LATVIAN ACADEMY OF SCIENCES

YEARBOOK 2019

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CONTENTS


ACADEMIA
SCIENTIARUM
LATVIENSIS

WE ESPECIALLY NEED IMAGINATION IN SCIENCE. IT IS NOT ALL MATHEMATICS, NOR ALL LOGIC. BUT IS SOMEWHAT BEAUTY AND POETRY.

Maria Mitchell, astronomer

OJĀRS SPĀRĪTIS, PRESIDENT OF THE LATVIAN ACADEMY OF SCIENCES

Dear Colleagues in Science,

This year, like every year, the Latvian Academy of Sciences confirms its unfailing role of national importance and responsibility in the development of education, science and economy of our country. With this new version of the "Yearbook", I would like to inform our partners in many countries in an attractive and popular way about the major directions of our national science policy as well as the international importance of our academically outstanding personalities and their research. I am convinced that information on the history, structure and achievements of the Latvian Academy of Sciences will make it possible to ascertain not only the unique and symbolic place of our ACADEMY in the spiritual life of the Latvian nation, but also build up the pride of each country's scientists and politicians for the symbolic role and place of THEIR Academy.

Along with other awards for scientific achievements, the Latvian Academy of Sciences annually awards also the special Cicero Prize to outstanding personalities in the humanities and natural sciences, education, culture and politics. One of the 2018 winners was the President of France Emmanuel Macron, whose thoughts and words express new and essential ideas for restarting Europe. In his words of gratitude for the Cicero Prize, he addressed the Latvian scientific community with the following: "France and Latvia are closely linked in their choice in favour of Europe, in their desire to see a strong Europe, a Europe that can protect its citizens and protect itself from external risks".

I am delighted with the achievements of Latvian scientists in 2018 and the extensive international cooperation projects that are part of the world's scientific and technological progress and their theoretical and practical input brings tomorrow closer. It is good to know that the language of science is so universal that it crosses borders and that it creates new knowledge. However, if economic and diplomatic ties between countries were to be obstructed or discontinued, I am convinced that scientists, as recognised leaders of public opinion, will be able to avert contradictions and delineate new ways of international cooperation.

THE PRESIDENT OF THE REPUBLIC OF FRANCE EMMANUEL MACRON'S ADDRESS ON PRESENTATION OF THE CICERO PRIZE

(Read out on behalf of the President Rīga, 6 December 2018)

Mr President of the Senate of the Academy of Sciences,
Mr President of the Academy of Sciences,
Ladies and Gentlemen,

I am particularly pleased to accept the Cicero Prize accorded by the Latvian Academy of Sciences and I thank you warmly for it.

Through you, Mr President of the Senate, I would like to thank the Latvian people, their President and their Government for this symbol of "strong friendship and strong relations" between our two countries, to use the expression of the President François Mitterrand, who was the first European Head of State to pay an official visit to Lithuania, Latvia and Estonia in May 1992.

The celebration of the centenary of the creation of the Latvian state throughout 2018 was the occasion of a special intensification of the bilateral relationship between France and Latvia. The inauguration at the Musée d'Orsay, last spring, of the superb exhibition "Untamed Souls" has highlighted great European painters originating in the Baltic countries who contributed to the awakening of national feeling. I welcome the major role played by Latvia in organising this exhibition, which is now also taking place in the three Baltic States.

This exhibition, inaugurated by the Presidents, in the presence of the Ministers of Culture and your Minister of Foreign Affairs, marked the beginning of a series of fruitful contacts, notably with President Raimonds Vējonis. On this occasion, the Foreign Ministers were able to sign an Action Plan of the Strategic Partnership, which sets ambitious goals for the relationship between France and Latvia over the next five years, in all areas of the bi-lateral relationship. In light of the troubled and uncertain international context, it is essential to continue the very close cooperation between our two countries, particularly in terms of defence and security. It is in our mutual interest. It is in the interest of the European project.

France and Latvia are closely linked by the choice for Europe, by a common destiny centred on the same European ambition, with the same desire to have a strong Europe, a Europe that knows how to protect its citizens and defend itself against external risks. If Latvia is today in the first circle of solidarity within the European Union, it is because it made the deliberate choice, already before 2004, to overcome difficulties, to be at the forefront of the project European Union and to hold high European values.

Before we embark on the year 2019, which will allow us to commemorate the 100th anniversary of the liberation of Rīga, I wish to reiterate the commitment of France to a sovereign, united and democratic Europe.

Thank you.

Translated by **Eduards Bruno Deksnis**

THE LATVIAN ACADEMY OF SCIENCES

TRANSFORMATION OF THE ACADEMY OF SCIENCES IN THE 1990S AND ACCOMPLISHMENTS IN LATVIAN SCIENCE

Jānis Stradiņš, *Dr. habil. chem., Dr. hist. h. c.*, Professor, Full Member of the LAS, Chair of the Senate, Latvian Academy of Sciences

In 2015, the Latvian Academy of Sciences celebrated the 200th anniversary of the establishment of Academia-200 Kurzeme Society for Literature and Art; during the first decades of its existence, this association had functioned as the first Academy of Sciences in the Baltic provinces of the Russian Empire until it was dissolved in 1939, with repatriation of the Baltic Germans. The Latvian SSR Academy of Sciences was founded in 1945/1946. It was composed of individual members and had a vast network of research institutes, design offices, workshops, libraries, and other institutions, which for almost 50 years served as the leading and most significant research system in Latvia. It introduced and developed branches of modern science previously absent in Latvia. The LSSR Academy of Sciences was formed according to the structure of the USSR Academy of Sciences, and coordinated its activities with its USSR counterpart, functioning however, relatively independently and efficiently, and earning a certain recognition in the Soviet Union and in some areas of research – even globally. It should be noted that the Latvian SSR Academy of Sciences had largely been formed on the basis of the Latvian State University and the Latvian Academy of Agriculture, hence its first academics were simultaneously the professors of these universities.

When the Republic of Latvia regained its independence in 1990/1991, a certain contribution in this process was also given by the progressive AS staff, and a logical problem arose: what shape should the Latvian Academy of Sciences take in these new conditions.

Academician Jānis Stradiņš

This question arose not only in Latvia and its two neighbouring countries Estonia and Lithuania, but also in other post-communist countries of Eastern Europe, where the Academies of Sciences had functioned similarly to that of the USSR. In two countries, where the former Academies of Sciences had been too closely bound to the old regime (the German Democratic Republic and Czechoslovakia), they were dissolved, while in other countries – transformed, giving autonomy to their institutes or incorporating them into universities. The three Baltic republics independently of each other chose the Nordic model – the academy of individual members, without institutes, the so-called personal academies, associations of leading scholars and scientists, even though Western Europe has a number of countries, where the Academies of Sciences do have institutes (e.g., Austria, the Netherlands). The overwhelming majority of the scientific community in Latvia was against the Academy acting as a "ministry of science", supervising its subordinate institutes and allocating funds to them.

In Latvia, the dispute about the academy of sciences started in 1989 and went on until 1992, to some extent, even to the late 1990s. The name of the Academy was changed to the Latvian Academy of Sciences (the LAS) in March 1990; the academic staff had to be upgraded to enable the transformation of the existing Academy. Part of the members united by the newly established public organisation – the Latvian Union of Scientists (founded in 1988) insisted on liquidation of the "old" Soviet Academy and foundation of a new national Academy of Sciences (without institutes). Such a solution would annihilate the previous 45 years of existence of the Academy of Sciences in Latvia. The new Academy would have lost claim to such outstanding Latvian scholars as academicians Jānis Endzelīns, Paulis Lejiņš, Pēteris Stradiņš, Augusts Kirhenšteins, Gustavs Vanags, Alfrēds Ieviņš, Solomons Hillers, Arvīds Kalniņš, Lidija Liepiņa, Artūrs Krūmiņš, etc.; the continuity would be interrupted, and the members of such a "National Academy of Sciences" could, most likely, be appointed or elected according to somewhat subjective criteria.

Another important issue was the prospects of existence of the newly established, strong institutes within the Academy of Sciences structure (the type of "a hybrid academy") or outside the Academy, mostly attached to universities, because, in essence, several Academy institutes had grown from the universities historically, and within the structure of the university it would be easier to include research into study programmes and attracting the young generation to science. Furthermore, in 1990, the Latvian Council of Science (LCS) had already been founded by the resolution of the Republic of Latvia Soviet of Ministers, and it distributed funding for state research projects. Therefore, the Academy of Sciences objectively could no longer supervise the institutes. And finally, the decision whether the Academy should be transformed by the government's (or the Supreme Council's) resolution "from the top", or should this change be effected on the Academy's own initiative (the Academy of Sciences Constitutional Assembly at that time in addition to the LAS members also included the elected representatives of the institutes)? The disputes on these matters raged for almost two years.

The option of "a hybrid academy" (individual members and large research institutes) was rejected by the majority of the institutes and by the large universities (UL), the Latvian Union of Scientists and the researchers' representatives in the political circles (the head of the Science Council at the time, academician Andrejs Siliņš, who urged scientists to actively engage in politics and later became a Chairman of the Parliament Standing Committee for Culture and Science, supported the conversion of the existing LAS into a classical type academy of sciences and opposed its dissolution). Nevertheless, the contested Academy of Sciences concept originally was not included even in the new Republic of Latvia draft law on scientific c activity, the preparation of which commenced in 1991/1992.

It should be noted though that the status of academies of science at that time was uncertain in Western Europe too, because science and its funding at the national level was governed by the respective national science councils, rich universities or there were state and private investor-funded research institutions (as the societies of Max Planck or Fraunhofer Institutes in Germany). Consequently, on 17–18 March 1992, in Stockholm the All-European

Academy Meeting "The Role of Academies as Learned Societies in the New Europe" was held. The representatives of the Latvian Academy of Sciences Jānis Lielpēters and Jānis Stradiņš were invited to attend the meeting, which laid the foundations for a new, not yet formalised organisation ALLEA (European Federation of Academies of Sciences and Humanities). This event partially legalised the admission of the LAS (at that time not yet recognised by the state of Latvia itself), into the international academic community. Since the summer of 1990, the direct relations of the LAS with the Royal Swedish Academy of Sciences motivated the LAS to shape the new version of its Charter after the Swedish model as "a personal academy" rather than "a hybrid academy" (with institutes). Thus, the Latvian Academy of Sciences gave up its former administrative power over funding and problem solving of the institutes, which were addressed independently of the LAS, whose authority was upheld by the more active individual Academy members, especially those elected by the LCS.

The General Meeting of the LAS, where the new LAS Charter and the Statutes were approved, was held on 14 February 1992 (to emphasise the historical link with the existing Academy of Sciences, whose first founding general meeting had taken place on 14 February 1946). It proceeded quite dramatically, since the first round of voting failed to achieve the majority of 2/3 of the votes cast, however, in the second round the Charter was accepted (68 votes – for, 1 – against, 1 – abstained). The general meeting was attended by the President of the Royal Swedish Academy of Sciences T. Laurent and Secretary General C. O. Jacobson. The adopted Charter established that "The Latvian Academy of Sciences is an autonomous legal entity made up of elected members of the Academy of Sciences and subsidised by the state. LAS Charter is approved by *Saeima* and therein are specified the operational objectives, main directions, legal and economic basis, the system of governance, rights and obligations of the LAS. *Saeima* or the Cabinet of Ministers may set the LAS specific tasks and mandate in the sphere of science." Although both the Charter and the Statutes provided that the institutions had the right to form an association with "the personal academy", in actual fact, with rare exceptions, such an association did not materialise, and in 1996–1998, as a result of the so-called "Cimdiņš' reform", the majority of the institutes were incorporated into the University of Latvia (and later, some also into the structures of the Rīga Technical University and the Rīga Stradiņš University).

The Latvian Academy of Sciences building
Photo: Jānis Brencis

The obstacles had to be overcome in order for *Saeima* – the Parliament of Latvia – to unanimously approve (in a modified form) the LAS Charter on 23 January 1997, granting this decision the power of law. Thus, the Latvian Academy of Sciences was permanently legally established as an important institution of the renewed Republic of Latvia, and no longer perceived as a relic of the Soviet regime, in opposition to the attitudes maintained earlier in some circles. This unanimous vote confirmed the authority attained by the LAS in the Latvian society. The LAS has become a nationally and internationally

recognised centre of multidisciplinary scientific excellence, expertise and publicity, an advocate of Latvian scientific achievements on the international scene, where such academies are seen as significant intellectual and cultural attributes.

According to its Charter, the tasks of the LAS include promoting research in basic and applied sciences, especially in interdisciplinary studies; research and cultivation of Latvian history, culture, and the Latvian language; active participation in policy making regarding the science in Latvia, and advising public institutions about scientific issues; elaboration of scientific terminology; organisation of congresses, conferences, discussions, and competitions; popularisation of scientific achievements and the Baltic history of science; maintenance of bilateral international contacts of Latvian scientists; safeguarding, preservation and further development of research ethics, principles, and traditions of discussion. In the scientific organisation aspect, the LAS participates in the evaluation of the choice of research directions in Latvia, including the debating and improvement of draft legislation related to research and innovation, working in close cooperation with the Latvian Council of Science.

What has been achieved by the LAS during the years of regained independence? It has significantly updated its membership, electing as members or honorary doctors the most notable Latvian scientists, who, before the restoration of independence, due to political or subjective motives, were not elected to the LAS. Currently, according to membership figures, the LAS is the largest Academy of Sciences in the Baltics (as of 1 January 2017, there were 127 full members, 127 corresponding members, 57 honorary members, and 97 foreign members). As time passes, there arises the disproportion in terms of age and sectoral representation and the LAS personnel grows older, which is also characteristic of the academies of sciences in other countries.

The renewed LAS has attracted the researchers of the Latvian diaspora, and to some extent, reintegrated the so-called "expatriate scientists" into the Latvian scientific community. Creation of the LAS honorary membership has helped bring into the LAS outstanding personalities of Latvian culture and art. In 1998, the nomination system for LAS awards and awarding of young scientists was put in order, thus stimulating the most renowned and promising scientists. Since 1998, joint prize allocation has been launched in cooperation with Latvian manufacturing companies (*Grindeks*, *Latvenergo*, *Dati*, *Latvijas Gāze*, *Itera Latvija*, etc.) and individual patrons.

The LAS has given a momentum and materially contributed to establishment of major research centres important to Latvian science, e.g., Ventspils International Radio Astronomy Centre (VIRAC), the Baltic Centre for Strategic Studies, signed agreements with a number of scientific and administrative institutions for implementing joint research.

Since 2004, the LAS has participated in the national research programming conducted by the Republic of Latvia Ministry of Education and Science. Of these programmes, *Letonika* (Letonics or Latvian Studies) and EKOSOC are directly managed by the LAS, while most of the other programmes of national importance are headed by the LAS members.

The LAS has become a good mediator in forming scientific ties between Latvian universities, academies and other higher education institutions and state research centres. The LAS has concluded contracts or cooperation agreements with academic educational institutions, and elected their lead researchers as the members of the LAS.

Since 1999, the Latvian Academy of Sciences has helped to maintain a high quality of the doctoral theses elaborated in Latvia, having evaluated them by the State Scientific Qualification Committee.

At general meetings, gatherings, and councils of the LAS a dispute culture is encouraged, comprehensive discussions of topical scientific and practical matters take place, the LAS is also in charge of the ethics of science (LAS and LCS Ethics Committee).

The LAS operates in close contact with the Ministry of Education and Science, the Latvian Council of Science, the Ministry of Health, the Ministry of Agriculture, the Ministry of Defence, and the Ministry of Culture.

The LAS has facilitated active regional studies, together with the Latvian Association of Local Gov-

ernments has held visiting sessions (for example, in Liv Coast, Selonia, Latgale, etc.).

Since 2002, the LAS has traditionally held a competition to define and promote the 10–12 most outstanding achievements of science in Latvia.

The LAS coordinates the work of the Terminology Commission; it renders support to national emeritus scientists and their club "Emeritus"; it promotes the activities of young scientists in collaboration with the Association of Latvian Young Scientists, individual student organisations ("Austrums"), etc.

The LAS establishes and maintains its own traditions (LAS insignia, promotion of scientific and technical history studies, and research of the history of the building housing the LAS).

It has to be admitted that in recent years, in addition to the large natural science institutes the LAS has also lost the humanities institutes, which until 2014 were located in the LAS building. The Latvian Academic Library, Archives of Latvian Folklore with the famous historical folksong cabinet *Dainu skapis* and other institutions have moved, too. With the strengthening of research in the universities, the role of the LAS in the science in Latvia has diminished. However, the LAS still encourages, evaluates, and provides professional expertise on research and innovation trends and results in the country. It would be beneficial to facilitate in-depth cooperation with universities and institutes. Unfortunately, insufficient state funding for the LAS activities and the fact that the LAS does not hold property rights to the Academy's high-rise building, impedes the expansion of the LAS work. Transfer of the high-rise building into the LAS ownership might significantly contribute to further development of the LAS, creating a more stable economic base and establishing the scientific and cultural centre of Latvia and, possibly, of the entire Baltic region in one edifice.

Presently, the Latvian Academy of Sciences is one of the essential vehicles for manifestation and implementation of the democracy in science in this country, where the researchers' weighted collective opinion is crucial.

The priority task of the LAS for the nearest future would also be the regaining of the partially lost influence within governmental structures as a qualified intellectual advisory body on national development strategy issues, which was of importance in the 1990s and in early 21st century. LAS together with the Latvian Council of Science must become a significant support for the Latvian Innovation and Research Strategy Council permanently running at the Cabinet of Ministers. LAS should be actively involved in promoting scientific and innovative technologies, become a scientific lobby in our country, and encourage interaction between science and technologies in all their manifestations.

Such is the position of the current LAS management which has gained approval with the researchers and the academic community of Latvia. This position is winning a growing support, although often a purely declaratory one, also in the political environment.

Building of *Academia Petrina* in Jelgava, the place where the Courland (Kurzeme) Society for Literature and Art was founded in 1815 – the first learned society in Latvia and predecessor of the Latvian Academy of Sciences. The president of the Latvian Academy of Sciences Ojārs Spārītis is holding the graphic design of the postage stamp (artist Elita Viliama) dedicated to the 200th anniversary of the foundation of the Courland Society for Literature and Art

STRUCTURE OF THE LATVIAN ACADEMY OF SCIENCES

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The Presidium of the Latvian Academy of Sciences. From the left: Andrejs Siliņš, Raita Karnīte, Jānis Spīgulis, Jānis Stradiņš, Tālavs Jundzis, Baiba Rivža, Andrejs Ērglis, Andrejs Krasņikovs, Pēteris Trapencieris, Ojārs Spārītis

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The newsletter *Zinātnes Vēstnesis* (*Science Bulletin*) reflects current events and the most important developments in the science life in three organisations – the Latvian Council of Science, the Latvian Academy of Sciences, and the Association of Latvian Scientists, the newsletter is available in printed and online versions in Latvian.

The *Latvian Academy of Sciences Yearbook* (annual report) is a follow-up edition published since 1991. Beginning with 2006, the annual reports are available both in printed and online versions. The Yearbook contains basic information on the Academy, research reports, the membership directory. The English version of the Yearbook is published every second or third year.

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The Division of the Humanities and Social Sciences brings together scientists of the highest rank and acclaimed arts and cultural personalities representing more than twenty branches of science: anthropology, archaeology, architecture, art, art history, art theory, bibliography, culture history, demography, economics, ethnology, folkloristics, history, history of science, journalistics, law, linguistics, music history, literature and literature theory, philosophy, pedagogy, political science, psychology, sociology, theology.

Foreign members of the Division are linguists and literary scientists, historians, economists, ethnologists, bibliographers, science historians, psychologists and philosophers from Australia, Canada, the Czech Republic, Estonia, Finland, Georgia, Germany, Italy, UK, USA, Russia, and Slovakia.

Division's honorary members are outstanding representatives from cultural, art and public spheres – writers, visual artists, musicians, directors of museums and libraries, state officials.

Among the full members of the Division are professors, leading researchers and heads of the largest highest-level scientific institutions in Latvia: University of Latvia and its scientific institutes – Latvian Language Institute, Institute of Literature, Folklore and Art, Institute of History of Latvia, Institute of Philosophy and Sociology, the Livonian Institute, Rīga Technical University and its Faculty of Engineering Economics and Management, Rīga Stradiņš University, University of Daugavpils, Liepāja University, Latvia University of Life Sciences and Technologies, Latvian Academy of Music, Latvian Academy of Arts and its Institute of Art History, Ventspils University of Applied Sciences, Vidzeme University of Applied Sciences, as well as of private research institutions.

The Division can count on a number of doctors honoris causa, the degree having been conferred to both national and foreign scientists – the scientific staff of the libraries and museums, education specialists, representatives of the highest clergy, etc.

The Division maintains close links with all scientific institutions, not only those the members of the Division are affiliated with. Members of the Division participate in research projects of national and international level that are carried out in these institutions. Most typically, the collaboration is carried

out in the following areas: literary theory, linguistics, history and archaeology, philosophy and sociology, and economics. Unique resource storage depositories are set up and available for investigation and research purposes.

The Division supervises the work of the LAS Terminology Commission, and is in charge of publishing of the *Proceedings of the Latvian Academy of Sciences*, Section A, an academic journal published since 1947. Beginning with 1992, the journal appears in two independent sections, A and B. The scope of Section A covers social sciences and the humanities. The members of the Division take part in compiling the National Encyclopaedia of Latvia.

While implementing the role of science promotion, the Division reviews and selects the best achievements of the year in the humanities and social sciences, and rewards the authors. The Division is responsible for assigning twelve awards in the humanities and social sciences.

The Division being a social partner and a participant in building science policy, its members are active in working groups set up by the Government of Latvia, as well as in public organisations. The representative of the Division is a member of the Permanent Composition of the Latvian Council of Science. The expert meetings are summoned to discuss topical issues of public concern, resulting in expert conclusion; whereas working groups are set up to evaluate the draft laws and regulations and prepare evidence-based proposals for the administration and the Government.

DIVISION OF AGRICULTURE AND FORESTRY SCIENCES

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The Division unites the leading scientists in agriculture and forestry sciences. The Division cooperates with the Ministry of Agriculture of the Republic of Latvia, Latvia University of Life Sciences and Technologies, Latvian Academy of Agricultural and Forestry Sciences, and other organisations in the development of recommendations for policy regarding enhancement in higher education and science, including activities aimed at increasing the international competitiveness of scientific institutions as well as closer cooperation with industry; joint organisation of conferences, expositions and other events aimed at popularising scientific achievements; cooperation in the organisation of young scientist contests in agricultural sciences; international cooperation and cooperation in holding

annual surveys of institutes of agricultural and forestry sciences. The Division participates in the European Union's *Horizon 2020* project 4D4F (Data Driven Dairy Decisions for Farmers, 2016–2019) and leads the National Research Programme EKOSOC-LV.

DIVISION ACTIVELY COLLABORATES WITH ITS PARTNERS:

Latvian Academy of Agricultural and Forestry Sciences (www.llmza.lv) is a non-profit scientific organisation, where the best scientists in agriculture, rural economy, veterinary science, food science, engineering sciences, food and wood processing are united on a voluntary basis.

Latvia University of Life Sciences and Technologies (www.llu.lv) is one of the leading universities of science and technologies in the Baltic Sea region, specialising in the sustainable use of natural resources and aimed at the enhancement of quality of life for society.

Institute of Food Safety, Animal Health and Environment *BIOR* (www.bior.lv) is a research centre of national importance, which develops innovative research methods and new practically applicable knowledge in the following areas: public and environmental health, food, fishery and veterinary medicine. In the area of its competence, Institute *BIOR* with its excellent research, technical and developed human resource base is the leader in the region. *BIOR* is a cooperation partner of the European Food Safety Authority.

Latvian State Forest Research Institute *Silava* (www.silava.lv) is the main centre of forest science in Latvia, leader of scientific ideas in forestry and related research and development. *Silava* develops innovative technologies to promote sustainable development and competitiveness in the forestry sector.

Institute of Horticulture (www.darzkopibasinstituts.lv) is the leading horticulture research institution in Latvia. The main directions of research are: diversification and breeding of horticultural crop cultivars suitable for the Baltic Sea region; environmentally-friendly horticultural production systems; storage and processing technologies of horticultural crops; basic research for horticultural science.

Institute of Agricultural Resources and Economics, Latvia University of Life Sciences and Technologies (www.arei.lv) was founded by merging several agricultural research institutes. Now it is the only research institute in Latvia engaged in breeding of field crops; its researchers specialise in breeding, arable farming and interdisciplinary studies in the science of economics.

DIVISION OF CHEMICAL, BIOLOGICAL AND MEDICAL SCIENCES

BOARD OF THE DIVISION

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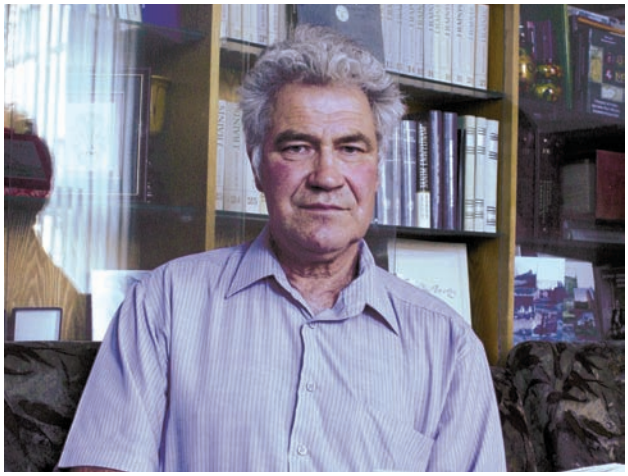

Pēteris Trapencieris, *Dr. chem.*

The Division unites scientists from the fields of biology, chemistry and medical sciences. The Division resumes the new developments in natural sciences in Latvia and discusses the problems in those directions. The highest expertise of the Division members is used to award the best achievements of scientists in the field. The Division organises regular meetings, where topical issues in chemistry, biology and medicine are discussed. The Division has organised several interdisciplinary seminars, and seminars with participation of postdoctoral researchers, publish lectures and discussions on topical issues in science.

The Division has a close cooperation with the main Universities and with research directions in the scientific institutions in all fields of chemical, biological and medical sciences in Latvia.

University of Latvia (www.lu.lv) coordinates research areas in life sciences such as material science, nanotechnology, medical physics, regenerative medicine and sustainable use of environmental resource and which are developed in the Faculties of Chemistry, Biology and Medicine. Pharmacological research is focused on fundamental investigations of biological activity of natural and synthetic substances and mechanisms of action of molecules, which may stop the pathological processes before they start.

Rīga Technical University (www.rtu.lv) has considered research excellence a priority right from the start. The Faculty of Materials Science and Applied Chemistry had employed renowned scientists Wilhelm Ostwald, Paul Walden, Lidija Liepiņa and Gustavs Vanags. Research in the field of materials is very diverse in the following directions: functional nanomaterials, nanotechnologies, green chemistry and bio-based technologies.

Rīga Stradiņš University (www.rsu.lv) performs research in medicine, pharmacy, dentistry, rehabilitation, and nursing science in Latvia. Its subunit A. Kirhenšteins Institute of Microbiology and Virology (www.rsu.lv/akmvi) provides expertise on host-pathogen interactions, urgent viral infections and importance of them in development of non-communicable diseases, biotechnology approaches and nanomedicine. The Institute has experience in coordination of EU projects (BALTINFECT; COST action CA15111).

The Latvian Institute of Organic Synthesis (www.osi.lv/en) is the largest academic drug discovery centre in the Baltic States. Institute is the inventor of 18 original medicines and more than 70 manufacturing processes of active pharmaceutical ingredients. The core competences are organic synthesis, medicinal chemistry, process chemistry. Pharmacology and advanced preclinical development studies are performed for anti-cancer, cardiovascular, anti-infective and CNS drugs. Institute has a developed network of partners all over the world with

academic research institutions and pharmaceutical companies.

The Latvian State Institute of Wood Chemistry (www.kki.lv) is a modern research centre with broad research infrastructure potential. The institute works on the development of knowledge-based, environmentally friendly low-waste technologies for obtaining competitive materials and products from renewable raw material resources of wood and other plant biomass. The main avenues of research are fundamental studies in wood science and applied studies for obtaining innovative products and materials.

The Latvian Biomedical Research and Study Centre (www.bmc.lv) is the leading scientific institute in molecular biology and biomedicine in Latvia. It performs basic and applied research in molecular genetics, vaccine development, genomics and proteomics, cancer biology, immunology, biotechnology, stem cell biology and structure biology. BMC maintains a number of unique facilities including National Biobank: the Genome Database of the Latvian Population. The Centre has a wide network of collaborations with industry partners developing new diagnostics and therapeutics.

DIVISION OF PHYSICS AND TECHNICAL SCIENCES

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Professor Jānis Spīgulis, *Dr. habil. phys.*

The Division unites leading Latvian and foreign experts in physics, astronomy, mathematics, computer science, mechanics, energetics and other fields of engineering. Activities of the Division include discussions of latest research results, offering advanced technologies to industry, assistance in development of Latvia's science policy and organisation of conferences and other public outreach events. The Division closely collaborates with Latvia's leading research institutions in the above-mentioned areas.

