

**NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF ARMENIA**

**R E P O R T
ON MAJOR RESEARCH OUTCOMES
FOR 2015**



DIVISION OF MATHEMATICAL AND TECHNICAL SCIENCES

Academician-Secretary – academician N.Arakelyan

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 16 academicians, 9 corresponding members, 28 foreign members as well as 4 honorary doctors.

During the reporting year 1 general meeting of the Division was held.

At the annual general meeting held on 2 April N. Arakelyan's report "On the main scientific and scientific-and-organizational results of the Division for the 2014 year" was approved. Scientific reports of the foreign members of NAS RA S.Adian, A.Sergeev, A.Manzhirrov, F.Mkrtchyan (RF), corresponding member B.Nahapetian, DSc(phys.-math.) A.Sahakyan (Institute of Mechanics), as well as cand. (phys.-math.) A.Sahakyan (Institute for Informatics and Automation Problems) were presented at the meeting.

In 2015 8 meetings of the Bureau of the Division were held. The following was considered and approved: the reports of the institutions of the Division for the year 2015, including the programs of basic funding; the working plan of the Division for 2015; the number of the postgraduate vacancies and their distribution among the Institutes for 2015-2016 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; the staff of authorized representatives of the scientific organizations of the Division; applications on maintaining of scientific objects of national value for 2016 as well as on state target programs. The main results of the scientific organizations of the Division, the results of the international and local conferences, organized by the Division Institutes, 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 are 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" (in common with Yerevan State Engineering University) (4 numbers), as well as the electronic "Armenian mathematical journal" (2 numbers).

320 scientific articles and conference theses (including 117 abroad) were published in 2015 by the researchers of the Institutes of the Division, as well as 6 monographs (including 3 abroad), 1 collection of scientific articles and 2 tutorials.

The Institutes of the Division have organized a number of scientific conferences.

7 Candidate's dissertations were defended by the researchers of the Institutes. 9 Candidate's dissertations were defended at the Scientific Councils of the Institutes of the Division.

A number of projects on international grants have been implemented in 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 2015 year were discussed and approved.

Institute of Mathematics

Major achievements

It has been proved that the class of functions $L(\log L)^{d-1}$ is the exact Orlicz class for the sequence of compact operators in $L^1(\mathbb{R}^d)$ converging almost everywhere. This result has applications in some convergence problems of orthogonal series by regular methods (Sup.:DSc(phys.-math.) G.Karagulyan).

Institute of Mechanics

Major achievements

The monograph “Asymptotic Theory of Anisotropic Plates and Shells” has been published by World Scientific Publishing. This version contains the translation of the book “Асимптотическая теория анизотропных пластин и оболочек”, as well as a new chapter devoted to the solution of 3D dynamical problems (Sup.: acad. L.Aghalovyan).

Springer Publishing has published the monograph “Effects of magnetoelastic interactions in thin conductive plates and shells” devoted to the problems of the stability and vibrations of conductive, perfectly conductive and superconductive thin bodies in electromagnetic fields (Sup.: acad. G.Baghdasaryan).

Outcomes of applied developments

Based on the results of fundamental research the following has been confirmed.

In fluid-plastic and smooth-plastic clay slopes the seismic interaction reduces to practical loss of soil-slide resistance. In this case it is appropriate to use the value of soil-slide resistance, determined in laboratory under dynamical conditions of testing.

In case of clay soils of tight structure with rigid and semi rigid consistence the dynamical interactions do not reduce to considerable decay of slide resistance. In calculations of slopes stability it is worth-while to use only the value of forces for seismic interactions and soil-slide resistance determined in static conditions of testing (Sup.:DSc(phys.-math.) S.Hayroyan).

Institute for Informatics and Automation Problems

Major achievements

The problem of monotone binary function recognition has been investigated on multi-dimensional multi-valued discrete grid. A new algorithm has been developed based on a special decomposition of the grid into the set of n-cube isomorphic structures. The complexity estimations have been derived. Special subcases of the problem of numerical characterisation of partitions of n-cube subsets have been investigated such as the upper sets, Sperner families and random sets (Sup: corr. member L.Aslanyan).

Outcomes of applied developments

The study of p-adic numbers and their various performances with the performance of the algorithms of arithmetic operations is in the final stage. A developed Optimizer of recursive functions has been used that gives a tangible advantage when working with p-adic numbers in comparison with existing algorithms. The result has been embedded in the Armenian Nuclear Power Plant on request of Research Institute commissioned by the AU. This has enabled the successful continuation of the research (Sup: corr. member H.Marandjian).

Department of Hydromechanics and Vibrotechnics

Major achievements

Special devices, so-called resonance stabilizers of wave processes (SWP) have been created to stabilize acoustic vibrations and waves in pipeline systems.

SWPs work using the phenomenon of resonance absorption of wave energy along the SWPs due to elastic deformation effect on the flow by elastic elements and permeable coating.

The method developed allows for selection of SWP features so as to ensure simultaneous stabilization of both disturbances of the Tollmien-Schlichting type resulting from viscosity and onset of

turbulences and acoustic disturbances related to elastic waves, including noise clipping in the constructions (Sup.: cand.(tech.) G.Avetisyan).

Outcomes of applied developments

The developed stabilizers of wave processes allow for significantly higher reliability, for noise reduction and in some cases for elimination of accidents and destruction of the construction elements interacting with fluid and gas, such as, for example, in hydraulic systems of machinery and facilities, electric power installations, in constructions of rocket and space engineering and aviation, and in various pipeline systems, including main oil, oil-product and gas pipelines.

The stabilizers developed are effective in attenuating the wave processes and hydraulic shock in pipeline systems of an oil-producing industrial complex (in field pipeline transport, in extraction, in boring).

Usage of stabilizers of wave processes allows the following: significantly lower amplitude of hydroblows (more than a fivefold reduction); a reduction in the pressure oscillations and vibration in pipelines; a reduction in the number of major accidents with pipeline breaking; longer lifetime of pipelines due to reduced dynamic loads and multifold decrease in the rate of corrosion.

Currently negotiations with the leading oil-producing companies of the Russian Federation (in particular, the “Rosneft”, “Transneft”, “Tatneft” and “Bashneft”) are underway to introduce stabilizers of wave processes in the pipeline systems of these companies. Service contracts for experimental development will be made jointly with the Russian Academy of Science Institute for Machine Science after A.A.Blagonravov and the Scientific Center for Nonlinear Mechanics and Technologies (Sup.: cand.(tech.) G.Avetisyan).

DIVISION OF PHYSICS AND ASTROPHYSICS

Academician-Secretary – academician Ju.Chilingaryan

Scientific Secretary – N. Davidyan

The Division of Physics and Astrophysics includes the Byurakan 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 13 academicians, 14 corresponding members and 30 foreign members.

During the reporting year 1 general meeting was held.

At the annual general meeting held on April 2 academician Ju. Chilingaryan presented the main results of the scientific and organizational activities of the Division for 2014. Scientific reports were made by foreign members of NAS RA R. Mirzoyan (Germany), Cajun Lee (Korea), A.Sedrakyan (Germany), S.Avakyan (RF), P.Sukiasyan (France), V.Gordzhyan (USA), A.Khodzhamiryan (Germany), M. Ghazaryan (RF).

During the reporting year a number of national and international scientific events have 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 continued.

The Byurakan Observatory has completed its works on improving and updating the control system of the telescope (2.6 meters). The lubrication system and the spinning dome device have been modified. A new receiver has been prepared.

Since January 2015 a new scientific structure - International Center for Relativistic Astrophysics Center-Network-Armenia has started operating. According to the decision of the National Assembly it has received the status of an international organization (ICRANet-Armenia). The center conducts research in the field of theory of Astroparticles and High Energy Astrophysics.

During the reporting year the Division has held 4 meetings of the Bureau. In particular, the possibility of implementing the proposals of the international scientific advisory board, aimed at improving the effectiveness of the Byurakan Observatory; the most important results achieved by the sub-division in the last 5-10 years and the cooperation with CIS countries have been discussed.

A joint expanded meeting of the Presidium of the National Academy of Sciences and the Division, dedicated to the 50th anniversary of the monthly journal "Astrophysics" was held.

The Institutions of the Division have received 4 licenses. 210 articles (including 117 abroad), 132 theses, 2 monographs and 1 manual have been published.

The Director of the Institute for Physical Research of NAS RA, corresponding member A. Papoyan in 2015 was awarded an honorary award "ICO Galileo Galilei Award" for important achievements in the field of "Spectroscopy of the high resolution of alkali atoms" and valuable contribution to the promotion of experimental nuclear physics in Armenia.

7 Candidate's dissertations were defended by the researchers of the Institutes.

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 2015 were discussed and approved

The following scientific journals are published on Division specialities: “Proceedings of NAS RA. Physics”, “Astrophysics” as well as the electronic “Armenian Journal of Physics”.

Byurakan Astrophysical Observatory after V.Ambartsumyan

Major achievements

The issue of reference point selection in the accelerated Universe has been considered. It has been shown that such a point in the reference frame could be only the cosmological horizon of the observer, since all the points of this sphere represent the same point for the same moment of time. At the observer's point acceleration will be then registered toward all directions resembling gravitational field and corresponding acceleration. The acceleration has been estimated to be equal to the well-

known anomalous acceleration acting on the American probes Pioneer and Voyager (Sup.: cand.(phys.-math.) H.Harutyunian).

For the first time in the WISE two-color diagram positions of the various subtypes of carbon stars have been divided (Sup.: cand.(phys.-math.) K.Gigoyan).

On the bases of optical specters and other parameters a uniform classification of active galaxies has been made. To ensure the reliability of the classification a comparison has been made between the charts of optical and infrared ranges. Optical and multiwaves parameters of each of the types of active galaxies have been described in detail (Sup.: cand.(phys.-math.) A.Mickaelyan).

For the first time in the theory of radiation transfer the laws of layers adding to the media, which contain sources of energy, have been obtained. The issue refers to the determination of the intensity of radiation emitted from the atmosphere in the case when both optical parameters and the emissivity of its components are known (Sup.: DSc(phys.-math.) A.Nikoghosyan).

The statistical analysis of a far (4 kpc) young stellar cluster, located in the vicinity of IRAS 05137+3919 source has allowed to indentify 4 pairs and one triplet. They include the pair of Ae/Be Herbig stars. The percentage and parameters of the multiple systems are comparable with the data obtained in the other clusters in which the percentage of binary systems is comparable with Galactic field (Sup.: cand.(phys.-math.) E.Nikoghosyan).

The modeling method has been developed to study the three-dimensional distribution of supernovae (SN) of different morphological classes. It has been found that in Sa-Sm galaxies, most of Ia - type SN belong to the galactic disk rather than the bulge (Sup.: cand.(phys.-math.) A.Hakobyan).

At the joint Armenian-Russian stations during 180 nights of observation approximately 300,000 measurements have been carried out and the orbits of 600 artificial satellites have been reconstructed (Sup.: cand.(phys.-math.) H. Harutyunyan).

Institute for Physical Research

Major achievements

It has been shown that “guiding” transitions are present in the spectrum among the hyperfine structure of Rb D₁ line excited by a π -polarized radiation in a strong transverse magnetic field. The dependences of the frequency shifts and dipole moments of the guiding transitions on the magnetic field are asymptotic for all other transitions. A Rb nanocell with $L = \lambda/2 = 397.5$ nm placed in a magnetic field (up to 7000 G) has been used to ensure sub-Doppler spectral resolution. The developed theoretical model describes perfectly the obtained results. (Sup.: DSc(phys.-math.) D.Sarkisyan).

An exact solution of the stationary Schrödinger equation for the potential $V = V_0/\sqrt{x}$ has been obtained. The exact equation for the spectrum comprises two Hermitian functions of nonintegral order which are not polynomial. The spectrum is given with high accuracy by the equation $E_n = E_1(n-1/(2\pi))^{2/3}$ with a relative error below 10^{-3} (Sup.: corr. member A.Ishkhanyan).

The influence of the effect of resonance luminescence trapping on spectral and kinetic characteristics of the radiation of laser crystals doped with rare-earth ions has been investigated. Duration of luminescence decay and spectral composition of $^4I_{13/2} \rightarrow ^4I_{15/2}$ transition in YAG:Er crystals has been studied. It has been shown that even in case of a low concentration of impurity ion the trapping leads to a noticeable increase in the luminescence duration. Precise value for lifetime of the Er ions 1.6 mcm laser radiation's $^4I_{13/2}$ upper level has been determined (Sup.: acad. R.Kostanyan).

