreign members of NAS RA related to their scientific activities and achievements in 2017 were discussed.

At the generall meeting of the Division held on 12 June the report of cand.(chem.) A.Hovakimyan on "Researches in the field of combined alicyclo-and heterocyclo [c] pyridines: chemical and biological properties "was heard and approved.

8 meetings of the Bureau of the Division were held within the year, where the following scientific and organizational issues were discussed: the working plan of the Division for 2018 and distribution of postgraduate studies of the Division, annual reports of the Division and Institutes, reports on scientific and technical activity and Basic funding of Institutes for 2018; applications of maintenances and development project of the scientific and technical activity, basic funding infrastructure applications and state targeted programs of the scientific organizations of the Division for 2019. The following issues were discussed: the publication of T.Kurtikyan's, DSc(chem.), monography on "Nitrogen oxides and heme-models, mosaic of interactions", the list of awardees dedicated to the 30th anniversary of Spitak earthquake, the issue concerning the two buildings of the Scientific Technological Center of Organic and Pharmaceutial Chemistry, the criteria for evaluating the effectiveness of the Institutes, the problem of the storage and neutralization of the backup lacker ethynol in "Nairit". The candidacy of Kh.Meliksetyan, DSc (geol.), as the authorized representative of the Institute was heard and approved; the candidacy of J.Karapetyan, the Director of the Institute of Geophysics and Engineering Seismology after A. Nazarov, as a member of the editorial board of the journal "Proceedings of NAS RA. Earth Sciences" was discussed and approved; the candidacy of academician L.Tavadyan as the research suprevisor of the Institute of Chemical Physics after A.Nalbandyan was discussed and approved.

38 researchers of the Institutes of the Division were on academic trips in Russia, Ukraine, USA, China, France, Italy, Germany and other countries for the purpose of joint research, as well as for participation in international conferences and symposia.

The Division jointly with the Institute of Chemical Physics NAS RA organized the V International conference "Current problems of chemical physics" dedicated to the 110th anniversary of acad. A.Nalbandyan and 75th anniversary of NAS RA with participation of 130 scientists, including 45 foreign participants; jointly with the Institute of Geophysics and Engineering Seismology after A.Nazarov NAS RA the Division organized International Science School "After 30 years of the Spitak earthquake", the conference "Actual problems of Geophysics, Engineering Seismology and Seismic Stable Construction" dedicated to the 110th anniversary of acad. A.Nazarov with participation of 98 scientists, including 21 foreign participants; jointly with the Institute of Geological Sciences the Division organized the International conference "The 30th anniversary of the Spitak Earthquake. Look

to future" dedicated to the 75th anniversary of NAS RA with participation of 107 scientists, including 66 foreign participants.

301 articles (158 in foreign journals), 84 abstracts (19 in foreign conferences), 7 monographs and 4 patents RA were published by the Institutes of the Division.

Five Candidates' and four Doctor's dissertations were defended in 2018.

The Division has taken part in annual meetings of the Institutes and discussion of scientific results.

Institute of Chemical Physics after A.Nalbandyan

Major achievements

The antiperoxyradical capacity in binary mixtures of flavonoids (quercetin, rutin, morin, naringin) has been determined. It has been shown that O-glucosylated flavonoids (rutin, naringin) with trolox or ascorbic acid show synergistic effect, while non-glucosylated flavonoids (quercetin, morin) with trolox or ascorbic acid show antagonistic effect. Kinetic models to explain non-additive effects of co-antioxidants have been proposed and the dependency of non-additive effects on the structure of antioxidants has been determined (Sup.: acad. L.Tavadyan).

A new type of chain reaction: oxidation of hydrogen by sulfur dioxide has been revealed resulting in the reduction of sulfur dioxide into elemental sulfur without any catalyst, which is of ecological importance ((Sup.: acad. A.Mantashyan).

Outcomes of applied developments

Chromatographic and mass-spectroscopic studies of chemical composition, in particular, qualitative and quantitative analyses of organic pollutants in the waters of lake Sevan, its river bassin, bed silt and atmospheric precipitations have been carried out. On the basis of data obtained appropriate analysis has been performed relating to three-dimensional distribution of organic pollutants in the lake and season dynamics of their concentration magnitudes (Sup.: cand.(chem.) S.Minasyan).

Due to high microhardness the boron carbide, synthesized by a more available microwave heating method, can be applied for manufacturing cutting tools, cutting and grinding disks, in military technology, medicine and other fields (Sup.: cand.(chem.) R.Mnatsakanyan).

Scientific Technological Center of Organic and Pharmaceutical Chemistry

Major achievements

A three-component, one-step method for preparing new derivatives of 2, 5, 6, 7-substituted 5,8-dihydropyrido[2,3-d] pyrimidine-4(3H)-ones has been developed. A number of new derivatives of 2,3,4,5-substituted 1,2,4-triazoles and 1,3,4-oxadiazoles has been synthesized (Sup.: cand.(chem.) T.Hovsepyan)

Outcomes of applied developments

A radical copolymerization of earlier synthesized monomeric and oligomeric bis-acrylamides with vinyl and acrylic monomers on a ceramic monolith and silica gel has been carried out. The porous characteristics of the obtained new composite sorbents with polyamide coating have been investigated. The specific sorption pore volume in regard of benzene vapors of samples of ceramic monoliths modified with copolymers of 1,6-hexamethylene-bis-acrylamide and methyl methacrylate, α,ω-acryl(1,6-hexamethylene-sebacoyl amide) and styrene reaches ~0.573 and 0.374 cm^3/g respectively. Based on the data of IR spectra and scanning electron microscopy, the structure and morphology of the obtained composite sorbents have been investigated (Sup.: DSc(chem.) S.Grigoryan).

Institute of General and Inorganic Chemistry after M.Manvelyan

Major achievements

The silicate solutions obtained from rocks by the hydrothermal-microwave method has been investigated in order to remove coloring impurities. A microwave electromagnetic method for the deep purification of dye ions has been developed, which makes it possible to reduce the concentration of dye ions by two orders of magnitude (Sup.: cand.(chem.) V.Baghramian).

Transparent biositalls have been obtained by two-stage crystallization of phosphor-silicate glasses, with the separation of solid solutions of $Ca_2Al(AlSiO_7)$ and $Ca_2Mg(Si_2O_7)$ as the main phases. The region of stability and formation of $3CaOAl_2O_3$ have been studied in the $CaO-CaF_2-Al_2O_3-SiO_2$ system (SiO_2 10-15; CaF 5 mol.%) in the range of 1200-1450 ^{0}C. The composition of the quick-hardening alumina cement has been developed (Sup.: DSc(chem.) N.Knyazyan).