MAJORITY OF THE INSTITUTES ARE PART OF THE UNIVERSITY OF LATVIA:

Institute of Solid State Physics (www.cfi.lu.lv/eng) – performs top-level fundamental and applied research in material sciences and related areas.

Institute of Mathematics and Computer Sciences (www.lumii.lv) – experts in physical and language

system modelling, software technologies, artificial intelligence and real time systems.
Institute of Physics (www.lu.lv/lufi) – one of global leaders in magnetohydrodynamics (MHD), has performed the world's first MHD Dynamo experiment confirming the origin of Earth's magnetic field.
Institute of Atomic Physics and Spectroscopy (www.asi.lv) performs high-level fundamental and applied research in atomic physics, spectroscopy, biophotonics and quantum optics.
Institute of Chemical Physics (www.kfi.lu.lv) – develops advanced nanostructures and nanodevices, carries out studies in radiation chemistry.
Institute of Material Mechanics (www.pmi.lv) researches deformations and fractures of materials and mechanics of composite structures, with prediction of long-term deformation and strength.
Institute of Astronomy (www.astr.lu.lv) investigates spectral, photometric and time-resolved measurements of stars, asteroids and satellites.
Rīga Technical University (www.rtu.lv/en/sciences) research is organised on six research platforms: energy and environment; cities and development; information and communication; transport; materials, processes, and technologies; security and defence. The research platforms ensure multi-faculty and interdisciplinary research in the areas of great significance for Latvian national economy and society.

THE DIVISION COLLABORATES WITH SEVERAL STATE RESEARCH INSTITUTES:

Institute of Electronics and Computer Sciences (www.edi.lv) works on novel information, communication and signal processing technology methods; smart integrated systems for data acquisition, processing and transmission; cyber physical systems; photonics; space data processing and satellite electronics.
Institute of Physical Energetics (www.energyresearch.lv) performs regional energy sector analysis and optimisation; energy – environmental policy studies; renewable energy resources.
Ventspils International Radio Astronomy Centre (www.virac.eu) aims at space research and global communications on the basis of large 16 m and 32 m radio-telescopes.

COOPERATING INDUSTRIES:

***Latvenergo* Group** (www.latvenergo.lv) – power supply utility operating on electrical and thermal energy generation and supply.
Tilde (www.tilde.lv) – provides language technologies for a connected world.
Emergn – develops large-scale and integrated IT systems for government and business needs.

INTERNATIONAL COOPERATION

ADVISOR TO THE PRESIDENT: **Ilze Trapenciere**
EXTERNAL AFFAIRS ORGANISER: **Kristaps Broks**

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The Latvian Academy of Sciences represents Latvia in global non-governmental international organisations: the International Science Council (ISC), the International Union of Academies of Humanities and Social Sciences (UAI), and is a member of the European Federation of National Academies of Sciences and Humanities (ALLEA). The LAS also participates in the Global Network of Academies of Sciences (IAP), and the Inter Academy Medical Panel on Global Health Issues (IAMP). Latvia is represented in *Academia Europaea* and *Academia Scientiarum et Artium Europaea* through individual membership of outstanding Latvian scientists, full and corresponding members of the LAS.

The encouragement of international contacts has always been one of the priorities of the Latvian Academy of Sciences. As of January 2018, LAS has concluded 31 bilateral agreements on scientific co-operation with foreign partner academies. Bilateral agreements of scientific cooperation are signed with Austrian Academy of Sciences, Azerbaijan National Academy of Sciences, National Academy of Sciences of Belarus, Bulgarian Academy of Sciences, Chinese Academy of Social Sciences, the Czech Academy of Sciences, Estonian Academy of Sciences, Finnish Academy of Science and Letters, Academy of Sciences – Institute of France, Georgian National Academy of Sciences, Berlin–Brandenburg Academy of Sciences and Humanities, Saxon Academy of Sciences and Humanities, Hungarian Academy of Sciences, National Academy of the Linsey, Italy, Israel Academy of Sciences and Humanities, Lithuanian Academy of Sciences, Montenegrin Academy of Sciences and Arts, Polish Academy of Sciences, Russian Academy of Sciences, Slovak Academy of Sciences, Slovenian Academy of Sciences and Arts, Royal Swedish Academy of Letters, History and Antiquities, Swiss Academy of Sciences, Ministry of Science and Technology, National Academy of Sciences of Ukraine, Academy of Sciences of the Republic of Uzbekistan.

International mobility fellowships offer valuable opportunities for high-qualified international scientists and postgraduate students to work and do research at the Latvian Academy of Sciences, Universities or research institutions. Fellowships operate under the agreements of mutual mobility concluded with 17 foreign academies and provide for 350 mobility days per annum.

Since 2016, the Latvian Academy of Sciences regularly participates in workshops, conferences and other activities of the Scientific Advice for Policy by European Academies or SAPEA project on a variety of issues. The SAPEA project enables to share knowledge and expertise from across Europe as it is part of the European Commission's Scientific Advice Mechanism.

In partnership with international research institutions, organisations, and companies the Latvian Academy of Sciences organises the awarding of a number of prizes, among them the Walter Zapp Prize, the European Prize of the European Academy of Sciences and Arts or Felix Award (since 2001), the L`ORÉAL Baltic – UNESCO fellowship "For Women in Science" (since 2005), as well as a Medal of the Baltic Academies of Sciences (since 1999).

Debates on "Future Europe" (22–23 February 2019) at the meeting organised by the German National Academy of Sciences Leopoldina and Leibniz Association. From the left: Terry Martin, Moderator; Damir Boras, Rector of the Zagreb University; Julian Revalski, President of the Bulgarian Academy of Sciences; Mircea Dumitru, Rector of the Bucharest University; Ojārs Spārītis, President of the Latvian Academy of Sciences; Ladislav Kavan, Council member, Czech Academy of Sciences
Photo: Arturas Žukauskas, Professor, the Lithuanian Academy of Sciences

COOPERATION BETWEEN THE BALTIC ACADEMIES OF SCIENCES – BALTIC CONFERENCES ON INTELLECTUAL COOPERATION

Baltic Conference on Intellectual Cooperation and 200th Anniversary of the Latvian Academic Science, Jelgava 2015. From the left: Valdemaras Razumas, President of the Lithuanian Academy of Sciences, Olli Martion, General Secretary of the Finnish Academy of Science and Letters, Ojārs Spārītis, President of the Latvian Academy of Sciences, Tarmo Soomere, President of the Estonian Academy of Sciences

The tradition of holding the Baltic Conferences on Intellectual Cooperation takes its history back to 1920s. In the beginning, conferences were organised by the Institute of Intellectual Cooperation at the League of Nations (Paris). Estonia, Latvia, Lithuania and Finland, were regularly participating at the Congresses, and conferences occasionally were attended by Sweden and Denmark.

The 1st Baltic Congress on Intellectual Cooperation took place in Kaunas (1935), and subsequently the conferences were held on annual basis with participation of university academics, scientists, public figures (ex-ministers, ambassadors), and politicians. By end of the 1930s, six Conferences on Intellectual Cooperation have been held. The last conference was the "Baltic Week" and it took place in Tallinn in 1940 just before the independence of Estonia, Latvia and Lithuania was interrupted.

From 1990, closer cooperation was established with the Royal Swedish Academy of Sciences and Norwegian Academy of Sciences. From 1991 to 1996, legal conferences were held, upon the initiative

of the Norwegian Academy of Sciences and Letters, in order to discuss legal and constitutional issues with special focus on the Baltic States.

Already in 1990, Estonian, Latvian and Lithuanian Academies of Sciences issued a communique on cooperation. It was then decided that the Academies would initiate and encourage scientific collaboration.

However, only in 1999 the tradition of historic Baltic Conferences on intellectual cooperation was revived at the 7th conference held in Rīga. Since then, the conferences have been organised by the Estonian, Latvian and Lithuanian Academies of Sciences and the Finnish Academy of Science and Letters. The main objective of the conferences is to promote intellectual and scientific cooperation between countries around the Baltic Sea, to better comprehend the issues of common history, culture, economics and politics, and to give impetus for joint efforts in tackling current challenges. Academies have always chosen important topics for the Baltic-Nordic region to be discussed at the conferences – issues of Baltic economic and scientific cooperation, celebrating the achievements of intellectual excellence, as well as sharing the common spiritual and cultural values determines the conference highlights.

Since 1999, also an international award – Medal of the Baltic Academies of Sciences is awarded during the Baltic Conferences on Intellectual Cooperation.

Since 1999, the following topics have been covered by the Conferences:

- 7th BCIC (Rīga, 1999) – The History of and Future Prospects of Mutual Cooperation of Baltic States, with particular focus on the protection of intellectual values and science;
- 8th BCIC (Tallinn, June 2001) – The Historical Experience of the Baltic States, research strategies in small countries, and the humanities during the past decade;
- 9th BCIC (Vilnius, June 2003) – Globalization, Europe and National Identity, with particular attention to science and culture of small countries;
- 10th BCIC (Helsinki, 2005) – The Baltic: Past, Present and Future. History and Politics, the Baltic Sea as a Body of Water and Scientific Collaboration around the Baltic Sea;
- 11th BCIC (Rīga, October 2007) – National Development Strategies of the Baltic States;
- 12th BCIC (Vilnius, November 2010) – Science and Society;
- 13th BCIC (Tallinn, January 2013) – European Research Area and Small Countries;
- 14th BCIC (Rīga/Jelgava, April 2015) – Academies of Sciences for Research and Innovation: Past and Future. Presidents of the Academies of the Baltic countries. Science administrators and prominent researchers from Germany, Poland, Norway, Finland and Slovakia participated at the conference;
- 15th BCIC (Helsinki, March) – Future of Teacher Education in the Baltic Region: Towards Research Based Teacher Education. This conference, organised by the Finnish Academy of Science and letters discussed present and future of teacher education in the Baltic countries, covering multiple perspectives of teacher education. The conference offered a forum for science policy discussion on teacher education and training. Several projects were presented on teacher training perspectives in Finland, Estonia, Latvia and Sweden;
- 16th Baltic Conference on Intellectual Cooperation is going to take place on 2–3 May 2019, at the Lithuanian Academy of Sciences. The topic of the conference is Genes: from the Past to the Future. The best scholars form the Baltic academies of sciences are going to present their research results.

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http://www.acadsci.fi/balticconference/index.php/home/history/

BALTIC CENTRE FOR STRATEGIC STUDIES OF THE LATVIAN ACADEMY OF SCIENCES

Tālavs Jundzis, *Dr. iur.*, *Dr. habil. sc. pol.*, Director of the Baltic Centre for Strategic Studies of the Latvian Academy of Sciences, Chairman of the Board

In 2018, the Baltic Centre for Strategic Studies of the Latvian Academy of Sciences (LAS BCSS) celebrated its 25th anniversary. Almost every country has an independent non-governmental organisation that conducts research and offers its proposals in the field of national defence and security. However, in rare cases, strategic research institutes are linked to national academies of science, given the specific nature of their activities. Latvia is one such case when, in November 1993, it decided to establish the Baltic Centre for Strategic Studies, appointing Tālavs Jundzis, *Dr. habil. sc. pol.*, *Dr. iur.*, the first Minister of Defence of the restored Republic of Latvia, as its Director.

Early on, the establishment of such a centre was supported by NATO officials, both in the form of various recommendations and specific research and professional development projects. For the renewed state of Latvia scientists' recommendations on building and strengthening its security, defence and statehood were of utmost importance. Considering that the situation was similar in Lithuania and Estonia, the Baltic Centre for Strategic Studies of the Latvian Academy of Sciences in its research initially addressed all three countries and worked closely with their scientists. One of the most important studies of that time was the analysis of national security risks and corresponding proposals for their reduction. This kind of research after the end of the Cold War was just in its early development stage in Europe, and Latvia was one of the first countries to carry it out and subsequently report on at international conferences and publications.

With Latvia's national independence and security becoming stronger, especially after its inclusion in the NATO and the European Union, the LAS BCSS expanded its research scope. Close attention was paid to the research on the processes of restoration of Latvia's statehood and the experience of non-violent resistance, which undeniably is of international importance. An interdisciplinary study on the doctrine of continuity in the context of Latvia's history has gained special significance and international attention, which proves and gives grounds for the legal continuity of the Latvian statehood during the Soviet and Nazi occupations. Thus, it is recognised that Latvia is not a new independent state, created as a result of the collapse of the Soviet Union, but a continuation of the State of Latvia, founded in 1918, which in 1991 regained its statehood after a long-term occupation and unlawful annexation.

Publications by the Baltic Centre for Strategic Studies of the Latvian Academy of Sciences

In this study researchers for the first time focused also on the political activities of Latvian exiles in their respective home countries – the United States, Canada, the UK, Sweden, Australia and elsewhere. Even during the Second World War or immediately after it, some 200 000 people fled from the Soviet occupation of Latvia. Having reached the western countries, they set up various exile organisations and continued to protest in various ways against the Soviet occupation of the Baltic States, and demanded the restoration of their independence. The LAS BCSS scientists were the first to assess the political and legal significance of these activities for the reconstruction of Latvia.

The most notable and significant achievement of the LAS BCSS is the creation and publishing of two original unique collections of academic articles on Latvia as a state and Latvians as a nation, including other minorities who have lived in Latvia for a long time. The collection of the academic papers was first prepared and published in 2013 in four volumes, and then, in 2018, a new fully revised edition *Latvia and Latvians* in two volumes, each in Latvian, English and Russian (the Russian version only in electronic form). In this collection, readers get an idea of Latvia in a globalised world, its constitutional foundations, economy, demography, language, education and science, cultural landscape, as well as various cultural aspects and sports. The collection presents reflection of the most significant events and processes in Latvian history. It contains a total of 49 articles by 44 authors, illustrated with 540 photographs, 90 charts and tables, 30 maps and an index of 3240 persons. Both volumes were created within the framework of the National Research Programme *Letonika*, and published with the help of private patronage funds.

Collection of academic papers *Latvia and Latvians* 2018

Over its period of activity, the LAS BCSS has held more than 60 scientific conferences – mostly international, with the participation of many foreign scientists. Seven years ago (in 2011) the LAS BCSS organised the 3rd World Congress of Latvian Scientists and was one of the organisers of the 4th World Congress of Latvian Scientists in 2018. Such congresses promote collaboration of Latvian scientists with the scientists of Latvian origin in many countries of the world and facilitate a more successful development of their research. Popular not only among scientists but also in the wider Latvian society are *Letonika* congresses, which are convened every two years and provide a platform for scientists to publish their research results on Latvian history, culture, language and similar issues. The LAS BCSS numbers seven such congresses and has been one of the main organisers of them.

The successful operation of the LAS BCSS is ensured by its legal status: it is a foundation that largely organises and implements its work at its own discretion and independently. It is registered in the State Register of the Republic of Latvia as a scientific institution and consists of five scientists, a director and one or two assistants. Other researchers are also attracted to specific studies in the required specialities; the LAS BCSS is engaged in cooperation with other scientific institutions both in Latvia and abroad. This has enabled the Centre to operate flexibly and efficiently, to respond promptly to the challenges to be addressed, and to use the financial resources from grant competitions or from private sponsors and patrons economically and proficiently.

Translated by **Rasma Mozere**

EUROPEAN POLICY RESEARCH INSTITUTE OF THE LATVIAN ACADEMY OF SCIENCES

Inna Šteinbuka, *Dr. hab. oec.*, Professor, Chairperson of the Council of the European Policy Research Institute, Latvian Academy of Sciences, Full Member of the Latvian Academy of Sciences
Zane Zeibote, Researcher, Executive Director, European Policy Research Institute, Latvian Academy of Sciences
Signe Groza, Research Assistant, European Policy Research Institute, Latvian Academy of Sciences

The European Policy Research Institute (EPRI) was established in 2017 with an objective to develop and implement research projects and programmes, ensure the quality and involvement of scientists in cross-disciplinary research and cooperation in European policies. The functioning of the EPRI is aimed at providing researchers and other stakeholders with the opportunity to acquire knowledge of the interdisciplinary challenges of European integration, implementation of the topical research and projects for the development of the society, particularly in the context of economic, legal, political and sociological aspects, with a view to promote visibility of the Latvian Academy of Sciences in the international scientific environment. Email: eppi@lza.lv

CONNECTIVITY COOPERATION BETWEEN CHINA AND EUROPEAN UNION

In 2018, the new impetus has received the research of the synergies and divergences of the various formats of cooperation between China and the European countries with a special focus on the Latvia – China relations. On 13 November 2018, Chairperson of the Board of EPRI, Special Advisor of the European's Commission Vice President Valdis Dombrovskis, Professor Inna Šteinbuka has participated at the "Academic Conference on Connectivity Cooperation between China and EU". This conference took place in Beijing, China, at the Institute of European Studies of Chinese Academy of Social Sciences. As a result, new research contacts have been established, and potential joint research has been discussed.

Professor Inna Šteinbuka has presented the summary of research findings published in two papers[1]. Her presentation "Strengthening Connectivity: viewpoint from Latvia" has been focussed on the different cooperation formats of China, Europe and Latvia.

1 Šteinbuka I., Muravska T., Kužnieks A. EU–China: New Impetus for Global Partnership. European studies. The Review of European Law, Economics and Politics. *Czech Association for European Studies*, 2017, Vol. 4, pp.121–139. ISSN-1805-8809 (print), eISSN 2464-6695 (online), ISBN 978-80-7598-032-8 (print). Indexed ERIHplus. Šteinbuka I., Muravska T., Kužnieks A. Cooperation formats of China and Europe: synergies and divergences. *Baltic Journal of European Studies*. Tallinn University of Technology, ISNN-2228-0588, 2017, Vol.7, No. 1(22) (abstracted in EBSCO databases), pp. 97–117.

Professor Inna Šteinbuka participated at the Academic Conference on Connectivity between China and the EU, starting cooperation between the European Policy Research Institute of the Latvian Academy of Sciences and the Institute of the European Studies of the Chinese Academy of Social Sciences

The EU and China have strong interest in each other's flagship initiatives, namely the "Investment Plan for Europe", and the "Belt and Road Initiative" ("Silk Road Economic Belt" and "21st Century Maritime Silk Road"). Furthermore, the new initiative "EU-China Connectivity Platform" is aimed at exploring these synergies. The research team led by Professor Inna Šteinbuka examines the recent developments in the EU-China investments, trade cooperation and the challenges of the ever-growing CEEC-China partnership in the different formats, including the new platform of 16 + 1.

Special attention is paid to the place of the EU-China partnership in the changing world order. With the U-turn in the US approach to multilateral system of trade relations and climate change, some of the ways for the EU and China to move forward are getting different in their strategies. A successful cooperation in the future might be determined by the extent to which China accepts the "European values", but the question will also arise as to whether EU is prepared to embrace the governance dynamics of China. The research team is trying to identify the new impetus of EU-China relations and give very concrete illustrations of where their potential future cooperation could be established, at the same time acknowledging that considerable uncertainty will still exist in the near future. China's relations with other global players such as Russia are of utmost importance, and the researcher reflects on how these relations might impact the advancements on EU-China dialogue and cooperation. Special attention has been paid to China's ever increasing role and influence when it comes to trade and investments with EU countries, cooperation in energy, science and innovation as well as climate change.

EPRI EUROPEAN UNION POLICY DISCUSSION FORUMS IN LATVIA

The first EU forum "Development and Challenges of the Latvian Economy" was organised by the EPRI in cooperation with the European Commission Representation in Latvia on 10 April 2018 to discuss the annual Country Report Latvia prepared by the European Commission in the framework of the European Semester. The discussion took place at the National Library of Latvia with around 40 participants from academia, government institution, policy making bodies, media and NGO according to the four themes: 1) Economic development, investment and productivity; 2) Labour market and demography; 3) Financial sector – money laundering and prevention; 4) Structural policy – health, education and welfare (prevention of inequality and poverty). Participants of the forum concluded that all of the aforementioned issues are interrelated and make a great impact on the economic development of Latvia. Especially, important are issues related to demographic situation and labour market because a gradual reduction of the Latvian population and, especially, emigration have started to create problems for employers looking for qualified specialists. Also, too slow increase in productivity is a serious obstacle for the economic development and reduction of the inequality of the regional development of Latvia. The most perspective sector of development is the bio-economy, which is also among the RIS3 priorities of Latvia. Participants argued that the GDP should not be the only criteria for the economic development, but such areas as the environment and social dimension should be taken into account. The economic development is also hindered by a low ability and interest of population to

The inauguration of the Forum of the European Policy Research Institute of the LAS "Development and Challenges of the Latvian Economy", 10 April 2018, Latvian National Library, Rīga
Photo: Vladimirs Rojenko

Round table discussion of the European Policy Research Institute of the LAS "The Future of Europe and Latvia", 25 September 2018, EU House, Rīga

lend resulting in a slow development of entrepreneurship and shadow economy, as well as the banking reputation crisis in Latvia. The Vice President of LAS Baiba Rivža stressed the importance of financial support for the education and science. An objective of the Latvian Government to allocate 1.5% of GDP for the education and science by 2020 is still an objective to be reached.

The second EU policy forum "The EU Financial Perspective for Implementing Recommendations for Latvia" took place on 13 June 2018. It was organised by the EPRI in cooperation with the European Commission Representation in Latvia and the European Electronic Communication Regulation Office (BEREC). The forum gathered around 40 participants from academia, government institution, policy-making bodies, media and NGO. During the forum the EU Multiannual Financial Framework (2021–2027) and its objectives were presented, as well as recommendations for Latvia for 2018–2019 financial and budget framework were discussed. During the forum participants actively debated about possibilities of Latvia for using the EU Cohesion Funds, financing for the rural development and direct funding in the presence of BREXIT and the future political priorities of the EU. The European

The Round Table discussion of the European Policy Research Institute of the Latvian Academy of Sciences "The Future of Europe and Latvia", 25 September 2018, EU House, Rīga

Commission recommends for Latvia to continue reducing the tax burden on low-income people by shifting tax income to such areas as property and capital. At the same time, the Government of Latvia has announced the tax moratorium on tax changes, which provides a good break for building a new plan for implementing a smart tax policy related to capital and property. The issues of tax policy, including fiscal discipline, fight with the shadow economy and money laundering, shifting the tax burden from low-income people to capital and property, are also very important for a new Parliament and Government of Latvia. It was particularly emphasised that reduction of a shadow economy is among priorities of the Latvia government as there was an increase in the shadow economy observed during 2017 and is closely related to problems in the banking sector. Among the most important social issues is the accessibility and quality of the health care. Increase in the health funding shall help to reduce long ques and increase quotas for health services. Nevertheless, the health financing in Latvia is still below the EU average indicator. This is not clear if Latvia has a plan how to fund health care needs after 2020. Moreover, a possibility to use budget deficit to cover additional spending will be eliminated in 2019. During discussion a special attention was devoted to increasing an efficiency of the governance of local government and state enterprises. In 2016, the Government of Latvia has adopted a comprehensive plan for the public administration reform; however, it does concern only the central government administration, but not local governments, which should also be more efficient, transparent and responsible for their decisions. State enterprises, which employ around 10% of the labour force are coordinated by the state and act according to the centralised corporative governance regulation. At the same time, municipal capital enterprises do not follow the same rules and, thus, lag behind as state enterprises in terms of good governance.

The third EU policy forum "State of the Union" was organised by EPRI on 25 September in collabration with the Representation of the European Commission in Latvia. It gathered over 30 experts who discussed the EU topicalities from the Latvian perspective in light of the State of the Union 2018 address by the President of the European Commission Jean-Claude Juncker.

The most fiercely discussed new proposals of the European Commission included the proposals to deepen the Economic and Monetary Union, proposals to strengthen the EU's global role, including proposal to move to qualified majority voting in specific areas of EU external relations and the proposal to focus more EU investments on Africa. Freshly proposed initiatives for tackling illegal migration and

reforming EU asylum system, as well as proposals for combating money laundering and improving the rule of law situation in certain member states were also addressed.

A good part of this debate inevitably also drew upon the next Multiannual Financial Framework. Almost all participants stressed the need to secure adequate financing for Cohesion Policy. Representatives of academia, including members of the Latvian Academy of Sciences, strongly emphasised, in particular, the need to focus on investing more in science. Despite the fact that the European Commission has already proposed increased funding opportunities under the new Horizon Europe programme, which will succeed Horizon 2020, participants noted about the difficulties of securing funding for the Eastern European member states and the need to respectively have more inclusive criteria within Horizon Europe to assist the competitiveness of research and science institutes in those member states.

The fourth EU policy forum "EU Political Challenges and How Latvia Should Position Itself: Researchers Advice" was organised on 14 December in collaboration with the Ministry of Foreign Affairs of Latvia. It covered the following four key themes: 1) EU after Brexit: opportunities and costs; 2) EU budgetary challenges: financial and political priorities; 3) Prospects for deeper EU defence integration; and 4) EU integration and regional cooperation vectors.

This forum was organised shortly after the Latvian general election and while the formation process of the new government was still ongoing with the idea to produce recommendations to the new policy-makers on what the key EU issues and challenges will be about which they will need to make swift and effective decisions in the year 2019 and beyond.

This event also took the form of a round-table discussion, which again attracted over 30 participants: a mix of academics, field practitioners and policy-makers. The discussion was webstreamed *via* Latvian Academy of Sciences, Latvian Ministry of Foreign Affairs and European Commission Representation in Latvia channels and watched by over 400 people online.

The forum featured two presentations by the EPRI researchers Aldis Austers and Gints Apals, *Dr. hist.*, Ambassador of Latvia to Ireland which gave the institute a good opportunity to present its research and capacity.

JOINING EUROPEAN DOCUMENTATION CENTRE NETWORK

In respond of expression its interest to join European Documentation Centre (EDC) network, the European Policy Research Institute has received a positive European Commission (EC) evaluation followed by an Agreement with the EC Representation in Latvia of support of a new mission and tasks of the Institute.

THE EDC AS A SPECIAL UNIT OF THE EPRI WILL BE WORKING WITHIN THE FOLLOWING MANDATE:

- Organising and / or co-organising Citizens' Dialogues, debates, conferences, and seminars;
- Establishing relations with Latvian regional European Direct Information Centres (EDIC), opinion leaders (Team Europe), and other EU networks and help Latvian academic and students' community connect with the EU;
- Taking part in the European Commission's general information activities and communication on the EU priorities.

In order to facilitate the successful implementation of this mandate, the EC will:

- Promote visits organised through the EC Visitor's Centre for the EDC's core community: students and researchers;
- Regularly invite EDC to participate in the Citizens' Dialogues;
- Support EDC to organise debates on the future of Europe;
- Reinforce networking through pan-European groups in order to exchange best practice.

According to the new mission of the EPRI, in October 2018, Professor Inna Šteinbuka, has moderated two Dialogues with Latvian students and research community in two universities: Latvia University of Life Sciences and Technologies (Jelgava) and Daugavpils University on the future of Europe and Latvia.

INSTITUTE OF ECONOMICS OF THE LATVIAN ACADEMY OF SCIENCES

Ņina Linde, *Dr. paed.*, Associate Professor, Director of the Institute of Economics of the Latvian Academy of Sciences

The Institute of Economics of the Latvian Academy of Sciences was established in 1946 and is one of the leading centres for Economic research that has wide partnership links with European and other countries of the world. The mission of the Institute is to study economic problems significant for Latvia and Europe, to seek and to create innovative and scientifically based solutions, to provide competent opinions about ongoing processes in the economy of Latvia, Baltics and Europe, and to note the future progress. Areas of studies of the Institute include:

- Investment attraction and entrepreneurship development;
- Reduction of differences in the entrepreneurial environment for improving the investment climate;
- Priority sectors of Latvian export;
- Interaction of economics and culture to create knowledge-based society;
- Opportunities for the development of tourism;
- Regional development;
- Social entrepreneurship;
- Human capital development;
- Study of entrepreneurial environment in the Baltic States;
- Increases in energy efficiency of different industrial processes;
- Studies on national economic development, etc.

The activities done by the Institute are the following:

- Creation of scientific research methods in social sciences;
- Financial market analysis;
- Scientific consultations on the development of research works, publications and dissertation theses;
- EU project development and implementation;
- Development of policy recommendations to policy-makers;
- Round-table discussions and expert meetings organisation;
- Annual European-Latvian Economic Forum organisation.