Ce and Pr- activated Lu₃Al₅O₁₂ crystals have been grown with up to 300 ppm of additional bivalent admixtures (Mg²⁺, Ca²⁺). After 1 kGy irradiation of the crystals by γ -radiation their optical absorption is 10 times less than in the crystals without additional admixtures. It has been shown that for the Lu₃Al₅O₁₂:Ce, Ca crystals with the Ce concentration $> 0.15\%$, the reduction of the slow component is accompanied by a significant increase of the light yield which reaches 50,000 photons/MeV (Sup.: DSc(phys.-math.) A.Petrosyan).

Outcomes of applied developments

A concept of an optical compensation 2-axis magnetometer has been designed to determine the strength and direction of the magnetic field. The system is based on the nonlinear Hanle effect, which leads to a sharp increase in the fluorescence signal of the $F_g=3 - F_e=4$ hyperfine transition of ^{85}Rb D₂ line in zero B -field. Computer control of double scanning of the magnetic field, as well as registration and processing of the optical signal has been employed. The developed vector magnetometer can be used for geomagnetic measurements (Sup.: corr. member A.Papoyan).

For the green ($\lambda = 0.52$ mcm) microchip laser operating in the regime of second harmonic generation of the $\lambda = 1.064$ mcm laser, the destructive influence of reflection from the optical contact interface of the active crystal ($\text{Nd}^{3+}:\text{YVO}_4$) and a nonlinear crystal with periodically polarized domain structure (PPNL: MgO) on the output characteristics has been studied. The results have been used to optimize the operating performance of the microchip laser (Sup.: acad. R.Kostanyan).

Works on the development of a memristor, a computing-memory element, as well as devices based on it have been carried out. The effect of complex memristive switching has been studied depending on the contact material. Stability of the memristor based on ZnO film doped with 10% lithium has been analyzed for the case of Pt, LaB_6 , Ag, and Al contacts. It has been shown that using $\text{SnO}_2:\text{F}$ transparent electrodes as contacts significantly increases the stability of the memristor with respect to cyclic resistive switching (Sup.: cand.(phys.-math.) Y.Kafadaryan).

A laboratory model sample of a new concept "stabilograph" has been developed and manufactured on the basis of acoustic vibrations sensors with ultra-high frequency range created by SFCO technology with the assistance of PSI Company. The device allows detection and computer recording at millisecond speed of the temporal translations of human body standing on a horizontal platform. The tests have allowed to identify ways to optimize the performance characteristics of the device (Sup.: DSc(phys.-math.) S.Gevorgyan).

Institute of Applied problems of Physics

Major achievements

The phenomenon of transition radiation when the boundary between two dielectric media is periodically deformed, has been investigated. It has been shown that instead of a separate peak of reverse transition radiation in the case of plate surface a group of peaks has been observed for periodically deformed surface (Sup.: acad. A.Mkrtchyan).

For the first time the phenomenon of ions accelerations and charged particles in resonance systems has been detected (Sup.: corr.member A.Mkrtchyan).

An acousto-plazmatic diode "Bell" for the purification of various formats and the creation of metal coat has been developed and created (Sup.: acad. A.Mkrtchyan).

It has been experimentally shown that in the X-ray shortwave range at white beam spectrum we can identify the beam with a wide angular and spectral distribution by using a temperature gradient applied to the single quartz crystal, pump it in the direction of the reflection and focus it, i.e. the operating parameters of the beam can be controlled in a large range (Sup.: cand.(phys.-math.) V.Kocharian).

Outcomes of applied developments

An acousto-plazmatic diode "Bell" for the purification of various formats and the creation of metal coats has been developed and created.

A shortwave (100 keV) X-ray device for the time-space lossless transfer of beams has been developed and is in the process of construction (Sup.: acad. A.Mkrtchyan).

Scientific and technical investigations have been conducted to develop a registration system of super-weak acoustic vibrations.

A new equipment to determine the medium composition by using acoustophysics methods has been developed (Sup.: corr.member A.Mkrtchyan).

A new X-ray diffraction method for the study of the temperature and deformation fields in crystals has been developed. It has been shown that the latter makes it possible to measure the anisotropy coefficient of thermal expansion.

A software package for the numerical calculations of parameters of the diffracted beams (reflected and transmitted), in the presence of external influences (temperature gradient and the acoustic field) in the medium of LabVIEW program has been developed (Sup.: cand.(phys.-math.) V.Kocharian).

Studies of thermal neutron diffraction in the presence of the superlattice in a single crystal of quartz has been conducted (Sup.: A.Movsesyan).

The electromagnetic properties in the millimeter wavelength range of metamaterials obtained on the basis of opal matrices consisting of nanocomposites have been investigated (Sup.: cand. (phys.-math.) S.Khlopuzyan).

A laboratory sample of the detector of thermal neutrons processing in the integral regime has been developed (Sup.: cand.(phys.-math.) V.Nalbandyan).

In the framework of Armenian-Russian laboratory investigations in the field of intensity, the energy width, focus, and other characteristics control of the reflected X-ray beams from a single crystal of quartz with energy range of ~ 100 keV in the presence of external influences have been continued. These investigations will allow to design and create the basic elements of hard X-ray "optics".

Band-pass filters of the hard X-ray radiation with controllable time-space parameters have been designed and developed. The energy width of the filter can be adjusted in the range of tens eV to several tens of keV.

The following has been designed: power source of small size and high stability, also the unit for creating a stable temperature gradient in the crystals, exciters and amplifiers of linear electromagnetic oscillations with a frequency range up to 20 MHz (Sup.: acad. A.R.Mkrtchyan).

Institute of Radiophysics and Electronics

Major achievements

The magnetic-optical properties of $\text{Bi}_x\text{Y}_{3-x}\text{Fe}_5\text{O}_{12}$ films grown on the amorphous grounds have been investigated and an experimental device for imaging of magnetic field made on their basis has been developed.

The opportunity of generation of THz waves under the action of optical pumping from semiconductor CaP films, placed in Fabri-Perrot microresonator consisting of multilayer breggian mirror, has been studied.. It has been shown that such a microresonator structure can lead to considerable growth of THz generation (Sup.: corr.member A.Hakhoumian).

The peculiarities of the Seebeck coefficient and power factor have been studied in porous thermoelectric materials with spherical hollow pores of varying diameter from nanometer to micrometer length scales. It has been shown that the presence of the pores with multi-scale hierarchical disorder leads to more considerable enhancement in the thermopower over its value in the bulk (Sup.: DSc(phys.-math.) R.Tarkhanyan).

Ultrarelativistic electron bunches of solid densities and nuclear radiation from nanolayers-plasma-targets under superintense laser pulses have been studied. For actual supershort and tightly focused—strongly nonplane ultrarelativistic laser pulses of linear and circular polarizations 3D3V problem is solved via numerical simulations.

The investigation of nonlinear interaction of superpower laser pulses of ultrarelativistic intensities with nanolayers and solid-plasma-targets shows that petawatt lasers are capable of producing via such two-target scheme high density field-free electron/positron bunches and substantial amounts of -quanta with energies up to 200 MeV (Sup.: corr.member H.Matevosyan).

A new strategy of reaching efficient matched conditions at the maximum speed in RF power delivery systems for plasma processes has been proposed and analyzed. Presented method incorporates

unique properties of high speed, automatic discrete matching networks, allowing creation of the shortest trajectories and bypassing inhibited states of network parameters. The special matching network model has been used to test optimal matching path finder method which allows to maximize the delivered power at the minimum time.

Characteristics of impedance meter based on DSP have been investigated. Especially, the relation of measurement speed and sensitivity versus number of samples in a data packet has been determined. It has been shown that the use of DSP, in particular Fast Fourier transform, allows using a lower price category ADC without compromising the measurement accuracy (Sup.: cand.(phys.-math.) T.Zakaryan, N.Poghosyan).

Light transmission through a perforated metal with hole arrays has been considered. Periodical, isolated and random arrays have been considered. Analytical expressions for transmission coefficients have been obtained for all cases. Independence of transmission coefficient of the incident wavelength for one dimensional dilute metal case has been proved (Sup.: DSc(phys.-math.) Zh.Gevorkyan).

The absorber layers CIS of thin film solar cells have been deposited by magnetron sputtering method using high-purity elemental targets, and their stoichiometry has been studied depending on regimes of post-deposition selenization processing. The aim of our studies was also to substitute the absorber layer CuInGaSe_2 with new type of absorber $\text{Cu}_2\text{ZnSnSe}_4$, when the rare metals In and Ga are substituted by cheap and earth-abundant elements Zn, Sn (Sup.: corr.member S.Petrosyan, cand.(phys.-math.) A.Musaelyan).

The X-Y coordinate sensitivity of the four component infrared detectors based on p-InSb/n-CdTe heterojunction has been studied. It has been shown that within rather large interval of displacements the linear dependence of the signal sign and magnitude can be found (Sup.: corr.member S.Petrosyan, cand.(phys.-math.) K. Avjyan).

The radioastronomic method of the measurements of RT-13 antennas of “Quasar-KWO” complex has been developed, measurements have been provided at the site of dislocation of that antennas (Irkutsk, Zelenchuk) (Sup.: corr.member A.Ghulyan, DSc(tech.) H.Piroumyan).

Outcomes of applied developments

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The measurements of radiation of “Cassiopeia-A” and “Swan-A” radiosources have been provided. The presence of periodic fraction in the decreasing flow from Cassiopeia-A has been confirmed.

For the purpose of localization of the epicenter of a possible earthquake the method of effective height of seismogeneous ionospheric nonhomogenities has been proposed. As a result of optimization of radiotelescope parameters the threshold of ionospheric-seismic correlations has reduced down to $M/3$ magnitude .

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The theoretical researches showing the efficiency of dual frequency and multi polarization, spatio-temporally combined radar-radiometric systems application for solution of various tasks of the Earth surface remote sensing have been carried out. Experimental measurements of clear air and clouds microwave emissive characteristics have been carried out and acquired data of field measurements at Ka (37GHz) band of frequencies have been processed (Sup.: DSc(phys.-math.) A.Arakelyan).

The effect of the water enriched with ions and nanoparticles for treatment of II and III degree burns as well as burn wounds burdened with radiation injury has been studied.. Experiments in rats and mice have shown that the use of such a drug is effective in reducing the formation of purulent wounds and strengthens the epithelium itself shortening the healing time of wounds and making the process painless (Sup.: cand.(phys.-math.) R.Khachatryan).

Junctionless nanowire MOSFET structures have been investigated. The effect of interface traps on device characteristics has been studied and modeled through a charge based model. A major concern is that these traps substantially modify the charge-voltage characteristics, thus asking for improvement of basic compact models. Different trap energies and densities have been analyzed in detail. The proposed model reproduces correctly the results obtained from Sentaurus Synopsys TCAD simulations (Sup.: cand.(phys.-math.) A.Yesayan).

The device intended for measurement of effectivity coefficient of electrical current sources, as well as the imitator of human respiratory process having the opportunity of regulation of respire frequency and duration have been developed. (Sup.: R.Simonyan).

ICRANet Armenia

Major achievements

Gamma-ray emission from 3C 120 radio galaxy has been investigated using the data from Fermi LAT and it has been shown that the emission is produced in the compact nuclear region.

High energy emission from PKS 1441+25 ($z=0.939$) has been investigated during recently observed flaring episode. It has been shown that the flares occur due to the changes in the electron cooling processes (Sup.: cand.(phys.-math.) N.Sahakyan).

DIVISION OF NATURAL SCIENCES

Academician-Secretary - academician V.Hakobyan

Scientific Secretary – S.Atshemyan

The Division includes the Scientific and Production Centre (SPC) “Armbiotechnology” (including the Microbial Depositary Centre, the Institute of Biotechnology and the Institute of Microbiology), the Scientific Centre of Zoology and Hydroecology (including the Institute of Zoology and the Institute of Hydroecology and Ichthyology), the Institute of Botany, 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 10 academicians, 11 corresponding members, 27 foreign members as well as 12 honorary doctors.