Outcomes of applied developments

The processing of high-silica rocks containing Al_2O_3 has been studied. A new, universal waste-free technology for their complex processing has been developed. The developed technology can also be applied for the processing of the copper-molybdenum combine's waste (Sup.: cand.(chem.) S.Saharunyan).

A new method of obtaining slow-acting fertilizers from aluminosilicates has been elaborated (Sup.: cand.(chem.) K.Grigoryan).

The optimal flotation conditions for oxidized copper ores have been investigated and theoretically based. A new technology for copper, molybdenum, zinc and lead extraction has been developed (Sup.: DSc(tech.) A.Hovsepyan).

Institute of Geological Sciences

Major achievements

The textural and chemical observation on phenocrysts and bulk rock chemistry suggest two different levels of magma chambers: cooler hydrous crystal-poor melts of upper crustal levels that generated the older ignimbrite units and (ii) hotter anhydrous crystal-rich melts of middle crust that led to the formation of the younger units. Application of numerous thermo- and barometers indicates at least two magma chambers, which were formed at depths around 10 to 13km and ca. 25km for the older amphibole-bearing and the younger amphibole-free units, respectively. With progressing volcanic activity, chamber(s) of successively deeper levels have been tapped during Plinian to Sub-Plinian eruptions (Sup.: DSc(geol.) Kh. Meliksetyan).

Assessment method of the rocky soils transfer speed during an earthquake, the ultimate magnitude of the accelerations, and clef emergence possibility on the ground has been elaborated, depending on the border magnitude of the soil layer slide deformation, the magnitude of the earthquake and the epicenter distance. The primary research demonstrated that in case of $6.0 \le M \le 7.5$ magnitude earthquakes in the epicenter zone the magnitudes of the soil transfer and accelerations can correspondingly reach up to 3.11cm and 1800cm/second^2 and cause apparent clefs in the rocky territories of the soil (Sup.: acad. E.Khachiyan).

The Ararat depression is not a graben and normal faults controlled structure; rather, based on detailed observations, structures in the study area are interpreted as oblique-slip reverse and thrust faults initiated in post Oligocene-Miocene time. The Armenian portion of the Ararat depression contains outcrop of obduction-related napes of oceanic crust. Syn and post Carboniferous volcanic activity was discovered in Khor Virap section (Sup.: DSc(geol.) A.Avagyan).

As a result of the mineralogical-geochemical studies of the open mine terrace documentation of Kajaran copper-molybdenum deposit, the prospects of gold and silver content in the ore, the peculiarities of allocation, as well as the prospects of gold and silver bearing in individual minerals have been determined (Sup.: cand.(geol.) A.Hovhannisyan).

Focal mechanism solutions of 58 earthquakes have been calculated and a catalogue of corresponding parameters has been compiled (Sup.: cand.(phys.-math.) H.Babayan).

Raster model of surface flow layer height for Sevan RBD has been developed. Methodology for assessment of water resources vulnerability from climate change has been developed based on the raster model of surface flow layer height and projected values of climatic parameters change (Sup.: cand.(tech.) A.Arakelyan).

Outcomes of applied developments

Engineering-geological studies have been carried out on the Tumanyan activated landslide. The activation reasons have been revealed and mapping has been done. Suggestions to stabilize the landslide have been formulated (Sup.: cand.(geol.) D.Arakelyan). Engineering-geological (Sup.: cand.(geol.) H.Baghdasaryan) and geophysical (Sup.: cand. (geol.) H.Babayan) complex examinations, as well as sliding slope stabilization calculations (Sup.: cand.(geol.) D.Arakelyan) have been carried out. Drainage areas have been suggested. The emergence reason of unexpectedly high anomalous contents (of water contamination) of several basic components in the composition of waters coming out of horizontal boreholes has been clarified (Sup.: cand.(geol.-min.) H.Shahinyan).

Phosphorus concentrates have been acquired from high ferrum and low phosphorus clay diatomites and their volcanic varieties (Sup.: DSc(geol.-min.) T.Avagyan).

A computer program has been developed for search and retrieval of terms in electronic dictionaries in the library of the Institute. The contents of virtual environment for earth sciences (vgse.geology.am) have been updated (spatial data and metadata), the user interface has been improved (Sup.: cand.(geol.-min.) A.Avagyan).

Institute of Geophysics and Engineering Seismology after A.Nazarov

Major achievements

Methods for X-ray radiometric testing of vein type ores have been developed and interpretation of obtained anomalies with the use of various probes devices and measuring instrumentation has been created ((Sup.: cand. (geol.) A.Tamrazyan).

Seismotectonic characteristics of strong earthquake focal zones have been given based on the " focus-capacity" concept and a scheme map has been compiled for seismically active blocks of the earth's crust in Armenia. According to the well-known empirical dependences, the maximum possible magnitude value has been estimated within the limits of these blocks (Sup.: cand. (geol.- min.) H.Gasparyan).

To solve the problems of engineering seismology a portable seismic sensor with their own frequency of 1 Hz has been manufactured and tested (Sup.: A.Gasparyan).

Outcomes of applied developments

Global monitoring modern seismic stations have been designed and established in Aragats and New Amberd.

A remote measuring and control system has been developed and established in Turkmenistan aimed at determining the water level (Sup.: cand. (geol.) J.Karapetyan).

A mobile measuring and control system has been designed, manufactured and applied to determine the water level in mines ((Sup.: S.Shakhparonyan).

DIVISION OF ARMENOLOGY AND SOCIAL SCIENCES

Academician - Secretary - academician Yu.Suvaryan

Scientific Secretary - cand.(philosophy) H.Kocharyan

The Division consists of the Institute of History, the Institute of Economics after M.Kotanyan, the Institute of Philosophy, Sociology and Law, the Institute of Language after H.Acharyan, the Institute of Literature after M.Abeghyan, the Institute of Oriental Studies, the Institute of Archaeology and Ethnography, the Institute of Arts, Shirak Centre for Armenian Studies, "Armenian Encyclopedia. Publishing house". All Armenian foundation for financing Armenian Studies acts in the frames of the Division.

The Division includes 7 academicians and 18 corresponding members.

In 2018 three general meetings of the Division were held.

At the annual general meeting of the Division on March 27 academician Y.Suvaryan's report on "The main results of scientific and scientific-organizational activities of the Division" was discussed and approved. The following scientific reports were heard: "Historical significance of the restoration of the Armenian new statehood" (acad. A.Melkonyan), "Artsakh issue: history, the new stage of struggle and the main ways of its solution" (corr. member A.Manasyan), "From the first agriculturers to statehood" (corr. member P.Avetisyan), "Kemalist Turkey's genocide policy towards Armenia" (NAS RA foreign member Z.Msrryan). DSc V.Ter-Ghevondyan, the director of M.Mashtots Matenadaran, was elected as a member of the Bureau of the Division.