Among the **successfully implemented projects** of experts of the Institute of Economics are the following:

- The research ordered by the Latvian Chamber of Commerce and Industry "Pilot project of the EU for identification of social enterprises and estimation of their economic impact in Latvia" (2013). The project had developed a method for identifying social enterprises and strategies, which engage the society into the social entrepreneurship.
- Project in cooperation with the Polish Academy of Sciences "Youth in Post-Soviet Countries: Comparison of Poland and Latvia" and the research on "Youth in transition countries – innovative potential, new context, new challenges and new problems" (2013–2014). The project was designed to analyse the current situation in the youth sector of post-communist countries.
- "Water tourism as a part of active and nature tourism in Latvia and Estonia" (2015) project, ordered by the Kurzeme Planning Region in terms of the Interreg Estonia-Latvia project "Riverways". The aim of the project was to identify communicative and cooperative ways for Latvian water tourism entrepreneurs. During the project's training session, several individual consultations for entrepreneurs were organised, so to ensure the best quality of their services in accordance with the "Q–Latvia" assessment criteria.
- The research ordered by the *Saldus rajona attīstības biedrība* – "Analysis of entrepreneurship environment in Saldus and Brocēni" (2015). The results of the research were taken into account as a basis for the development strategy of Saldus and Brocēni regions. As a result of the analysis, incentives and hindering factors of the entrepreneurial environment development and competitiveness were identified. The research was conducted in close cooperation with municipalities of the two regions, entrepreneurs and citizens.
- Market research on UK, Ireland, Norway, Sweden and Finland health services markets to promote health tourism to Latvia (2017). The research was conducted in order to identify comparative advantages of health services located at foreign markets and to promote them more efficiently.
- The research on the development of entrepreneurship that has been conducted upon a request of the Zemgale Planning Region (2018) "Implementation possibilities of entrepreneurship support system in Latvia and Lithuania" as part of the Interreg V-A Latvia-Lithuania 2014–2020 project LLI-131 Creating of business support system and the availability in Zemgale, Kurzeme and Northern Lithuania (Business Support). The Institute had compared legislations of both countries and conducted surveys among Latvian and Lithuanian businesses. In addition, the Institute carried out various focus groups with entrepreneurs, municipality officials and workers of business support institutions. The result of that was the development of recommendations for policy-makers on increasing the effectiveness of business support.

RIVERWAYS

Estonia Latvia Programme
Linking Estonia and Latvia
Part-financed by the European Regional Development Fund

European Union

Discussing economic identity of Latvia in Europe and in the world. From the left: Māris Kučinskis, Prime Minister of Latvia; Prof. Inese Vaidere, Member of the European Parliament; Prof. Juris Binde, President of *Latvijas Mobilais Telefons*; Aigars Rostovskis, President of the Latvian Chamber of Commerce and Industry; Prof. Baiba Rivža, Vice President of the LAS and Dr. Ņina Linde, Director of the Institute of Economics of the LAS

Each year starting from 2017, the Institute organises an annual international conference at the Latvian Academy of Sciences – European-Latvian Economic Forum, which serves as a platform for the exchange of experiences and for cooperation of scientists, entrepreneurs and politicians. In this way, it stimulates the entry of local and foreign investment into the country and its regions. This contribution is necessary for the development of an innovative national economy in a long term.

The I European-Latvian Economic Forum 'Made in Latvia' – Latvian Economic Identity in Europe and the World", which took place at the Latvian Academy of Sciences in Rīga on 26 of April 2017, was a very successful attempt in gathering together social scientists, entrepreneurs and politicians for working under the most vital idea – the definition of the national economic identity. The main aims of the Forum were: to attract attention to the large resources found in Latvia, and to stimulate the inflow of the local and foreign investments in Latvia; to make use of the scientific potential in order to find out new niches and sources for the development of entrepreneurship in Latvia; to create a platform for exchange of experiences and cooperation of scientists, entrepreneurs and politicians, so that it will serve as a mechanism for resolving social economic problems.

The I Economic Forum was opened by the Prime Minister of the Republic of Latvia Māris Kučinskis and by different members of the European and National Parliament (*Saeima*). Around 130 participants were present on-site (among whom were representatives of 17 foreign embassies found in Rīga: Hungary, Germany, Japan, France, Poland, Russian Federation, Italy, Azerbaijan, China, Lithuania, Finland, Moldova, UK, Georgia, Sweden, Ukraine and Canada. In addition, there was an opportunity to follow the course of the event *via* a live stream ensured by the main sponsor of the Forum – *Latvijas Mobilais Telefons*.

The II European-Latvian Economic Forum "INDUSTRIAL *r*EVOLUTION 4.0: Digital Economics, Data Protection & Compliance Best-Practice" took place in Rīga at the Latvian Academy of Sciences on 7–8 of September 2018. The forum was held under the patronage of the Ministry of Finance of Latvia, and its main sponsor was the leading Latvian telecommunications company *Latvijas Mobilais Telefons*.

The organisation and holding of the Forum were supported by the Scientific and Humanistic Research Foundation Antonio Meneghetti, the Latvian Chamber of Commerce and Industry, the National Research Programme EKOSOC-LV, *Latvijas Mobilais Telefons* (LMT), the German-Baltic Chamber of Commerce and Industry, the Free City magazine, the Baltic Course International magazine and the Foreign Investors' Council in Latvia (FICIL).

The forum was opened with a welcoming speech of the Prime Minister of Latvia Māris Kučinskis, who highly admired the organisation's initiative to hold such a high-level event. He also noted that in order to achieve the country's goal – to enter the top ten countries of the European Union with the highest level of well-being of its inhabitants – an interdisciplinary approach to the digital economy is required as it will make it possible to get acquainted with the results of the interaction of science, technology and innovation. More than 150 people attended the Forum in real life and approx. 2000 people watched it online *via* the stream. The main ideas and conclusions of the Forum are summarised in a single Forum Resolution submitted to the Government of Latvia and to the responsible organisations of the European Union.

More information: www.eilza.lv, www.economicforum.lv

Welcome speech of the Director of the Institute of Economics of the LAS Dr. Ņina Linde during the opening ceremony of the II Economic Forum in September 2018

II European-Latvian Economic Forum "INDUSTRIAL rEVOLUTION 4.0: Digital Economics, Data Protection & Compliance Best-Practice" organised by the Institute of Economics of the LAS at the Latvian Academy of Sciences on 7–8 September 2018. From the left in the front: Jānis Dūklavs, Minister of Agriculture of Latvia; Prof. Baiba Rivža, Vice President of the LAS; Prof. Inese Vaidere, Member of the European Parliament; Prof. Juris Binde, President of *Latvijas Mobilais Telefons*

ON THE ACTIVITIES OF THE NATIONAL SCIENTIFIC QUALIFICATION COMMISSION

Alma Edžiņa, *Dr. chem.*, Secretary of the National Scientific Qualification Commission

In 1999, Latvia moved from a two-level scientific qualification to one level, the process was administered by the Latvian Council of Science (LCS). It was decided that in Latvia doctoral degree holders would have state diplomas instead of university diplomas, therefore a National Scientific Qualification Commission (NSQC) was created, which would ensure that the research subject to a scientific degree would comply with the generally accepted international standards in terms of content and methodology. On 30th March 1999, the Statutes of the National Scientific Qualification Commission were adopted (Cabinet of Ministers Regulations No. 127). The Cabinet of Ministers (CM) approved the composition of the NSQC, consisting of two representatives from the Ministry of Education and Science, five representatives of various branches from the LCS, one from the Council of Higher Education, one from the Rector's Council and one from the Latvian Professors Association, three from the Latvian Academy of Sciences and six representatives of universities, a total of 20.

On 14 April 1999, the first meeting of the NSQC was held, chaired by A. Siliņš, Chairman of the LCS. Academician R. Valters was elected Chairman of the NSQC. Since then, the composition of the NSQC on the Cabinet decision was changed every five years; four of the members of the Commission have been elected at all the periods. The idea was that the requirements for the doctoral degree in Latvia would be higher than those set during the Soviet time, that the applicant had to have five publications in journals approved by the LCS and presentations at least two foreign conferences, and one of the reviewers of the doctoral thesis had to be a foreign expert. The list of such experts was created by the LCS. In the first half of the year, six works were reviewed. By 2004, it turned out that five articles were too high a requirement for doctoral students. The UL had signed a contract with the University of Denmark for the preparation of doctors of law, and professors at the University of Denmark had objected to such stringent requirements as post-Soviet regulations. As a result, after persistent efforts by the UL, the requirements were reduced. In August 2004, amendments were made to the CM Regulations that the results of the doctoral research had to be published – the number of publications or journals was not important.

At present, the NSQC works in compliance with two normative documents – the Statutes of the NSQC and the Regulations of the Cabinet of Ministers No. 1001 on the Procedure and Criteria of Promotion. The Commission has coped with the requirements set out in these regulations, and the quality of doctoral theses has increased, but the Achilles heel of Latvia's science still is the small number of publications in high impact journals, this being one of the quality indicators. The fields of science that have traditionally been of high level in Latvia – chemistry, physics, biology – hold the level; the humanities and social sciences – fare worse, although there are some good works, for example, in history. The doctoral theses in which the NSQC selected reviewers have indicated flaws and expressed their remarks, are returned to the Doctoral Councils for improvement. In cases of serious objections, the thesis is given to yet another reviewer. If this reviewer also considers that the thesis cannot be defended, it is rejected. There have been appeals against the decisions of the NSQC to the Latvian Science Council, but the LCS has always given the thesis to another

reviewer and so far has approved the opinion of the NSQC. Over the years, the dynamics of the number of doctoral theses up to 2013 was on the increase. In 2013, the NSQC reviewed 326 theses, in 2014 – 270, in 2015 – 276 theses; this number of doctors meets Latvia's needs. With the expiry of the European Social Fund (ESF) scholarships, the number of works to be examined by the NSQC is also decreasing. In 2016, 180 promotion papers were reviewed and 148 in 2017 95% of the doctoral theses are prepared at five universities of Latvia, the leader being the University of Latvia.

On 23 October 2015, a new panel of the NSQC was approved and is currently operating. Members of the Commission unanimously elected academician J. Ekmanis as Chairman, who had been part of the NSQC for its whole duration and had good knowledge of the work of the Commission. Ilga Jansone was elected Chairperson of the Commission after the demise of J. Ekmanis. With a view of the future, more power could be given to the Promotion Boards and the NSQC could be dispensed with. The transition to the OECD classification of sectors and sub-sectors of science will also unify the system of titles of scientific degrees by switching to the PhD (Cabinet of Ministers Regulations No. 522). It envisages that the degrees with the titles indicated in the decision on the accreditation of the respective study programme prior to 17 August 2018 are conferrable until 31 December 2019.

Translated by **Rasma Mozere**

THE LATVIAN ACADEMY OF SCIENCES ARCHIVES

Ruta Skudra, Chief Archivist of the Science Archives, the Latvian Academy of Sciences

The Charter of the Latvian Academy of Sciences (LAS) stipulates that the Academy of Sciences may hold archives in which it has the right to preserve the manuscripts and documents of scientists, writers, people who belong to the fields of art and cultural, as well as other material relevant to science and history. The repository of such documents is the archives of the Academy of Sciences, established in 1949, whose funds currently hold nearly 16 000-storage units (documents archived in files), including more than 10 000 files of permanent storage and over five thousand staff files for the period from 1946 to 2015. In 2002–2004, about 29 000-storage units – collection of the archives of the former LAS scientific institutes, special construction bureaus and experimental factories, which until then was preserved by the LAS archives, were transferred to the State Archives of Latvia in accordance with Decree No. 116 of 7 December, 2001, of the Directorate General of the State Archives.

The stock of the Latvian Academy of Sciences archives, which is a part of the Latvian National Archives, consists of historically generated documents of LAS and related groups of researchers, commissions and councils as well as individual science researchers. These documents are of historical, juridical, political, scientific, economic or cultural-historical information of public importance. They include closed records of permanent and long-term storage as well as personnel documentation: minutes and decisions of the Academy of Sciences (AS) General Assembly, AS sessions, AS Senate meetings, AS Presidium meetings, minutes of meetings and sessions of the AS departments, documents of candidates of the LAS bonuses and of the joint LAS and sponsors' awards, international cooperation documents, personal files of the deceased members of the Academy, etc.

The LAS Archive contains the Decision No. 94 of 7 February 1946 of the Council of People's Commissars

In the presidium hall of the Academy in the 1940s. From the right (sitting): P. Valeskalns, J. Peive, P. Lejiņš, A. Upīts, M. Kadeks, A. Kirhenšteins, P. Nomals; from the right (standing): J. Magone, J. Vecvagars, A. Kalniņš, P. Stradiņš, S. Sirsone, R. Egle

of the Latvian SSR "On Establishment of the Latvian Academy of Sciences", which records the names of the first 13 AS academicians and 5 corresponding members. The full members are: *Dr. philol*. Jānis Endzelīns, *Dr. geogr*. Professor Matvejs Kadeks, *Dr. agr*. Professor Arvids Kalniņš, *Dr. biol*. Professor Augusts Kirhenšteins, *Dr. arch*. Professor Artūrs Krūmiņš, *Dr. agr*. Professor Paulis Lejiņš, *Dr. sc. ing*. Professor Pēteris Nomals, *Dr. agr*. Professor Jānis Peive, *Dr. med*. Professor Pauls Stradiņš, *Dr. med*. Professor Aleksandrs Šmidts, Professor Ernests Štālbergs, *Dr. philol*. Professor Andrejs Upīts, Professor Pēteris Valeskalns, as well as corresponding members:, Assistant Professor candidate of Economics Jānis Bumbieris, *Dr. med*. Professor Jānis Miķelsons, Assistant Professor Arvids Pelše, *Dr. agr*. Professor Pēteris Rizga and Assistant Professor Kārlis Strazdiņš.

The 1946 General Assembly file contains the minutes of the first AS General Meeting whose agenda envisaged elections to the Academy's governing posts. Professor Paulis Lejiņš was elected President of the Academy of Sciences, Professor Matvejs Kadeks became Vice-President of the Academy of Sciences, Professor Jānis Peive – Academician-Secretary, members of the Presidium – Professor Augusts Kirhenšteins, Professor Pēteris Valeskalns, Professor Artūrs Krūmiņš and Professor Aleksandrs Šmidts.

The LAS archive also keeps the personal records of the full members of the Academy of Sciences, among them documents created as a result of scientific or public activities of two former presidents of the Academy – Paulis Lejiņš and Jānis Peive, the former academician-secretary Vilis Samsons as well as those of individual scientists. In 2000, the archives of the Latvian Association of Engineers from Ottawa, Canada, were deposited at the AS Archives to be transferred to the National Archives of Latvia in 2018.

The LAS archives not only ensures the collection, preservation, record-keeping and use of the above mentioned documents, but also provides methodological assistance to the Academy staff, commissions and councils in the organisation of documents before their transfer to the archives; it compiles and supplements the reference system of the stored archives documents, such as historical records, inventory lists, card files, etc. Noteworthy is the participation of the archives employees in the preparation of such a voluminous work as the book *Latvijas Zinātņu Akadēmija: izcelsme, vēsture, pārvērtības* (The Latvian Academy of Sciences: Origin, History, Transformation) by the academician Jānis Stradiņš, which contains several hundreds of references to the archives documents of the Latvian Academy of Sciences. Assistance was provided to scientific institutes when working on the history of institutes. In 2009, a statement about the bonuses awarded by the Academy of Sciences Presidium for the period between 1962 and 1992 as well as other materials were prepared. The LAS Archives organises and controls the document value examination of the records held by the Academy structures, ensures the availability of archival documents, issues thematic and socially legal references, and provides researchers with archival documents for research. Within the time limits set by the National Archives of Latvia, records of the archive funds and files are drawn up to draft an archives certificate and submit it to the National Archives of Latvia.

Meeting of Nordic and Baltic Presidents of the Academies of Sciences. Presidents of the Academies of Sciences signing the final Communique of the meeting Lielupe, Latvia, 1996

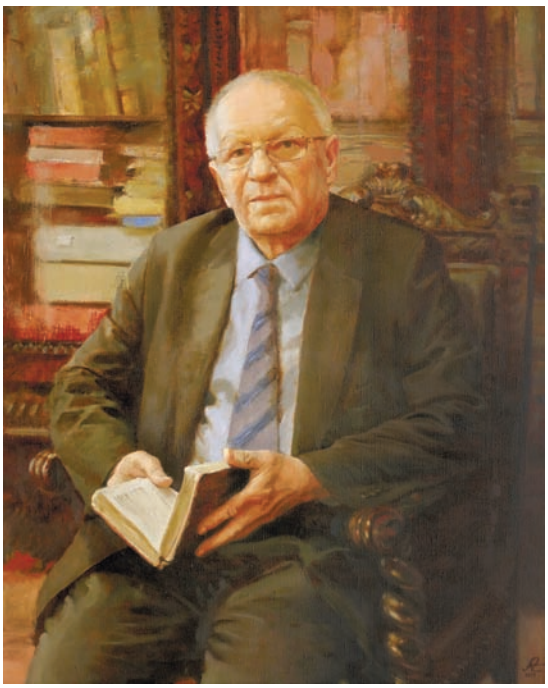
Translated by **Rasma Mozere**

PORTRAITS OF THE PRESIDENTS OF THE LATVIAN ACADEMY OF SCIENCES

Edvarda Šmite, *Mg. art.*, Art Researcher

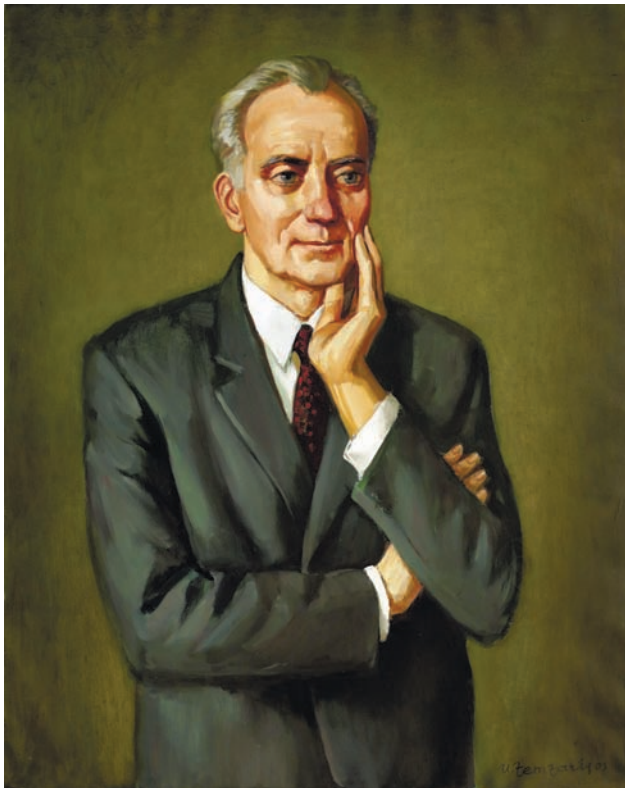
Looking back at history, one may say that the second millennium for the Latvian Academy of Sciences (LAS) began with a yet another anniversary – 55 years since the founding of the Academy in 1946. Once again, it was time to reassess the past and look into the future. It seems that it was in this atmosphere that a decision was made to create a portrait gallery of the LAS presidents. It is noteworthy that the decision was taken at a time when the study *Latvijas Zinātņu akadēmija: izcelsme, vesture, pārvērtības* (The Latvian Academy of Sciences: Origin, History, Transformations) had recently been published by the science historian Jānis Stradiņš in 1998. From 1998 to 2004, the author himself was the President of the LAS. And the results of this sound decision are already visible. Portraits of nine presidents are exhibited in the Academy's assembly hall. Between 1946 and 2012, they administered the work of the LAS and largely determined the principles and guidelines of its operation.

LAS presidents have always belonged to Latvia's science elite. Moreover, their election to this high post meant that their colleagues appreciated both their contribution and reputation in the scientific environment and their personal qualities. The post required not only experience and merit in the field of science but also the ability to engage in a dialogue or a wider discussion, to assess arguments and to make optimal decisions for a particular

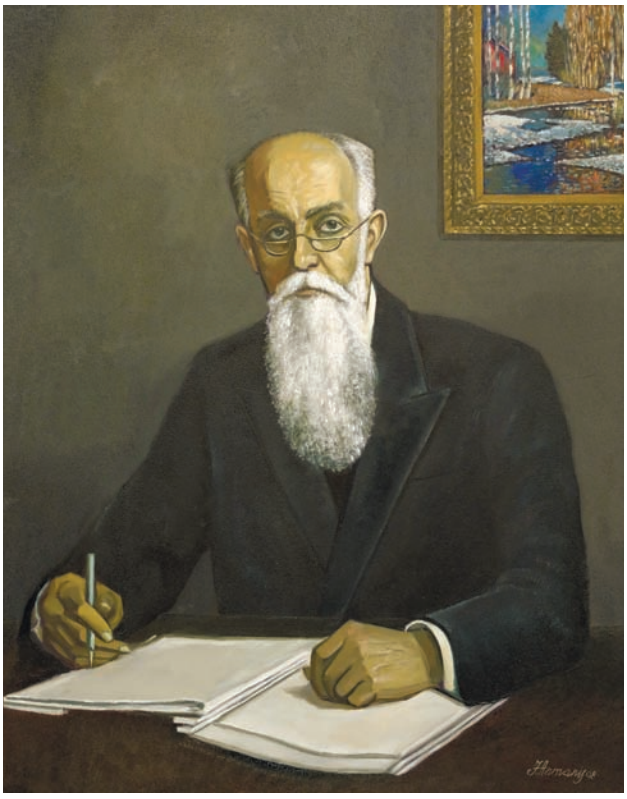


Andris Začests
President of the Latvian Academy of Sciences Jānis Stradiņš
Photo: Jānis Brencis

Uldis Zemzaris
President of the Latvian Academy of Sciences Jānis Lielpēteris
Photo: Jānis Brencis



Uldis Zemzaris
President of the Latvian Academy of Sciences Tālis Millers
Photo: Jānis Brencis



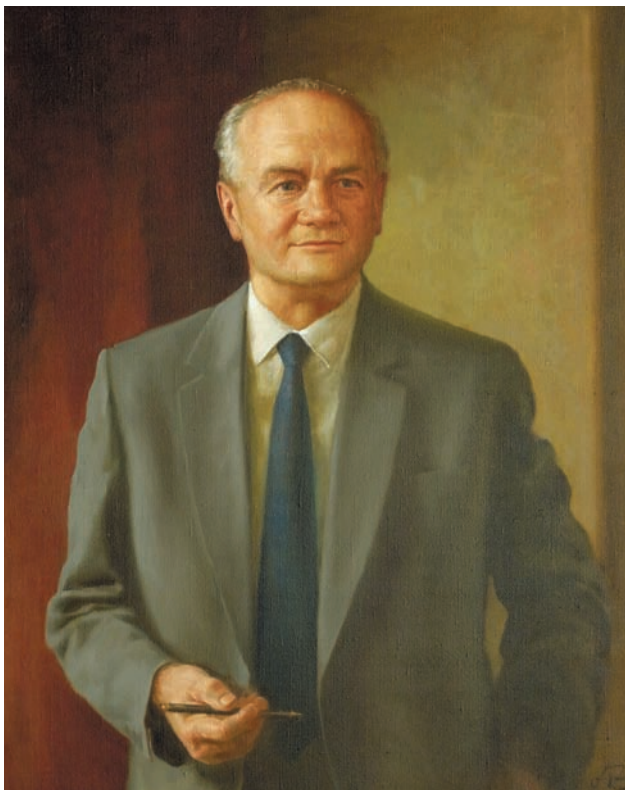
Jānis Anmanis
President of the Latvian Academy of Sciences Paulis Lejiņš
Photo: Jānis Brencis

situation, often necessitating settling for an acceptable compromise instead of maintaining a categorical position.

The gallery currently consists of nine portraits. They are works of well-known Latvian painters who, since 2001, have accurately executed the LAS commissioned portraits of the presidents. The paintings reveal a series of issues related to the commission of a formal 'parade' portrait and their execution. Artists had to create a certain iconographic model that could both be repeated and modified when painting each successive president. How to really portray a scientist – at a certain stage of the research process or in the president's office? How deeply can one grasp a person's individuality and how can one look at it with the help of a portrait? Some of the former presidents had to be painted only after the photographs left behind as they had already deceased, but their portraits were critical for the creation of the gallery and the history of the LAS. Naturally, the result was largely determined by each painter's approach to the task.

The first to paint the portraits of presidents was the artist Uldis Zemzaris – an observant and keen character builder. His paintbrush created the portraits of the physicist Jānis Lielpēters (1931–2009; President of the LAS 1989–1994) and of the chemist Tālis Millers (1929; President of the LAS 1994–1998), dated 2002 and 2001. In these portraits, the painter has emphasised the individuality of each model and thus we have the representations of strong and fascinating personalities-scientists. It may have been the artist's deliberate choice not to feature any post-related symbols or reference to the high and responsible post; instead, he has given centre stage to the facial features and posture of the academicians.

Portrait painting for the gallery has not been carried out in chronological order, but every next artist was given the choice of the most congenial prototype and paint it without undue haste. After a longer break, the painting of the presidents' portraits was resumed in 2008, but this task was given to other painters. In 2008, Jānis Anmanis painted



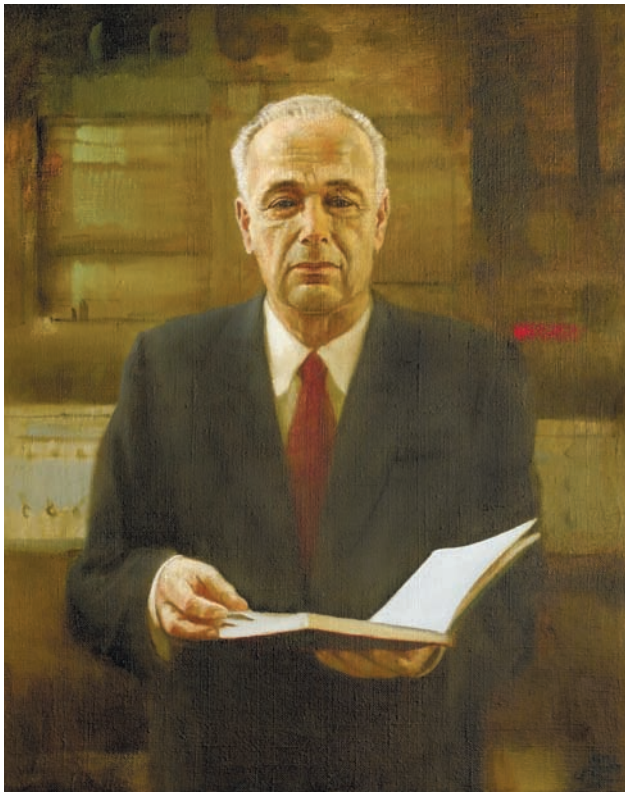
Andris Začests
President of the Latvian Academy of Sciences Jānis Peive
Photo: Jānis Brencis

Andris Začests
President of the Latvian Academy of Sciences Juris Ekmanis
Photo: Jānis Brencis

the first President of the LAS, agronomist and animal husbandry specialist Paulis Lejiņš (1883–1959; President of the Latvian Academy of Sciences 1946–1951) and the chemist Bruno Puriņš (1928–2001; LAS President 1984–1989). The work of Jānis Anmanis was complicated by the situation that the reputable academician had to be imagined in the official working environment. The impressive image of the first President did not seem to require any special complements, as everything in the portrait shows an experienced and serious scientist who was the first, after World War II, to assume the responsibility of establishing and administering the Latvian Academy of Sciences. The agronomist Paulis Lejiņš represented the generation of academic scientists who received their education in the early 20th century, so the portrait of the painter Vilhelms Purvītis in the background of this portrait, along with the grey-haired scientist himself, reminds us of the link with the pre-war Republic of Latvia.

Bruno Puriņš, a chemist, in the painting made in 2008, is depicted in the laboratory of a scientific institute, and this approach has made it possible to enhance the expressiveness of the portrait and the environment. The electrochemical laboratory equipment, technological gear, utensils, reagents, and the white overalls, a must for the job, make it interesting for both the colour scheme and composition of the painting.

The longest and most productive cooperation for the Latvian Academy of Sciences as a commissioner has been with the painter Andris Začests of the Art Academy of Latvia. The numerical proportions of the portrait gallery show that between 2008 and 2013, five portraits have been created that constitute a set of works typical for the artist's manner and the illustrative pictorial representation of his vision. Academicians, as high-standing officials, are no longer depicted as scientists in their characteristic work environment; instead, the portraits display the inevitable dominance of the dark shades of business suits, typical of 'parade' portraits. Such is the portrait of the President and



Andris Začests
President of the Latvian Academy of Sciences Aleksandrs Mālmeisters
Photo: Jānis Brencis

Andris Začests
President of the Latvian Academy of Sciences Kārlis Plaude
Photo: Jānis Brencis

the Chairman of the Latvian Council of Ministers, Jānis Peive (1906–1976, President of the LAS 1951–1959), in which a revelation of a calm and well-balanced character dominates the photographically accurate facial features. The academician whose field of scientific activity was agricultural chemistry is depicted holding just a pen.