3 general meetings, 26 Bureau meetings of the Division were held during the reporting year.

At the annual meeting of the Division held on 2 April the report of the Academician-Secretary of the Division, academician V.Hakobyan on the scientific and scientific-organizational activities of the Division in 2014 was heard. The issues obstructing the activities of the Institutes of the Division were discussed and the following proposals were made: to provide funding to repair the old devices or to buy new ones, also to pay attention to the institutes and laboratories merged into the centers and deprived of funding; to provide funding for scientific expeditions, etc. It was proposed to conduct the elections of academicians and corresponding members in the Division with the concept of 2/3, as it was before, and conduct the election at the general meeting with the concept of 50% + 1, as in this case the risk factor decreases; to ensure that innovative results obtained by the NAS RA institutions and members are represented to the Government of RA; to support the Institute of Molecular Biology in the organization of the immune serum “Immunomodulator” production.

At the annual meeting the scientific reports of newly-elected foreign members and leading scientists of NAS RA were heard: P.Langer “Cooperation between the NAS RA and the University of Rostock in the field of naturally occurring substances and catalysis”, A.Bazyan “Mechanisms of emotional and motivational states in the mammalian brain and the manifestation of appropriate behavior”, A.Kamalov “Collagen biomatrix in reconstructive urology”, L.Oganesyants “Scientific support for the development of viticulture and winemaking”, Y.Tadevosyan “Violation of lipid homeostasis in peripheral blood mononuclear cells in cancer”, G.Fayvush “Anthropogenic impact on natural ecosystems of Armenia”, M.Babakhanyan “Import of some crops plants of strategic importance to Armenia and NKR”, H.Hovhannisyan “Production and use of probiotics in Armenia”.

At the general meeting on 29 April the candidacies for the open positions of the head of the Center for Ecological-Noosphere Studies of NAS RA (A.Saghatelyan) and the head of the Institute of Molecular Biology (A.Arakelyan) were discussed. The candidacies were approved to be presented to NAS RA Presidium.

At the 26 meetings of Bureau the following reports were discussed and approved: the 2015 working plan of the Division; the reports of the institutions of the Division on 2014 and 2015 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; the results obtained by the institutions during last 5 years in the frames of ISTC project; the applications of the Institutes for new appliances; the reports of the Institutes on the scientific-organizational activity in 2015; final reports on 2013-2015 period; possible cooperation between the Institutes of NAS RA and Academy of Sciences of Georgia; the report on the activity of the head of the Institute of Physiology N.Ayvazyan during last 3 years; the perspectives of the Armenian-Belarusian Limited Liability Company (LLC) in Sevan; the report on the activity of the head of the Institute of Biochemistry S.Chailyan during last 3 years; the Program of Fundamental Scientific Studies on 2015-2020.

The reports of the directors of the Institutes of the Division on the scientific and organizational activities in 2015 were discussed at the on-site meetings of Bureau.

The travel expenses for scientific visits of researchers from the Division Institutes were discussed and more than 15 travel grants were provided from the NAS RA funds preappointed for the scientific visits.

10 local and international events were organized by the Institutes of the Division including seminars, conferences, scientific expeditions, a total of 502 participants, 96 of which were from abroad.

309 articles (138 – in local and 171 – in foreign journals) and 132 abstracts (57 – in materials of local and 75 – in materials of foreign conferences), 7 monographs, 5 educational tutorials and 4 patents were published by the Institutes of the Division.

17 candidates' dissertations were defended by the researchers from the Institutes of the Division at 5 specialized councils of Division.

Institute of Botany

Major achievements

The work on taxonomic treatments of about 3800 species of the flora of Armenia for the "Manual of the vascular plants" (instead of 3200 species, given in a multi-volume edition of "Flora of Armenia") has been completed. The editorial treatment of monograph has started.

During the taxonomic accounts of the family Ulmaceae it has been detected that it represents genera *Ulmus* and *Celtis*. Genus *Alchemilla* represents 24 species, 4 species of which are endemic of Armenia.

The taxonomic accounts of the tribe *Silene* (*Caryophyllaceae*) of the South Caucasus have shown that the tribe is represented by 7 genera and 63 species. 6 species are endemic of the study area and 5 species of genus *Silene* are endemic of the Caucasus.

The analysis of the tribe *Caryophylleae* in the Southern Transcaucasus and surrounding regions has shown that the tribe is represented by nine genera, 15 of which are endemic of the Southern Caucasus. According to current molecular research it has been detected that *Dianthus orientalis* is not a monophyletic group (Sup.: DSc (biol.) M. Hovhanisyan).

A scientific-popular publication "Ornamental trees and shrubs for greening work" (Zh.Vardanyan, G.Gatrchyan, M.Grigoryan, Yu.Paytyan, Yerevan, 2015, 326 pp.) which can serve as a useful source for specialists, working on greening of Armenia, has been published. The book has an important practical value in the matters of gardening of settlements and, particularly, of the city of Yerevan. An assessment of decorative trees has been provided in the book, interesting data on ornamental trees and shrubs have been given, issues on landscaping of cities and towns aimed to improve their decorative effect have been discussed. Morphological, biological and ecological characteristics for 150 ornamental woody plants and garden forms have been given (Sup.: corr.member Zh.Vardanyan).

Centre for Ecological-Noosphere Studies

Major achievements

Environmental geochemical studies have undergone a qualitative change: transition from the detection and the mapping of anomalous concentration of elements to a quantitative assessment of a public health risk reflection in space and time, so geochemical data have become more available when making decisions (Sup.: DSc (geol.-min.) A.Saghatelyan).

Outcomes of applied developments

The Center in partnership with the State Service of Food Safety of the Ministry of Agriculture RA implements testing of food imported into the country. Over the accounting year more than 425 tests have been done. As a result, no cases of excess of maximal acceptable concentrations of toxic elements have been revealed (Sup.: DSc (geol.-min.) A.Saghatelyan).

In the frames of an agreement concluded with the Zangezoor copper-molybdenum plant, monthly monitoring of heavy metals in natural and industrial waters and soils, as well as of ions,

physicochemical parameters, oil products, xanthogenate, BOD, COD in waters has been conducted (Sup.: DSc(geol.-min.) A. Saghatelyan).

According to the agreement concluded with Jrtouk LTD, studies have been implemented and expert assessment of soils and vegetation cover of the area of water reservoir of Vedi has been done to determine normality of contents of heavy metals, ions, oil products and pesticides (Sup.: DSc(geol.-min.) A.Saghatelyan).

The UNESCO Chair “Education for sustainable development” in the frames of a project “Education for the future” has organized a number of events such as a scientific and educational seminar on a topic “Environmental soil pollution with heavy metals” (Sup.: cand.(biol.) G.Poghosyan).

A popular science newspaper “Most” has been issued (Sup.: DSc(geol.-min.) A.Saghatelyan).

Through combination of data on the contents of toxic elements and consumption of fruits and vegetables growing in Armenia’s several mining regions (Kapan, Kajaran and a number of rural regions) calculation has been done of daily intake and risk index. As established, the obtained indices exceed safety limits proving the existence of a medium- and long-term health risk. Risk assessment of meat pavilions in Yerevan market places has been done. From meat counters with high infestation risk fresh meat samples have been taken for subsequent microbiological analysis. The results obtained have indicated that the samples do not meet microbiological safety requirements.

In Yerevan, public survey has been conducted into consumption of a number of widely used products of plant origin (bread, coffee, tea). The results obtained are compiled as a food consumption database, which will serve as a base for assessing exposure and public health risk. Studies of adulteration of dairy products put into consumer market have been done. As a result, cases of milk adulteration with water and inconsistency of physicochemical indices with standards have revealed (Sup. cand.(vet.) D.Pipoyan).

Scientific Centre of Zoology and Hydroecology

Institute of Zoology

Major achievements

As a result of studies and assessment of wildlife diversity and influence of anthropogen factors in Ararat Marz from the collections of the Institute of Zoology and collections of foreign institutions 13 new insect species have been described. 29 species of insects new for Armenian fauna have been recorded. Karyotypes of 10 insect species have been described for the first time (Sup.: cand.(biol.) M. Kalashyan).

Species diversity of parasites of mammals, domestic and wild birds and fishes, and the list of animals infected with these parasite species, as well as biohelminths’ circulation in pastures of Ararat, Armavir, Aragatsoth and Kotayk Marzes has been studied, 45 species of ecto- and endoparasites have been revealed. Species diversity of phytoneematodes in the agroecosystems of Ararat valley in the conditions of open and protected ground has been studied. Gall-forming and stem parasite phytoneematodes and phytopathogenic virus infection carrier phytoneematodes have been registered (Sup.: acad. S.Movsesyan).

Through observations of investigative behavior characteristics of lab animals (mice, rats) targeted to coping of the stress situation (coping strategy) it has been found out that in the situation of uncontrolled stress (artificial inoculation of malignant tumor) laboratory animals inclined to passive strategy are more resistant to pathogenic effect than animals prone to the active response (Sup.: DSc(biol.) G.Sargisov).

Based on data on the genetic characteristics of Armenian muflon and domestic sheep hybrids - locuses of Transferrin (Tf), Ceruloplasmin (Cp) and Hemoglobin (Hb), it has been shown that homozygosity level of Transferrin compiles up to 47,0%, of Ceruloplasmin – 35.3%, and of Hemoglobin – 5.9%, which shows the stable condition of heredity of these locuses from muflon (Sup.: cand.(biol.) A.Antonyan).

Outcomes of applied developments

The obtained data about animal parasites and their composition in Ararat, Armavir, Aragatsotn and Kotayk regions and the list of animals infected with these parasite species, as well as biohelminths' circulation data in pastures can be used to assess the parasitic situation of the environment. The data can be used to identify the nature and the level of infestation of intermediate and definitive hosts (Sup.: acad. S. Movsesyan).

Studies have been conducted in order to identify insects and predatory mites prospective for control of agriculture pests, as well as selection methods to organise their reproduction and preservation have been designed. *Amblyseius finlandicus*, *Kampimodromus aberrans* and *Phytoseius plumifer* have been identified as main species of Phytoseiid mites in Ararat marz. For the first time *Amblyseius segnis* predatory mite has been found in Ararat region previously discovered only in Ijevan. For the first time the preservation methods of *Phytoseiulus persimilis* mite in low temperature conditions has been designed and a frigostable laborator population, which maintenance period was shifted from 30 to 45 days, has been created (Sup.: DSc(biol.) K.Dilbaryan).

Scientific Centre of Zoology and Hydroecology

Institute of Hydroecology and Ichthyology

Major achievements

Ecological situation of Lake Sevan is still unstable. Even though, there are some perspectives of improvement.

Bioproductivity of phytoplankton community is highly decreased compared with the previous years. There are some species successions and fluctuations in the community of phytoplankton indicative of positive processes taking place in the lake.

As a result of Lake Sevan water level rise the macrophyte zone, which has protective function, has enlarged. It limits the impact of catchment basin on the lake as well as promotes the formation of abundant biodiversity in a coastal zone. Across all coastal zones of Lake Sevan chara species have been dominant and green neatlike algae have been subdominant. Taking into consideration that chara species are oligosaprobic species, it is obvious that water quality in the lake is improving.

Due to habitat changes in the littoral zone of Lake Sevan the role of gammarids, the most preferable food components of Sevan trout, has been increased. New species of phytophil invertebrates *I. pumilio* and *C. pulchellum* from dragonfly larvae as well as *C.(Physa) acuta* from gastropods have been discovered. For the first time during the last years the portion of chironomids exceeded the portion of oligochaets.

The process of replenishment of Lake Sevan ichthyofauna by fertile generation of whitefish has continued. Despite the attempts of the government to recover the population of Sevan trout there are still not enough natural conditions for the natural reproduction of this fish species in the spawning rivers. The populations of valuable endemic fish species Sevan Khramulya and Sevan barbell are still under critical conditions. Invasive species Armenian spirin and stone moroko continue to grow in quantity. On the other hand resources of crucian carp have depleted dramatically as a result of uncontrolled catch (Sup.: DSc(biol.) B.Gabrielyan).

Constructed mechanical water treatment plants can not satisfy the demands in recovery of water quality yet. Furthermore, water inflowing into the rivers from water treatment plants in Martuni and Gavar cities promote the rise of water pollution by bacteria. Water is not self-purifying during the flow from input places to the river mouths and as a result can have negative impact on water quality of Lake Sevan.