On April 27 at the general meeting of the Division the report of NAS RA foreign member G.Areshyan on "Problems of studying the historical dynamics of Armenian identity" was heard. The candidacy of DSc (phil.) V.Katvalyan for the vacant position of the director of the Institute of Language was discussed and approved. DSc(phil.) A.Zakaryan's candidacy was discussed for the post of the editor-in-chief of the Historical-Philological Journal of NAS RA. Academician A.Melkonyan was elected as the chairman of the editorial board of the "Historical-Philological Journal" of NAS RA.

At the general meeting of the Division on June 6, the scientific report of corr. member A.Sargsyan "Current state of Western Armenian language and perspectives of its integration with Eastern Armenian Language" was heard. The candidacy of academician A.Melkonyan for the vacant position of the director of the Institute of History was discussed and approved.

In the reporting year the Division held 12 sessions of the Bureau.

The following issues were discussed and approved: the 2018 working plan of the Division and scientific organizations of the Division, state targeted applications of 2019 maintenance and development of the financial and technical basis of the scientific and technical-engineering work, 2017 current reports on implementation of the above-mentioned projects, 2018 applications for post-graduate studies, annual general meeting program of the Division, the membership of scientific councils of the Institutes of History, Philosophy, Sociology and Law, Language, the editorial staff of the "Fundamental Armenology" electronic journal, the plans and deadlines for scientific councils of the Division, long-term programs for Armenology and social sciences, the process of preparing for publication of the first part of the first volume of the "Armenian History", activation of international relations of the Division institutions and other issues of scientific-organizational character.

During the sessions of the Bureau of the Division the process of implementation of the program of activities through recommendations of the committees on the effectiveness of the activities of the Division institutions was heard and discussed.

The year 2018 was a jubilee year for the NAS RA system, including the Division. The Academy of Sciences of Armenia celebrated its 75th anniversary. Within the system of Academy of Sciences the Division of social sciences was also established, Institutes of History, Language and Literature were grounded. The Division organized a series of scientific events within the framework of this jubilee.

The Division organized and realized an international conference dedicated to the 100th anniversary of the Republic of Armenia and May heroic battles. Jointly with the RA Ministry of Diaspora the Division organized also an international conference dedicated to the 175th anniversary of the publication of the "Bazmavep" periodical.

On February 23 the Division organized an international conference "Artsakh in the crossroads of the Armenian statehood" dedicated to the 30th anniversary of the Artsakh Movement's new cycle.

On December 20 at the session of the Bureau the scientific and scientific-organizational activities of the scientific organizations of the Division for 2018 were discussed and approved.

Three volumes of "Historical-Philiological Journal", "Herald of Armenology" and "Journal of Social Sciences", as well as two volumes of English electronic journal "Fundamental Armenology" were published.

The Institute of Language after H. Acharyan has published two volumes of the "Language and Linguistics" journal, the Institute of Arts has published three volumes of "Kanthegh" journal.

128 books (7 abroad), 17 textbooks and manuals and 1031 articles (369 abroad) were authored by the staff of the Division scientific organizations. The second volume of the Encyclopedic Dictionary was published.

Institute of History

Major achievements

The first book of the second volume of the multi-volume “History of Armenia” was published. It covers the period from the beginning of the 4th century to the middle of the 9th century. The book elucidates the adoption of Christianity, establishment of Persian-Byzantine and Arab rule, the Armenian liberation struggle, socio-economic life, history of culture and other issues.

Within the framework of the theme "The Armenian Statehood from the Ancient Times to 1918" (Sup.: acad. A.Melkonyan) various aspects of the political and socio-economic history of the Vaspurakan Armenian state in the VI-XI centuries have been covered, the features of the development of this feudal region have been worked out. Based on the analysis of narrative sources, some issues of the history of other Armenian political entities have also been interpreted.

The armed struggle in Baku in March 1918 has been highlighted on a broad source-study basis and in the frame of the October events of 1917 in Transcaucasus. This struggle is one of the rare manifestations of a united struggle of Armenian leaders representing different political and military centers. The goal of this work is also to reveal the roots of the Azerbaijanian falsification.

Institute of Archaeology and Ethnography

Major achievements

In the reporting year Washington's annual Folklore Festival (Folk Life Festival) was dedicated to Armenia. The scientific research group of ethnologists and Cultural Studies specialists of the Institute, together with the US-based Smithsonian Institution, one of the world's largest museums and research centers, elaborated and realized a project named "Armenia: Creating Home". The work performed in terms of presenting a concept of targeted collection, scientific description and exhibition of the most prominent elements of folk culture, which is vigilant of today's household and economic life, has no precedent for similar festivals international practice: it was highly appreciated by the organizers of the festival. Eleven pavilions representing Armenian wine-making culture, Armenian bakery tonratun with baking and distributing lavash bread, writing, needlework, carpet weaving, khachkar and many other elements of culture received about 800,000 visitors in 10 days (Sup.: corr. member L.Abrahamyan).

As a result of excavations of the new site Lernagog 1 and study of corresponding materials, an ancient settlement was revealed and researched dated to the 8-7th millennia BC, which introduces the culture of the Early Holocene pre-ceramic Neolithic (PPNB/C) period. The results and new data from the excavations are an important contribution to the sphere of understanding the mechanisms of formation of the first agricultural societies in the Near East, as well as to studies related to the area of their spreading. These works evidence the existence of a new centre with parameters typical to the core zone of “Neolithic revolution” in the regions to the north of river Araxes (Sup.: A.Petrosyan and M. Arimura).

Outcomes of applied developments

Significant work has been done in the field of historical and cultural heritage, preservation, restoration, museum enrichment, excavations and field research. The fortress of Dashtadem, Mastara's newest antique dwelling, 6 church complexes, and 1 oil-press were excavated. To include in the list of historical and cultural monuments of the Republic of Armenia, the Ministry of Culture of Armenia has been provided with data of more than 350 ancient sites discovered by the Institute's expeditions.

800 units of historical and cultural values - bronze, iron, glass, bone and stone materials and objects have been reconstructed and prepared for passing to museums (Sup.: corr.member P.Avetisyan).

Total of 1441 units of books have been included in the Koha Online catalogue from the G.Areshyan nominal fund. An electronic data base of the periodicals of the Institute has been prepared, which was placed at the electronic site of the Institute.

Due to the efforts of the group of Applied Ethnography, 1049 pages of materials of the Protocols of Marxism-Leninism archives located in the Republic of Georgia and concerning the Politbureau meetings of Transcaucasian Federation were brought to Armenia (Fond 13, lists 1, 12, 13, 14, on the whole 24 cases). After elaboration, these documents will be included in the archives of the Institute (Sup.: DSc(hist.) H.Kharatyan).