The presidents of the Academy of Sciences have been painted in such a way that it should be clear to the viewer that they, while in peaceful attitudes, are carrying out their responsible work in charge of the life of Latvian science. They are all depicted in a similar manner, each of them is characterised by the academically administrative environment associated with books, as in the 2013 portrait of the academician Jānis Stradiņš (b. 1993, President of the LAS 1998–2004), reading or signing documents as in the portrait of Kārlis Plaude (1897–1975, President of the LAS 1959–1970), or, in the spirit of the era of modern technologies, with a mobile phone in hand (Juris Ekmanis, 1941–2016, President of the LAS 2004–2012). When searching for the characteristic features of each model, as well as diversifying the portraits, the artist has found for each one a nuanced posture, turn of the head, the presence of technological equipment in the background, a controlled yet significant facial expression, like in the portrait of the doctor of engineering sciences, academician Aleksandrs Mālmeisters (1911–1996, President of the LAS 1970–1984). The group of portraits, painted by Andris Začests, can be characterised by a balanced use of emotions and harmonious range of colours to create images that give the five portraits a formal yet consistent solemn mood.

As with every academy, the portrait gallery of its presidents is a certain symbol of the country's prestige and international recognition. Whatever evolutionary paths the contemporary art of portrait painting might pursue in the decades to come, the portraits of the leaders of the Latvian Academy of Sciences will continue to constitute a prominent part of its collection of regalia and symbols.

Translated by **Rasma Mozere**

RESEARCH NOVELTIES

STONE AGE FEMALES IN LATVIA

Gunita Zariņa, *Dr. hist.*, Full Member of the Latvian Academy of Sciences, Senior Researcher, the Institute of History of Latvia, the University of Latvia

The Stone Age is the first of three periods of human technological prehistory, before Bronze and Iron Ages. During it, stone (flint in particular) along with other materials (like wood, bone), found in the nature, were widely used to make weapons and working implements. Three Stone Age subperiods are distinguished: Palaeolithic, Mesolithic and Neolithic, although their distinction varies enormously from one region (and culture) to another. Opinion of archaeologist Ilga Zagorska is, that the first people in the territory of Latvia arrived at the end of Palaeolithic, about 12 500 years ago, i.e. in the mid-11th millennium BC.

As DNA studies of ancient inhabitants show, the first arrivals in the territory of Latvia are related to western and eastern hunter-gatherer groups, pointing to a closer link with western hunters-gatherers from the Central Europe (Fig. 1).

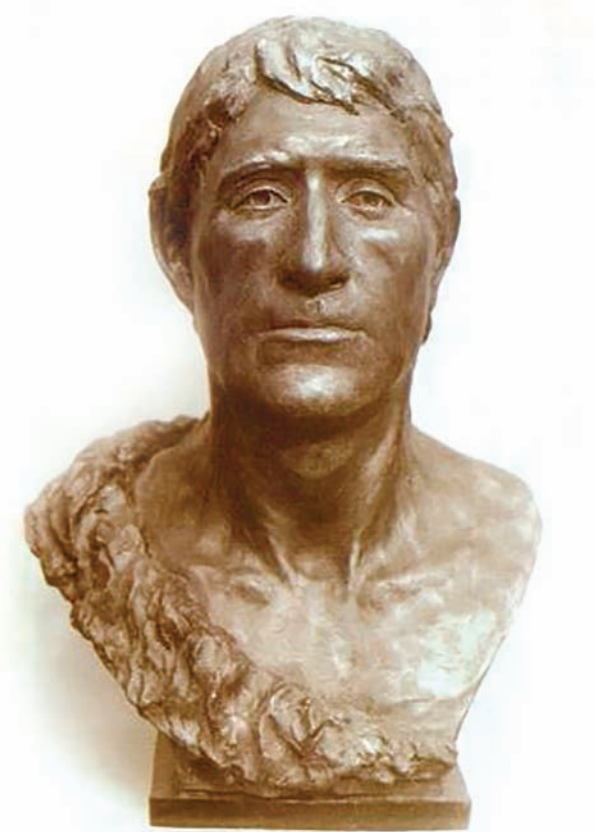


Fig. 1
Zvejnieki, burial 2. Reconstruction: M. Gerasimov and G. Lebedinskaya (Moscow)
Photo: F. Zagorskis 1987

Initially, hunter-gatherers made summer settlements on the shores of the biggest rivers (Daugava, Lielupe) and connected water bodies (Lake Lubāna, Dviete River). During the winter, they went back to areas with a milder climate. In the Mesolithic, along with warming of climate, settlements became permanent and spread from the valleys of the biggest rivers to basins of inland lakes. The shores of Lakes Usma, Lubāna, Burtnieki became densely populated with permanent hunter, fisher, gatherer settlements. Burial sites appeared beside settlements, now these are important source of information on health, nutrition, mortality, life expectancy of ancient people; on the basis of this information it is possible to reconstruct to some extent structure of society and rituals.

Zvejnieki burial site in the North end of Lake Burtnieku, at the estuary of the Roja River is one of the most researched Stone Age historical sites in the Northern Europe. Zvejnieki Mesolithic and Neolithic settlement existed there (with possible gaps) from the 8th to 3rd millennium BC. Archaeological research of 328 burials was possible.

In burials, attributed to Mesolithic and Middle and Late Neolithic periods, males, females and children are represented, indicating permanent nature of settlement, while burials, attributed to Early Neolithic, contain only males, probably roaming hunters.

Fishery, hunting and gathering were the main sources of sustenance until the end of the Stone Age there. During summers fishery (pike, perch, bream, tench, crucians, eel, pike-perch, roach) and gathering of berries, nuts, mushrooms, edible roots were dominating, leaving hunting of large game (elks, deer, wild boars, also beavers) and also some fishery for winters. Stable isotope analysis of human bone

Fig. 2
Zvejnieki, burial 316, female mandible, dated 5285 ± 55 BP
Photo: A. Zariņš

material suggest 50–60% share of plant products in nutrition, the remainder consisting mainly of fish (up to 20–30% in Mesolithic), game meat made only 10–20%. During Neolithic, the share of fish somewhat decreased, share of meat increased to 20–25%. Such nutrition structure ensured important role in food provision for females, they participated in all necessary activities except, perhaps, hunting. As a result, there is no noticeable distinction in nutrition quality between males and females.
Zvejnieki population had high dental attrition in all Stone Age periods, suggesting, besides abrasiveness of food, also intensive use of teeth as work implement. Both males and females have probably used teeth for various jobs, for example, such as holding leather pieces while sewing them. For example, female aged 35–40 in burial 316 has heavy wear of molars and canines on both sides of maxilla and mandible that might suggest of treating tendons by dragging them through teeth (Fig. 2).
Ethnographical research of Inuit have found similar use of teeth by both males and females, leading to heavy wear, especially for incisors (Fig. 3).
Forty-one per cent of Mesolithic burials were of children, aged below 14; 28% of infants aged below four years. Burials of children and infants were constructed with great care, with ochre addition, two thirds had grave artefacts, mainly bone pendants, and bone spearheads, knives, chisels (Fig. 4). Pronounced children mortality maximum before age of four probably suggest that transition from breast-feeding to adult diet was a serious challenge for child's health, considering the random nature of food procurement in contrast to stability and nutrient qualities of mother's milk.
Estimate of life expectation for Mesolithic is 35 years for males and 38 years for females. Males mostly die at the age of 30–40, when at their prime and actively participate in hunting and violent resolving of conflicts, while females more often (twice as much as males) reach age of 45–55. However, social selection effect at burial is possible there, for female burials are almost two times fewer than male. On the other hand, social status of women certainly could be high, as suggest, for example, grave artefacts for a rich female burial 57 (aged 45–50, dating 6825±60 BP). Bone dagger with handle in form of elk head – a symbol of power and special role of this woman in the community. Also stone axe, flint knife, flint cutter and scratcher, bone spearhead an pendants are present in this burial.
What secured relatively long life of Mesolithic women?
Probably slow reproduction rate in Mesolithic also had some effect on female life expectation. Several researchers have pointed out that in hunter-gatherer communities sexual maturity of girls was reached, on average, three years later (around age of 16) than in agricultural communities. There is opinion that the first childbirth for hunter-gatherer women was at the age of about 19.
Stable isotope analysis of Latvian Mesolithic material indicate weaning at the age of three, like in other Mesolithic communities. That prolonged time intervals between childbirth up to four or five years. Besides, during food gathering infants were carried with mothers, and the next child could be born and survive only when the previous one was able to care for himself. Therefore, possible number of children was relatively low. Such naturally low reproduction rate in Mesolithic was much more favourable for female health than growing reproduction rate in subsequent historical periods.

Fig. 3
Sadlermiut (Inuit group) woman using teeth to stretch skin while sewing (from C. F. Merbs, 1983)

It has been found, that an average number of childbirths per female during whole reproductive period grew from 5–6 in hunter-gatherer community to 6–7 in agricultural / cattle breeder community. Principal factor for that was early weaning. Regularly available foodstuff – milk, cereals – enabled faster transition to adult food structure, shortened time to the next childbirth, as a result, increasing number of children per reproductive period.

As not all Zvejnieki Mesolithic women survived until the end of reproductive period (about the age of 40–45), the average number of children per women was close to four. As only half of them survived until reproductive age that ensured reproduction of population, but not increase.

In the late Stone Age, (Neolithic) female mortality at the ages of 20–25 is increasing, also several girl deaths at the age of 17–20 are found. Supposedly, that is due to faster biological maturity of the girls and earlier first childbirth – a serious challenge for female health. At the same time proportion of women, dying at the age of 45–55 decreases. As a result, an average female life expectancy decreases to 35 years, but male – increases to 36 years; also proportion of males, reaching the age of 40–60 increases. So, average male and female life expectancy becomes more similar.

Nitrogen stable isotope ratios ($^{15}N/^{14}N$) in permanent teeth can be used to estimate weaning age. Analysis of nitrogen stable isotope ratios in dentine layers enables estimation of the diet during the corresponding age of the individual. Therefore, the 10 layers of the first permanent molar are especially significant, as they reflect childhood diet from the time of birth up to the age of eight years. During the breastfeeding period, the nitrogen isotope ratios will be approximately 3‰ higher than after the end of the breastfeeding because of the increased ratios in the breast milk. Therefore, it is possible to track the breastfeeding and weaning periods by the drop in nitrogen stable isotope ratios. The results of such analysis of Zvejnieki anthropological material indicate some decrease in the age of weaning from three years in Mesolithic to 1.5–2 years in Late

Neolithic. The decrease of nitrogen isotope ratio was found, for example, at Zvejnieki burial 137. It was attributed to Corded Ware culture of Late Neolithic, which is being connected to beginnings of farming in the territory of Latvia. The onset of farming seems to be responsible for significant decrease of weaning age and acceleration of reproduction rate. Further research in this area, including more representative data from more individuals and burial sites, is required to obtain conclusive proof of this hypothesis.

The transition from hunter-gatherer to farming society concludes with coming of the Bronze Age. A farming community is better provided with self-produced sustenance. Possibility to substitute mother's milk quickens weaning and parting of the child from mother. The mother faster gets pregnant with the next child. The age period from 20 to 40 becomes a continuous childbearing and breastfeeding. Besides that, female work is needed also in the field. As a result, female mortality in the period considerably increases, average life expectancy in the Bronze Age decreases to 33 years, while male life expectancy increases to 41 years. Such pronounced difference of life expectancy remains in Latvia also in the Iron Age and Middle Ages. Only in the 19th century, with improving of social and economic situation and availability of medical services, male and female life expectancy again becomes equal.

Fig. 4
Zvejnieki, burial 226, dated 5345 ± 60 BP, child aged 2 years
Photo: F. Zagorskis

POPULAR ENLIGHTENMENT IN THE 18TH AND 19TH CENTURIES AND ITS LEGACY TODAY

Pauls Daija, *Dr. philol.*, Corresponding Member of the Latvian Academy of Sciences, Leading Researcher, Institute of Folklore, Literature and Art

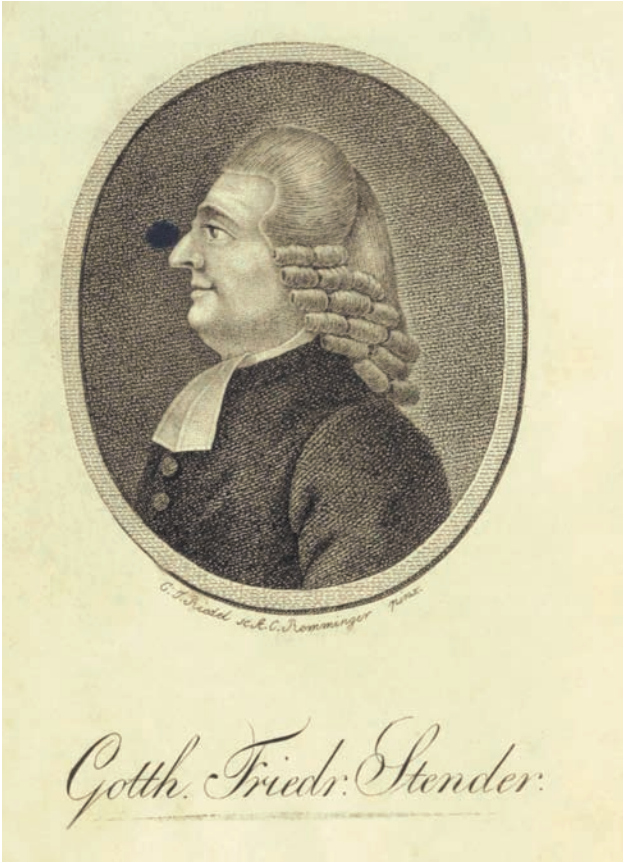
The role of the Baltic German Lutheran parsons in stimulating and developing the intellectual climate of the Baltic Provinces in the late 18th and early 19th centuries has been acknowledged by studies of various disciplines in the 20th century. Latvian and German scholars have demonstrated that the Baltic German intellectuals were promoters of Latvian literary culture and predecessors of Latvian national emancipation. The ongoing studies in the 21st century, backed by an increasingly closer collaboration among scholars in the Baltic countries and Germany as well as a growing amount of easily accessible digitised data, continue to explore the Baltic German contribution to the Latvian literary culture, emancipation and enlightenment. In contemporary approaches, literary history is advanced in dialogue with the studies of cultural history, history of religion and translation studies. The shift towards interdisciplinary approaches opens up new research directions and may help understand the historical changes in detail.

There are various reasons why the research of history of the Baltic German parsons could provide substantial insights in knowledge dissemination and Latvian emancipation and why this discussion is significant in the 21st century, too. First, despite many academic and popular efforts, the Baltic German cultural heritage in regard of its impact on Latvian culture, still remains understudied and underappreciated in wider society thus often resembling *terra incognita* in the collective memory of contemporary Latvian society. The emancipative role played by the educated Baltic German minority in the history of Latvian national awakening might be a good starting point to facilitate discussions on the complex and heterogeneous past of Latvian society. Second, today when culture becomes increasingly open to foreign influences in the age of globalisation, the awareness of history of cultural exchange and various, often competing forms of cultural import can make us better equipped to discuss the challenges of global culture and their impact on the national identity. Third, acknowledging the work of the Baltic German Lutheran parsons in the era of the 18th century secularisation reveals the role of the Church in society in promoting cultural development and social change thus expanding the view on religious movements and escaping the narrow characterisation of clergy that still has to overcome the stereotypes partially established by Marxist interpretations in the Soviet time. In this context, it is crucial to examine the synergy between the Lutheran rationalist parsons' activities and Herrnhutian Brethren that promoted Latvian emancipation in various ways; however, they also had many ideas in common. In current research, intriguing parallels can be found in the studies focusing on the enlightening activities carried out by Catholic clergy, especially the Jesuits in the 18th and 19th centuries.

Current investigations in the late 18th century and early 19th century history of the Baltic German parsons as cultural mediators between the Popular Enlightenment movement in German-speaking countries and the Baltic Provinces of Russia have turned the attention towards the ways and means the German ideas were brought to Latvian (and Estonian) peasants. Popular Enlightenment in German-speaking countries strived to educate and enlighten the peasants or

the 'common people' by using direct communication (often addressing the parish from the pulpit) and printed media – books, periodicals and almanacs written for the peasant reading public. This philanthropic work that addressed both the modernisation of rural society and increase of agricultural production, was, however, a coin with two sides. During the events of the French Revolution, the European public became aware of the fact that information and education might give rise to riots, and in the Baltics, too; it was often necessary to make excuses for the necessity to educate the lower classes of society. As these events overlapped with the so-called 'reading revolution' in Western Europe, historical analysis of contested views on information, education and new media can provide productive insights into the 21st century debates on issues that are not unrelated to Enlightenment discussions.

These studies envision closer look upon the German works that were translated into Latvian, including books and treatises of such outstanding German reformers as Rudolf Zacharias Becker, Joachim Heinrich Campe, Friedrich Eberhard von Rochow, Christian Gotthilf Salzmann, Heinrich Zschokke. The impact of these authors on Latvian translated literature remains yet to be explored and analysed, and Latvian literary history has many gaps to be filled by acknowledging the role of the works by these authors. The analysis of how the ideas of these reformers shaped Latvian literary culture, new forms of ethnic identity and self-awareness of the emerging Latvian middle class in the 19th century can broaden our knowledge on the tradition of Latvian Enlightenment established by Gotthard Friedrich Stender and continued by Lutheran parsons in Liefland and Courland — Gustav von Bergmann, Alexander Johann Stender, Jakob Florentin Lundberg, Karl Hugenberger, Hermann Trey, Christoph Reinhold Girgensohn. These Baltic Germans considered themselves 'Latvian friends' and devoted their professional and often private lives to their Latvian peers. When scholars of Latvian literature attempt to trace the beginnings of the first Latvian popular science works, novels, drama, poetry, belletristic fiction and agricultural treatises, they find these works published by the aforementioned authors. However,



Gotthard Friedrich Stender

in the canon of Latvian literature the role of Lutheran parsons still remain to be more strongly recognised and rescued from oblivion. Their philanthropic and enlightening work made the preconditions for the national awakening in the mid-19th century along with the Young Latvian movement, and here lies the most significant relevance of their activities. Yet, it might be characterised also as a paradoxical, since most of the Baltic German intellectuals had no national aims and did not foresee conflicts among the Baltic ethnic groups later in the 19th century.

Current scholarship is also interested in the interactions between the private initiative characteristic to the Enlightenment-era reformers and various charitable societies that strengthened social and spiritual changes. The history of Livonian Public Welfare and Economic Society, the Courland Society for Literature and Art, and Latvian Literary Society among others provides a fascinating insight into the developments of reform projects and debates on Enlightenment ideas.

Largely thanks to the recent studies, a new perspective on Lutheran parsons has emerged by characterising them not only as cultural mediators, but also, metaphorically speaking, cultural ambassadors who imported foreign ideas to the Baltic littoral by adapting them to regional contexts and employing them to promote education and enlightenment of Latvian population. While parsons did not always welcome radical ideas of abolishment of serfdom advocated, for instance, by Garlieb Merkel, at the same time most of them were opponents to the Germanisation of Latvians and envisioned independent Latvian culture. Their perceptions of Latvians that fluctuated among the concepts of 'noble savages' and 'common people' experienced significant changes when the Baltic German parsons influenced by Johann Gottfried Herder began to collect Latvian folksongs and became interested in linguistic and ethnographic studies of Latvian traditional culture.

During the first decades of the 19th century, the Baltic German parsons began to support ethnic Latvian authors by providing them with opportunities to publish their works and backing their education financially. The first generation of Latvian rural intellectuals – from Elkuleju Indriķis to Ansis Leitāns, Ernsts Dinsbergs, Ansis Līventāls and Jānis Ruģēns – made an entrance in the Latvian public sphere thanks to the guidance of Lutheran parsons, and hence the path was open to further developments in Latvian literary culture while at the same time it marked the end of the Baltic German hegemony in Latvian letters.

The studies of the Baltic German parsons' contribution to Latvian education, enlightenment and literary culture open up an intriguing field of inquiry where by no means all the answers have been found and all the questions have been asked. Further investigations should bring into focus the international contexts of the Baltic Popular Enlightenment, the interactions between foreign influences and regional features and the image of Latvians that was developed by the Baltic Germans and perhaps inherited by Latvians themselves. The ongoing 21st century debates on Latvian national identity and place in Europe demand incorporation of the historical perspective, and the story of Popular Enlightenment can be an appropriate and fruitful point of departure for extending these debates.

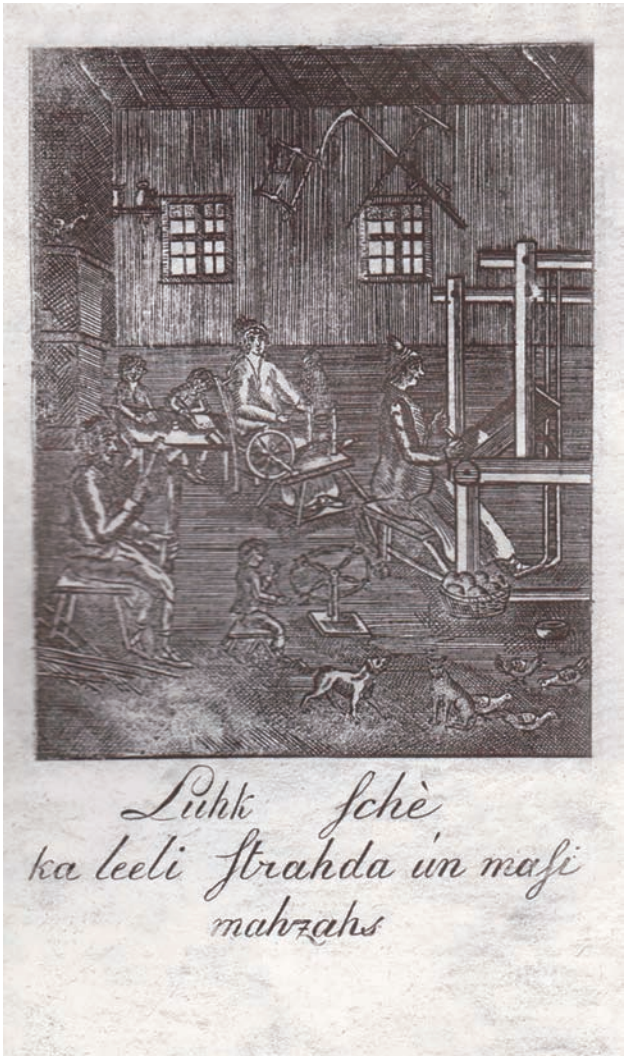


Image from Friedrich Erdmann Stoll's book *Jauna boksterēšanas un lasīšanas grāmata* (1813)

Image from the 18th century Courland Latvian Almanac

MULTI-VOLUME EDITION **ART HISTORY OF LATVIA** AS A NATIONAL RESPONSIBILITY

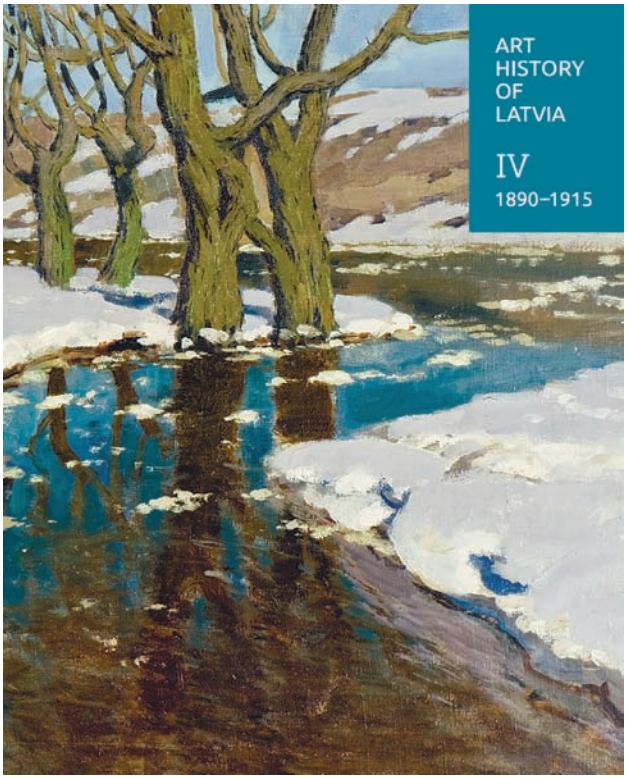
Kristiāna Ābele, *Dr. art.*, Senior Researcher, Institute of Art History, Latvian Academy of Art, Corresponding Member of the Latvian Academy of Sciences

During the past five years since early 2013, the central axis in the research and publishing activities of the Institute of Art History at the Latvian Academy of Art has been an academic multi-volume edition *Art History of Latvia* (*AHL*). The basic programme for this series of seven planned collective monographs was elaborated by Professor, *Dr. habil. art*. Eduards Kļaviņš who is director of the Institute since 2012 and editor-in-chief of *AHL*. Contributors of texts include researchers of the Institute and other departments of the Academy of Art as well as invited scholars. Financially decisive for the implementation of this ambitious project is the support of the State Culture Capital Foundation of Latvia won in annual competitions since 2012 / 2013 and later combined with private funding and profits from the sold copies. Aiming to cover the whole span of development from prehistorical beginnings of artistic production in the territory of Latvia to the changing contemporary scene, the team started its work with volume IV, *Period of Neo-Romanticist Modernism. 1890–1915* (2014, 640 pp., 916 images; with contributions by Eduards Kļaviņš, Kristiāna Ābele, Silvija Grosa and Valdis Villerušs) and volume V, *Period of Classical Modernism and Traditionalism. 1915–1940* (2016, 694 pp., 997 images; with contributions by Eduards Kļaviņš, Stella Pelše, Valdis Villerušs, Katrīna Teivāne-Korpa, Ilze Martinsone, Rūta Rinka and Marta Šuste), both shortlisted as major scientific achievements of these years by the Latvian Academy of Sciences. The release of the volume 3 in two books (ca. 400 pages each), *Period of Classicism and Romanticism. 1780–1840* (by Eduards Kļaviņš, Elita Grosmane, Valdis Villerušs, Imants Lancmanis and Inese Sirica) and *Period of Realism and Historicism. 1840–1890* (by Eduards Kļaviņš, Kristiāna Ābele, Valdis Villerušs, Daina Lāce, Silvija Grosa and Inese Sirica), is scheduled for the first quarter of 2019. Simultaneously, texts are being prepared and images collected for other volumes, still requiring a varied amount of research: volume 1, *Art of the Stone, Bronze and Iron Ages. 8500 BC–800 AD / Medieval Art. 800–1561*; volume 2, *Period of Classical Elements. 1561–1680 / Period of Baroque and Rococo. 1680–1780*; volume 6, *Time of the First Two Totalitarian Occupations. 1940–1945 / Period of Social Realism and Diaspora Art. 1945–1985*; volume 7, *Period of Late Modernism and Postmodernism. 1985–2015*.

In the Baltic and North European context, the general editor and co-authors of this project were largely inspired by such national art histories as *Signums svenska konsthistoria* in Sweden (13 vols. by 2006) and *Eesti kunsti ajalugu* in Estonia, with four volumes of six published 2005–2017. Unlike these and other models, *AHL* is published in identical Latvian and English versions, using the same layout (designed by artist Ieva Vīriņa). This solution makes not just simplified generalisations and main facts but the full scope of details and argumentation available to international audiences, considering that main foreign readers of these publications will be experts interested in specific aspects beyond the limits of a summary. The relevance of this decision is proven by reviews about the pilot volume of *AHL* in art history journals *Centropa*, *Kunstchronik* and *Kunstiteaduslikke Uurimusi*. According to Lithuanian colleague *Dr*. Laima Laučkaitė, "the English version of the volume presents the foreign reader with an unknown panorama of the Latvian art at the turn of the century and reflects the level of contemporary

Latvian art history research. The book provides the art historians of Central and Eastern European countries with interesting comparative material." (*Centropa*, 2015, vol. 14, No. 2, p. 208). Similarly, Professor, *Dr.* Lars Olof Larsson from Kiel concluded "in this work Kļaviņš and his team have created an impressive monument to the versatile and vigorous period of art around 1900 in Latvia" (*Kunstchronik*, 2016, No. 4, p. 193).