Outcomes of applied developments

The perspective of growth of whitefish industrial resources in Lake Sevan during the period of 2013-2015 has been registered which is the result of replenishment of population by fertile generation.

The resources of fish in the Lake were estimated by the Institute as 413000kg in 2015. The number of crucian carp in Lake Sevan has decreased as a result of catching pressure growth and the resources of Sevan trout have remained the same as in 2014 - 1000-2000kg. Aimed at recovering whitefish population and based on the suggestions provided by the Institute the regulation of catching of the fish from 20 of November to 25 of December has been redoubled according to the command of the minister of Nature Protection (Sup.: DSc(biol.) B.Gabrielyan).

The process of Freshwater crayfish catching in the whole territory of Lake Sevan has been studied. Age structure of catch carried out by different devices has been studied as well as the portion of non industrial size crayfish in the catch has been estimated. It has revealed that during the last two years as a result of implementing of new catch devices – Chinese traps, springy traps and tarpaulins the portion of not industrial size crayfish has increased dramatically and in some cases can reach 50%. It is very dangerous for crayfish population and can be the reason of crayfish industrial resources depletion. The suggestion to prohibit using of these catch devices for crayfish in Lake Sevan was provided to the Ministry of Nature Protection. Resources of crayfish in the lake have been estimated as 4000000kg in 2015 (Sup.: cand.(biol.) E.Ghukasyan).

Institute of Biochemistry after H.Buniatyan

Major achievements

A new atrial peptide from pigs heart has been isolated. Identification of amino acids composition of this peptide is currently taking place by means of HPLC and mass spectrometry.

When using DNA isolated from bacterial strains of *Bacillus anthracis* E7 (epizodical virulent strain), *B. anthracis* S55 (strain for vaccination) and closely related strains of *Bacillus thuringiensis* K1, *B. thuringiensis* Z-52, *B. thuringiensis* HD-1 as a result of the PCR amplification reaction of *pagA* gene amplification has been observed only with the DNA of a virulent and vaccine strains of anthrax. When using three DNA samples of related strains *B. thuringiensis* *pagA* gene amplification has not been observed, indicating the specificity of the method developed for the diagnosis of anthrax. Consequently, the developed method and current primers can be used in the diagnosis of anthrax and in the study of the effect of proline rich cytokines on the anthrax infection *in vivo* (Sup.: DSc(biol.) S. Chailyan).

It has been shown earlier that DPPIV hindered the aggregation of A β (1-40/42) peptides. It has appeared that the simultaneous presence of Glutaminyl cyclase and DPPIV supports the peptides aggregation, promoting the development of Alzheimer's disease. Hence the inhibition of any of these enzymes can be a new approach in prevention/treatment of the pathology. In contrast to the rheumatoid arthritis, at arthritis of some other etiology in the synovial fluid with both high and low ADA activity low-molecular isoenzyme has not been registered. At *ex vivo* inhibition of ADA in synovial fluid by synthetic compounds, 1deaza-adenosine, EHNA and 3 deaza-EHNA are more effective, similar to the cases of the enzyme, purified from some human tissues. Free sugars (glucose, sucrose) *in vitro* influence the activity of ADA2 from human blood plasma (Sup.: DSc(biol.) S.Mardanyan).

The research on the detection of the specific features of bifunctional nature of Ca²⁺/calmodulin-dependent protein phosphatase calcineurin in pathophysiology of cancer has been continued. The activity of calcineurin has been determined in plasma and tissue samples of three breast cancer developmental stages in two age-grade groups which have not previously received any treatment. The results obtained have demonstrated a significant increase in calcineurin activity in both plasma and tissue samples of the first stage of breast cancer. In the second stage of breast cancer some decrease has revealed in calcineurin activity, but the enzyme activity still remains enough high. In the third stage of breast cancer the significant decrease in calcineurin activity has been found out. It is suggested that a strong decrease in calcineurin activity in the third stage of disease is a result of serious disturbance of homeostasis and/or it is bound with mutations in transcriptional factors. It has been also demonstrated that the age of breast cancer patients affects the calcineurin activity. It should be underscored that the type of cancerous cells (ductal or globular) does not affect calcineurin activity (Sup.: DSc(biol.) N.Barkhudaryan).

Outcomes of applied developments

A new atrial peptide from pigs heart has been isolated. Identification of amino acids composition of this peptide is currently taking place by means of HPLC and mass spectrometry (Sup.: DSc(biol.) S. Chailyan).

The simultaneous presence of Glutaminyl cyclase and DPPIV supports the peptides aggregation promoting the development of Alzheimer's disease. Hence the inhibition of any of these enzymes can be a new approach in prevention/treatment of pathology (Sup.: DSc(biol.) S.Mardanyan).

For lactate bacteria's increase and reproduction a new nutritional environment has been worked out in which the quantity of bacteria increases by 10 times. The research has been made for their immobilization and protecting of viability on natural compounds. Viability period of immobilized dry preparations is two years. The extraction of dry preparations by means of this kind of technology is cheap and available (Sup.: H.Sargsyan).

Quantum dots and silver nanoparticles sensibilized by various antigens/antibodies have been applied in a new type of immunoassay based on resonance energy transfer. It provides high sensitivity of the assay. In particular, quantum dots and silver nanoparticles have been synthesized, spectrum of absorbance and fluorescence of which have been coincided. It provides effective energy transfer between nanoparticles. Such system provides detection of antigen in the range between 50-1000 ng/ml. The interaction of these nanoparticles and therefore resonance energy transfer depend on the presence of antigen in media. High concentration of antigen in the media leads to the inhibition of the interaction of nanoparticles with consequent blocking of resonance energy transfer between them. And vice versa the reverse picture has been observed at low concentration of antigen in media. Therefore this approach permits to determine various antigens/antibodies with high sensitivity (Sup.: cand.(biol.) V.Gasparyan).

Scientific and Production Centre "Armbiotechnology"

Institute of Biotechnology

Major achievements

The activity of L-isoleucine strain-producers has increased up to 15% due to the optimization of technological parameters (Sup.: cand.(biol.) A.Chakhalyan).

The yield of target amino acid in L-alanine strain-producers has significantly increased (Sup.: cand.(biol.) G.Avetisova).

As a result of the optimization of technological parameters for fermentation, the yield of synthesized arginine has significantly increased in recombinant strain-producers of *Brevibacterium flavum* carrying arg genes (Sup.: cand.(biol.) A.Hovsepyan).

On the basis of an aromatic aminotransferase gene, selected from the complete enterobacterial genome, two enterobacterial (*Citrobacter freundii* and *Erwinia aroidea*) aminotransferases of technological significance have been cloned, expressed and characterized by the created primers (Sup.: cand.(biol.) A.Hambardzumyan).

Detection of biologically active short peptides containing new non-protein amino acids has been realized by Docking software. The methods for production of 5 - the most active peptides have been developed (Sup.: cand.(chem.) Yu.Danghyan).

The methods of HPLC analysis for the study of a number of biologically active substances have been developed and improved. Enantiomeric yield and C, H, N, S elemental composition of a number of non-protein amino acids and their derivatives synthesized at the Center have been determined (Sup.: cand.(chem.) A.Tsaturyan).

The influence of a number of newly synthesized non-protein amino acids on the activity of enzyme collagenase has been studied and effective inhibitors of enzyme that can be potential components of antitumor drugs have been revealed (Sup.: cand.(biol.) N.Hovhannisyan).

Under pilot plant conditions the sterilization parameters of nutrient medium for the process of D-tryptophan production from racemate and technological parameters of the sterilization process on the whole have been optimized (Sup.: cand.(tech.) A.Vardanyan).

4 new β -benzoylphenyl substituted optically active derivatives of α -aminopropionic acid with potential analgesic properties have been synthesized; the universal method for their production has been developed (Sup.: cand.(chem.) S.Dadayan).

It has been shown that in co-cultivation of lactic acid bacteria and yeasts on average 20% increase of synthesis of bacteriocins has been observed depending on genera of the used strains of yeast (Sup.: cand.(biol.) F.Tkhruni).

A new combined method (RA Patent No. 2925A, 2015) enabling to isolate products with high bactericidal action (26000 Au/ml) and in high yield (64%) from the culture liquids obtained by the cultivation of various kinds of lactic acid bacteria has been developed (Sup.: DSc(chem.) A.Aghajanyan).

New mesophilic strains producing endoinulinase and cycloinulofructosyl-transferase have been selected. The method for production of cyclofructans from inulin under flow conditions using the enzymes isolated from those strains has been developed (Sup.: cand.(biol.) V.Ghochikyan).

Effective methods for the asymmetric synthesis of unsaturated (*S*)- α -amino acids have been developed and enantiomerically enriched new α -amino acids have been characterized (Sup.: cand.(chem.) A.Mkrtchyan).

Outcomes of applied developments

The production of optically active non-protein amino acids has been continued. In the European market (“Iris Biotech”, “Acros Organics”) more than 15 non-protein amino acids names have been realized(Sup.: academ. A.Saghyan, cand.(chem.) S.Dadayan, cand.(chem.) A.Poghosyan).

The production of new fertilizers “Ecobiofeed” and “Ecobiofeed+” for agriculture purposes has been organized. 15t biofertilizers have been produced to be realized in the farms of RA (Sup.: cand.(biol.) G.Avetisova).

Scientific and Production Centre “Armbiotechnology”

Institute of Microbiology

Major achievements

On the basis of symbiotic and free-living nitrogen-fixing bacteria multicomponent biofertilizer - *Rhizomix* has been developed, the use of thereof significantly increases the productivity of peanuts, soybeans, chickpeas and promotes the increase of proteins in the grain (Sup.: cand.(biol.) V.Hakobyan).

Peculiarities of leaching of the mineral of copper – chalcopyrite by newly isolated chemolithotrophic bacteria have been studied. It has been shown that the efficiency of extraction of copper and iron from chalcopyrite significantly increases with the use of the mixed cultures of sulfur and iron oxidizing bacteria that is prospective in microbiological leaching of non-ferrous metals (Sup.: DSc(biol.) N.Vardanyan).

In conditions of experimental light regimes the dynamics of microalgae biomass accumulation has been studied and fatty-acid compositions of lipids in a number of *Chlorella* and *Scenedesmus* cultures have been determined. At the same time the conditions promoting secondary carotenogenesis in the mentioned strains of microalgae have been optimized (Sup.: cand.(vet.) V.Goginyan).

Bacteria belonging to various genera of microbes which are cycloinulofructan producers have been isolated (Sup.: cand.(biol.) L.Markosyan).

New strains of lactic acid bacteria with high antimicrobial activity producing hydrogen peroxide and other low molecular weight compounds have been obtained. The mentioned bacteria kill pathogenic and putrefactive microorganisms prolonging the shelf life of food products (Sup.: DSc(biol.) H.Hovhannisyan).

Outcomes of applied developments

The production of acido-lactic product “Narine” on the basis of lactic acid bacteria *Lactobacillus acidophilus* ИИМИА В-9602 (Er.317/402) has been continued. The product is made in accordance with AST 173-98 N17 (the declaration of conformity of the Customs Union TC N RU Д-AM.АИ58.В.02628, 10.09.2015) and implemented in pharmacy chains “Esculap”, “Natali-Pharm”, “Alfa-Pharm” and delivered to a number of maternity homes and kindergartens (Sup.: acad.A.Saghyan).

Scientific and Production Centre “Armbiotechnology”

Microbial Depository Center

Major achievements

Reproductive properties and methods of maintaining viability of different genera and species of microorganisms maintained at the MDC have been studied. The inulinase activity of over 130 lactic acid bacteria has been studied and the active strains have been characterized (Sup.: cand.(biol.) K.Chitchyan).

A number of *Bacillus thuringiensis* and *B.laterosporus* strains possessing expressed insecticidal activity to harmful insects - leaf beetles spread in Armenia have been tested and revealed (Sup.: P.Tadevosyan, N.Ghazanchyan).

Institute of Molecular Biology

Major achievements

For the first time it has been shown that non-inactivating KCNQ1 channels could be converted to inactivating ones via point mutations in the amino acid sequence of S5-S6 region of the protein (Sup.: cand.(biol.) V. Vardanyan).