Institute of Oriental Studies

Major achievements

Within the framework of the program "Armenia and the Problems of Political, Social, Cultural and Ethnic History of Turkey, Iran, Caucasia and Arabic Countries of Mashriq" (Sup.: acad. R.Safrastyan) the Institute has brought forward and substantiated with a monograph a new conceptual approach according to which the mass uprisings taking place in the Arab world since 2011 known as "Arab Spring" are an effort to modernize the political and economic life in the modern world. This approach allows to interpret the rapid changes in the Arab world in a new way.

Within the framework of the program "International relations in Near East, Eastern Asia, South Caucasus and the Republic of Armenia" (Sup.: corr. member N.Hovhannisyan) the researchers of the Institute after studying the implementation of the "soft power" policy by the example of Turkey and China, have come to the conclusion that in the modern world that policy is of great importance and without its comprehensive and detailed study it is impossible to analyze thoroughly the regional and geopolitical processes.

Outcomes of applied developments

The researchers of the Institute have periodically provided scientific and scientific-analytical materials contributing to the development and realization of several main directions of the foreign policy of RA to the relevant authorities. The head of the Institute has had numerous meetings with foreign diplomatic missions in Armenia and during those meetings, based on the results of studies, the main trends of the foreign and internal policy of RA and of regional developments have been presented. The employees of the Institute have been actively involved in the discourse around the RA foreign policy and have presented the results of their scientific research.

Institute of Language after R. Acharyan

Major achievements

Important observations have been made within the topic 'Issues in General-Comparative and Applied Linguistics' (Sup.: DSc (phil.) V.Hambardzumyan). The following topics have been

examined: relationship between language and culture; relationship between language and religion; the role of public and psychological factors in the history of the language; lexicographical issues in the South Caucasian territory have been interpreted from the viewpoint of the linguistic geography; the results of the first experiments on the use of modern statistical methods in Armenian linguistics have been presented. A number of remarkable lexical and etymological adjustments and additions to the Armenian etymological dictionary have been done. Materials for the Armenian historical dictionary are prepared, the first volume of the etymological dictionary is ready, the vocabulary units relating clay and wood processing have been studied giving the etymological classification of the units.

Within the frames of the topic "Problems of the Historical Development of Armenian Language" (Sup.: cand.(phil.) G.Mkhitaryan) new data have been obtained as a result of the semasiological examination of native Armenian vocabulary of certain semantic groups. The study of grapes and wine relating semantic group in the vocabulary of Grabar (Old Armenian) has been completed. Within the study of the lexical and grammatical patterns of the classical Old Armenian language, the morphological and world-building structure of the verb paradigm units has been described, the voice of the verb has been examined, the military vocabulary in Movses Khorenatsi's "History of Armenia" has been studied.

Historical development of explanations on grammatical categories of Western Armenian in the educational manuals used in Diaspora has been observed. The canonical forms of the Western Armenian verbs, adverbs, prepositions, conjunctions, and interjections in Western Armenian have been determined, and the grammatical rules have been systematized and presented (Sup.: corr. member A.Sargsyan).

A great deal of work has been done in the study of dialectal units currently functioning in the territory of Armenia within the topic "Study of Armenian Dialects" (Sup.: DSc(phil.) V.Katvalyan). The first phase of the complex program called "The Dialectal Overview of the Republic of Armenia" has been completed, the general descriptions of Mush, Bayazet, Diadin dialects, Gandzak mid-dialect, and Maku and Artsap speeches used in the Region of Gegharkunik have been given, the peculiarities of those dialectal units in the Region have been defined, dialectal descriptions of 52 settlements have been set down, dialectal speech samples have been recorded, a comprehensive glossary of dialectal words has been created.

Outcomes of applied developments

Research works in the field of Armenian Studies contribute to clarification of the national identity issues, history, culture, national character, psychology, development stages and perspectives, as well as revealing and valuing the essential features of the Armenian people, civilization peculiarities. The results of our studies are important in terms of general linguistics, and they are valuable for a number of adjacent fields. A lot of works are also of practical significance. Each volume of "New Words" is demanded both by the specialists and the public in general, the materials prepared by the specialists of the Institute and designed for the theory and practice in language science are used in the university system and in other educational environments.

In the reporting year, the following works of that kind have been prepared in the Institute: Manual for Grabar authored by V.Hambardzumyan, An Essay on Orthoepy of the Modern Armenian Language (tutorial, authored by S.Tioyan and co-authored by F.Khlghatyan), Armenian Language Study Manual authored by O.Khachatryan (with a co-author).

The website *hamabarbar.am* (created by cand.(phil.) F.Hakobyan) has been launched, with a large database of electronic concordances that will greatly enhance the use of electronic concordances in linguistic research, and assist the synchronic and diachronic study of language data.

Another website *appliedlinguistics.am* has been created (by cand.(phil.) F.Hakobyan), which aims at presenting scientifically relevant problems of applied and computer linguistics. It can be useful for linguists, linguist-programmers, students, and for a wider range of scientific society.

Institute of Literature after M.Abeghyan

Major achievements

In the field of "The History of Armenian Literature" the creation of series of books named "The 5-17th century Armenian sources about European countries" (Sup.: DSc(phil.) V.Devrikyan) has been carried out. The first volume dedicated to Spain and Portugal has been prepared for publication. Series of books will represent the historiography, chronology, travelogues, geographical works, literature and verse of the Armenian medieval authors about the European countries.

The principles of translation of the 5th century historiography have been carried out in the field of literary theory. The original historical text in Classical Armenian (grabar) is compared to its translations in modern Armenian, Russian and English. The similarities and differences of the original and translations have been revealed due to the principles of word for word and semantic translations.

Outcomes of applied developments

In the field of Armenian ancient history studies two hundred pages album "History of Armenia" (Sup.: DSc(phil.) V.Devrikyan) has been published. The Album combines the works of Armenian historians and the 19th century Italian artists who painted on the themes of the history of Armenian people. This Album is designed for a wide range of readers. It shows the reproduction and interpretations of the Italian painters of the Armenian history episodes.

Institute of Philosophy, Sociology and Law

Major achievements

In the frame of the theme "Historical-philosophical, socio-political and legal studies of the Armenian reality" (Sup.: acad. G.Poghosyan) in the context of transition to a parliamentary system of government in Armenia, theoretical and applied research has been conducted to address social-legal, political and migration processes and an analysis of the results of the 'Velvet Revolution' in Armenia has been made.

Both planned research in four principal scholarly directions (philosophy, sociology, law and political science) and empirical sociological studies related to an in-depth analysis of the socially significant phenomena have been conducted. The sociological studies were organized and conducted jointly with the authoritative international organization Gallup/Baltic Survey, which is funded by the US International Republican Institute. The findings were then presented to all governmental, political party and non-governmental organizations concerned and to mass media.

For the first time, opportunities for introduction of consociational democracy in the South Caucasus countries have been studied within the context of a holistic discourse.