The volumes are structured as a sequence of individually authored chapters, proceeding from historiography and a detailed discussion of the artistic life to developments in particular branches of art that is the main content of these books. The contributors are free to modify the proposed thematic programme according to their research results and preferences. However, as Eduards Kļaviņš stressed in the preface of the volume 4, "the primary aim of the texts is to elucidate the history of art and not to illustrate the political, social or even general cultural history with artworks". Although the periods of 1890–1915 and 1915–1940 were relatively well explored in Latvian art historical research already before the start of *AHL*, the new task to elaborate versatile and balanced overviews made authors deal with numerous previously unanswered questions and guided them to new discoveries. A major change against the background of previous traditions in this discipline of national humanities is the break with the ethnocentric approach that had prevailed since the first Republic of Latvia throughout the 20th century to be gradually replaced with a multi-ethnic perspective only during the last decades. As already voiced in a number of interviews with the *AHL* team, the work on each volume generally requires "two years and the whole life": the knowledge and expertise revealed in chapters by Eduards Kļaviņš himself, the book art historian Professor, *Dr. art. h. c.* Valdis Villerušs or the retired Director of the Rundāle Palace Museum *Dr. art. h. c.* Imants Lancmanis have been accumulated in the course of a half-century. By years of birth, contributors represent all the currently active generations of researchers born between the 1930s to the 1980s, with some very challenging assignments fulfilled by emerging scholars of the youngest generation, e.g. the doctoral student Marta Šuste and



Art History of Latvia. Volume IV *Period of Neo-Romanticist Modernism. 1890–1915*

Art History of Latvia. Volume V *Period of Classical Modernism and Traditionalism. 1915–1940*

Dr. art. Inese Sirica. Last but not least, *AHL* is a greatly collaborative project supported by other actors in the field of art publishing, numerous heritage institutions throughout the country, individual researchers and private collectors. The names of the Latvian National Museum of Art, art publishing house *Neputns*, Rīga History and Navigation Museum, Latvian National History Museum, National Administration of Cultural Heritage and Rundāle Palace Museum would be followed by a long and prominent list of other museums, libraries, archives and municipal offices.

According to the state of preliminary research in different segments of art and architecture, some *AHL* texts basically interpret and summarise comprehensive previous publications by contributors themselves or their colleagues whereas other give pioneering insights into previously unexplored areas still waiting for meticulous investigation. Thus, the result is not just a compendium of established truths but also an inspiring material for new quests and discussions. As the humanities are becoming increasingly international, the function of a national art history is to treat the artistic and architectural heritage enclosed by a transparent border of a state as a field of responsibility and be ready to inform the rest of the world about everything related to this area. The *AHL* team keeps working with a strong sense of this responsibility.

The launch of the book *Art History of Latvia*, Volume IV at the Latvian Academy of Arts on 21 November. Left to right: Eduards Kļaviņš (editor-in-chief and contributor), Valdis Bērziņš (translator), Silvija Grosa (contributor), Kristiāna Ābele (contributor and editor), Ieva Vīriņa (designer), Valdis Villerušs (contributor), and Stella Pelše (main translator)
Photo: Didzis Grodzs

THE COLLECTIVE MONOGRAPH ON THE RESEARCH ON TRANSFORMATION OF THE STATE **SIMTAM PĀRI. VIEDĀ LATVIJA**

Baiba Rivža, *Dr. habil. oec.*, Professor of the Latvia University of Life Sciences and Technologies, Full Member of the Latvian Academy of Sciences

The collective monograph (henceforth, monograph) *Simtam pāri. Viedā Latvija* (Beyond A Hundred Years. Smart Latvia), edited by Academician Baiba Rivža, the Latvian Academy of Sciences (LAS), summarises the results of the projects supported by the National Research Programmes (VPP) EKOSOC-LV (2014–2018). Taken together with other monographs on individual projects of the programme, it constitutes a shelf of books. This compilation of findings from complex contemporary studies of economic and social issues, supplemented by a range of smart research tools developed for such investigations has been identified as one of the twelve most important scientific achievements in Latvia in 2018.

OVERVIEW

The monograph *Simtam pāri. Viedā Latvija* is a compilation, which summarises the principal economic and academic findings from a major research programme in the field of social sciences "Transformation of the National Economy, Smart Growth, Governance and a Legal Framework for Sustainable Development of State and Society – New Approaches for Building a Sustainable Knowledge Society, EKOSOC-LV" led by academician Baiba Rivža. It includes extensive conclusions and recommendations for necessary changes to rectify the complex situation; additionally, tools are provided for such change (a smart index of country development, body of debates held by the *Saeima*, guidelines for ecosystem sustainability, a model for employee participation in raising company capital, a methodology for the development of social innovation, scenarios for alternative development of regions and state, etc.). The results are complemented by views expressed by national and international experts, examples of good practice from the knowledge economy and other smart processes. The monograph provides a general picture of the development of the country, which is very important within the context of how information is fragmented. The material presented in this monograph may be widely used in formulating development strategies and decision-making at different levels of management, in master and doctoral studies, further national development studies, the work of NGOs, etc.

It is significant that both studies and the compilation of the results in this monograph is based upon endogenous growth theory, which was highlighted by the 2018 Nobel Prize in Economics. The theory holds that it is essential to achieve economic growth by developing the internal potential of a system – strengthening human capital (including scientists), the creation and use of new technologies, the economic use of resources, etc.

The creation of a smart or knowledge-based is essential for Latvia therefore the national economic development has been studied so extensively for the first time during the independence period in

terms of participating researchers and cooperating institutions: 200 researchers from universities and regional institutions of higher education, industry experts, local government representatives, etc. were involved. Moreover, the research presents the inter-institutional point of view, as well as the range of topics and interdisciplinary aspects (i.e. a smart or knowledge-based economy, social considerations, a focus on rural and regional aspects, legal considerations).

LAS Academician *Dr. habil. oec.* Baiba Rivža, leader of EKOSOC-LV was the editor-in-chief of the monograph *Simtam pāri. Viedā Latvija*, *Dr. oec.* Elita Jermolajeva – the science editor, Ausma Mukāne – the managing editor.

STRUCTURE OF THE RESEARCH AND THE MONOGRAPH, STUDIES AND ECONOMIC FINDINGS

Sustainable development of the state and society was studied extensively from the standpoint of economic transformation, resources, demography, the environment, governance, legal framework, knowledge-based society in the following ten projects:

1. Studying the competitiveness of the Latvian companies on external markets and provision of proposals for its strengthening – led by LAS Academician, Professor of Rīga Technical University (RTU) *Dr. habil. oec*. Remigijs Počs.
2. Development of Innovation and Entrepreneuship in Latvia in compliance with the Smart Specialisation Strategy – led by RTU Professor *Dr. oec*. Natalya Lāce.
3. Processes of Latvian rural and regional development and possibilities within the framework of economy – led by LAS Academician, Professor of the Latvia University of Agriculture (LLU) *Dr. habil. oec*. Baiba Rivža.
4. Renewal of society through reducing the risk of depopulation, through demographic development and strengthening links with the diaspora for the transformation of the Latvian economy – led by LAS Academician, University of Latvia (LU) Professor *Dr. habil. oec*. Juris Krūmiņš.
5. Reflection on values and social agency during social and economic change – led by Professor of Rīga Stradiņš University (RSU) *Dr. sc. inf.*, Sergey Kruks.
6. Social and political transformations in Latvia in the post-crisis period – led by Vidzeme University of Applied Sciences (ViA) Assoc. Professor *Dr. sc. pol*. Feliciana Rajevska.
7. Involvement of society in social innovation for providing sustainable development of Latvia – led by RTU Assoc. Professor, Senior Researcher *Dr. paed*. Karine Oganisjana and RSU Professor *Dr. oec*. Inna Dovladbekova.
8. Cultural environment development, preservation of nature diversity and urbanization processes within the context of the balanced development of Latvia – led by ViA Professor *Dr. oec*. Agita Līviņa.
9. Impact of social awareness changes on sustainable provision of Ecosystem services – led by Professor of Science at the University of Daugavpils (DU) *Dr. biol*. Inese Kokina.
10. Elaboration of sustainable model for increasing the effectiveness of the legal framework for economic transformation– led by Correspondent Member of the LAS, Professor of the University of Latvia *Dr. iur.* Ārija Meikališa.

Both during the period of the research and in terms of results laid out in the monograph, the ten previously noted projects were grouped together as follows: 1) spatial development projects (3, 8, 9) led by Academician B. Rivža; 2) social development projects (4, 5, 6) led by Academician J. Krūmiņš; 3) economic development projects (1, 2, 7), led by Academician R. Počs; 4) the legal framework together with project 10 which spanned all the other projects led by Professor A. Meikališa.

Each section of the monograph dealing with related projects provides summary of research progress, conclusions and recommendations, describes problem settings and solutions, also gives examples of best practice of smart development, thereby demonstrating that knowledge-based economy or high and medium high-tech manufacturing companies and knowledge-intensive service providers are

found in every region of Latvia. The growth rate of the smart or knowledge-based economy has been faster in the regions than in the capital city, contrary to prevailing erroneous myths; the polycentric development of the country must be continued, and the whole territory of the country has to developed in a balanced way. Generally, a greater share of the smart economy has to be achieved as it is not the goal of Latvia to be a land of cheap labour.

The section on development scenarios presents findings following the method developed by Thomas L. Saaty – The Analytic Hierarchy Process (AHP), the essence of which is to combine expert assessments of the importance of criteria and sub-criteria set out by scientists on development of the country, with mathematical analysis. Alternative scenarios for smart development of Latvia are modelled – an innovative or specialised scenario of competitiveness or efficiency, leadership and competencies, a visionary or territory view of leadership and competence, given that Latvia is not a land of cheap labour. Experts as well as scientists have advanced models for the development of particular regions – a smart economy, smart management, smart resources and smart people.

Opinions offered by foreign experts (Tiiu Paas, Estonia; Jonass Jasaitis, Lithuania; Juris Dreifelds, Canada) highlight those values that are the goal of economic growth, namely constitutional rights on the welfare of the population, socially evolving social initiatives, personal creativity, new levels of awareness that convert to greater economic astuteness. The uniqueness of the forests and land of Latvia are highlighted, natural wealth, and space outside of urban centres – such resources that are not at the disposal of all countries should be used strategically. They provide Latvia with unique global advantages. Social science specialists act as compasses for this path of development.

In order for Latvia to move forward riding the new inevitable wave of global technology rather than being left behind, the most important keywords are: education, lifelong learning, work-based education, transfer to the economy of science-generated technologies, economic diversity and flexibility, labour productivity, a territorially balanced approach in future development, all manner of cooperation between citizens and institutions, a deliberate choice for smart development as the way forward, etc. An innovative tool for rural and regional development was developed by investigators, namely, an index for smart development in the regions, which allows evaluating the performance of regions in blocks – smart management, smart economy, smart resources and smart people – and testing compliance with smart growth by identifying strengths and weaknesses, and also possible solutions.

The monograph chapter *A Chronicle of Events*, presents the most important project events which transpired during the course of investigations, including regional forums organised by the LAS, EKOSOC-LV and the Latvian Union of Local and Regional Authorities together with regional higher education institutions, municipalities and other institutions, which have provided opportunities for wide-ranging dialogue and expression of diverse views on the future development of Latvia within the complex context of complicated globalisation, climate change, and the demographic situation.

The research and discussions have demonstrated the growing role of local governments: municipalities should become more determined leaders, i.e. promote entrepreneurship, drive change, overcome stereotypical thinking and spread new thinking, making scientifically sound decisions, which will lead to development of basis for development: smart people, smart governance, smart resources and smart economy.

ACADEMIC FINDINGS

The information segment of the monograph contains a compilation of the results achieved during the implementation period 2014–2018 for the VPP. Thirty-six doctoral theses have been defended during this period; the statistics are available for scientific publications noted in international databases: Scopus, 75, EBSCO, 168, Web of Science, 18. There were 12 summer schools dedicated to in-depth investigation of selected topics, including one that dealt with the most important development criteria and sub-criteria adopted for modelling national development

scenarios based on AHP. A number of new projects have been included in international programmes.

The relevance of the monograph *Simtam pāri. Viedā Latvija* for academic study and further research is reinforced by its extensive glossary, including explanations of modern terms.

Close inter-institutional cooperation during implementation of the VPP, production of the monograph *Simtam pāri. Viedā Latvija*, dealing with specific projects and its publication has enriched the experience and motivated for further inter-institutional and inter-disciplinary research on development trends in Latvia. For example, LAS, LLU, LU, and RSU embarked in 2019 on a project, INTERFRAME-LV, to investigate the international environment in which Latvia finds itself, processes and trends touched by globalisation, in order to understand both their positive and negative impact, and to make better use of opportunities and threats. The need for more in-depth study of global processes affecting Latvia has also been expressed in expert opinions to be found in the monograph *Simtam pāri. Viedā Latvija*.

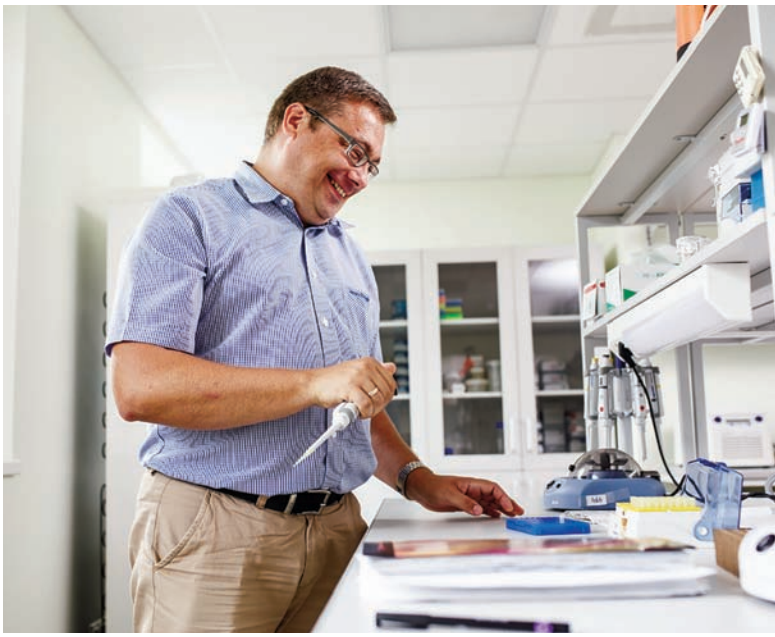
Books published within National Research Programme EKOSOC-LV (2014-2018) headed by Professor Baiba Rivža

THE BASIC BIOLOGICAL RESEARCH FOR THE FUTURE HORTICULTURE

Gunārs Lācis, *PhD*, Corresponding Member of the Latvian Academy of Sciences, Institute of Horticulture, Latvia University of Life Sciences and Technologies

Horticulture has old traditions in Latvia, and the climatic conditions and soil are favourable for it. The climate allows sustainable growing of various horticultural crops including rare and novel ones, but demands climate adapted cultivars and careful choice of growing technologies. Horticultural production has high profitability and potential for growth to provide the markets with diverse local foods, raw materials and innovative niche products, and it occupies an important niche in the overall structure of the agriculture. Horticulture in Latvia faces several traditional challenges of region such as winter hardiness, including resistance both to extreme temperatures and to temperature fluctuations, length of the growth season, which limits the use of very late ripening cultivars and some crops. Resistance to diseases and pests also has always been an important issue for growers and researchers due to conditions of relatively high moisture and winter injuries, which, for example, increases susceptibility to infection and promotes fungal diseases. Recently, the horticulture sector faces new challenges as climate change, which in turn leads to the increased outbreaks of traditional diseases, evolution of more aggressive pathotypes and emerging of new pathogens, atypical for country. In order to overcome existing and foreseeable challenges and to ensure environmentally friendly, sustainable horticulture, the knowledge is needed in the future, both about the plants involved and about the effects of abiotic and biotic factors, and their interactions.

The Institute of Horticulture (LatHort) is directly involved in the acquisition of new knowledge and development of technologies to support the advancement of the sector, to boost its competitiveness.



PhD Gunārs Lācis in the laboratory

Therefore, in order to provide the complex support of sector, it has defined several priority research directions:

- Diversification and breeding of horticultural crop cultivars suitable for the Baltic Sea region, which includes breeding of fruit plant cultivars (well adapted to climatic conditions of Latvia and with high ecological plasticity, highly productive and resistant to most important diseases and pests, suitable to innovative growing technologies, suitable for fresh consumption and processing), research and maintenance of horticultural plant genetic resources, and evaluation of introduced varieties for breeding and practical purposes.
- Environmentally-friendly horticultural production systems, which main tasks are: promoting of

the development and modernisation of horticulture industry in Latvia – to create the necessity for further innovative applied and essential research, providing of farmers with innovative fruit and berry cultivars, rootstocks, as well as growing technologies, and consulting and training of farmers.

– Storage and processing technologies of horticultural crops with the aim – to create a new knowledge and products as well as to develop innovative technologies which would contribute to technological progress and increase of Latvia horticulture and food sector competitiveness. The main activities of direction include evaluation of new fruit cultivar suitability for processing, development of new products and utilisation of by-products as valuable source of food ingredients, the determination of chemical composition of traditional and non-traditional fruits, berries and their products, and estimation of shelf life and storage conditions for different fruit crops and cultivars.
– Basic research on horticultural crops, which includes characterisation of germplasm genetic diversity, research on genetic mechanisms of plant and environmental interactions, research on plant biology, identification and monitoring of diseases and pests, characterisation of diversity of plant pathogens and pests in relation to their hosts, and establishment of virus free nuclear stock collections.

Knowledge on horticultural plant biology, interaction with other organisms in changing environmental conditions, new possibilities for use in the development and improvement of healthy food is necessary for the successful development of horticulture and its related branches. Therefore, the aim of basic research on horticultural crops at LatHort is to acquire new knowledge through basic scientific methods, promoting the sustainable development of horticulture and related biology, chemistry and food sciences, creating an informative base for applied research. Studies on the biological basis of horticultural crops are being carried out in several interrelated directions: plant genetics and molecular biology, plant pathology and entomology, and the chemistry of horticultural plants and their processing products.

For development and introducing of new, sustainable growing technologies in practical horticulture it is essential to understand the biology of the used plant species, the mechanisms of heredity, to define the valuable characteristics and identify potential donors, and evaluated local, climate-adapted plant material. The Unit of Genetics and Biotechnology at the LatHort has since its establishment carried out the evaluation and characterisation of Latvia fruit crop genetic resources using various molecular marker technologies for characterisation of genetic diversity, improvement of genotype identification (e.g., collection-wide evaluation and genotyping of apple, sweet and sour cherry, as well as black currant, raspberry, outdoor grape and sea buckthorn germplasm collections), identification of agronomically important traits (self-incompatibility in *Prunus* species, resistance to apple scab). Investigation of the fruit crop genetic resources also involves identification of the historical origin and cultivation prevalence of certain crops (e.g., clarifying history and ways of introduction for outdoor grapes and sea buckthorn grown in Latvia, identification of apple landraces, grown for long time in the country). The acquired knowledge is further used for the improvement of genetic resource preservation, selection of raw material for breeding, and more precise identification.

Using the latest genetic and biotechnological methods, studies are being carried out on the interaction mechanisms between fruit plant species and biotic stressors (diseases), the development of resistance-specific molecular markers (apple and pear scab), genetic and biological aspects of the interaction of pathogens and host plants in orchard and in storage (apples and pears). The aim of the research is to find out the natural defence mechanisms of plants for resistance to fungi caused diseases, and to identify the possibilities of their use in breeding. For example, large-scale complex study has been implemented to support resistance breeding programme for apple and cultivar selection for pears – totally 324 apple and 242 pear genotypes were evaluated for resistance to scab in field conditions,

and was analysed its association with specific and general resistance genes. Additional gene expression studies were performed on 192 apple samples, as well as 32 apple genotypes were included in mRNA and miRNA quantification and analysis. Presently, studies on interactions have been initiated among apple and pear genotypes and disease-causing agents involved in the storage decays, searching for the possible fruit-resistance mechanisms.

One of the factors contributing to the environmentally friendly technology of plant growing are diseases influencing the development of fruit industry and caused by pathogenic organisms. With changes in cultivation technologies, cultivars and climatic conditions, the structure of pathogenic populations also changes, new and more aggressive forms and disease races are emerging, resulting in an increase in the pathogen prevalence and ability to overcome current cultivar resistance. Therefore, the identification of pathogens and major pests, the study of the diversity of indigenous pathogen populations and the race composition determination has been made with the aim to compare the pathogen populations in Latvia with other countries, to make possible to predict the increase of pathogen aggressiveness, the formation of new forms of diseases and the possibilities of their spreading, providing knowledge for purposeful selection of new cultivars and breeding of resistant plant forms. These studies use both classical methods of microbiology and plant pathology and molecular biology technologies.

Studies on harmful organisms of plants have been carried out in the Unit of Plant Pathology and Entomology in the framework of a number of national and international projects. The focus has been on research about the spreading, genetic diversity of viruses important for main fruit trees, their elimination from the planting material, strawberry root rot caused by *Gnomonia fragariae*, studies on black currant reversion virus and its vector *Cecidophyopsis* mites, biology of European pear rust (*Gymnosporangium sabinae*). The studies are continued on the identification of the genetic diversity and racial composition for the apple and pear scab causal organisms (*Venturia pyrina* and *V. inaequalis*), including activities in frame of the international research network VINQUEST. Active surveys have been carried out in recent years for sea buckthorn diseases and pests, as well as studies on the virulence of *Neofabraea* fungi and their interaction with host plants (apples and pears).

According to statistics, the fruit cultivation has increased by 25% over the last decade, consequently increasing the amount of processing by-products, seeds and pits form a significant part of the waste. However, all these by-products contain valuable compounds and ingredients that can be used as additives in foods, increasing their nutritional value. For example, the potential amount of quince (*Cidonia oblonga*), apple (*Malus×domestica*) and grape (*Vitis*) seeds useful for further processing globally may reach significant volumes (32–57 thousand, 81–566 thousand and 2–5 million tons per year, respectively). The studies performed at the LatHort Unit of Processing and Biochemistry proves that seeds are the valuable source of lipophilic compounds, whereas fruit and seed oil is rich in bioactive compounds, such as tocochromanols, essential fatty acids, phytosterols, carotenoids and squalene. The chemical composition of plant oils significantly affects their suitability for certain industrial sectors. Studies showed that grape seed oil composition is influenced not only by the species but also by the genotype. In Latvia, in recent years, the growing of Japanese quince (*Chaenomeles japonica*) is increasing, the processing is developing. The amount of seeds in the Japanese quince fruits is on average 10%, whose oil contains high-quality compounds, including unsaturated fatty acids (dominating by oleic acid and linoleic acids), which in turn are important for pharmaceutical and cosmetic industries.

In recent years, a number of masters and doctorate works have been elaborated in the field of basic biological research, which directly or indirectly provide knowledge for the development of further applied studies.

Arturs Stalažs "*Cecidophyopsis* mites harmful to *Ribes* plants, species composition, distribution and association with host plants in Latvia" *(Dr. agr.)*. In the study, the composition and distribution of the species of the genus *Cecidophyopsis* was determined, as well as their relationship with various genotypes of

genus *Ribes* plants, grown in Latvia. The study showed that gall mites occurring on *Ribes* plants are not narrowly specialised by host plants and close relationship was found among some mite species, and species *C. alpina* and *C. aurea* are considered to be involved in transmission of *Blackcurrant reversion virus*.

Baiba Lāce "Impact of agro-ecological factors on development of European pear rust caused by *Gymnosporangium sabinae* (dicks.) G. Winter and integrated pest management possibilities for its control" (*Dr. agr.*). In the study, for the first time were identified *Gymnosporangium* species occurring in Latvia – *G. sabinae* (Dicks.) G. Winter, *G. cornutum* ex F. Arthur Kern and *G. clavariiforme* (Jacq.) DC., as well as their severity depending on pear genotypes. It was stated, that the same development stages of pathogen as on leaves were observed also on twigs, small differences were found in their speed of development.

Vitalijs Radenkovs "Quality assessment of enzymatically hydrolysed bran" (*Dr. sc. ing.*). The study focusses on the processes of enzymatic hydrolysis of bran and evaluation of the obtained product quality. It carries out the following studies: determination of the most effective concentration of enzymes for hydrolysis of bran, evaluation of enzymatic hydrolysis effectiveness, changes of bran microstructure, evaluation of biologically active compound content and changes in bran microflora.

Karina Juhņeviča-Radenkova "Impact of different storage technologies on apple fruit quality" (*Dr. sc. ing.*). The study evaluated and compared the significance of selected storage technologies for the maintenances of apple quality, including determination of the optimal ripeness degree of apples for long-term storage, analysis of the dynamics for apple structural-mechanic properties during storage, the chemical properties of apples before storage and their changes during storage, evaluation and comparison of the sensory quality during storage of apples, clarifying of the microflora development on the apple surface during storage, and assessment of the quality changes of apples during shelf life in the commercial network.

Toms Bartulsons "Characterization of miRNA involved in apple (*Malus×domestica* Borkh.) resistance to aplle scab (*Venturia inaequalis* (Cooke) Wint.)" (*Mg. biol.*). Study characterised the reaction of apple to scab infections by analysis of miRNA potentially involved in resistance, and the differences between miRNA and resistance gene expression in various resistance groups were identified.

Krista-Kristīne Lejniece "The inheritance of apple (*Malus×domestica* Borkh.) resistance to scab (*Venturia inaequalis* (Cooke) Wint.) in hybrid breeding material by gene pyramiding" (*Mg. biol.*). The study evaluated and characterized apple resistance against apple scab, the heredity and effectiveness of the selection process in hybrid families, combining analyses of molecular and apple scab field resistance scoring data. The study showed that the resistance of the apple scab in field is affected not only by resistance genes, but also by the origin of apple cultivar, tree health status and resistance to other diseases.

Inga Mišina "Japanese quince Seed Oil qualitative characteristics and antimicrobial activity evaluation" (*Mg. sc. ing.*). The study estimated Japanese quince oil qualitative characteristics, their antimicrobial activity and compared with commercially produced oils.

Kristīne Vēvere "*Neofabraea* spp. and other fungi as causal agents of apple and pear cankers and fruit rots" (*Mg. agr.*). The aggressiveness of fungal isolates on apples and pears of various cultivars was evaluated in the storage and greenhouse trials for three years. The study concludes that among *Neofabraea* spp. the most aggressive and virulent on fruits in the storage are *N. perennans*, *N. malicorticis* and *N. kienholzii* isolates. Regardless of *Neofabraea* spp. host (apple or pear tree), isolates from apple are pathogenic to pears and *vice versa*.

GENOMICS AND MICROBIOMES IN TREATMENT OF DIABETES

Jānis Kloviņš, *Dr. biol.*, Director of the Latvian Biomedical Research and Study Centre, Associate Professor of the University of Latvia, Full Member of the Latvian Academy of Sciences

The priority of the Latvian Biomedical Research and Study Centre (BMC) is to improve the practice of translational medicine by transferring, as quickly as possible, knowledge obtained from laboratory investigations to medical institutions. The goal of this approach is to raise the effectiveness of treatment of various diseases. One of the largest groups at the BMC is a team led by Professor Jānis Kloviņš – Human Genetics and Molecular Medicine group – comprising scientists investigating issues related to treatment of type 2 diabetes (Fig. 1).

The number of cases of type 2 diabetes (T2D) is rapidly increasing in Latvia, due both to certain genetic factors and a less healthy contemporary lifestyle. Out of more than 80 000 people in Latvia who suffer from diabetes, approximately 90% have been diagnosed with T2D. High blood sugar levels, characteristic of this illness, lead to a number of adverse effects on the patient's organs and body, as a whole, as well as on life expectancy. Hence, it is very important that patients scrupulously follow treatments prescribed by a physician. Researchers at the BMC have investigated in detail metformin, the main medication prescribed for the treatment of T2D. Although it is the most commonly used antidiabetic drug world-wide, approximately 30% of patients experience adverse gastrointestinal reactions, which have led to patients discontinuing regular use of this medication, or opting for a different form of treatment.

The Genome Database of the Latvian Population, LGDB (*Valsts iedzīvotāju genoma datu bāze*, VIGDB), established at the Latvian Biomedical Research and Study Centre, has an important role in the implementation of these studies. It contains records of more than 35 000 inhabitants of Latvia. LGDB collects biological samples (DNA, leucocytes, serum and plasma) and associated data since 2006, therefore, forming a comprehensive system for identifying, storing, and processing the health and genetic information of the Latvian population, serving research, prophylactic and therapeutic purposes. Given the huge amount of information about many common and rare diseases, LGDB has become the second largest biobank in the Eastern European region. One of BMC's key research areas is the investigation of metabolic diseases in order to understand their molecular mechanisms and to find biomarkers that would allow personalised treatment of patients in addition to developing new therapies. The most important resource in these studies is the patient group OPTIMED ever since it was formed in 2010. It currently comprises more than 500 T2D patients, who together with other diabetic patients recruited in LGDB create a cohort of more than 4000 patients. The OPTIMED project was launched in the framework

Fig. 1
Research team of Jānis Kloviņš

of the Latvian State Research Programme (SRP) *Development of Advanced Prevention Strategies, Treatment, Diagnostic Tools and Methods, Biomedical Technologies for Improving Public Health* (SRP Biomedicine) and supported from 2010 to 2013. It is ongoing in a second SRP project *Molecular Mechanisms, Pharmacogenetics and New Medicines for Treatment of Diabetes and Cardiovascular Complications*, financed up to 2017. Within OPTIMED framework patients with 2TD are recruited in a 3-year prospective longitudinal study.