The alerting trend has been observed towards the increase of the prevalence of resistant phenotypes to nalidixic acid (quinolone antibiotic) and ciprofloxacin (fluoroquinolone) among clinical Salmonella isolates. Polymerase chain reaction testing has detected high prevalence of *gyrA* and *parC* genes, determining the resistance to the mentioned antibiotics (Sup.: cand.(biol.) Zh. Ktsoyan).

Using bioinformatics approaches biological pathway activity perturbations have been evaluated in malignant and chronic lung diseases. The results have enabled the identification of disease subgroups with similar clinical manifestations but characterized by involvement of different pathomechanisms (Sup.: cand.(biol.) A.Arakelyan).

It has been shown that Turkic-speaking populations of the north-western and northern regions of Iran have genetic background similar to geographically close ethnic group, which is consistent with elite-dominance model of language spreading (Sup.:DSc(biol.) L.Yepiskoposyan).

Outcomes of applied developments

The mtMART database of mitogenomic information has been created (Sup.: DSc(biol.) L. Yepiskoposyan).

The PSFC application for a biological pathway signal flow calculation in Cytoscape environment has been developed (Sup.: cand.(biol.) A.Arakelyan).

The *in vitro* test-system for investigation of epigenetic changes during neurodegenerative diseases has been developed (Sup.: cand.(biol.) N.Babayan).

The genes associated with powdery mildew resistance (causal agent - ascomycete *Erysiphe necator* (Schw.) Burr., synonym *Uncinula necator*) have been screened in ten native and new cultivars of Armenian grapes. As a result, cultivars, characterized by the presence of the corresponding resistance-associated alleles have been selected (Sup.: cand.(biol.) H. Devejyan).

Institute of Hydroponics Problems after G.Davtyan

Major achievements

It has been shown that growing conditions (hydroponics, soil and wild nature) have not influenced the contents of essential oil (0,12-0,15 %) of a valuable medicinal plant *Teucrium polium* L., though the chemical composition has been considerably different. In all cases the important terpenoids are α -bisabolol, α -bergamotene and spathulenol. Soil and wild plants are more similar with their essential oil chemical composition. They contain common terpenoids such as β -pinene, limonene, pharnezene, germacrene D, tetrahydrogeranylacetone. Essential oil of hydroponic *Teucrium polium* L. is richer with sesqui- and bicyclic monoterpenoids. Standardization of *Teucrium polium* L., gathered from different parts of Armenia and Artsakh, has been implemented according to the following indexes: active substances, ashes, moisture and others(Sup.: corr.member S.Mayrapetyan).

Innovational technology has been elaborated to obtain high quality planting and medicinal raw material of valuable *Asparagus officinalis* L. by combined (*in vitro* and hydroponics *in vivo*) method. Explants (hypocotyls, root, shoot, apical meristem, root collar) have been extracted from 25-30 day plantlets germinated from seeds on the nutrient medium (with 5g/l agar) initiating callus induction with further organogenesis.

It has been shown that hypocotyl explants after the 8th replanting proceed organogenesis in 2/3 of callus tissue. On ½ MS medium in the presence of plant growth regulators (1,0 mg/L BAP, 0,5 mg/L α -NAA and 2,4D) 15-20 shoot-regenerants have been grown. In root explants from callus tissues, after the 11th replanting 53% of rhizogenesis has been observed, in case of shoot explants - after the 10th replanting. Root-regenerants after 25 days of growing on ½ MS medium with 0,3-0,5 mg/L IBA or α -NAA have been cut and replaced, where root formation is 62 and 40% respectively. 25-30 shoot-regenerants have been observed in each test tube.

The possibility of *Picea pungens* planting material growth has been investigated in *in vitro* culture for the first time. Callus tissue has been obtained (Sup.: DSc(biol.) E.Sargsyan).

Outcomes of applied developments

The innovation technology proposal for organizing soilless production of different tree-shrub saplings, medicinal and spice plants in Echmiadzin scientific industrial hydroponics station-nursery (Darman Ltd) is ready for investment (Sup.: cand.(biol.) Kh.Mayrapetyan).

Proposals to sell decorative tree-shrub and fruit tree saplings (pyramidal thuja, platan, oak, thuja, box-tree, privet, buck-eye, Caucasian Persimmon, etc.), obtained as a result of developing hydroponics cultivation biotechnology (nearly 25000), have been sent to Yerevan Municipality and other interested organizations with the aim of signing contracts (Sup.: cand.(biol.) A.Hovsepyan).

Practical radioprotective proposals have been made utilization of which will give an opportunity to reduce biological accumulation of RN in crops and to obtain radioecologically safer agricultural products (Sup.: cand.(agric.) L.Ghalachyan).

Institute of Physiology after L.Orbeli

Major achievements

Investigations in the human erythrocytes ghosts have been conducted by means of immunoblotting to study integrin receptors. As a result of this study it can be assumed that there are two kinds of integrin in the erythrocytes membrane (Sup.: DSc(biol.) N.Ayvazyan).

A series of studies on the perfused frog brainstem by intracellular recording of potentials of neurons previously identified as reticular, in response to stimulation of the auricular region of the cerebellar cortex have been completed (Sup.: corr. member L.Manvelyan).

The effects of oxytocin on the characteristics of action potentials in rhythmogenic areas of the myometrium have been studied. It has been shown that oxytocin increases excitation and promotes synchronization of the activities in all rhythmogenic areas of the myometrium, including the ovarian locus which is the most active area in norm (Sup.: DSc(biol.) K.Kazaryan).

In the Laboratory of Immunology and Tissue Engineering mesenchymal stem cells collection from human's adipose tissue has been created, as well as Cardiomyocyte sustainable culture from neonatal rat heart, which has a typical regular heart contraction of the heart (Sup.: cand.(biol.) Z.Karabekian).

DIVISION OF CHEMISTRY AND EARTH SCIENCES

Academician-Secretary – corresponding member L.Tavadyan

Scientific Secretary – cand.(chem.) A.Avetisyan

The Division includes the Scientific Technological Center of Organic and Pharmaceutical Chemistry with its three institutes: the Institute of Fine Organic Chemistry, the Institute of Organic Chemistry and the Molecular Structure Research Center, as well as 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 11 academicians, 6 corresponding members and 21 foreign members of the NAS RA.

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

At the annual meeting of the Division held on 2 April the reports of the Academician-Secretary, corr. member L.A. Tavadyan, directors of the research institutes, as well as foreign members of NAS RA of the Division, related to their scientific and organizational activities in 2014 were discussed.

At the general meeting of the Division held on 25 December the annual reports of Division and institutes, as well as the reports of Base Fundings of scientific and technical activities of institutes for 2015 were discussed and approved.

15 meetings of the Division were held during the reporting year, including 5 enlarged sessions, where scientific and organizational problems were systematically discussed.

The scientific reports of the foreign member of NAS RA, professor of the Department of Chemical Engineering of Imperial College, London S. Kazarian on “Spectroscopic Imaging: New Trends and Emerging Applications”, deputy director of M. Manvelyan Institute of General and Inorganic Chemistry of NAS RA N. Zulumyan on “A new cost-effective method for the acid processing of serpentinous ultramafites”, as well as an innovation proposal of the president and general director of “M&MAVR” OJSC M. Hamamchyan on “Proposal on application of ore mineral resources of some nonmetallic and silicate deposits of the Republic of Armenia” were discussed at the enlarged sessions of the Division with participation of specialists from both the institutes of NAS RA and the institutes of higher education.

At the enlarged sessions of the Division the following issues were discussed and approved: the annual report on the activity in 2014 of the editorial board of the journal “Proceedings of NAS RA. Earth Sciences”, the annual reports on the activities in 2014 and 2015 of the editorial board of the “Chemical Journal of Armenia.

At the meetings of Bureau the following was discussed and approved: the working plan of the Division and the positions of postgraduate studies, the applications of Base funding of scientific and technical activity, the applications of Target Programs of the Institutes of the Division for 2016, Summary reports of Thematic funding of scientific and technical activities of the Institutes for the period 2013-2015, the liquidation of the Laboratory of Monitoring and Innovation of the Institute of Geological Sciences NAS RA, the creation of a new structural unit – Laboratory of Geopaleontology and Geomonitoring, as well as approval of the nomination of the Head of the newly established laboratory.

At the enlarged sessions of the specialized committee, organized by the Division a scientific project-proposal “Problems of recycling the tails of ore enrichment, accumulated in the tail dumps of Zangezur copper-molybdenum combine of RA” was discussed.

8 researchers of the Institutes of the Division have been on academic trips in Russia (Moscow, Kazan, Sochi, Zvenigorod), China, Republic of the Philippines, Turkmenistan, Georgia and other countries for the purpose of joint research, as well as for participation in international conferences and symposia.

The Division jointly with the A. Nazarov Institute of Geophysics and Engineering Seismology NAS RA organized the II International Conference of Young Scientists “Modern problems of geophysics, engineering seismology and earthquake engineering”, with participation of 70 scientists, including 20 foreign participants; jointly with the M.G. Manvelyan Institute of General and Inorganic Chemistry NAS RA organized the IV International Conference on “Chemistry and Chemical

Technologies”, with participation of 150 scientists, including 20 scientists from Russia, Belarus, Ukraine, Georgia, Kazakhstan and Uzbekistan; jointly with the A.B. Nalbandyan Institute of Chemical Physics NAS RA and the N.N. Semenov Institute of Chemical Physics RAS organized the IV International Conference “Current Problems of Chemical Physics”, with the participation of 150 scientists, including 70 scientists from Russia, Belarus, Germany, France, Italy, Austria and Switzerland.

343 articles (145 in local and 198 in foreign journals), 76 abstracts (46 in local and 30 in foreign conferences), 7 monographs, 1 tutorial and 9 patents RA were published by the Institutes of the Division.

2 Doctoral and 10 Candidate’s dissertation were defended in 2015.

The Division organized and assisted the annual reporting back meetings of the Division Institutes and discussions of scientific results.

Institute of Chemical Physics after A.Nalbandyan

Major achievements

Synergetic and antagonistic effects of four bioantioxidants: flavanoids (quercetin, rutin, morin, naringin) in the binary mixtures with ascorbic acid and a water-soluble analog of α -tocopherol, trolox, have been revealed. Chemical mechanism of nonadditive cooperative effect of the antioxidants has been suggested (Sup.: acad. L.Tavadyan).

At the non-catalytic gas-chemical process of propane oxidative cracking in a two-sectional metallic reactor high yield up to 90% of the valuable products, ethylene and propylene, has been gained by variation of concentrations of the initial reagents and temperature inside the reactor, which is the best rate in the field (Sup.: DSc(chem.) S. Arsentiev).

Based on the kinetic analysis of methane oxidation mechanism developed in the laboratory and mathematical modeling combined with experiment, it has been established that the selectivity of methane oxidative conversion into methanol can be increased by raising methane pressure in the reacting mixture at constant pressure of oxygen, but not of general pressure of the reaction mixture in contrary to popular opinion (Sup.: acad. A. Mantashyan).

Scientific Technological Center of Organic and Pharmaceutical Chemistry

Institute of Fine Organic Chemistry after A.Mnjoyan

Major achievements

New derivatives of amino acids, which demonstrate properties of anticholinesterase and the further investigation of which underlies the creation of a medicine for the treatment of Alzheimer’s disease have been synthesized (Sup.: corr.member V.Topuzyan).

Outcomes of applied developments

The investigation of the liver protecting properties of the mixture “Silimarin-Flamin” of herbal origin under the conditions of toxic cirrhosis of the liver is in process (Sup.:cand.(biol.) G.Gasparyan).

Scientific Technological Center of Organic and Pharmaceutical Chemistry

Institute of Organic Chemistry

Major achievements

The pheromone (chemical signaling connection) of predatory spider *Emboasca Vitis-Evarcha-albaria* as well as one of the active components of the sex pheromone of eastern moth (*Grapholita*

molesta) which enables to combat the given vermins effectively in a nontoxic way has been developed and synthesized (Sup.:DSc(chem.) J.Chobanyan).