For the eighth consecutive year the international conference *Philosophy in the Present-Day World* was held in the Institute on the occasion of the *World Philosophy Day* established by UNESCO.

The most important findings of the research conducted in the Institute and the proposed recommendations were published in monographs and in a number of scholarly articles both in the Republic of Armenia and abroad.

Outcomes of applied developments

In the field of applied sociological research, three public opinion polls were conducted to study the "Velvet Revolution" that occurred in the country, the preparation for parliamentary elections and the election campaign. The public opinion polls were carried out jointly with the internationally recognized BalticSurvey/Gallup organization on the initiative of the International Republican Institute (IRI, US). A separate public opinion poll was also conducted prior to the Yerevan City Council elections.

The results of the public opinion polls and their analysis were presented in detail to the Armenian authorities, political parties, non-governmental organizations and analytical centers and they received extensive coverage in the country's media.

Institute of Economics after M. Kotanyan

Major achievements

Within the scope of the Research project entitled "Approaches to Identifying Unreported Sales Revenue and Constraining the Chances for Tax Evasion Practices in the Republic of Armenia" (Sup.: corr. member V.Harutyunyan) it has been shown that during the last two decades, scholars from various countries were focused on researching "informal and or/shadow economy" phenomenon, since among priorities of economic development of nearly each country identification of the size of the shadow economy and the reduction thereof is stressed. The research, in details, provides the impact of new tax administration mechanisms and new tax code, in effect, on collecting the state budget revenues, reducing the size of the shadow economy, and minimizing corruption risks by stressing the importance of ensuring equal competitive conditions; various issues of practical implications have been discussed and addressed by providing possible solutions as well.

The research has been carried out to identify the causes, economic and political facts that explain the emergence of the informal sector and the growth of the size of the underground economy in the context of measuring the size of the shadow economy and elaborating respective measures to reduce the size of thereof.

Within the scope of the research project entitled "Issues on Developing Nuclear Energy in the Republic of Armenia" (Sup.: cand. (econ.) H.Markosyan) by structuring the global trends on developing nuclear energy sector it has been shown that the sector development perspectives under the conditions of current technology development are highly subjective and are under the doubt, associated with the decline in the supply of nuclear fuel, lack and the quality of nuclear wastes' processing technologies, and of nuclear fuel supplied; lack of storage facilities for permanent maintenance of nuclear wastes; constant decrease of the number of new reactors to be exploited, constant decrease of per unit cost while exploiting the renewable energy; competitiveness increase; and other factors.

Within the scope of the research project entitled "Export Promotion and Import Substitution Issues in the Republic of Armenia" (Sup.: cand.(econ.) L.Sargsyan) it has been justified that export of the Republic of Armenia was highly concentrated: the average share of 4 product groups (precious stones and metals, base metals and articles thereof, products of prepared food, mineral production) in the total exports amounted to 82.99% in the period 2000-2016. It is noteworthy to state that intermediary goods exports prevailed over the exports of other goods and the value added thereof created in the production is vulnerable to the changes in the global prices thereof. The trade deficit-to-GDP ratio of the Republic of Armenia comprised more than 16% in 2016 pinpointing the fact of significant trade imbalance.

Outcomes of applied developments

Within the scope of the research project entitled "Approaches to Identifying Unreported Sales Revenue and Constraining the Chances for Tax Evasion Practices in the Republic of Armenia" (Sup.: corr. member V.Harutyunyan) the studies conducted have shown that the tax revenue-to-GDP ratio almost has not been changed in the recent years (21.1% in 2017, 21.6% in 2018 and 20.7% is predicted for 2019), which means that the significant reduction of the size of the shadow economy or improvement of the tax administration hasn't been reported so far and is not expected, therefore, the analysis of the measures aimed at reducing the size of the shadow economy has been carried out focused on enhancing the effectiveness of public administration as well as proper enforcement of legal norms.

In the framework of the studying the main purpose of the research, the main cause-roots of the shadow economy have been presented and classified in accordance with different variables and factors such as the industries of the economy, the size of the company, current risks, and problems in legal

and administration system, and etc. Applied research recommendations have been made in relation to the formulated research questions. Furthermore, specific mechanisms have been proposed to regulate the shadow economy in accordance with ensuring the goals of the state-national interests, and national security, and without hindering the activities of the law-obedient taxpayers, and increasing the effectiveness of identifying those companies that operate, do business (partially or fully) in the informal sector of the economy.

Within the scope of the research project entitled "Issues on Developing Nuclear Energy in the Republic of Armenia" (Sup.: cand. (econ.) H.Markosyan) the studies conducted have shown that it is not expedient to build a new energy block of the Armenian Nuclear Power Plant, since the global trends on constructing the NPPs is characterized by constantly increasing estimated budget and non-compliance with deadlines. The construction of new nuclear blocks in the world is reducing, which shows the decay of economic interest towards the sector. In 2016, the construction of 3 reactors was launched (one in Pakistan and two in China), while in 2017 only the construction of one block was launched in India.

Within the scope of the research project entitled "Export Promotion and Import Substitution Issues in the Republic of Armenia" (Sup.: cand.(econ.) L.Sargsyan) the findings obtained state that along with producing competitive items the studies prove the necessity to elaborate specific mechanisms that would promote the exports thereof. For that purpose the expansion of the Armenian trade representations abroad has been proposed as well as the necessity to obtain trademark certifying the quality and the promotion thereof through all the possible marketing channels along with the participation in different fairs has been substantiated. It has been also proposed to create the export platform of the Republic of Armenia to support the exporting firms of the Republic of Armenia, where the registration of the firms will be voluntary and with low membership fee. The exporting firms will present their assortment in the mentioned platform, while the trade representation of Armenia will be in charge of promoting the platform.

Within the scope of the research project entitled "Issues of Agricultural Insurance in the Republic of Armenia" (Sup.:cand.(econ.) M.Manucharyan) the studies conducted prove that the main precondition for introducing a viable insurance system is the comprehensive assessment of agricultural risks. For that purpose, it has been proposed to carry out comprehensive risk assessment programs at the expense of the state budget. Considering the costliness of introducing a viable agricultural insurance system, and the factors that hinder the promotion of this process, it should be implemented by stage by stage (and or gradual) approach. The implementation of experimental (pilot) programs in large economies and specific regions is considered a required and necessary precondition before introducing the agricultural insurance system, namely with respect to specific number of risks. In the Republic of Armenia, it is appropriate to commence the insurance of agriculture with insuring the risk of thunderstorms.