The OPTIMED Pilot Project MetfoGene, carried out in Latvia, was the world's first study to successfully analyse the pharmacokinetics of metformin intolerance, revealing a genetic variation in the OCT1 gene, in the presence of which there is a significantly higher risk of metformin induced adverse reactions. Results from this study were published in 2012, in the journal *Pharmacogenetics and Genomics*. Continuing the pharmacokinetics study, the efficacy of metformin was analysed in 102 diabetic patients from the OPTIMED project, and in 131 patients living in Slovakia. Based on previously acquired knowledge, a new genetic analysis panel was developed for testing of 108 genome variants, and further used for screening of all patients in OPTIMED cohort. This approach allowed us to discover two genetic markers close to the OCT2 and OCT3 genes that significantly influenced the effectiveness of metformin therapy. It proved to be more difficult for patients who were carriers of these genetic variants to achieve the therapeutic goal of lowered blood glucose levels. By examining both variants in a different study group of healthy people, we discovered that the presence of these gene variants determines lower levels of metformin concentration in the blood (Fig. 2). Results of this study were published in 2016 in the *European Journal of Endocrinology*. Further research to confirm our results is continuing in cooperation with the international MetGen consortium (http://www.pgrn.org/metgen.html), in the framework of which collaborative articles have been published in several prestigious scientific journals, including in 2016 in *Nature Genetics*. Unique clinical resources, combined with the latest "-omics" technologies and functional research, will make it possible to apply the acquired markers in clinical practice.

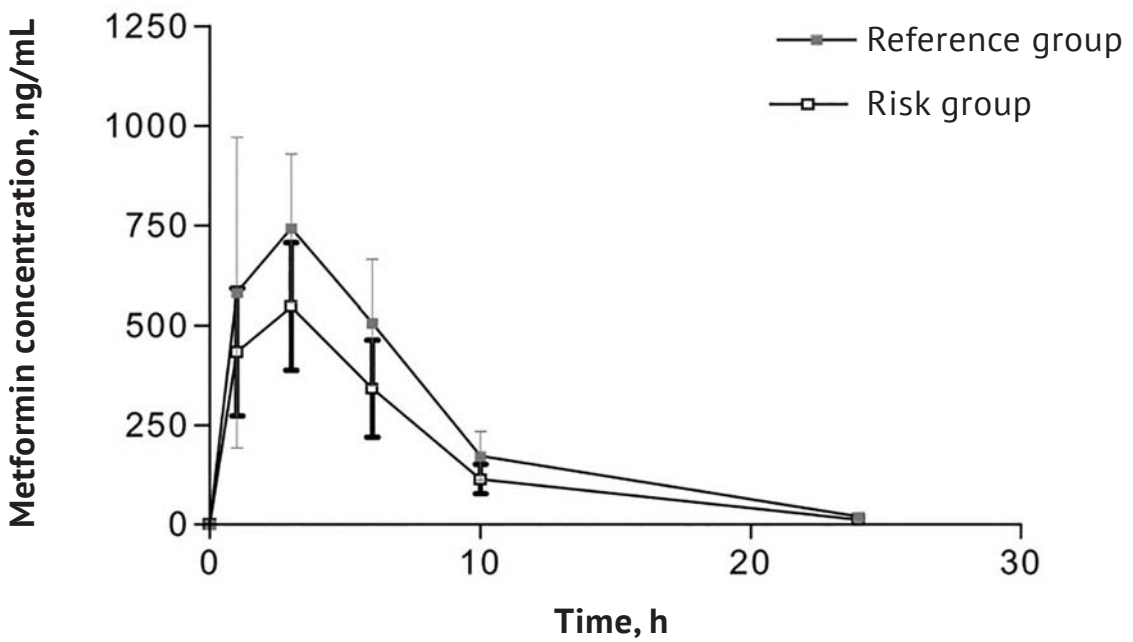


Fig. 2
Concentration of metformin in blood plasma after oral administration of 500 mg metformin in 25 healthy subjects grouped by number of risk alleles

In addition to pursuing research on human genomes, the scientists at the BMC already in 2015 developed a hypothesis about the potential role of human gut microbiome in metformin's mechanisms of action. Microbiome is a set of microorganisms (bacteria, viruses, fungi, etc.) and continuum of the ecological niche they create in particular location, e.g., the gut microbiome is set of all those microorganisms in our intestines that have significant role in ensuring various vital processes. The number of different microorganism cells that live in our body (in the intestinal tract, mouth, nose, skin, etc.) is 1.5 times greater than the total number of cells in human body, while the number of their genes is 100 times higher than the number of human genes. It is known that the composition and "wellness" of gut microbiome play an important role in the development of T2D, as well as microbiome can interact with different drugs, therefore, affecting the mechanisms of action, effectiveness and side effects. Metformin is also widely studied in this context, but the longitudinal (long-term or multi-visit) design of patient recruitment that we have chosen and the analysed group of patients in our study have provided an opportunity to examine aspects thus far unexplored, and to gain new knowledge about this fascinating interaction.

Therefore, a clinical study MIKROMET16001 (www.clinicaltrialsregister.eu) was launched in March 2017, supported within the framework of the State Research Programme. In this study, for the first time, 25 healthy subjects were enrolled, taking metformin for seven days and collecting both blood and microbiome samples at three time intervals: before starting the use of metformin (M0), 24 hours after the first dose of metformin (M24h), and after seven days long metformin administration (M7d). Blood samples collected during the study were used for haematological and biochemical analyses, faecal samples for gut microbiome analysis; the participants' diet and any adverse reactions were recorded in specific questionnaires. Emphasis was placed on analysis of samples and data obtained in terms of evaluating the taxonomic composition of gut microbiome and metformin-induced changes within it. The results provided information on previously unreported aspects of rapid reaction of gut microbiome to metformin therapy – a significant reduction in inner (alpha) diversity was observed already within 24

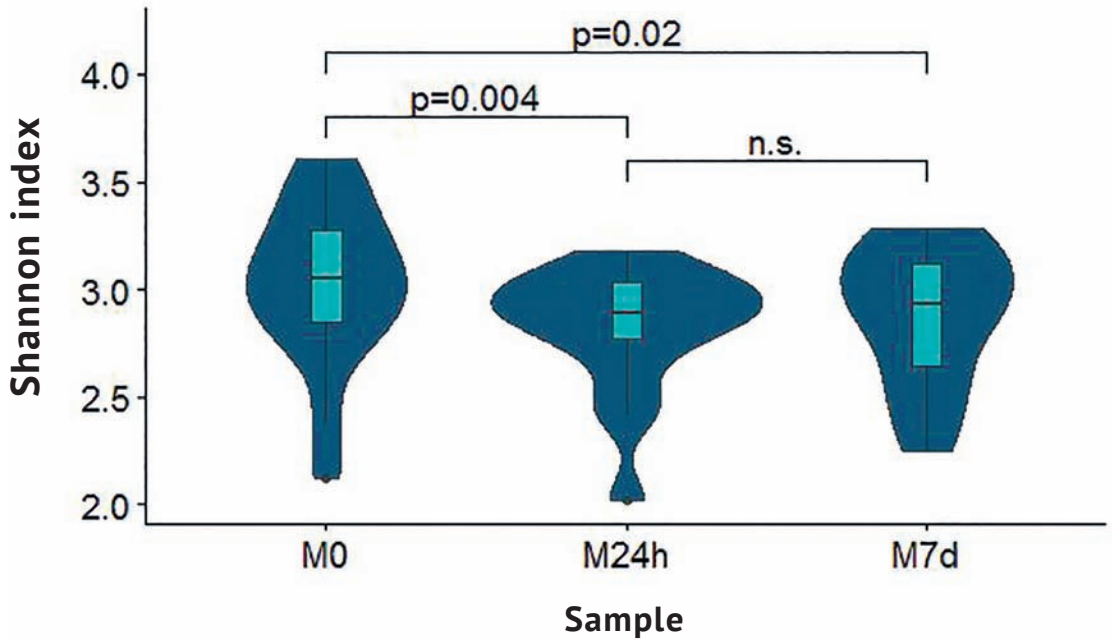


Fig. 3
Changes in the inner (alpha) diversity of samples during metformin use

hours after the first dose, and the effect was also maintained after one week long metformin administration (Fig. 3). In addition to reduced inner diversity, an increase in abundance of opportunistic pathogens, such as the *Escherichia-Shigella* genus, was observed in those groups of individuals who experienced adverse gastrointestinal reactions during the study, suggesting that these changes could be responsible for adverse reactions to metformin therapy.

However, an interesting positive effect of metformin therapy on the gut microbiome composition was observed. Analysis of the taxonomic profile revealed a relationship between the use of metformin and a reduction in abundance of the *Peptostreptococcaceae* family. Increased number of bacteria from this family is associated with such diseases as non-alcoholic fatty liver disease, ulcerative colitis, colorectal cancer, and reduced life expectancy. Results of this study were published in 2018 in the journal PLOS ONE.

In addition to gut microbiome analysis in healthy individuals, an intensive analysis is carried out at the moment to evaluate interaction between metformin and other antidiabetic drugs and gut microbiome in 100 T2D patients from the OPTIMED cohort. Both analysed cohorts will provide with unique results and the possibility to subsequently develop methods for modifying the gut microbiome with aim to reduce the observed side effects and therefore to encourage patients to adhere to the treatment prescribed by their physician. In general, the main future goal is to improve the quality of life of T2D patients and to ensure a personalised approach in the choice of therapy. A project has already been elaborated for a following study to develop methods for modifying the human gut microbiome composition in order to reach the set goals. In case of success, this approach would enable many tens of thousands of people worldwide to benefit from optimal control of diabetes with considerable attendant economic benefits. Moreover, studies on microbiome and its interaction with various types of diets has attracted the attention of the research group led by Jānis Kloviņš New research projects are already underway studying the effects on human health (and microbiome) induced by food products that are in widespread use in Latvia, and the acquired results could further help people to avoid gaining excess weight and/or developing diabetes.

Translated by **Eduards Bruno Deksnis**

DEVELOPMENT AND ELABORATION OF OSTEOREFLEXOTHERAPY IN LATVIA

Georgs Jankovskis, Professor, *Dr med. habil.*, Honorary Member of the Latvian Academy of Sciences

In 1953, postgraduate Georgs Jankovskis started researching osteoreception at the Institute of Experimental Medicine of the Latvian Academy of Sciences; his first publication on osteoreceptive reflexes appeared in 1956 in the journal of the Latvian Academy of Sciences. During the research, it was found that each bone marrow has its self-sensitivity, threshold of irritation, form of respiratory, circulatory, muscle reflectory answer-back reaction to electrical and baroreceptive irritation in healthy and pathological animal bones. These differences in bone marrow sensitivity have been observed also in patients.

The birth of osteoreflexotherapy (ORT) is considered 24 April 1957. Then, Jankovskis, while being a researcher of back then Institute of Experimental and Clinical Medicine of the Latvian SSR Academy of Sciences (IECML), in his theses presented studies on reflexes of bone marrow using a healthy bone and bone with tuberculosis. At Rīga Municipal Tuberculosis Hospital, ORT for the first time was used in treating a patient with tuberculosis of a knee joint. Osteoreceptors (nerve endings and receptors in bones) are mechanically stimulated when puncturing the bone structure with an injection needle; the main stimulation is done in bone marrow – most commonly by injecting saline under pressure. When injecting saline in the bone, a baroreceptive stimulation of osteoreceptors and a heightened inner pressure of bone is achieved. As a result, prolonged endogenous stem cell propagation and differentiation from a bone is maintained in the human body. Mechanical stimulation of osteoreceptors through the spinal cord and brain evoke neural, neurochemical, quantitative and qualitative changes in bone stem cells and other responses or reflexes in a bone by influencing its functionality. *Reflexus ossus* or bone reflex is any reflex that is induced by stimulation of a bone receptor. Consequently, osteoreflexotherapy elaborated in Latvia is a bone reflex and a bone stem cell therapy method.

Between 50s and 60s of the 20th century scientists of the Experimental Laboratory of Physiology of IECML lead by Georgs Jankovskis continued to study physiology of bones and basis of skeletal bone neurophysiological regulation in accordance with hypothetical theory of P. K. Anokhin (1932) and P. Vīners regarding physiologically functional system.

The origin of the next theoretically and experimentally proven bone sensory system (BSS) element is considered the year 1961. Back then, G. Jankovskis and G. Praulīte put forward a hypothesis about osteoreceptor representation in the brain and the switch from osteoreceptive excitement to the brainstem efferent motion cores. Representation of osteoreception is experimentally proven in the first and second sensory motor zones of the cerebral cortex, in Deiters' nucleus, cerebellum, cerebral cortex, thalamus, hypothalamus, hippocampus, and in other nucleus, spinal ganglia (Fig. 1); in translation of osteoreceptive excitement are involved: ganglion bulbar, spinothalamic, spinocerebellar, vestibulospinoal tracts.

From the 60s to 90s of the 20th century, the scientists of IECML (*Dr. habil. med.*, prof. G. Jankovskis, *Dr. biol.* G. Praulīte, *Dr. habil. med.* A. Mertens, *Dr. biol.* I. Beldava, *Dr. habil. biol.* O. Ozoliņš, *Dr. med.* B. Līviņa, *Dr. med.* A. Čūriškis, *Dr. med.* M. Vītola, T. Kancāns,

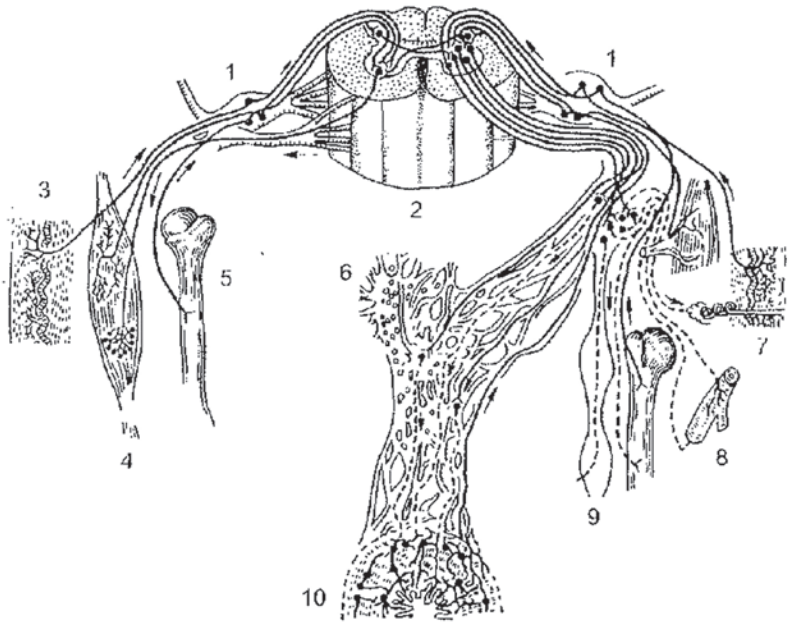


Fig. 1
Reflex arcs in the spinal cord caused by afferent impulses from the bones, muscles and skin (used: E. Airapetjancs reflex bow scheme, 1959 and supplemented by nerve impulses from the bones (G. Jankovskis, 1982)

1 – spinal ganglion
2 – the spinal cord
3 – skin
4 – skeletal muscle
5 – bone
6 – sympathetic ganglia and viscera
7 – sweat gland
8 – blood vessels
9 – sympathetic ganglia circuit
10 – internal organs (intestine)

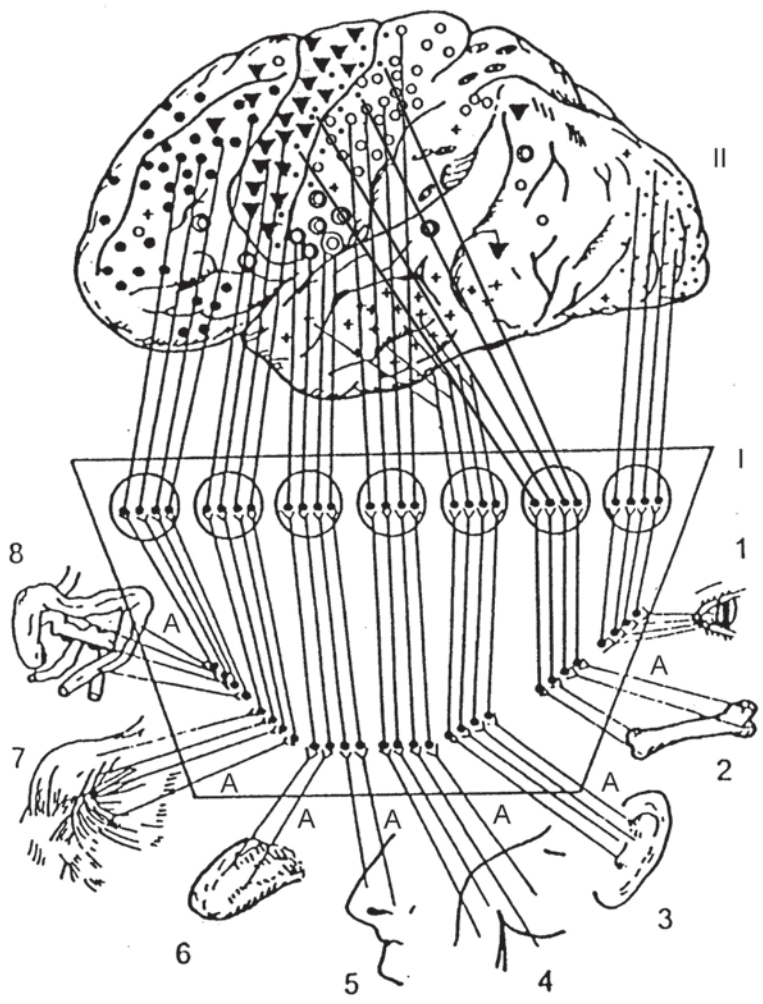


Fig. 2
The scheme structure of the osseous sensory system (K. Bikovs, 1959), the scheme sensory systems supplemented with bone sensory system (G. Praulīte, 1967; G. Praulīte, G. Jankovskis, 1971)
Receptors:
1 – situated in the eyes
2 – in the bone
3 – in the vestibular apparatus
4 – in the skin
5 – in the nose
6 – in the tongue
7 – muscles
8 – viscera

I – transmission pathways of nerve impulses to and within the CNS

II – areas of sensitivity representation of sensory systems of the brain cortex

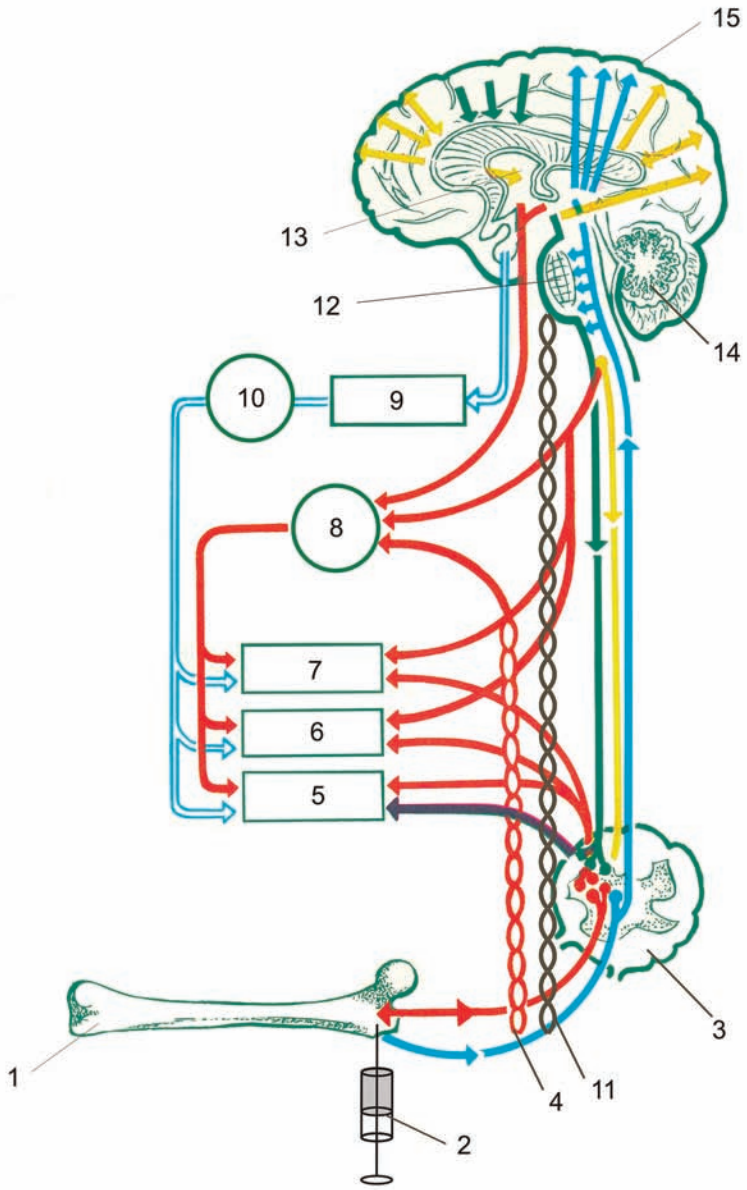


Fig. 3
The influence of osteoreceptive irritation
(G. Jankovskis, 1982)

1 – nerve of the bone
2 – syringe with a needle
3 – spinal cord
4 – ganglions of the vegetative nerve system
5 – skin, muscles, bones
6 – blood vessels
7 – viscera
8 – biologically active substances
9 – hormones
10 – endocrine glands
11 – spinal cord ganglion
12 – reticular formation
13 – hypothalamus
14 – cerebellum
15 – brain cortex

Dr. habil. med. V. Logins, *Dr. biol.* A. Lazda, *Dr. med.* I. Blumberga, *Dr. med.* K. Strēlis, *Dr. habil. med.* I. Taivāns, *Dr. med.* V. Orlovs, *Dr. biol.* T. Freivalds, *Dr. biol.* K. Ošiņa) studied the relevance of bone nucleus to CNS and discovered the bone sensory system (BSS): osteoreceptors have strong functional ties to spinal cord and brain. Osteoreceptors send nerve impulses by somatic and sympathetic nerves and emerge with centrifugal nerves into a united band of nerves at the respective level of spinal cord (Fig. 1), and in the brain all the way to the cortex of the cerebellar hemisphere (Fig. 2). The elements of BSS hierarchical structure are: osteoreceptors, spinal ganglia (Fig. 3), brainstem, thalamus, hypothalamus, Caudate nucleus, hippocampus, cerebellum, Deiters' nucleus, cerebral cortex. The representative zones of osteoreception in the hemispheres of the cerebral cortex are located next to the zones of other somatosensory and interoceptive systems (Fig. 2). This suggests of strong ties and interactions between BSS and other sensory systems. Therefore, by stimulating osteoreceptors, multiform bone reflexes in the bone with bone reflector related organ systems can be achieved through CNS (Fig. 3), and this forms the mechanism of neural osteoreceptor stimulation.

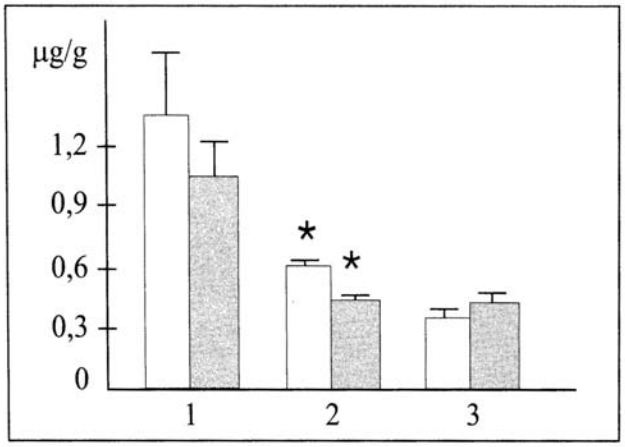


Fig. 4

γ - aminobutyric acid content changes in the hypothalamus (1), striped body (2), brain stem (3) affect osteoreceptor irritation
(G. Praulīte, V. Kluša, R. Muceniece, I. Liepa, 1989)

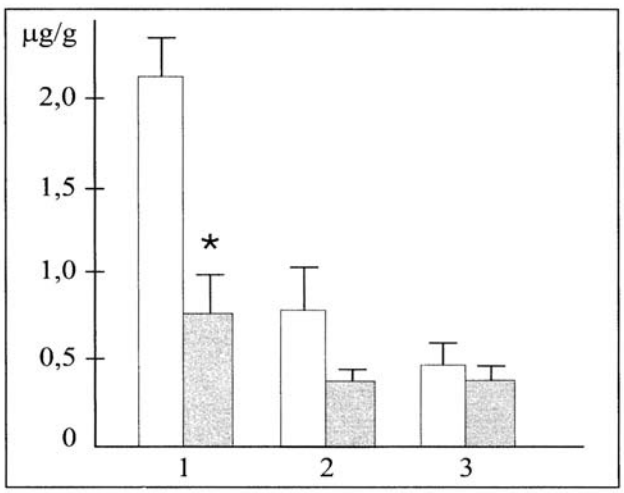


Fig. 5
Serotonin content changes in hypothalamus (1) striped body (2), brain stem (3) affect osteoreceptor irritation
(G. Praulīte, V. Kluša, R. Muceniece, I. Liepa, 1989)

– control group of animals

– experimental group of animals

Osteoreceptor stimulation affects the biosynthesis of serotonin, dopamine, amino acids, noradrenalin and other neuromediators in the brain (Fig. 4, 5); changes the blood content of immunoglobulins and glucocorticoids, etc., this forms the mechanism of neurohumoral stimulation. Osteoreceptor stimulation changes the content of nucleic acids (RNA and DNA) in bone marrow; facilitates growth of bone mass by 16.3% and mass of bone marrow by 13.6% ($p < 0.03$), increases the proliferative potential of brain mesenchymal stem cells, etc.

Pressure of saline affects the quality and quantity of brain stem cells. When these activated cells are introduced into the general blood circulation, they are attracted by the enzymes of damaged tissue. Regenerative processes are ensured using this mechanism by creating the regenerative mechanism of bone stem cells. Therefore, ORT is theoretically based, experimentally proven and clinically approved as a prophylactic and therapeutic method without medication. Mechanisms of ORT: neuro humoral and bone stem cell regenerative, self-regulating, homeostatic and others support ORT's osteobiotechnology applications in more than 80 different disease prophylaxis and therapy. They are: osteoporosis, bone fractures, spondylosis, periarthritis of shoulder and scapula, epicondylitis of elbow, deforming osteoarthrosis, hip joint region osteo enthesopathy, aseptic necrosis of metatarsal bone heads and Keller disease, Deutschlander's disease, Kienböck and Preiser's disease, Osgood–Schlatter disease, myopathies Erb's palsy disease, migraine, acute or chronic brain infarct, neuralgia of *nervus trigeminus*, cardialgia, depression, cenestopathies, bronchial asthma, myelopoiesis, phantom pain, diabetic foot, difficulties with postural balance, difficulties with dimensional orientation, dependence on nicotine, dependence on alcohol, dependence on alcohol and nicotine, alcohol abstinence syndrome, dependence on narcotic and toxic substances, skeletal muscle atony syndrome, Parkinson's syndrome, phobias (fear), carpal tunnel syndrome, multiple sclerosis, accommodation spasms and myopia for children, stuttering, enuresis and others. In all cases, ORT is recommended as a monotherapy.

It can be combined with massage, physiotherapy, pathogenic and symptomatic pharmacotherapy.

The human organism ages over its lifetime. Many age-related illnesses can be treated with osteoflexotherapy, which is based on the stimulation of osteoreceptors in close contact with the central nervous system. Applying immunocytochemical methods and light microscopy, an increase in CD105, CD29 and CD54 antigen-expressing cell counts was observed after the therapy, which could be attributable to the number of mesenchymal stem cells, as well as a decrease in counts of CD4 and CD8 antigen-expressing cells and lymphocytes, consistent with a possible decrease of inflammation, and an increase in bone density. Osteoflex therapy holds potential as a prophylactic approach for overall health improvement.

Differences between ORT osteobiotechnology and other modern stem cell refectory therapy methods: it affects osteoreceptors directly; osteoreceptors are stimulated only once; in less frequent cases more times per week – based on results of clinical, stem cell, and other studies. To ensure regenerative processes of damaged tissue in the human organism the increase of bone stem cell number is caused by mechanically stimulating these cells in several ORT performances. ORT is done several times per week usually in cases of severe illnesses; self-regulating and homeostatic mechanisms of BSS feedback loop ensures stimulative functions for up to two months; ORT is bio-safe, easily performed and financially (economically) beneficial.

Osteobiotechnology elaborated in Latvia is recognised as a medical discipline. The study about the bone sensory system is a new knowledge in physiology and medicine, which is the scientific basis of ORT. Osteodiagnosis, osteoprophylaxis, osteoreflexotherapy, ORT effectiveness evaluation, prediction of ORT effectiveness during the first ORT, or immediately after it and others are developed and introduced in medical practice.