Institute of General and Inorganic Chemistry after M.Manvelyan

Major achievements

Cordierite and cordierite-mullite heat-resistant ceramic materials at a ratio of components of 1: 0.4 to 1: 9, by sol-gel methods have been synthesized. These materials have low values of thermal expansion ($6,0-42,0$) $10^{-7}K^{-1}$ and high resistivity ($l_{gp} = 10,2-13,1 \Omega \cdot cm$) and can be used in the electronics and semiconductor technology as a substrate. The possibility of synthesis of tialita- $AlTiO_5$ having high heat resistance has been investigated by the same method (Sup.: cand.(tech.) A.Kostanyan).

The interaction process of glass with cubic boron nitride has been studied under dynamic and isothermal conditions. It has been revealed that the interaction of molding glass with βBN is accompanied by the glass crystallization. The beginning of the crystallization process is demonstrated by anomalous change of the glass viscosity within the temperature range of $420-440^\circ C$. The study of microstructure has discovered that the formation of crystalline phase on the interface of "melt – βBN " suppresses the abrasive oxidation (Sup.: DSc(tech.) N.Knyazyan).

Outcomes of applied developments

Mineral fibers prepared from andezito-dacites of Aragatsohn region (Aparan) as raw material have been studied. They are produced from silicate melts in the temperature range of $1330-1360^\circ C$. In the drawing speed of fiber of 700-2750 prepared fibers with 6-20mcm differ in high temperature of exploitation - $600^\circ C$, high mechanical characteristics and chemical resistance. These fibers have the following characteristics: tensile strength – 2,6-3,2 GPa; elastic modulus - 80-90GPa, chemical resistance at 1N H_2SO_4 , mass loss (3hours, $100^\circ C$) – 1,8-2,0%, chemical resistance at 2N NaOH(3 hours, $100^\circ C$) – 12-13%, diameter of filament - 11-12 mcm, maximum application temperature - $600^\circ C$ (Sup.: cand.(chem.) G.Petrosyan).

Surface sulfidation of copper oxidized minerals with silicon sulfide (SiS_2) and sodium thiocompound ($Na_2[SiS_3]$) has been investigated in the mill. It has been indicated that the application of mechanochemical activation gives an opportunity to raise the sulfidization due to generation of active surfaces. The ejection of sulfide layer (CuS_2) gives an opportunity to pass from internal diffusion regime to kinetical regime during the appearance of surface of new substances. It increases the rapidity of process and the quantity of the sulfidized copper (Sup.: cand.(chem.) A. Hovsepyan).

Institute of Geological Sciences

Major achievements

Estimation of modern geodynamics and velocity of continental deformation in the region of Armenia and Lesser Caucasus has been studied. In collaboration with Georgian University after Ilia regional geodynamic network has been established (Sup.: DSc(geol.-min.) A.Karakhanyan).

According to new geochemical and volcanological data of laboratory of volcanology as well as provided geophysical studies (Skolbeltsyn et al., 2014), a new model of magmatism in the Arabia collision zone has been presented, that suggests occurrence of two slab breakoffs in the south and in the north in Miocene (10-15 Ma). It has been demonstrated that this process can lead to the rise of convection in asthenosphere on a wider territory and trigger partial melting of lithospheric mantle sources (Sup.: cand.(geol.-min.) Kh. Meliksetian).

A method of determining the border deformation of soil slide in natural conditions has been developed for which the values of length and relative mobility of the clefts caused by a strong earthquake ($M \geq 6.0$) have been accepted as a benchmark (Sup.: acad. E. Khachiyani).

Rb-Sr isochronous age determinations of Tsav intrusion have been carried out which allow to review the existing ideas of its age and phasing. The results of the studies of the Lesser Caucasus

copper-molybdenum porphyry systems have been summarized (within the frames of SCOPES program) based on which the geological and genetic problems of their origin have been elaborated (Sup.: corr. member R. Melkonyan).

Latest geodynamic and geo-structural data have been acquired concerning the development history of the South-Eastern sector of Ararat valley in Armenia and a new geodynamic development model has been proposed. New, previously unknown geological formations and structures including surface ruptures have been discovered within the Ararat valley. A geological map with the scale of 1:200 000 for the South-Eastern sector of Ararat valley has been made (Sup.: DSc(geol.-min.) A.Avagyan).

In Amasia ophiolite complex Barremian-aged milk-colored radiolarites with relayed tuffites have been described for the first time and the presence of subareal volcanic activity has been recognized. The red radiolarites covering the lavas of the second area have a middle Oxfordian-early Kimmeridgian age, and those covering the third area exhibit Berriasian age (Sup.: cand.(geol.) L.Sahakyan).

Outcomes of applied developments

Within the frames of “The seismic risk assessment of Kapan, Sisian, Goris cities of RA Syunik region,” the following has been elaborated: ground classification map of cities and neighboring territory; seismic risk map of cities and neighboring territory expressed by the ground acceleration (PGA) values; cities ground utility map (the suitability of the soil within the borders of the city for construction purposes); the number and digital map distribution of the expected destructions (collapses, damages on different levels) of different types of buildings connected to each earthquake scenario within the borders of the cities; the number of the expected deaths and the wounded, also their digital map distribution connected to each earthquake scenario within the borders of the cities; the expected damage levels of the communication lines (scale and maps) (Sup.: DSc(geol.-min.) A.Karakhanyan).

Lithological and structural peculiarities of the diatomite rocks in Vorotan-Goris diatomite basing basin have been discovered. The concentrate acquired as a result of enriching the rocks containing new types of phosphorus (the absorption of P_2O_5 by the plants) also corresponds to the standards presented for the phosphorus fertilizers (Sup.: DSc(geol.-min.) T.Avagyan).

A method of determining the border deformation of ground slide in natural conditions has been elaborated for which the values of length and relative mobility of the clefts caused by a strong earthquake ($M \geq 6.0$) have been accepted as a benchmark. Concluding from 44 strong earthquake aftermaths, corresponding empiric formulas between the border deformation and earthquake magnitude, as well as the plane cut surface have been acquired. The border deformation magnitude for Spitak earthquake is 0.29×10^{-4} . The border deformation magnitudes for past earthquakes are the best benchmark for the prediction of new earthquakes in the same region (Sup.: acad. E.Khachiyan).

Institute of Geophysics and Engineering Seismology after A.Nazarov

Major achievements

Estimations of geomagnetic field acceleration values have been reviewed for the specification of models built on the base of observed peculiarities of geomagnetic field dynamics. To provide uniformity of geomagnetic data in space and time in the models of the present generation extrapolated and interpolated values of geomagnetic acceleration have been used (Sup.: DSc(phys.-math.) A. Simonyan).

A methodological approach to assess the actual seismic vulnerability (seismic protection) of buildings and constructions has been developed for different constructive systems constituting urban complexes (on the example of Gyumri) (Sup.: cand.(phys.-math.) V. Grigoryan).

An ultra-sensitive, three-way (N-S, E-W, Z), digital, broadband seismograph has been designed, manufactured and tested in field conditions, reacting to slight movements of various character. It is intended to solve various problems in geophysics, in earthquake-resistant construction, military affairs. The average distance of response is 100 m (Sup.: A.Gasparyan).

Outcomes of applied developments

Vertical and horizontal vibrostands management software has been compiled (Sup.:A. Gasparyan).

Six-channel registrar of seismic signals has been designed, manufactured and tested in field conditions, (data logger) with hard drive (Sup.: S. Shahparonyan).

The basic network has been compiled for monitoring radio-emanation observations based on the results of the analysis of engineering-geological, hydro-geological conditions and particular radio-emanation conditions of the territory of Gyumri (Sup.: R. Gasparyan).

DIVISION OF ARMENOLOGY AND SOCIAL SCIENCES

Academician –Secretary - academician Yu.Suvaryan

Scientific secretary - cand.(philosophy) H. Kocharyan

The Division of Armenology and Social Sciences incorporates the following institutions: the Institute of History; the Institute of Economics after M.Kotanyan; the Institute of Philosophy, Sociology and Law; the Institute of Linguistics after H.Acharyan; the Institute of Literature after M.Abeghyan; the Institute of Oriental Studies; the Institute of Archeology and Ethnography; the Institute of Arts; the Armenian Genocide Museum-Institute; Shirak Centre for Armenian Studies; as well as “Armenian Encyclopedia” Editorial and Publishing Office. All Armenian foundation for financing of Armenian Studies also acts in the frames of the Division.

The Division includes 10 academicians and 19 corresponding members.

3 general meetings of the Division were held in the reporting year.

At the general meeting on February 4 the Program of events dedicated to the 100th Anniversary of the Armenian Genocide was heard and considered. The candidateship of DSc (philology) S.Hayrapetyan for the vacancy of the director of NAS RA Shirak Research Center of Armenian Studies was considered and presented to NAS RA Presidium.

At the annual general meeting held on 2 April the report of academician Yu.Suvaryan on “The main results of scientific and scientific-organizational activities of the Division for 2015” was considered and approved. The following scientific reports were presented: “Armenian-Turkish social relations and the 100th anniversary of the Armenian Genocide”(academician G.Poghosyan); “Reflection of the Armenian Genocide in Armenian fine arts”(corr. member A.Aghasyan); “The 20th century in the historical process: a view by a historian” (foreign member A.Chubaryan, RF); “Armenian Genocide and British Diplomacy: a brief essay” (foreign member Z.Msryan, Lebanon); “The actuality of critical reconsideration of the problems of periodization of the Armenian past” (foreign member G.Areshyan,USA) and “The state of investigation of the Armenian architecture and perspectives of its development” (foreign member A. Ghazaryan, RF).

At the general meeting of the Division on November 25 the scientific report of the academician R. Safrastyan on “The Near East and Turkey: the status quo and the trends of changes” was heard. The voting for NAS RA Toros Toramanyan award took place as well, it was decided to grant the award to NAS RA foreign member A. Ghazaryan.

During the current year 14 Bureau sessions were held.

The following issues were considered and approved: the applications of the projects on keeping and development of the infrastructure of based funding during 2016 scientific and scientific-technical activities, on preservation of scientific objects having national value, on the state special target projects, as well as current reports on the mentioned procedures; scientific board staffs of the Institute of Arts and the Institute of Literature after M. Abeghyan; the schedules of the current meetings of the scientific organizations of the Division; the order of presenting and financing of applications of the foundation financing Armenian Studies; projects presented for grants by the New Nakhijevan of the Armenian Apostolic Church and Russian eparchy; the plan of the Division activities dedicated to the 70th anniversary of the victory in the World War II. The following issues were considered and discussed: on the realization of new and interdisciplinary investigations in the frames of NAS RA basic studies during 2015-2020, on participation in international project “Horizon 2020”, on supporting the electronic journal “Basic Armenology” (in English), on presenting suggestions towards cooperation with Academy of Sciences of Georgia, on celebration of the 75th anniversary of the Journal “Herald of Social Sciences”, on the results of post-graduate students’ entrance exams in 2015 and other issues of scientific and organizational nature.

On December 23 the meeting of the Bureau of the Division considered and confirmed the report on scientific and scientific-organizational activities of the Bureau and scientific organizations during 2015.

Some scientific events of the Division were dedicated to the 100th anniversary of Armenian Genocide, in particular the International Conference “Armenian Genocide 100: from recognition to compensation” with participation of Armenian and 25 foreign specialists.

During 2015 three numbers of the “Historical-Philological Journal”, the “Herald” and “Journal of Armenian Studies” were published. With the aim of activation of theoretical and applied Armenian Studies and the development of the collaboration between the corresponding centres, the journal “Basic Armenology” (in English) was established, two volumes of which were published during the current year.

156 monographs and collections (included 20 abroad), 11 tutorials, 882 articles (included 167 in foreign journals) were published by the Institutes of the Division.

Institute of History

Major achievements

The second book of the third volume of the academic multivolume “The History of Armenia” was published. It covers the period of the New History of Armenia - from 1901 up to 1918. The book elucidates the issues of social-economic conditions, national and social movements of the beginning of the 20th century, episodes on the activities of the voluntary groups during the years of World War I and the self-defense battles of 1915. The problems of Genocide and Patriocide are elucidated in a new way. The special sections introduce the political situation in Armenia after Russian revolution of 1917, the May heroic battles of 1918, the pages of formation and development of the Armenian periodical press and Armenian Diaspora in the New period, the rise of cultural life in the second half of the 19th century and the beginning of the 20th century.