Within the scope of the research project entitled "The Cluster Mechanisms for Innovative Development of the Defense Industry in the Republic of Armenia" (Sup.: cand.(econ.) G.Harutyunyan) it has been proposed that the Government needs to initiate respective steps aimed at creating defense industry clusters simultaneously in several regions of the Republic of Armenia, namely by considering the Defense Aviation Repair and Maintenance Military Unit (or Defense Aviation Repair and Maintenance Plant) as the core of the cluster in Gyumri; with Patnesh CJSC being the core in Hrazadan; considering the 65th military factory CJSC as the core in Yeghvard; while Goris Gamma OJSC being considered as the core of the cluster in Goris. The initiation of clusters are justified and are based on the availability of the respective industrial, science and education, and transportation infrastructure, related and supporting industries (although limited), and on the demand for making the development of the regions more equitable.

Institute of Art

Major achievements

The monograph by corresponding member of NAS RA A.Aghasyan „The loss of Armenian fine and applied arts on the territory of the Ottoman Empire (from Hamidian massacres till nowadays)" was

published, where in the form of a short historical essay the huge and irreparable damage, which was caused to Armenian art of that period, is presented. Basing on the works of Armenian and foreign researchers, numerous articles, memoirs and letters of witnesses and bystanders on this topic, as well as on available archival documents and materials, the author brings solid and irrefutable evidence of planned, felonious extermination and misappropriation of manuscripts, as well as monumental frescos, mosaic panels, icons, decorative sculptures and khachkars, works of ecclesiastical art and applied folk arts of high artistic merit once kept in Armenian monasteries and cathedrals. Examples made by A.Aghasyan eloquently witness to cultural vandalism towards invaluable monuments of Armenian art, which reached its apogee in the reign of sultan Abdul-Hamid II and the Young Turks and is periodically committed till nowadays.

The unfinished manuscript of one of the outstanding researchers of Armenian medieval art N.Kotandjyan "The monumental painting of early medieval Armenia (IV-VII centuries)" has been published.. The book dedicated to early medieval Armenian frescoes and mosaics has a wide historical coverage – from the appearance, dissemination and official adoption of Christianity in Armenia till the period of Arab invasion. The author addresses to the problem of appearance of monumental painting in Armenia, shows its origins, covers the history of scientific study of Armenian monumental frescos and art of mosaic, specifies the peculiarities of decorative programs composed by Armenian theologians, examines those artistic movements and tendencies, which defined the development of early medieval Armenian monumental painting, draws stylistic and iconographic parallels between the art of Armenia of those times and other Christian countries.

Shirak Centre for Armenian Studies

Major achievements

In the scope of "Shirak's archaeological and historio-ethnographical studies-2" program (Sup.: DSc(phil.) S.Hayrapetyan) during the expansion of the Mets Sepasar's excavation site, three adjacent shelters of the Bronze Age were revealed, where the abundance of stone found in various tools allows to determine that excavations are the oldest stone tools. The burial materials found during the rescue excavations of Jrapi and the abundance of Urartian materials dating back to 7th century BC are unique facts that testify the interrelations of Shirak's native tribes and Urartians living in 7th century BC. The excavations of Azatan have completely reestablished the fact that the settlement and the fort were declining in the 8th-7th centuries. In the castle the invention of absorbed cellars is a novelty in the housing architecture of ancient Armenia.

The locations of Virtirukh Etiun country/11-12 c. BC/ and its capital Amigui have been specified and new etymologies have been proposed for the names of the *Shirak Tekor/ Tikor* river and its coastal settlement *Tikor/ Digor.* The centers having light and sun worship have been discovered in the cuneiform country Etiuni by the corresponding etymology of cuneiform toponymes and linguistic-ethnographic facts having the indication to prove that the population in Etiuni country had predominantly Indo-European-Armenian descent, cult and structure typical of Indo-Europeans.

National Bureau of Expertise SNPO

Major achievements

As a result of participation in research activities, including conferences and workshops, holding seminars, as well as of other activities (scientific-methodological, scientific-research, scientific-practical, scientific-experimental-analytical, scientific-educational) scientific support for organizations and implementation of forensic expertise (physical and technical examinations and chemical expertises, food products and drinks, ecological, soil and biological, economics and accounting, construction and technical, engineering and technical, commodity, firearms, traceological, photo-

technical, portrait, audio and video, handwriting, authorship and document, road accident circumstances, technical state of vehicles and transport-traceological, arson and explosives, cultural, forensic medical, computer and technical, psychological) have been implemented with the use of methods appropriate to modern scientific concepts of forensic expertise.

The Organization took part in the following events:

- International Congress on "Actual Problems of Forensic Medicine and Expert Practice-2018'' (Moscow, the Russian Federation),
- International scientific and practical conference "Criminalistics and Forensic Expertise: Present and Future Effective Weapon in Combating Corruption" (Chisinau, the Republic of Moldova),
- the 30th Annual Meeting of the European Network of Forensic Science Institutes (ENFSI) (Budapest, the Republic of Hungary),
- International scientific and technical conference on "Current issues of standardization of forensic support of justice in Ukraine. Development prospects" (Kyiv, Ukraine),
- International Scientific and Practical Conference "Current Issues of Forensic Expertise and Forensic Science" (Kharkiv, Ukraine),
- a conference and several events dedicated to the 75th anniversary of the National Academy of Sciences of Armenia.

The Organization and Kharkiv Research Institute of Forensic Examinations of the Justice have signed an agreement on cooperation, active work has been launched aimed at developing mutually beneficial cooperation in scientific-methodological and scientific-research directions, emphasizing the importance of deepening cooperation in the field of training of highly qualified personnel, conducting joint scientific researches in the field of criminalistics and forensic expertise and in other related areas.

Taking into account the fact that at present the state competent bodies in the Republic of Armenia assign a number of complex and extensive expertise in the National Bureau of Expertises on various expertise and new subspecies as well as taking into account the credibility of the ongoing expertise and the importance of continuing the provision of results, the scientific and organizational experience in the performance of forensic examinations in international partner organizations has been studied, which allowed not only to preserve, but also to ensure the development of the infrastructure of the forensic research. In this regard, it is important to note that in 2018, new partnerships were established with European partner law enforcement agencies, including the Estonian Institute of Forensic Medicine, with the Director of the Estonian Institute of Forensic Medicine, as well as newly appointed Ambassador Extraordinary and Plenipotentiary of Japan to the Republic of Armenia, Mr. Jong Yamada, with the aim of introducing the latest technologies, methods and equipment, replenish and expand the relevant logistics base and capabilities of the expert subdivisions' laboratories etc. In order to ensure the continuity of the INL program and the involvement of the National Bureau of Expertises in various Japanese and European programs, relevant written petitions were made by the RA General Prosecutor's Office and the Ministry of Foreign Affairs of the Republic of Armenia.

The experts of the Organization have participated in the CEPOL Training Program of the European Union Law Enforcement Agency Training Agency.