From 60s to 80s of the 20th century doctors of various specialties from Latvia, Lithuania, Bulgaria, Ukraine and elsewhere sent approximately 3500 letters to IECML asking for help to acquaint the novel lessons and learn the specialty of osteoreflexotherapeutist. Because of this, scientists of the institute developed the Rīga School of Osteoreception in 1987, where ORT can be acquired by doctors of various specialties. ORT is used in medical practice on a daily basis by osteoreflexotherapeutists in Latvia, Azerbaijan, Bulgaria, Lithuania, Russia, Germany, Turkey, Belarus, Georgia, Israel, Poland, Uzbekistan and elsewhere in the world; they study mechanisms of ORT and broaden the application possibilities, publish results of the studies.

Author licenses of 26 inventions of Latvian scientists and keyword priority, osteoreflexotherapy, used for the first time, are shown in the database of the European Patent Office.

Two discoveries have been made in Latvia in honour of its centenary – physiology of bone sensor system and regenerative medicine – osteoreflexotherapy.

Our patient philosopher Andrejs Rubenis in his article *The Osteoreflexophilosophy* expressed the thought that the human bone sensory system, alike human beings, participates in thinking, using the sensory systems of the ability to influence the constitutional qualities.

LATVIAN INSTITUTE OF ORGANIC SYNTHESIS JOINS FORCES WITH NINE EXCELLENT RESEARCH INSTITUTIONS TO SHAPE BETTER RESEARCH ENVIRONMENT IN THE EASTERN EUROPE

Maija Dambrova, *Dr. pharm*., Professor of Rīga Stradiņš University, Head of Laboratory of Pharmaceutical Pharmacy of Latvian IOS, Full Member of the Latvian Academy of Sciences
Osvalds Pugovičs, *Dr. chem*., Director of the Latvian Institute of Organic Synthesis, Corresponding Member of the Latvian Academy of Sciences
Zlatuše Novotná, *Dr. chem*., Head of Strategic Partnership & International Relations, Central European Institute of Technology, Masaryk University, Czech Republic
Jiří Nantl, *Dr. chem.*, Director of Central European Institute of Technology, Masaryk University, Czech Republic

In January 2018, the Latvian Institute of Organic Synthesis (IOS) started participation in the Alliance4Life, a project implemented under the Health thematic priority of the European Commission's *Horizon 2020* programme funding actions to bridge the divide in European health research and innovation and to build capacities and exploit opportunities to increase their participation in EU funded collaborative projects.

Alliance4Life is a bottom-up initiative of ten leading life science institutions from **nine EU-13 countries** that aims at closing the divide in European health research and innovation (Fig. 1).

Members of the Alliance are progressive research institutions that have the necessary strength to stimulate institutional change:

- Masaryk University/CEITEC (Coordinator), Czech Republic;
- St. Anne's University Hospital Brno/ International Clinical Research Center, Czech Republic;
- Biomedical Research Center of the Slovak Academy of Sciences, Slovakia;
- Medical University of Lodz, Poland;
- School of Medicine – University of Zagreb, Croatia;
- University of Tartu, Estonia;
- Vilnius University – Faculty of Medicine, Lithuania;
- Latvian Institute of Organic Synthesis, Latvia;
- University of Ljubljana, Slovenia;
- Semmelweis University, Hungary.

Substantial inflow of investments and funding from both the EU and national governments has allowed for an overall increase in scientific developments in Central and Eastern Europe (CEE). Though infrastructure alone could not close the R&I gap in Europe so far, financial support needs to be complemented by measures on research and innovation strategy at institutional and national levels.

Institutions gathered in the Alliance4Life believe that improving governance and managerial practices as well as transforming the best institutional culture will enhance efficiency and increase return on investment. The research excellence of the

Alliance4Life partnering institutions (such as Nature-index, citations, participation in H2020), considering also experience with synergies between H2020 programmes and European Structural & Investment Funds (ESIF), makes them perfectly suited to serve as early adopters and transmitters of the best practices to achieve most ambitious research goals.

The experience and expertise of Alliance4Life institutions represent a valuable source of knowledge and inspiration for the EU research policy as well. Alliance4Life partners are ready to share acquired experience and expertise both at the conceptual, content, administrative, and technologic levels. During the regular meetings (Fig. 2), Alliance4Life partnering institutions discuss typical constrains, challenges, needs, interests and opportunities, identify main challenges and peculiarities of the health R&I faced by involved institutions and their researchers, sort out determinants of success in health R&I, especially "soft" underlying measures needed to compete successfully for funding and to achieve excellent R&I performance. Alliance4Life Focus Groups include Science evaluation, Research ethics and integrity, Human resources and mobility, Grants and research funding, Core facilities and big data, Knowledge and technology transfer, and Science communication. In these domains of expertise, specified training sessions are organised by invited lecturers from both the most experienced Alliance4Life partners and internationally prominent research institutions.

The partnership is focussing on raising institutional profiles to attract and retain international talents and to provide the right operational framework conditions including improved research management. Moreover, the goal is to help overcoming traditional national conditions inherited from the communist era that were neglected during the political transformation in the CEE region. Alliance4Life intends to become a role model for institutions in less performing regions and to serve as a hub of excellence through close collaboration with renowned European networks established in high performing countries. The

Fig. 1
Alliance4Life consortium

Fig. 2
Kick-off meeting of the Alliance4Life project 15–17 January 2018 in Brno, Czech Republic

Alliance will contribute to science policy and shape priorities at national and EU levels, especially with insight suggestions on how to increase participation in the Framework Programme (FP) and on using synergies between ESIF and FP to their full potential.

DEVELOPMENT OF INSTITUTIONAL CULTURE AND ENHANCEMENT OF GOVERNANCE

Alliance4Life considers the development of institutional culture and governance to be the key to further performance improvement, primarily at the level of individual institutions but also at the systemic level. Improvements in governance and management will be achieved through acquiring additional and new skills, at the level of scientific leadership positions for the principal investigators and administrators. The plan is to develop a common training programme tailored to these needs and support it by exchange of scientific and administrative staff.

CAREER DEVELOPMENT STRATEGY FOR RESEARCHERS

A major drawback of the research environment in CEE is the underdeveloped career system for researchers, and, in some cases, practices that are not conform to internationally accepted principles of career paths in the field of research and innovation. Alliance4Life examines human resources policies and practices at partnering institutions, and supports developing sound principles of careers paths for researchers. In particular, the importance of doctoral education and training is recognised. Taking into account the similar economic and cultural background and in order to promote the recently established research excellence centres, Alliance4Life will work towards enhancing mobility within CEE region, especially as a part of career progression. Alliance4Life will collaborate towards promoting career opportunities and advantages of pursuing scientific careers in CEE, and will share information on job openings.

OPTIMISATION AND COORDINATION OF RESEARCH INFRASTRUCTURE USAGE

Life sciences are resource demanding, with respect to research infrastructure. Alliance4Life members examine options to coordinate planning and usage / sharing of research infrastructure, including e-infrastructure. Knowledge about managerial practices in the area of research infrastructure is shared among consortium members. Efforts will be made to coordinate the development of core facilities, and promote shared understanding of performance-monitoring and reporting practices including pricing policies.

OPEN SCIENCE PRINCIPLE

Alliance4Life endorses the principle of open science as one of the guiding principles. In accordance with this, the consortium will collaborate in strengthening the ability of collaborating institutions to communicate with the public, and various stakeholders. In particular, Alliance4Life recognises the importance of developing efficient mechanisms to raise education and awareness in the general population. Therefore, the consortium will strongly support dissemination and transfer of knowledge to the society as well as enhancing entrepreneurial and innovative spirit within research institutions.

EXCELLENCE IN SCIENCE AND UNITED SCIENCE POLICY

While Alliance4Life acknowledges that a single research policy within the EU is an attainable and reasonable goal, the consortium strongly advocates for continuing support actions within the next Framework Programme – Horizon Europe to further enhance capacity building and cultural change in the research and innovation sectors of the EU-13. However, most emphasis should be put on increasing success for candidates from CEE in competing for all categories of European Research Council grants.

Alliance4Life is open to collaborations with other research organisations and dedicated projects in this field. The consortium is ready to contribute actively to national and European debates on sustainability of research institutions supported previously from ESIF.

Alliance4Life consortium is committed to build a vibrant community of research institutions that will live up to the highest standards of institutional and scientific performance. It is our hope that the joint effort represented by the Alliance4Life will be a source of inspiration and advice to other institutions in our countries, also to EU-13 regional and national governments and to European institutions. Alliance4Life aspires to be a joint endeavour to redefine science policy, promote innovative research, and effectuate a lasting impact on human welfare.

IN PURSUIT OF INCREASING THE FUNCTIONALITY OF ORTHOPAEDIC IMPLANTS

Kārlis Agris Gross, *Dr. sc. ing.*, Associate Professor
Dārta Ūbele, *Mag. chem.*
Liene Plūduma, *Dr. sc. ing.*, Professor
Biomaterials Research Laboratory, Faculty of Materials Science and Applied Chemistry, Rīga Technical University

Repair of damaged organs and tissues represents one of the greatest challenges in the healthcare industry. By entering the repair site, either by surgery or minimally invasive techniques, the natural function of tissues is disrupted. Repair of the damaged tissues demands a deep understanding of the interaction between the inserted biomedical device and the internal biological system – progress that cannot yet be followed *in-situ* at the cellular level. While improved tools would be advantageous to follow the healing process, the developments are predominantly restricted to improved implant surfaces. Implant surfaces – prompted by the increase in functionality of smart phones – need to also include addition features for improving the success rate of operations.

The implant material further improved at the Biomaterials Research Laboratory is hydroxyapatite, referred to as the mineral component of teeth and bone. Methods for improving the performance of hydroxyapatite implants requires the attention of a materials scientist / engineer, or be a task for a biologist where bone morphogenetic proteins may be added to promote bone cell activity, or an antibacterial agent is added to lower the risk of infection. Strategies for improving the implant material will be discussed.

Bone implant surfaces first interact with the biological environment and so the tissue healing can be promoted by chemical, topographical, electrical and mechanical ques. Most of the work has been conducted on chemical modifications, while less has been done on the topography and electrical potential on the surface. This exploration is still active before the knowledge from stiff hydroxyapatite implants can be applied to more flexible implants.

Most of the developmental work has been conducted on chemical modifications, replacing an element in $Ca_{10}(PO_4)_6(OH)_{2,}$ and following markers of bioactivity. Extensive work has been conducted for about three decades, addressing ions that have biological benefit, while other approaches have looked at naturally occurring minerals, or the first biomaterials used in orthopaedics. This approach has considered Mg ions given the favourable biological response [8], or carbonate as a replacement for phosphate to emulate bone [4], or fluoride to replace hydroxyl ions as found in enamel [6], or replacing silicate for phosphate following the good bone bonding to bioglasses [3]. Reports have shown the extent of replacements in high crystallinity calcium phosphates.

A new approach, recently revisited with more rigour, is the study of low crystalline analogues of hydroxyapatite, recognising that minerals in nature initially exhibit disorder and assemble into more periodic structures over time. In infants, bone mineral has a low crystallinity, imparting a higher solubility for faster bone remodelling. Additionally, the mechanical properties of low crystallinity apatite can absorb more energy, supporting the endeavour for infants to learn by providing a material that can absorb more energy [7] resulting from the numerous falls. Other advantages of the disordered structure have not been addressed, and so in reference to chemical modifications, present research is seeing whether chemical replacement is faster or can be achieved at higher concentrations, and whether

there is further improvement to the bone healing process. This is a new direction embarked by a seldom few, due to the difficulty in identifying low crystalline arrangements and changes over time.

While chemical replacements have mostly been addressed in hydroxyapatite monoliths, allowing concurrent modifications inside the biomaterial and on the surface, topographical changes are restricted to the surface. The most common approach has been to use commercially available surface modification processes to scope the range of different topographies. This search has been limited by existing capabilities to precisely identify the height, shape and geometry of raised or lowered featured from the planar surface. Texture analysis tools have shown how processing parameters provide better bone attachment [11], but have not identified the characteristics that promote improved bone bonding.

A third direction for increasing the functionality involves imparting an electrical field for activating bone cells for bone growth. The search is justified by the observation of an electrical potential formed with a bone fracture that disappears over time. The possible use of electrical phenomena was suggested as early as 1967 [1]. This scientific enquiry was initiated in Japan [12], possibly resulting from a technology transfer from the electronics industry, nearly three decades ago. The approach was taken from the practice of forming electrets: a ceramic body was placed between two metal contacts and heated in an electric field, thereby forcing the structure to adjust and generate a static electrical field. The only parameters for increasing the electrical field involved time, temperature and intensity of charging.

A new approach has been to include hydroxyl ion dipoles in an atomic assembly that is more easily charged, and can generate a higher electrical field. Recognising that hydroxyl ion dipoles show the potential to control charge, we have introduced an advanced method for measuring the concentration of hydroxyl ions in hydroxyapatite (Fig 1.). After establishing an analysis technique for hydroxyl ion measurement [5], and understanding the ease of hydroxyl ion depletion during thermal processing, research activities were directed to replenish the empty hydroxyl ion sites within the hydroxyapatite structure. Hydrothermal processing was found to increase the hydroxyl ion content (Fig 2.). A new hydroxyl ion quantification method and optimising of the hydroxyl ion concentration by hydrothermal processing have given advanced characterisation and processing tools, for further improvements in electrically charged hydroxyapatite.

After optimising the processing conditions to increase the degree of hydroxyl alignment and increasing the hydroxyl ion content, a further benefit could be given from crystal engineering by considering the size, shape and orientation of the crystals. Starting with a randomly arranged collection of crystals prevents the maximum charge generation, but designing the

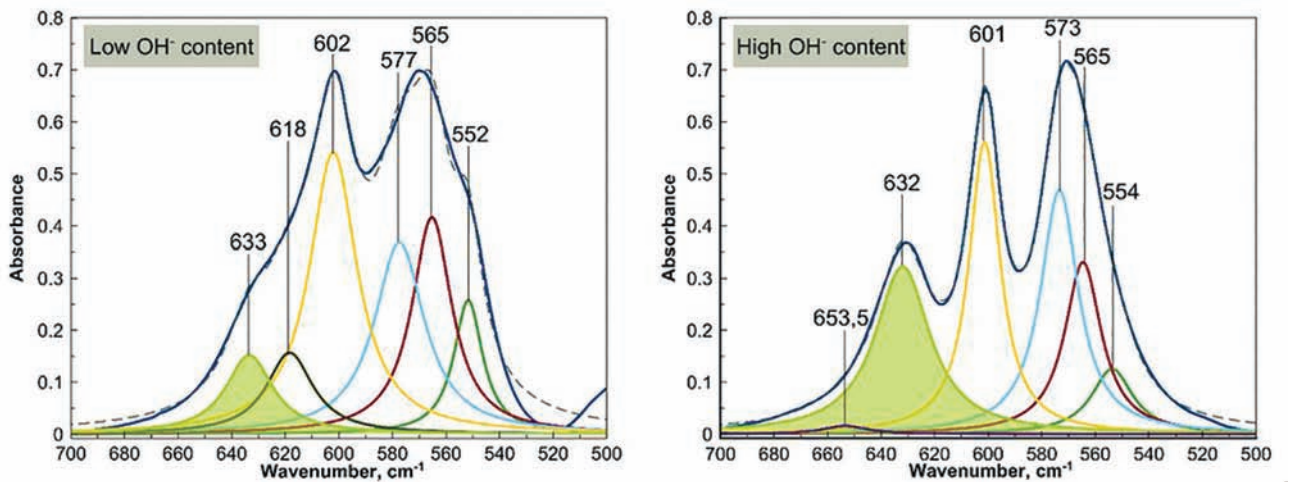


Fig. 1
Deconvoluted Fourier transform infra-red spectra of hydroxyapatite coatings with a low hydroxyl ion content (before hydrothermal treatment) and a high hydroxyl ion content (after hydrothermal treatment) [1]. The hydroxyl ion content is proportional to the area in the green shaded peak

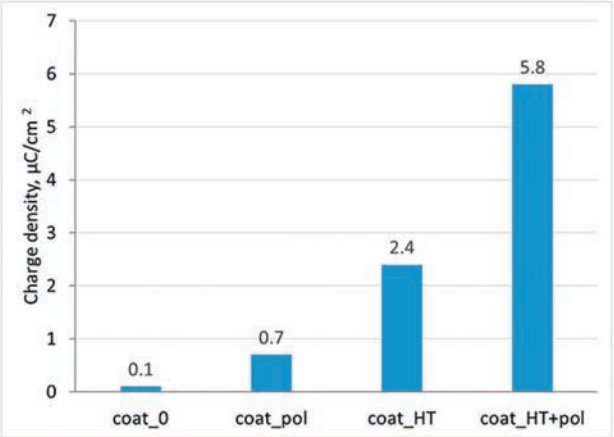


Fig. 2
The charge density in coatings can be increased to different degrees depending on the post-processing method:
0 – without additional treatment;
pol – polarised in electrical field;
HT – hydrothermally treated) [2]

atomic spatial assembly can provide the highest achievable charge. The crystal orientation can provide the spatial atomic assembly for the highest electrical charge [9]. Recent measurements have shown a significant increase in charge density [2] by providing the best crystal orientation, filling hydroxyl ion sites in the lattice by hydrothermal treatment and orientation of the hydroxyl ion dipoles by polarisation (Fig. 2.). This interdisciplinary approach has utilised every aspect of the materials science discipline to design and functionalise the coating using the full potential of the material.

The improvements in production technology must be accompanied by accurate and sensitive measurement methods. With polarisation / depolarisation equipment only available to selected laboratories in the world, the development in this field was provided only by a selected number of research laboratories. The established method that measures the number of charge carriers in the material is the traditional approach, but since the cells only see the implant surface, a measure of the electrical potential on the surface would provide more insight. A new activity, presently coordinated from Latvia, is looking to see whether a new method can measure the surface potential. In addition to developing a surface potential measurement device, the equipment will need to be validated with a comparison to conventional charge measurement methods. Developments in materials engineering that offer control in chemistry, the hydroxyl content, the crystal alignment along with new characterisation methods are essential for designing biomaterials for the best outcome.

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RESEARCH ACTIVITIES AT THE INSTITUTE OF SOLID STATE PHYSICS, UNIVERSITY OF LATVIA

In 2018, the Institute of Solid State Physics of the University of Latvia (ISSP UL) celebrated its 40th anniversary. Established for education and science, during these 40 years ISSP UL has become one of the leading research institutions in Latvia, especially within the fields of solid-state physics, material sciences, nanotechnology and photonics.

The institute currently employs around 100 well-skilled PhDs providing internationally competitive research, and offers innovative solutions for industrial applications. Cleanroom facilities and advanced infrastructure for different kinds of material synthesis and analysis organised as Open Access Laboratories are available for every scientist and serve the research needs of the industrial partners.

A very challenging task of ISSP UL is not just to increase its infrastructure capabilities and number of employees, but also to create and maintain the environment and the culture within institute that stimulates and stipulates the formation of well-functioning passionate world-class scientific teams that will ensure the sustainability in all terms. One of the super-team building conditions is to be outstanding in the field by providing high-quality publications as well as participation in the international projects. In the following sections recent scientific highlights, including projects are shown.

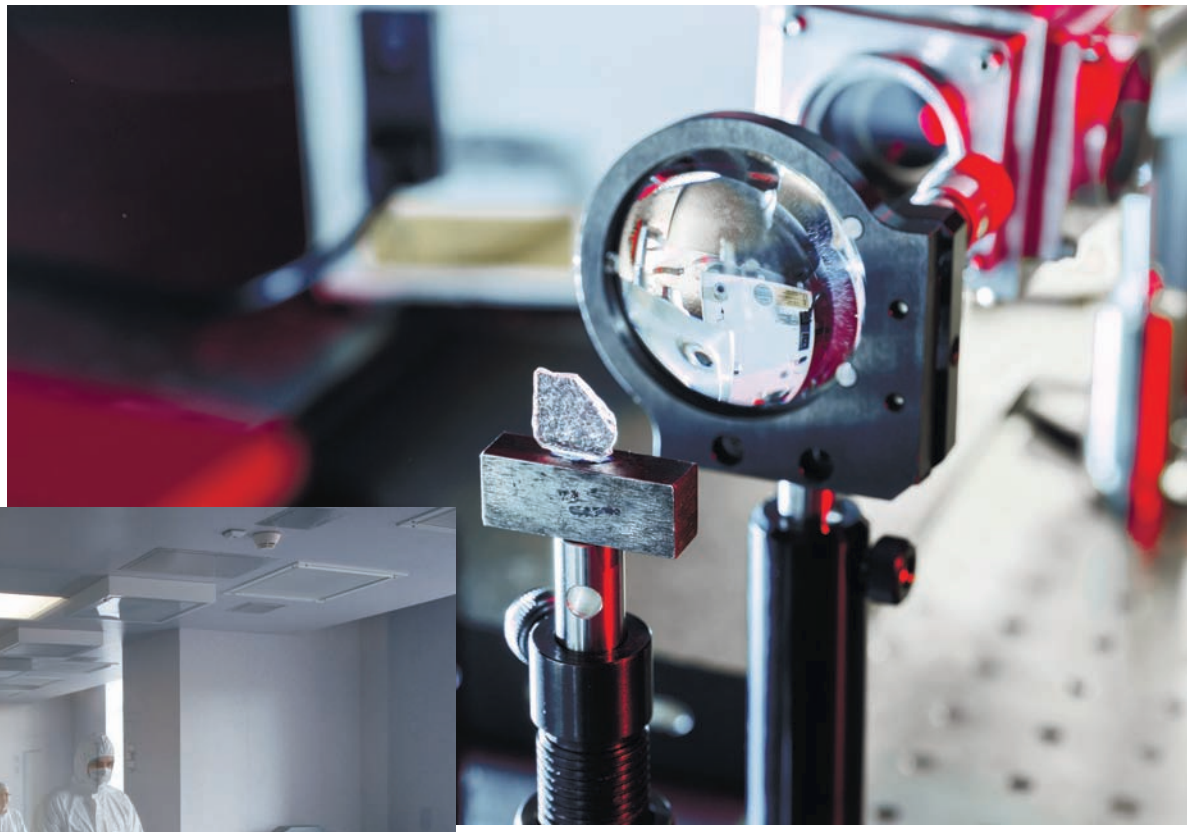

Fig. 1. Transport oxyfluoride glass ceramics
Fig. 2. Cleanroom facilities at the ISSP UL

NOVEL MATERIALS FOR INFRARED LIGHT CONVERTORS AND WHITE LIGHT SOURCES

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Jurģis Grūbe, *Dr. phys.*
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Guna Krieķe, *Mg. sc. ing.*
Andris Antuzevičs, *Mg. phys.*
Meldra Ķemere *Mg. phys.*

In the past 10 years, the field of transparent glass ceramics has attracted scientific and practical interest due to the relatively simple and inexpensive synthesis procedure when compared to growth of single crystals. The glass material is usually obtained by a rapid quenching of a molten mass of ingredients and nanocrystals are precipitated by a subsequent thermal treatment of the casted glass. By varying the initial composition and thermal treatment parameters, such as temperature and duration, the precipitated crystalline phase, particle size as well as their morphology and distribution in the glass matrix can be controlled. In principle, such glass ceramic composite material combines the transparency, durability and chemical stability of a glass matrix with a highly efficient luminescence from nanocrystals.

Novel transparent glass ceramics with fluoride nanocrystals doped with rare-earth ions have been sintered by ISSP UL researchers. The important optical properties for applications have been optimised, by controlling the size of the nanocrystals and concentration of the rare-earth ions, namely, the luminescence efficiency and the colour of the emitted light. The obtained oxyfluoride glasses and glass ceramics efficiently transform the infrared radiation (IR) into the visible light (Fig. 3). By variation of the chemical composition, materials are obtained which emit white light, are long-term durable and applicable in the light sources (Fig. 4). The efficiency of the materials and compatibility with optical waveguides allow one to use them for the development of optical sensors and IR visualisation.

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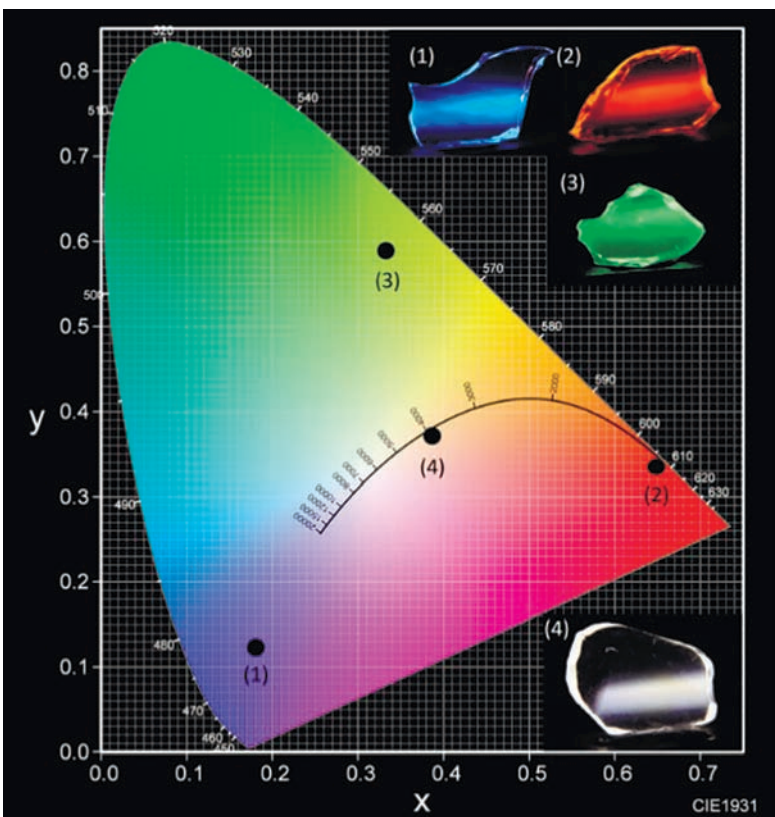
Fig. 3
Upconversion luminescence of Er3+ doped oxyfluoride glass and glass-ceramics obtained at different temperatures



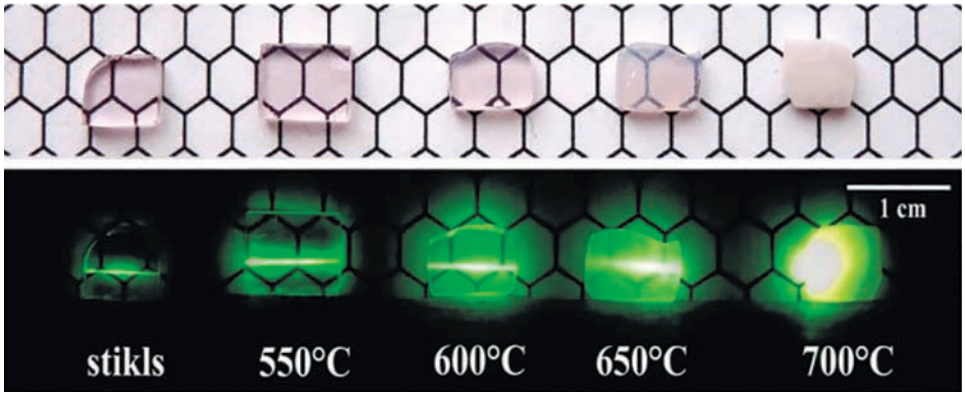


Fig. 4
UV excited photoluminescence of rare-ions activated oxyfluoride glasses and glass-ceramics (1), (2), (3), (4) and corresponding colour coordinates in the CIE1931 colour diagram

WASTE HEAT TO ELECTRICAL ENERGY VIA SUSTAINABLE ORGANIC THERMOELECTRIC (H2ESOT) – FP7 FET PROJECT

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It is estimated that mankind waste ~20% of the 15 terawatts required annually for global power consumption as low level heat (< 200° C). This amounts to 10^{20} J/year, which is greater than the total annual energy usage of all EU member states. Could one turn waste heat directly into electricity? Yes it is possible do this using the thermoelectric (TE) effect.

Widespread availability of new low-cost organic thermoelectric devices would allow direct heat-to-electrical energy harvest from this vast. Essentially unexploited, resource generating a new industrial sector based on local power generation from otherwise wasted energy sources (engines, boilers, heat pumps, etc.) amounting up to 50 billion €/yr. New materials and devices are needed to achieve such disruptive technology, as present approaches are not viable for reasons either of: (i) device inefficiency, and/or (ii) global raw material unavailability preventing widespread implementation. During period 2013–2015, ISSP UL participates in the project "Waste Heat to Electrical Energy *via* Sustainable Organic Thermoelectric" (H2ESOT) under FP7 Future Emerging Technologies (FET) programme. The aim of the project was to advance efficient, thermoelectric generators using only low-cost, readily available, renewable and sustainable organic materials. H2ESOT arose out of curiosity to investigate *ad hoc* and unpublished suggestions that the molecule tetrathiotetracene (TTT) could provide highly efficient material for TE devices. Efficiency of such TE materials is compared by a dimensionless figure of merit – ZT. In theoretical models, 1D conduction in single crystals of TTT_2I_3 can be predicted to afford ZT values > 2. Employing materials this efficiently, powerful new ways to trap and use profitably waste heat become viable. Over three years since 2013, six partners in chemistry, experimental and theoretical physics and electrical engineering came together to test the hypothesis that TTT_2I_3 and related materials could be exceptional thermoelectric materials. ISSP UL was responsible for crystalline thin film preparation and characterisation.