The issues on recognition and compensation of Genocide and Patriocide have been studied upon the conceptual level within the frames of the theme “The stages of development of the statehood in Armenia” (Sup.: acad. A.Melkonyan). The generalized picture of material damage caused to the Armenian people as a result of the Genocide committed by the Turkish government, expropriation of the lands of the Armenian communities and organization of attacks on Kesab have been presented. The variants of possible assertion of a claim to Turkey for compensation of the material damages caused to Armenians on the grounds of standards and principles of international law have been indicated.

The military-political and administrative-economic situation in Western Armenia (July, 1914 – February, 1917) has been investigated. The Armenian volunteer movement, the Genocide of western Armenians and self-defense battles, the formation of the provisional administration of Van (governorship), the activity of the Russian military General-Governor in the regions of Western Armenia taken from the Ottoman Empire, issues connected with the salvation of western Armenians and restoration of the Armenian villages, the colonial policy of the Russian authorities and other problems have been elucidated on the basis of newly exposed archive documents.

The life and activity of the devoted figure of the Armenian national-liberation movement Hamazasp (Hamazasp Srvandztyan), his valuable contribution into the national-liberation movement at the end of the 19th century and the beginning of the 20th century have been investigated on the basis of various actual materials.

The memoirs of the famous representative of historical science, and, however, during the Soviet period little known historian and economist-statistician A-Do (Hovhannes Ter-Martirosyan, 1867-1954) have been elaborated. Various events – tragic and heroic - that took place in Armenia in 1880-1920 have been introduced in the book.

The history of Nor Bayazet gavar (1920-1930) has been explored for the first time within the frames of the theme “The Armenia and Armenians in the modern times. Armenian question” (Sup.: cand.(hist.) K.Khachatryan). The administrative changes, the structure of population, social-economic situation, social-political and cultural-educational life and other problems have been introduced on the basis of the newly exposed documents, statistical information, materials of periodical press of the mentioned period and from the positions of modern historical science.

The contribution of Armenia to the military-industrial complex of the USSR has been investigated. The industrial and scientific contribution of the Second (Soviet) Republic into the military-industrial complex of the USSR during the Soviet period has been exposed for the first time in the Armenian Historiography in the general context of the military-industrial complex of the USSR.

The significance of the military-defense measures in the strengthening of the defense and ensuring of security of the Republic is provided in the book.

The periodical press of western Armenians (1900-1922) has been investigated within the frames of the theme “Source studies and Historiography” (Sup.: cand.(hist.) A.Shahnazaryan). The main – national and social aspects of the Armenian non-Party press published in Constantinople and Izmir have been introduced. About forty newspapers have been analyzed on the ground of separate investigations and the general review. Their role and significance in the history of the Armenian periodical press has been mentioned. The History of the periodical press of the first decades of the 20th century has become the subject of the scientific investigation for the first time.

The historical heritage of Ashot Hovhannisyan has been investigated. It is the first attempt of the critical analyses of the great scientist’s creative work.

Institute of Archaeology and Ethnography

Major achievements

With implementation of comparative methodologies often disputed problems concerning “shared pain” and events of “saving” of the Armenians by the Turks have been investigated, in the context of the Armenian Genocide. It has been shown that the main motivations of the so called “savings” were mainly concerned to profit gaining (economic and sexual exploitation, robbery, bribery), violent changing of religion and turcification. It has been demonstrated that the abused topics on “true memory” and “shared pain” are dangerous reflections of Turkish rejection policy by which both the criminals and the perishes of the Genocide are put on the same level (Sup.: DSc(hist.) H.Marutyan).

In the frames of the project “Creation of complete chronological table of the Stone Age Armenia, according to new data” Early Paleolithic station of Haghtanak 3 on the Debed river basin has been investigated. Due to paleomagnetic analysis it has come out that these layers are 1.77 million years old. These data enable to date back the early habitation of the territory of the Republic of Armenia to this very period (Sup.: B.Gasparyan).

Due to radiocarbon dating of the contexts of the new found “vishap” stones on Aragats mountain it has turned out that the lower chronological border of these objects of monumental art of the Armenian Highland and the “sacred landscapes” organised around them goes back to ca. 2200-2036 BC (Sup.: cand.(hist.) A.Bobokhyan).

Outcomes of applied developments

In the archaeological site Areni 1 cave, excavated by the Institute, and with the aim of organisation of tourism, electric light system has been implemented (B. Gasparyan).

In the frames of reconstruction of Dashtadem castle an area of 1000 m², particularly the fortification walls, throne hall, constructions of industrial significance, has been excavated and prepared for reconstruction (Sup.: cand.(hist.) H.Melkonyan).

Institute of Oriental Studies

Major achievements

One of the main achievements of the Institute during the reporting year was the publication of dozens of works on the study of the Genocide by the researchers of the Institute dedicated to the 100th anniversary of the Armenian Genocide. In the work of corr. member N. Hovhannisyan “The Armenian Genocide is corroborated by the international scholarly, legal and human rights community” the author has put forward new conceptual and strategic approaches in evaluating the Armenian Genocide in the Ottoman Empire in 1915. In the work of academician R.Safrastyan “The Decision of the Ottoman Government on the Deportation of Armenians (May 30, 1915)” the most important document - the decision of the Ottoman Empire of May 30, 1915 on the deportation of Armenians – has been studied, presented and analysed.

Within the framework of the program “Armenia and the Problems of Political, Social, Cultural and Ethnic History of Turkey, Iran, Caucasasia and Arabic Countries of Mashriq” (Sup.: acad. R.Safrastyan) it is important to mention the publication of two issues of the periodical “Contemporary Eurasia”. Against the background of the recent developments in the region the publication of such periodicals has drastically grown. The first issue of the periodical is dedicated to the problems of domestic and foreign policy of Turkey and Iran, the challenges and prospects facing those countries. The second issue discusses the current developments taking place in the Arab world, the new political and ideological movements and the history of political transformation of the Middle East in the recent years.

Institute of Language after R. Acharyan

Major achievements

A comprehensive study of the Armenian vocabulary has been carried out according to the different development stages and different linguistic layers, semantic groups and functional spheres. Etymological, semantic and functional peculiarities of separate word units have been studied, clarifications and additions have been suggested. Within the frame of the theme “Problems of Study and Classification of Modern Eastern and Western Armenian” (Sup.: cand. (philology) N.Sargsyan) the study of clerical vocabulary of Armenian has been completed. The terms of the field have been observed from the diachronic perspective starting from the 5th century to present day. Particular importance has been given to the semantic changes, revealed by different basis, not only words from IE proto-language, but also borrowings from Assyrian, Hebrew, Greek and Iranian languages have been studied.

The study of Armenian cinematographic terminology has been completed, complete structural-semantic and functional study of the terms has been carried out. A dictionary of Modern Armenian neologisms has been compiled, which includes about 1600 new words, with relevant grammatical explanations and original examples, referring to various functional fields of language.

Within the frames of the theme “Study of Armenian Dialects” (Sup.: cand.(philology) V.Katvalyan) investigation of separate concepts and phrasiological units, dialectical manifestations of different semantic fields has been carried out, a number of words for different concepts in Armenian dialects and the peculiarities of religious vocabulary have been put forward. The study of clerical vocabulary in Armenian dialects has been summed up, a semantic-functional classification of clerical vocabulary, an investigation of synonymic sets and phrasiological and folkloristic units, functional analyses of phonetic variants have been carried out.

Within the frames of the theme “Problems of General Comparative and Applied linguistics” (Sup.: DSc(philology) V.Hambardzumyan) etymological clarifications and additions have been done, investigation of words of Grabar authors, which have not been recorded in dictionaries, investigation of analytical word formation of Grabar have been done, study of some semantic groups of Grabar word-stock and etymological classification have been carried out. Russian linguistic terms created by G. Jahukyan have been classified according to fields, structure, type and meaning. Separate works of Armenian lexicography have been studied and scientifically evaluated.

Within the frames of the theme “Problems of the Historical development of Armenian Language” (Sup.:cand.(philology) G.Mkhitaryan) a study of a number of newly formed, new, dialectical and foreign words used in different works of Grabar and Middle Armenian has been carried out. A number of words of Iranian origin have been analyzed, while studying dictionaries newly formed and developed words have been reported, names of concepts of different semantic groups and their word formation structures, semantic peculiarities, borrowings of Middle Armenian, dialectical words and word forms in manuscripts have been viewed

Institute of Literature after M.Abeghyan

Major achievements

In the sphere of the study of the ancient Armenian literature, within the framework of the theme “Publications of original texts of the Armenian medieval literature in ancient Armenian books”, an issue has been discussed: which works of the ancient Armenian literature were particularly published in books printed prior to 1801. Textual principles have been revealed, which were used in publications of medieval original texts. Within the framework of the theme, the following books have been published: V. Devrikyan “Armenian book on the world crossroads” /part 2, 18th century/ and “Voskan of Yerevan” /Life and publications: in Armenian, Russian and English/.

Within the framework of the theme “Native country of western Armenians in literary sources”, literary-cultural life of Western Armenia and western Armenian milieu in the late Middle Ages and in the 19th century has been studied. Within the framework of the study of the results, the Russian translation of the memoirs “History of Extermination of Lesser Armenia and Its Great Capital City Sebastia” of western Armenian intellectual K.Gabikian, survivor of the Armenian Genocide has been published with detailed footnotes, which refer to the Armenian writers, folklore, culture and ethnography of Sebastia.

Issues of studying the history of Armenia and Armenian literature conjointly have been discussed. A. Mousheghyan, DSc(philology) has analyzed this issue on the basis of evidences on the ancient Armenian dynasties existing in the Armenian history of the 5th century and of their new re-reading.

On the same methodological basis, medieval Armenian sources concerning the crusades and collapse of Constantinople have been discussed (Sup.: cand.(philology) H.Vorskanyan): how the failure of the Armenians’ political expectations was reflected in medieval political poetic lamentations.

In the sector of the modern Armenian literature (Sup.: academ.S.Sarinyan), within the framework of the study of classical Armenian literature, issues of transition from the medieval Armenian literature to the new era literature have been discussed, the typological characteristics of the Armenian literature of the 17th – 18th centuries have been revealed, which are peculiar to the new era literature.

The influence of European literary movements of the 18th- 19th centuries on the Armenian classicism, romanticism and realism has been studied. The study results have been reflected in the printed third volume of the six-volume academic edition of “History of Armenian Literature” and in the printed sixth volume of the work by S.Sarinyan entitled “Two Eras of the Armenian Literature”.

The first volume of the three-volume collection of works entitled “Literary Documentaries” has been compiled and prepared for publication (Sup.: DSc(philology) R.Aristakesyan). It presents literary movements of the 1920s, theoretical and critical disputes of the time, literary manifests and program articles with respective analyses and footnotes.

The sector of textual criticism has separated the two versions of the novel on the basis of the common ideological and chapter-division concept of the existing chapters of the novel, as well as on the printed and unprinted versions of the project by Avetik Isahakyan entitled “Master Karo”, and has prepared the first version for publication, which will be the seventh volume of the complete collection of Isahakyan’s works (with 14 volumes) (Sup.:DSc(philology) A.Isahakyan).

Institute of Philosophy, Sociology and Law

Major achievements

The most important historical-philosophical, socio-political and legal studies of the Armenian reality research (Sup.: academ. G. Poghosyan) which is supported through base funding, was conducted in 2015 in four areas of scholarship, viz. philosophy, sociology, law and political science.

Within the context of the commemoration of the 100th anniversary of the Armenian Genocide a detailed analysis of the demographic and territorial losses of Western Armenian population as a result of the Armenian Genocide and of its long-term historical, political, legal, sociological, social and philosophical implications has been made. Thorough research into the historical and legal aspects of

the Armenian Genocide has been carried out. In particular, the elements of the corpus delicti and issues related to the international legal liability for the Genocide have been analyzed.

For the first time the US Presidents' statements about the Armenian Genocide have been addressed in a comprehensive manner, in the form of a holistic discourse. The semantic structure of discourse has been identified, as well as various types of discursive forms about the Genocide have been marked out, in particular, the maneuver discourse that makes it possible to avoid both recognition and denial of the Genocide.

The Institute's researchers presented their findings at two international and numerous national conferences dedicated to the 100th anniversary of the Armenian Genocide. They also published scholarly articles and monographs on the subject (Poghosyan, G. Public Perceptions of the Armenian-Turkish Relations; Safaryan, G. Historical and Legal Aspects of the Armenian Genocide; Zolyan, S. The US Presidents about the Armenian Genocide (Semantic Analysis of the Maneuver Discourse)).