For the first time the Organization has implemented the introduction of a new dendrochronology instrumental scientifically validated research technique in the field of forensic science, with the implementation of the LINTAB LTM06-E model and the TSAP-Win computer program. In this regard, extensive work has been carried out in the Ecological, Soil and Biological Expertise Department of the Organization for the creation of databases on the intensiveness of trees in different regions of Armenia, as well as the preparation of digital maps on the trees and their distribution in selected areas.

Based on the memorandum signed between National Bureau of Expertises and Rostelecom Armenia, the process of PC Crash computer program and Implementation of the VZM 300 Express Pulse Apparatus have been carried out.

The Organization has completed the following international scientific-research projects:

- NATO's "Science for Peace Project. EAP. SFPP 984597, Solid state gas sensors against security and military threats",
- "Molecular pathogenesis of mitochondrial OXPHOS diseases" A-2151 funded by the International Science and Technology Center (ISTC).

Outcomes of applied developments

The Organization performed 9825 judicial expertise during the year.

The following manuals have been published by the relevant departments of the Organization during the reporting period:

1. "Burnout syndrome among doctors, deficiencies in providing medical care",
2. "For the psychologists involved in criminal proceedings in cases involving juvenile victims or witnesses",
3. "Behavior with evidence of biological origin and nature traces"
4. "Women's crime problems in the Republic of Armenia".

A significant amount of work has been done in the Organization with the aim of successfully implementing international accreditation of the expert departments of the Organization through a national or international (European or American) competent structure. In this regard, effective discussions and work have been carried out with the head of the Quality Assurance Department of the Estonian Forensic Science Institute during which the expert and quality assurance departments of the Organization have also discussed scientific-research activities in different narrow directions aimed at increasing the reliability of the ongoing expertise, as well as a number of other issues related to the involvement of the ‘’National Bureau of Expertises’’ SNPO in a series of international grants.

The Nuclear Technology Safety STC of Kazakhstan and the National Bureau of Expertise of the Republic of Armenia have developed and submitted to funding a pilot project on the development of the universal model on the program of export control in chemical industry. The purpose of this pilot project is the development of export control regulatory documents that will provide organizational and methodological support to a number of companies and organizations in post-soviet countries in the international exchange of goods and services, as well as in the export control system of the internal compliance program. The program was presented during the third seminar on " Export Control on Dual-use Materials and Technologies in Central Asia" held in Yerevan.

STATE TARGET PROGRAMS

Creating a cloud computing environment for solving scientific and applied problems

Coordinator V.Sahakyan, cand.(phys.-math.), deputy director of the Institute for Informatics and Automation Problems

The program was aimed at addressing the problems of natural sciences (in the sphere of hydrometeorology, nature protection, seismology, biology and ecological monitoring of Lake Sevan) and the development of a cloud infrastructure using the national e-infrastructure.

Leading specialists took part in the program from the Institutes of Informatics and Automation Problems, Geological Sciences, Geophysics and Engineering Seismology after Nazarov, Institute for Physiology after Orbeli, International Scientific and Educational Centre, Ministries of Emergency Situations and Nature Protection, as well as the following organizations that are authorized to carry out monitoring in Lake Sevan and its catchment basin: "Sevan" National Park, "Environmental Impact Monitoring Centre", "Hydrogeological Monitoring Centre", "State Hydrometeorological and Monitoring Service", "Hydroecology and Ichthyology Centre" SNCO of NAS RA.

During the reporting year, cloud infrastructures and services have been studied, which can provide cloud computing resources, applications and storages for solving scientific problems through the network. The main cloud infrastructure has been developed using the OpenStack environment. Storage (Swift), network (Neutron) and processing (Nova) services were studied. The Keystone Identity Management service has been implemented. The cloud storage service has been developed to store the data received from experiments and different calculations. Implementation of scientific metadata storage was run on the basis of iRODS (Integrated Rule-Oriented Data System), open source data management system.

In the field of meteorology, research and scientific activities have been carried on, a number of problems have been solved, such as the implementation of the system of data acquisition and processing from the meteorological stations, the digitization of the historical archive of meteorological data, the implementation and use of WRF (Weather Research and Forecasting) model to gain operational weather forecasts, improvement and implementations of the meteorological workplace design and the improvement of the forecast for meteorological dangerous hazards. A cloud service has been developed to study weather data and verify the accuracy of the weather forecasting models in Armenia, which collects atmospheric components near the Earth surface received from land stations, satellite image processing and weather forecasting models.

In the field of nature protection, atmospheric emission management and an atmospheric air pollution monitoring automated system have been created, as well as the atmosphere pollution mapping, assessment and forecasting system using the WRF-Chem software package for regional air pollution simulation.

In the field of seismology, activities have been accomplished aiming at the development of specialized cloud computing environment, the update of software being used, and technical works have been continued to receive real time data from the seismological network of stations of the Institute of Geological Sciences of NAS RA. In collaboration with the Institute of Geological Sciences, Geophysics and Engineering Seismology after A.Nazarov a database of instrumental registrations has been developed, the parts subject to digitization have been separated and scanned, special tools have been developed to filter the instrumental records and separate seismically useful sections, then digitize and develop them.

In the field of biology, modelling of the previously obtained complex biological system, the complex biological systems for characterizing the processes of a broad spectrum, comparing experimental methods with the results of computer modelling have been carried out. Testing simulations have been performed the results of which have been checked by calculating the average square deviation of the protein atomic positions. Other parameters have been calculated, in particular, the amount of native contacts depending on time, the dependence of protein-bilayer minimal distance from simulation, as well as different diffusion coefficients. Software modules and codes have been developed for the MD data analysis. An Interactive Data Visualization Platform has been developed

and implemented for molecular dynamics modelling. The suggested Platform is an integrated environment to analyse, process and visualize the scientific data.

In the field of environmental monitoring of the Lake Sevan works have been carried out on the improvement and technical maintenance of the previously existing software platform of Lake Sevan and its catchment basin monitoring single electronic database. The environment has been adapted to the modern capabilities of Internet browsers. The components of software platform were updated. The reliability and security of data backup system has been raised.

During the implementation of the State Target Program, the results have been published in 30 articles.

Applied significance of galarmin at different infectious diseases

Coordinator S. Chailyan, DSc(biol.), director of the Institute of Biochemistry after H.Buniatyan

The effect of galarmin and its derivatives on mice streptococcal infection has been studied. The streptococcal infection virulence in internal organs of mice, as well as the antibacterial effect of galarmin d-15 derivatives has been assessed in vitro and in vivo.

The biological activities of galarmin and its analogs have been studied using a molecular docking method, AutoDock Vina software, that showed strong interaction of proline-rich peptides with the intracellular catalytic domain of the epithelial growth factor receptor (EGFR) and with mice mitogen-activated protein kinase 14 (MAPK14). Study of series of peptides, bPrp1, bPrp (-Y), bPrp (-VY) showed that shortening of the molecules was accompanied by a proportional decrease in the energies of interaction with peptides in the both cases. GxNH2 is a shortened copy of galarmin, in which the last proline is amidated. Galarmin and GxNH2 interact with MAPK14 with the same energy, whereas galarmin was 10 times more active than GxNH2 with respect of EGFR.

The interaction of peptides with above receptors occurs in the immediate vicinity of the cluster of β-sheets and may lead to different modulations of these macromolecules with corresponding effects. Taking into account the very strong interaction of the mentioned peptides with EGFR associated with cancer and MAPK14 that directly linked with the inflammatory processes, these peptides may be used as a therapeutic tool. The changes in the activity of some integral marker proteins and lipids metabolic pathways, as well as the modulatory effects of galarmin on these processes were investigated. The influence of galarmin on the activity of the phosphoinositides signaling system key components in human blood lymphocytes was studied. The severity of the inflammatory processes was assessed based on the phospholipase A2 activity. Mann-Whitney test was used to compare the differences between groups. The data obtained shows that treatment of galarmin is accompanied by statistically significant double decrease in the Na/K-ATPases activities and increase in the Ca-ATPase and phospholipase A2 activities by 1.4 and 1.2 times respectively.

The effect of liposome encapsulated galarmin on viability of white mice subjected to lipopolysaccharide (LPS)-induced stress was demonstrated. Stress model was developed by intraperitoneal injection of (E. coli O111:B4) LPS to mice in dosage 1mg/kg. It has been shown that mice treated with liposome encapsulated form of galarmin (25μg/kg) exhibited 20% higher viability compared to mice treated with free peptide.

Monitoring of residual pesticides in food produced in the RA

Coordinator A. Saghatelyan, DSc(geol.-min.), director of the Center of Ecological-Noosphere Studies

Of 280 fruit and vegetable samples, 247 soil samples and 5 soil-like samples from a pesticide storage facility gathered from agricultural lands in 25 rural communities in all Armenia's regions,

pesticide residues were detected in 39 soil samples including three samples from pesticide storage facilities, and 7 carrot samples taken from village of Aramus. In 69 out of all studied fruit and vegetable samples residual mancotseb was detected which did not exceed allowable limits accepted by both the UN and EURASEC.

In carrot samples DDT contents varied from 0.007 to 0.058mg/kg amounting to 0.023mg/kg on the average. In soil samples DDT contents varied within 0.0028-46.49mg/kg constituting 2.01mg/kg on the average. 26 soil samples showed a 1.03-464.9 times excess against MAC accepted in the RA. Assessment of health risk to the population has indicated that the detected contents of DDT can be a carcinogenic risk factor. The implemented research and results obtained underpinned development and subsequent publication of 2 methodological manuals and a guidance intended for soil sampling in order to determine pesticide contents and fruit and vegetable sampling for determining pesticide residues.

Investigations of a strategically important for Armenia limnosystem - Lake Sevan and karyological investigations of bioresources of the lake during the period of water level rise and under climate change conditions

Coordinator B.Gabrielyan, DSc(biol.), director of the Scientific Center of Zoology and Hydroecology

The structural components of Lake Sevan biocenoses and their trophic relations have been studied, bioconditions of hydrobionts in the lake have been assessed and the factors limiting their spatial development have been revealed. To recognize the features of energy transfer the assessment of calorific values of different components of biocenoses has been done and predator-prey relations in different bioforms have been analysed. Assimilation processes have been studied, the effect of drainage basin on the Lake has been revealed. Trophic status of the lake has been assessed.

Studies have shown that due to mild winter and relatively high water temperature during the year the succession processes were activated which affected the pace of processes ongoing in the ecosystems as well as the development cycles of hydrobionts.

In July 2018 algal bloom in Lake Sevan was registered due to intense growth of cyanobacteria of the genus Anabaena. Dominant species were *Anabaena flos-aquae and A. spiroides.* Maximum parameters of phytoplankton community were also registered during algal bloom. The number was 16 528 000 cell/l, and the biomass was 66.122g/m^3. Group changes registered in phytoplankton community of Lake Sevan and algal bloom mainly were caused by temperature rise, water level fluctuations and the growth of biogen compounds (mainly phosphorus).

According to classification of Drachev (1964) water of pelagic zone can be assessed as "from pure to quite polluted" and for littoral zone – "quite polluted".

The results of studies of benthic fauna have shown that during 2018 totally 27 species of animals were revealed: 4 species of Oligochaeta, 3 species of Hirudinea, 1 species from Crustacea, Ephemeroptera and Odonata, 10 species of Chironomids, 3 species of Bivalvia and 4 species of Gastropoda.

Studies aimed to assess predator-prey relationships among fish species of Lake Sevan have shown that the only species out of 8 from 3 families having predator lifestyle is endemic species Sevan trout. Other species are peaceable. The preys for Sevan trout are juveniles of Eastern spirilin, Sevan barbel and Crucian carp. Probably Sevan trout has a significant role in the decrease of low valuable species number in Lake Sevan.

The analyses of the results have shown that the range of calorific values of organic material of hydrobionts is 4.619-6.912 kkal/gr. The lowest values were registered for the macrophytes (Myriophyllum 4.619-4.676 kkal/gr, Ceratophyllum 4.633 kkal/gr) and the highest values – for the fish (crucian carp – 4.882 kkal/gr, whitefish – 6.912kkal/gr).

Trophic status of Lake Sevan has been assessed as mesotrophic.

Mapping the Armenian gene pool

Coordinator A.Arakelyan, cand. (biol.), director of the Institute of Molecular Biology, DSc(biol.) L.Yepiskoposyan, Leading Scientist

The collection of samples of modern and ancient DNA continued. Nineteen DNA samples of ethnic Armenians, whose ancestors originated from the same region of historical Armenia, have been subjected to whole genome sequencing. Earlier, we collected samples of ancient DNA that were used in an international scientific project aimed at studying the population history of the Eurasian steppes after the Bronze Age migrations. The results have been published in "Nature".

Using the methods of computational biology, it has been shown that geographic location and population affiliation affect the distribution of genetic variants associated with chronic diseases. In particular, it has been revealed that the Armenian population carries a specific set of genetic variants associated with the immune system, hematological diseases, skin diseases, cancer and diabetes. These results indicate the need in realization of the national genome project.

The main directions of the comparative study of the Armenians in their and other national environment: challenges and prospects of the research

Coordinator R.Karapetyan, cand. (hist.), Institute of Archaeology and Ethnography

Within the program research works in the Armenian communities of Kiev and Tbilisi have been carried out. One international and one republican conference have been organized, reports have been presented at international and republican conferences and seminars with the participation of foreign experts. Besides, contacts have been established and memorandums of cooperation have been signed with various scientific and community organizations. One monograph and three articles have been published