The most important result of the research activities is the fact that for the fifth consecutive year the Institute holds an academic conference *Philosophy in the Modern World* dedicated to the *World Philosophy Day* established by UNESCO. Proceedings of the conference are published as a separate collection of articles (Editor-in-Chief: academician G.Poghosyan). This year, the national academic conference was dedicated to the 100th anniversary of the Armenian Genocide.

Institute of Economics after M. Kotanyan

Major achievements

Within the scope of the research project entitled "The Possible Impact of the Accession to the Eurasian Economic Union on the Economy of the Republic of Armenia" (Sup.: DSc(econom.) A.Tavadyan) it has been justified that it is required to correct and agree upon the priorities of the economic policy of the EAEU member-states, define objectives, and design a new model of economic development. The principles for the choice of integration directions of the economic development of the Republic of Armenia have been designed. It has been justified that the possibility of designing the best scenario of the EAEU functioning is rather high only in case if all key requirements of the Agreement on the EAUE are met, and agreed fiscal, monetary and specifically currency policies are implemented.

Within the scope of the research project entitled "Issues of the Public Debt Management and Approaches to address them in the Republic of Armenia" (Sup.: DSc(econom.) A.Bayadyan) the need for separating the public debt management and political decision making processes from each other has been stressed and justified. The importance of defining the purpose of each loan agreement that would increase the public debt, and the need for supreme right with respect to borrowing decisions have been justified.

In order not to face a debt crisis it has been proposed to increase the share of the domestic public debt in the total public debt, and, namely, the share of savings bonds. In order to ensure the manageability of the public debt it has been proposed to define by the law additional threshold and/or constraint criteria with regard to the public debt.

Within the scope of the research project entitled "The Demographic and Material Losses during the Genocide and Reparation Issues" (Sup.: corr. member V.Harutyunyan) interpretations on demographic, material and financial losses caused by the Genocide have been provided. The above stated losses have been estimated based on the records of the National Archives of Armenia. The issues of the possible forms of compensation for losses have been studied. The issues on international responsibility for the committed genocide, establishment of the Genocide Fund, and Reparation and/or Compensation package have been studied.

Outcomes of applied developments

Within the scope of the research project entitled "The Possible Impact of the Accession to the Eurasian Economic Union on the Economy of the Republic of Armenia" (Sup.: DSc(econom.) A.Tavadyan) directions for coordinating crisis response measures to increase the potential of the economies of the EAEU member-states have been assessed. The research has addressed the key articles

of the Agreement on the EAEU and the possibility of making respective changes in these articles in order to ensure the economic growth of Armenia.

The exports-to-GDP ratio has been calculated. It has been justified that in case of Armenia the above stated ratio needs to be no less than 30%. By taking into account the fact that currently this ratio doesn't exceed 15%, the measures and steps for increasing the exports of the foodstuffs both to the EAEU member-states and to the EU, and other countries have been proposed.

The need for coordinating the macroeconomic policies of the EAEU member states has been justified, which is, de jure, the requirement of the Agreement of the EAEU. The possible impact of meeting these requirements has been presented. Based on that, systemized steps have been designed and proposed that are required to be implemented in order to increase the "integration effect" of the economy of the Republic of Armenia as much as possible.

Within the scope of the research project entitled "Sources of Funding and Higher Efficiency from the Use of these Means in the Agriculture of the Republic of Armenia" (Sup.: DSc(econom.) A.Bayadryan) the efficiency of the agriculture funding, providing loans, and their use, access to funding in order to improve the performance of small and medium-sized enterprises, and agricultural cooperatives have been studied, and based on these findings the obstacles have been identified and approaches to address them have been proposed.

In order to ensure the development of Agriculture sector of the economy it has been proposed to establish specialized financial institutions and provide tax incentives for the 5-year period in order to promote further development of cooperatives and enhance their capabilities, promote the rise of entrepreneurship, justified by the study of the best practices applied in the developing countries.

The positive impact of mortgage loans has been analyzed and justified, that would entail introduction of innovations, innovative business processes in the production and their development.

Institute of Art

Major achievements

The study of cultural ties between the Armenian and other peoples has been continued, which – apart from scientific importance – includes a no less topical political component. For the history of cultural ties between Armenians and other peoples the work entitled "From the History of Armeno-Russian Artistic Ties: Saint-Petersburg" (Yerevan, NAS RA "Gitutyun" Publishing House, 2015, 208 p.), co-authored by corresp. member A. Aghasyan and DSc(arts) A. Asatryan, is particularly valuable. Being the most important accomplishment of the Institute in the sphere of Armeno-Russian cultural relationships, it features a substantial review of the artistic ties between the Armenian and Russian peoples in the XIX – the first two decades of the XX century, particularly, in visual arts and music.

A number of archive materials, revealing previously unknown facts and data, forgotten works, individuals and developments have been introduced to scientific circles for the first time. Career portraits of the artists and sculptors, who were professionally trained, lived and created in Saint-Petersburg, the capital of Russia, are presented. A comprehensive investigation of the life of Hovhannes Nalbandyan, a graduate and long-time Professor at the Petersburg Conservatory, a violinist and pedagogue, has been conducted. The musician's concert activities have been restored for the first time, based on the documents, recollections and letters, as well as the facts and data from the printed media of the time.

Efforts have continued towards investigation of the creative legacy of eminent masters of Armenian medieval art. The book "Grigor Magistros – Author of Sharakans and an Aesthete" (Yerevan, NAS RA "Gitutyun" Publishing House, 2015, 130 p.) by DSc(arts) A.Arevshatyan, presents the Armenian medieval scholar and figure of culture Grigor Magistros Pahlavuni's creative legacy, musical in particular, exemplifying by his sharakans and lyrics. Musical and aesthetic views, narrated by Magistros in his "Papers" and "Explication of Grammar", have been thoroughly analyzed.

The art of diaspora Armenians has continued to be a subject for comprehensive research work. A major accomplishment in that field is "The Music of Alan Hovhannes at the East-West Cultural Juncture" (Yerevan, NAS RA "Gitutyun" Publishing House, 2015, 140 p.) by DSc(art) L.Yernjakyan. This is the first monograph dedicated to the oeuvre of the world-renowned American composer of Armenian background. Basing on the archive materials, foreign original sources and data from the

press, the author has outlined the composer's creative path, analyzed the East and West cultural dialogue evolved in his musical pieces of various times, dwelled on the theoretical-aesthetical foundations and spiritual-symbolistic aspects of melodic thinking, revealed in the composer's works on Armenian and oriental themes.

Armenian Genocide Museum-Institute

Major achievements

The Armenian Genocide Museum-Institute has carried out considerable work devoted to the 100th anniversary of the Armenian Genocide within the program "Studies on the History and Historiography of the Armenian Genocide" (Sup.: DSc(hist.) H.Demoyan). In 2015 the Armenian Genocide Museum- Institute was reconstructed and the new exhibition of the museum was opened. New exposition area of the museum has 12 halls instead of the old exhibition's three and consists of 52 main sections. The main collection includes thousands of new materials found and purchased in the last 7-8 years. Unique photographs, books, documents and other exhibits are presented in the new exhibition. From January to December of 2015, AGMI has opened a large number of temporary exhibitions not only in the Republic of Armenia and Artsakh, but also in many foreign countries: Georgia, Czech Republic, Estonia, Latvia, Lithuania, Norway, Spain, France, Cyprus, United States (Los Angeles, New York), Romania, Russia, Slovakia, Poland, etc. On April 28 the Armenian Genocide Museum-Institute opened a temporary exhibition "Armenia 1915: Paris hosts the collection of the Armenian Genocide Museum-Institute of Yerevan" in Paris. On 8-12 July 2015 the Armenian Genocide Museum-Institute organized and hosted the XII conference of the International Association of Genocide Scholars titled "Comparative Analysis of 20th Century Genocides." The conference brought together hundreds of the best specialists in the field of Genocide Studies from all over the world. AGMI has published many new books dedicated to the 100th anniversary of the Armenian Genocide, as well as the current issues of its two journals: "Journal of Genocide Studies" and "International Journal of Armenian Genocide Studies".

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) in Shirak region two old places have been discovered and investigated, early bronze-aged settlement and a micropleus in the territory of Eghnajur community and early iron-aged micropleus in Jradzor. In the scope of the project the Center has organized regional readings under the heading "I remember and demand" with the participation of 130 pupils from final classes of high school dedicated to the 100th anniversary of the Armenian Genocide, ten days' republican school of young historians under the title "Some issues on the recognition of the Armenian Genocide and the rehabilitation of historic right" with the participation of 30 young, young scholars of NAS system and institutions, magistrates post-graduates., teachers of history; the Center has organized the third ethnographical "Bread festival" with the participation of all regions and national minorities.

Armenian encyclopedia. Publishing house

Major achievements

The following works have been published: "Encyclopedia of Armenian Typography and Book Art" (Vol.: 1120 pages, format: 70 x 100 1/16) and "Agricultural Encyclopedia" (Vol.: 1096 pages, format: 84 x 108 1/16) (Sup.: cand.(chem.) H. Ayvazyan).

National Bureau of Expertise SNPO

Major achievements

In 2015 the National Bureau of Expertise celebrated its 10th anniversary. A conference on "Application of contemporary scientific methods and technology in the field of expertise" devoted to the anniversary was held. A collection of materials of the conference consisting of 79 scientific articles was published and then approved by RA SCC.

The Organization took part in the V St. Petersburg International Legal Forum.

The National Bureau of Expertise has been actively engaged in the project: "Science for Peace and Security (SPS) Program, Solid State Gas Sensors for Security and Military Threats". Within the program a scientific meeting was held attended by representatives from the Institute of Chemical Technology in Prague, the Research Institute of the Ministry of Defence of the Czech Republic, Yerevan State University and the National Bureau of Expertise.

The project (№ A-2151) entitled "Nuclear and mitochondrial genetic variants and molecular bases of mitochondrial OXPHOS diseases" presented by the National Bureau of Expertise and the Center for Medical Genetics and Primary Health Care was approved by International Scientific-technical centre at the summer session of the council and guaranteed to be funded, a bilateral agreement as well as subagreements were signed between the Center for Medical Genetics and Primary Health Care and the International Scientific- technical Centre.

The organization has actively participated in the activities of the European Network of Forensic Science Institutes (ENFSI).

In 2015 the employees of NBE took part in ENFSI Drugs Working Group 21st Annual Meeting in Dublin Castle, Ireland and in the ENFSI 27th Annual Meeting held in Forensic Science Institute of the French Gendarmerie.

Continuing cooperation links with similar foreign institutions an agreement was signed with the Forensic Center of the Department of Justice of the Republic of Kazakhstan in 2015.

During the accounting period experts and specialists of the organization have trained 360 employees of competent bodies who have the responsibilities to get the initial data for expertises and the authorities to nominate expertises.

9573 forensic expertises in frame of 28 forensic types and 122 forensic subtypes and technological directions have been implemented.

Outcomes of applied developments

From April 6 to 19 2015, a delegation from the National Bureau of Expertises, supported by the International Science and Technology Center (ISTC), made a business trip to Japan (Tokyo). The delegation members visited departments and laboratories, where they were introduced to the technological and analytical equipment, in total 16 leading Japanese institutions. In order to strengthen the Armenian-Japanese cooperation the first round-table was organized on the studies of anthropogenic impacts on the environment, researches of the experience of appropriate leading institutions in Japan.

Research and studies have been carried out by the organization's department of photo-technical, portrait, audio and video expertises, as a result of which "Identification of a person by external characteristics" educational handbook was published.

Periodic assessments were carried out by "National Accreditation Body" SNPO in the food and beverage expertise department and ballistics expertise department of the organization, as a result of which it is certified that the abovementioned testing laboratories are in compliance with the requirements of RA laws of Accreditation system and of ISO / IEC 17025-2005 standard requirements.

It should also be noted that on November 24 to 25 of this year periodic assessment was carried out by "National Accreditation Body" SNPO in the organization's certification body of military and dual-use goods and technologies (product), which certified that the abovementioned certification body is in compliance with ISO / IEC 17065-2013 standard requirements.