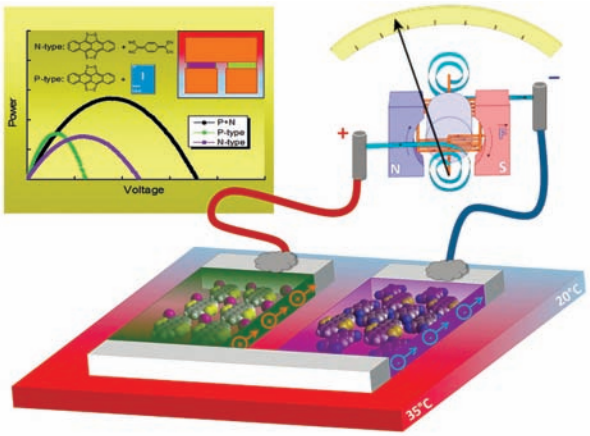

Fig. 5
Artistic visualisation of a thermoelectric device

The goal of the ISSP UL group was to develop technology for the preparation of p-type $(TTT)_2I_3$, and n-type $TTT(TCNQ)_2$ thin-films and their use in TE devices (Fig. 5). The best p-type films are formed from co-deposition of TTT and I_2. Similarly, co-deposition of TTT and TCNQ allowed access to n-type thin films. By using successive vacuum deposition processes, a "proof of concept" planar single couple TE generator (TEG) devices were fabricated. The simple fabrication process proposed allows easy duplication of such TEG modules therefore the power of device could be multiplied several times. Power of 5.5 pW K^{-1} was measured for single junction TEG at room temperature. This value is mainly limited due to electrical conductivity of polycrystalline thin films. Two options to improve conductivity were proposed: one is optimising crystallite orientation in thin film plane, another is to reduce the impact of grain boundaries on charge carrier mobility by developing denser packing of polycrystalline thin films. Opportunities to increase thin film electrical conductivity should be pursued to raise the power output of the thin film TEG.

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XAFS SYNCHROTRON RADIATION STUDIES OF CONSTRUCTION NUCLEAR MATERIALS

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Jānis Timošenko, *Dr. phys.*

One of the main challenges for the next generation of nuclear fusion reactors is to improve the resistance of construction materials towards radiation- and heat-induced damage (Fig. 6). This year we have completed HORIZON 2020 EUROfusion project "When and how ODS nanoparticles are formed?" By using the world's leading synchrotron radiation big facilities, we investigated the local structure of oxide dispersion-strengthened (ODS) ferritic steels and investigated the formation mechanisms of the nanoparticles within the structural materials for the next generation of fusion reactors. These materials are promising for high-temperature applications, allowing one to increase the reactor working temperature above 650° C.

In this project, ISSP UL scientists carried out a series of X-ray absorption spectroscopy experiments, to obtain experimental evidences about the formation of nanoparticles within ODS steels during different manufacturing stages, to optimise the manufacturing process and to validate existing theoretical models. By using world's leading synchrotron radiation big facilities (Fig. 7), we have developed a **new methodology** for the investigations of nanoparticles formation mechanisms with the ODS steels. In a series of X-ray absorption experiments, we have **discovered the formation mechanisms** of oxide nanoparticles and investigated how they are formed and what happens with the oxide nanoparticles during different stages of steel production. It allowed significant improvements in the steel manufacturing process (Fig. 8): to find minimum oxygen content to ensure complete oxidation of Y and Ti in the ODS steels; to find most appropriate processing parameters to completely dissolve metastable phases and enhance Y-Ti-O nanometric precipitation in the ODS steel powders.

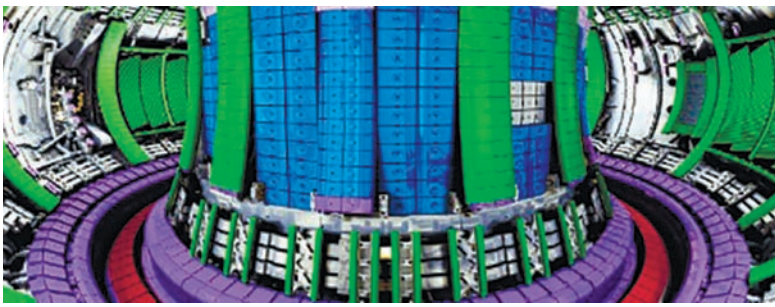

Fig. 6
Nuclear fusion reactor walls // https://www.euro-fusion.org

Fig. 7
ELETTRA – world's leading synchrotron radiation big facility and experimental beamlines (Italy, Trieste)

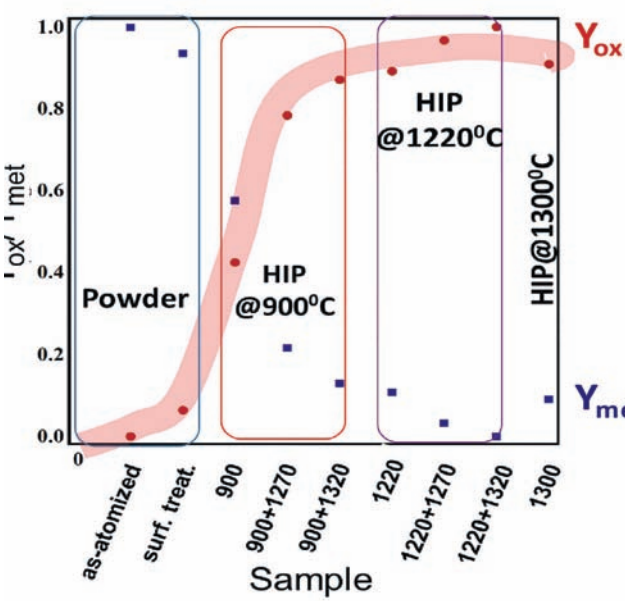

Fig. 8
Linear combination analysis of the XANES spectra. Experimental evidences about the formation of nanoparticles within ODS steels during different manufacturing stages treatments: high pressure (HIP) and high temperature

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NANOSTRUCTURING AND STRENGTHENING OF LITHIUM FLUORIDE CRYSTALS UNDER SWIFT HEAVY ION IRRADIATION

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Lithium fluoride (LiF) crystals play an important role in radiation damage studies as a model material for the understanding of damage creation mechanisms in dielectric materials, luminescent dosimeters, fluorescent imaging detectors, colour centre lasers, etc. [1, 2]. Increasing attention is given to structural damage processes under severe irradiation with swift heavy ions and the search for radiation-resistant materials for use in nuclear and related technologies [1]. Over the last few decades, investigations have been carried out at the *Institute of Solid State Physics of the University of Latvia* (Dr. J. Maniks, Dr. I. Manika, Dr. R. Zabels) in cooperation with the *GSI Helmholtz Centre for Heavy Ion Research* (Darmstadt, Germany), *National Large Heavy Ion Accelerator* (Caen, France) and *Heavy Ion Synchrotron DC 60* (Institute of Nuclear Physics, Astana, Kazakhstan). These efforts focused on understanding irradiation-induced extended defects (dislocations and defect aggregates) and their role in the formation of nanostructures and associated modifications of mechanical properties of heavily irradiated LiF crystals.

In order to understand the influence of the energy and the energy loss of ions on the previously mentioned phenomena, irradiation was performed with a large variety of ions (^{3}He, ^{4}He, ^{12}C, ^{36}S, ^{48}Ti, ^{58}Ni, ^{84}Kr, ^{131}Xe, ^{197}Au, ^{208}Pb, ^{209}Bi,^{238}U) in the energy range of 3 to 2600 MeV covering energy losses (dE/dx) from 2 to 26 keV/nm [2–4]. A wide range of characterisation methods were used including optical spectroscopy, X-ray diffraction, nanoindentation, and selective chemical etching. Changes in micro-mechanical properties were measured with a nanoindentor (G200, Agilent) along the ion track and on cleaved surfaces parallel to the direction of the ion beam. Hardness and Young's modulus were calculated from experimentally obtained loading-unloading curves [2, 3].

A peculiarity of irradiation with swift heavy ions is the damage formation beyond their penetration depth. The ion range (R) depends on ion energy and energy loss, and the ranges for different ions vary from a few micrometres to approximately 100 micrometres. The SRIM code can be used to calculate the ion range for a given ion species and energy. The results of radiation damage studies in LiF crystals using swift heavy ions are described in detail in a previous review paper [2]. A few selected illustrations of structural modifications and mechanical property changes are described in the following.

DISLOCATIONS WITHIN ION TRACKS

A novelty of investigating ion-irradiated ionic crystals was the observation of dislocations within ion tracks and identifying their role in the formation of bulk nanostructures [2–4]. To reveal the dislocation structure in irradiated crystals, samples were subjected to short-time selective chemical etching (only for few seconds) following irradiation and studied using atomic force microscopy. Analysis of the results and reference data leads to the conclusion that small, nanometre-size prismatic interstitial-type dislocation

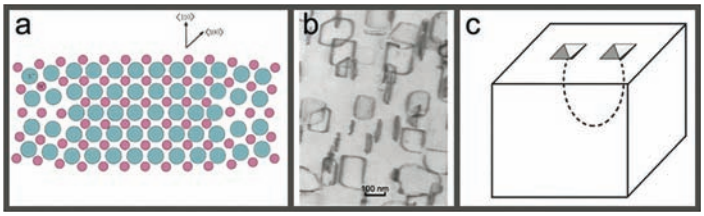

Fig. 1
a – The scheme of prismatic interstitial dislocation loop (larger circles denote fluorine anions, smaller ones – lithium cations;
b – transmission electron microscopy image of prismatic dislocations loops in LiF;
c – scheme of etch pits of dislocation loop on cleaved surface

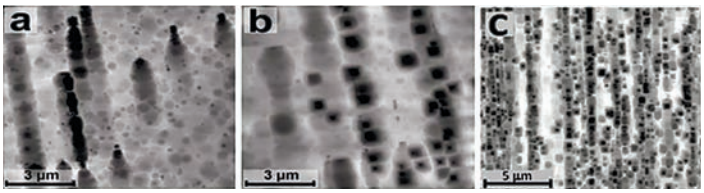

Fig. 2
Rows of dislocation etch pits on (001) face along the ion tracks in LiF crystals irradiated with 2.6 GeV ^{197}U ions:
a – at fluence of 10^8 ions/cm^2 which creates individual tracks (far standing);
b – at 10^9 ions/cm^2; **c** – at 10^{10} ions/cm^2 which correspond to the initial stage of track overlapping

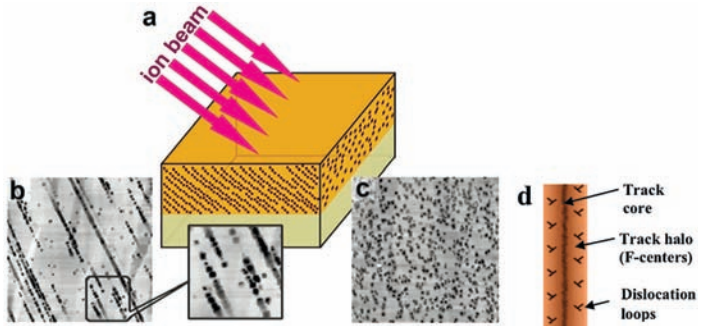

Fig. 3
Scheme of irradiation and dislocation structure in LiF crystals irradiated with 2.4 GeV ^{209}Bi ions under 20° against the normal (**a**); dislocation rows along the ion path after chemical etching (**b**); track etch pits on the frontal cross-section (**c**) and scheme of a dislocation row in the ion track exhibiting core damage (**d**). The ion fluence was 5 × 10^9 Bi/cm^2

loops are created on planes (Fig. 1 – 3).
Dislocations and their embryos can already be seen in individual (well-isolated) tracks of swift heavy ions at low fluences (Fig. 2a), while their growth, accumulation, and self-organisation is observed in overlapping tracks at higher fluences (Fig. 2b, c). However, dislocation structures depend not only on irradiation dose (fluence), but also on energy loss and atomic mass of the projectiles. In the case of swift heavy ions (^{84}Kr, ^{131}Xe, ^{197}Au, ^{208}Pb, ^{209}Bi, ^{238}U), with electronic energy losses above 10 keV/nm, dislocations are arranged in a row along the ion trajectory (Fig. 2, 3) [2–5]. Such arrangement is observed at different irradiation angles. For light ions, as well as for heavy ions at a lower energy loss, ion- induced dislocations also are formed; however, their distribution is irregular.

DEPTH PROFILES OF ION INDUCED DAMAGE

Hardness tests on cleaved surfaces enabled us to investigate the evolution of damage and associated changes of mechanical properties along an ion track (damage depth profile). Hardening appears at fluences corresponding to the initial stage of track overlapping and further increases with irradiation dose (Fig. 4a). The magnitude of the hardening can be used as a characteristic parameter of ion-induced damage. To identify the dominating damage mechanisms that contribute to mechanical property changes, the depth behaviour of hardness was compared to the variation in electronic and nuclear energy loss along the ion trajectory calculated by the SRIM code. For all investigated ion species, along the majority of the ion track, damage is formed *via* the process of electronic energy loss and induced ionization processes. However, in a narrow zone at the end of the ion track, where the electronic loss is reduced to virtually zero and nuclear energy loss reaches a maximum, considerable contribution to damage by elastic collisions was observed.
Damage evolution in the dislocation subsystem in heavily irradiated crystals was compared with the F-centre concentration depth behaviour. Confocal microscopy with laser excitation and optical registration

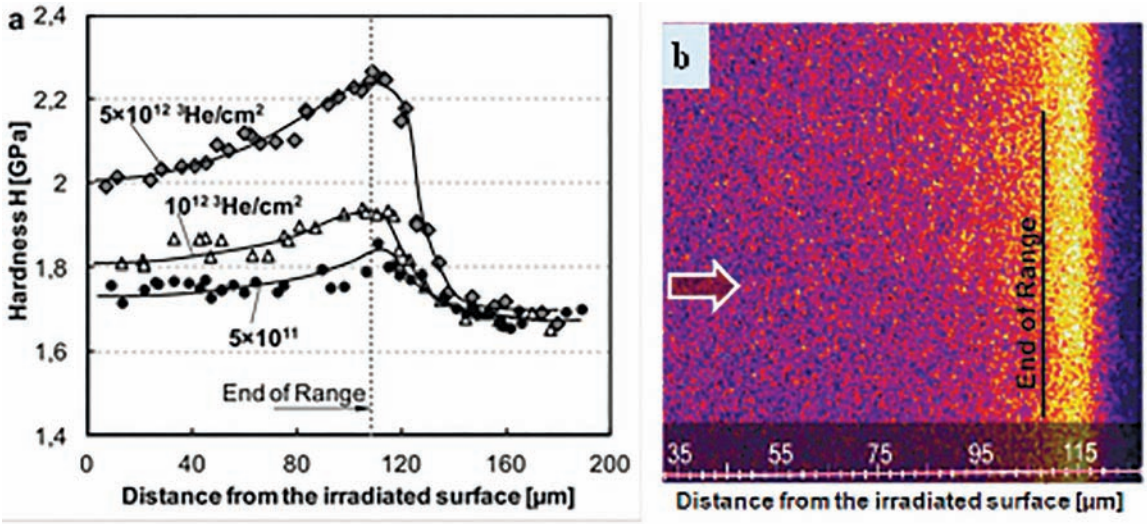

Fig. 4
The depth behaviour of hardness (**a**) and laser-excited photoluminescence (emission at 660 nm wavelength) along the ion path (**b**) for LiF crystals irradiated at with 13.5 MeV ^{3}He ions at fluence of 5×10^{12} ions/cm^2. The direction of the ion beam is shown by the arrow

of the F_2-centre luminescence was applied to visualise the distribution of complex colour centres along the ion track length. A confocal image of the luminescence of F_2 centres in LiF irradiated with 13.5 MeV ^{3}He ions at fluence of 5×10^{12} ions/cm^2 is shown in Figure 4b. The brightness of the image increases along the ion track and reaches a maximum at a depth of about 15 μm beyond the range. The discrete distribution of bright spots indicates partial overlapping of tracks at the given fluence. A comparison of the depth profiles of photoluminescence and hardening shows that the hardening effect occurs in a deeper zone, confirming that hardness changes are mainly caused by non-luminescent extended defects (Fig. 4a, b). Since dislocations can serve as sinks for different radiation defects, these results imply an interaction between complex colour centres and dislocations in heavily irradiated crystals.

ION-INDUCED NANOSTRUCTURING

A nanostructured zone will form under irradiation with swift heavy ions (e.g., ^{238}U, ^{209}Bi, ^{197}Au, ^{84}Kr) at energy losses above 10 keV/nm and high fluences in the range of 5×10^{11}-10^{13} ions/cm^2. At energy losses below 10 keV/nm, ions primarily create a dislocation-rich network (> 10^{10} dislocation/cm^2), which contributes significantly to an increase in hardness. Formation of nanostructures in this case was achieved only at very high fluences and comparatively low ion energies [2]. Quantitative information on the variation of inter-planar distance and lattice tilting of the irradiated samples was obtained using high-resolution X-ray diffraction reciprocal space mapping (Fig. 5). The results for a non-irradiated crystal and for samples irradiated with C and U ions are plotted using a Cartesian coordinate system. The broaening along the q_z direction indicates variation of the inter-planar distance while the broadening along the q_y direction marks the size reduction and tilting of domains. An increase of the inter-planar distance of up to 0.1% was observed in the irradiated samples. This effect can be related to generation of prismatic dislocations and to internal and long-range stresses [2]. In the nanostructured samples, both the tilting of domains and variation of the inter-planar distance appeared (Fig. 5c). Low tilt angles were observed that indicate the formation of a mosaic-type nanostructure. A fragmentation of LiF crystals with a reduction of the coherent domain size was also observed in neutron-irradiated crystals. X-ray diffraction data largely confirm that the single crystalline structure in heavily irradiated LiF is maintained; however, samples undergo notable structural damage the extent of which depend on the irradiation type, energy, and fluence (Fig.5d).
Results show that the hardness increases with the irradiation dose (fluence), reaching a plateau value of 3.5–4.5 GPa (200% increase) at very high fluences. The dominant process of swift heavy ion induced plastic deformation in LiF shifts from dislocation to shear bending mechanisms at high doses. The main requirements for the formation of localised shear

bands is a high deformation stress (large hardness changes) and an open lattice structure for atomic rearrangements. The formation of a free lattice volume leads to ion-induced swelling [2].

EFFECT OF HARDENING BEYOND THE ION RANGE

Earlier reports by different authors contain information about the appearance of colour centres in LiF at an unexpected depth within the crystal (up to 3 mm beyond the ion penetration depth) for irradiations with various heavy ions [1]. The present study confirms this behaviour, and evidence severe structural damage beyond the range of ^{12}C and ^{3}He ions in LiF that even changes mechanical properties in this zone. The formation of extended defects was shown to proceed at depths which exceed the calculated ranges for ^{3}He and ^{4}He ions by a few hundred micrometres and the zone of increased hardening extends over 10 micrometres beyond the projected ion range [6]. These results suggest that the formation of extended defects and hardening beyond the ion range is a complex phenomenon, which is related to secondary particle formation and emissions (γ-rays, X-rays, and electrons) *via* nuclear reactions induced by the energetic heavy ions and the LiF target nuclei. Ion channelling effects also contribute to the observed behaviour.

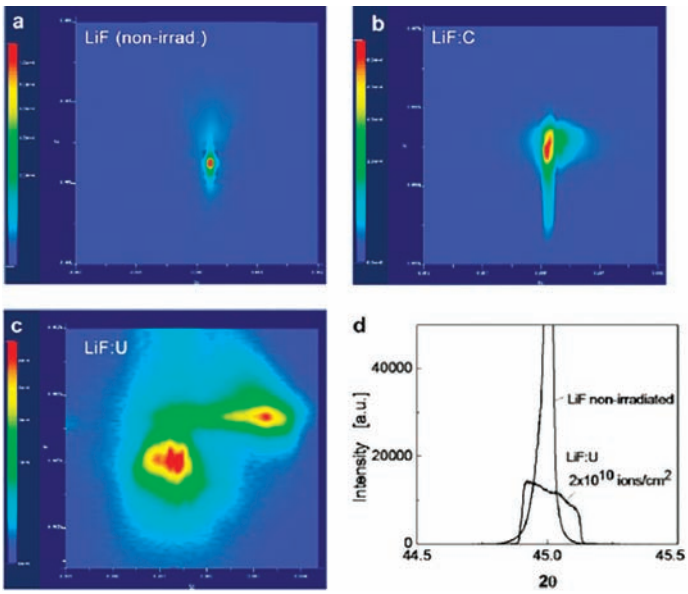

Fig. 5
X-ray diffraction reciprocal maps for LiF crystals: **a** – non-irradiated; **b** – irradiated with 133 MeV ^{12}C ions at fluence of 10^{12} ions/cm^2; **c** – irradiated with 2.6 GeV ^{238}U ions at fluence of 4×10^{11} ions/cm^2; **d** – X-ray diffraction patterns before and after irradiation with 2640 MeV ^{238}U ions at fluence of 4×10^{11} ions/cm^2

CONCLUSIONS

The formation of ion-induced dislocations is the main damaging process, which modifies the structure and the mechanical properties of the LiF crystals. The dislocation formation depends on the ion energy, ion energy loss, and irradiation dose (fluence). The results presented here for the LiF model system along with the described characterisation methods may have implications for understanding damage processes in a wide range of materials for nuclear and other energy-related applications. Along these lines, we have begun to investigate ion-induced structural and mechanical modifications in technologically important materials, such as MgO and graphite.

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SMART INDUSTRIAL ROBOTIC SYSTEM FOR COGNITIVE MANUFACTURING

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INTRODUCTION

Currently we are in the midst of the 4th industrial revolution or Industry 4.0, where the level of automation and digitization in production is continuously increased by deploying new digital tools of information and communication technology [3]. Between 2017 and 2020, it is estimated that more than 1.7 million new industrial robots will be installed in factories around the world [4]. Majority of installed industrial robots are used to automate processes where robot operations must be pre-programmed in order to manipulate with objects with predefined position and orientation in 3D space. The goal of the proposed system is to demonstrate advanced technologies that are capable of ensuring operation of industrial robots also in unpredictable situations. This requires decision making in real-time taking into account the assigned task and obtained information about the surrounding area of interest and objects in it – their shape, position, orientation, etc. Recent development in artificial intelligence and computer vision algorithms provide new possibilities for digitalization of processes where an ability to act and make decisions regarding the corresponding situation is needed. The progress in 3D cameras has enabled ways of acquiring increasingly precise, real-time, three-dimensional information about the environment. Equally important is the integration of artificial intelligence into the automation of industrial processes, which enables autonomous decision-making in non-standard situations. Also, Internet of Things (IoT) development has provided a new ways how actuators and sensors interact with the physical. According to Statista (Statistics portal), a major online market research portal, the number of IoT connected devices worldwide will be just over 30 billion in 2020, doubling in just five years. Statista estimates the number of machine-to-machine (M2M) devices, which are key to smart manufacturing processes, to also more than double from 1.5 billion now to 3.3 billion in 2021.

This paper describes a flexible solution for cognitive manufacturing – an integrated system that includes control of industrial robot, 3D computer vision, artificial intelligence algorithms and IoT network for data collection, handling and communication from/to auxiliary sensors / actuators. As a demonstration example, a task of picking and placing of various types of objects from random arrangements is selected.

ARCHITECTURE OF PROPOSED SYSTEM

The proposed system is based on Robot Operating System (ROS) framework that integrates and controls all subsystems. ROS provides hardware drivers for different hardware components (3D cameras, robot manipulators, etc.) and defines standard for the way in which data is exchanged between different nodes. Such approach provides high flexibility of 3D computer vision (CV), artificial intelligence (AI) computation, industrial robot and auxiliary sensor / actuators components, allowing to use different hardware with small software changes. Overall architecture of the proposed system is illustrated in Figure 1. Pick and place node is the central unit of the system, it acquires information from CV nodes and IoT network, as well as exchange information with AI node to manage robot movement accordingly

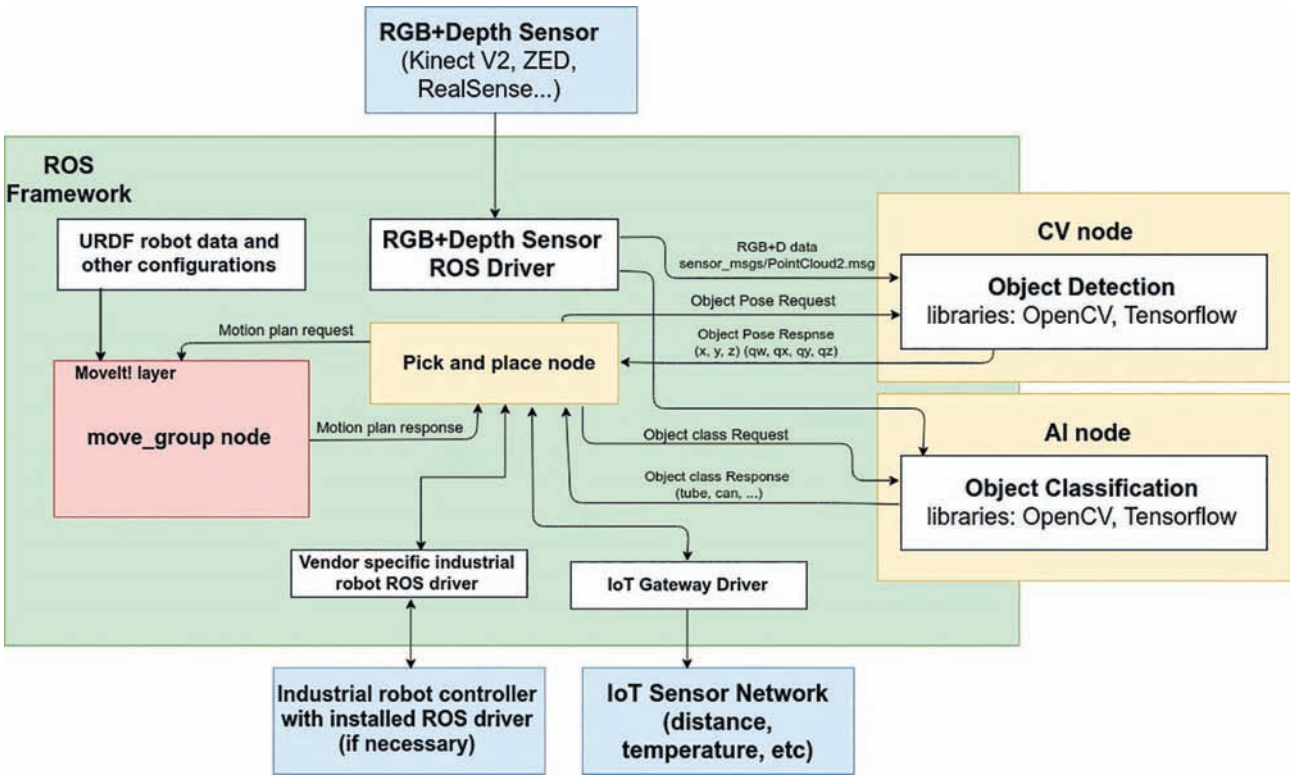

Fig. 1
Architecture of the proposed system

to the defined tasks, current surrounding situation and sensor information. More detailed information can be found in [1].

CONTROL OF INDUSTRIAL ROBOT

In terms of system flexibility, hardware abstraction is important so industrial robots from different manufacturers could be programmed and controlled in one way. There are multiple frameworks that offer compatibility with different industrial robot brands, but most popular of them is ROS-Industrial (ROS-I). Basically, it extends the advanced capabilities of ROS software to industrial robots working in the production process. ROS-I consists of many software packages, which can be used for interfacing industrial robots. ROS-I is being used in the proposed system as a high-level controller in conjunction with a low-level controller provided by industrial robot. Robot control node works as an integrator of all the subsystems and is mainly responsible for movement and trajectory creation depending on object position in container, object class or other information from sensors.

In the selected demonstration example for picking and placing of arbitrary arranged different objects, the robot movement is implemented in following way – linear path generation for picking up an object respectively to its position and orientation, while avoiding collisions with obstacles in the environment, linear path generation to move object in classification position to classify what kind of the object has been picked and other features of the object, after that the object is moved to appropriate position (box) depending on classification result.

COMPUTER VISION

Computer vision is used to perceive the changing environment and modify systems actions accordingly. The CV subsystem receives colour frames and depth information from a camera sensor and returns information about objects to the robot control. The camera sensor could be placed above the pile of objects as well as at the end-effector of the robot manipulator.
For the selected demonstration example, the first step is detection of the region of interest (i.e.

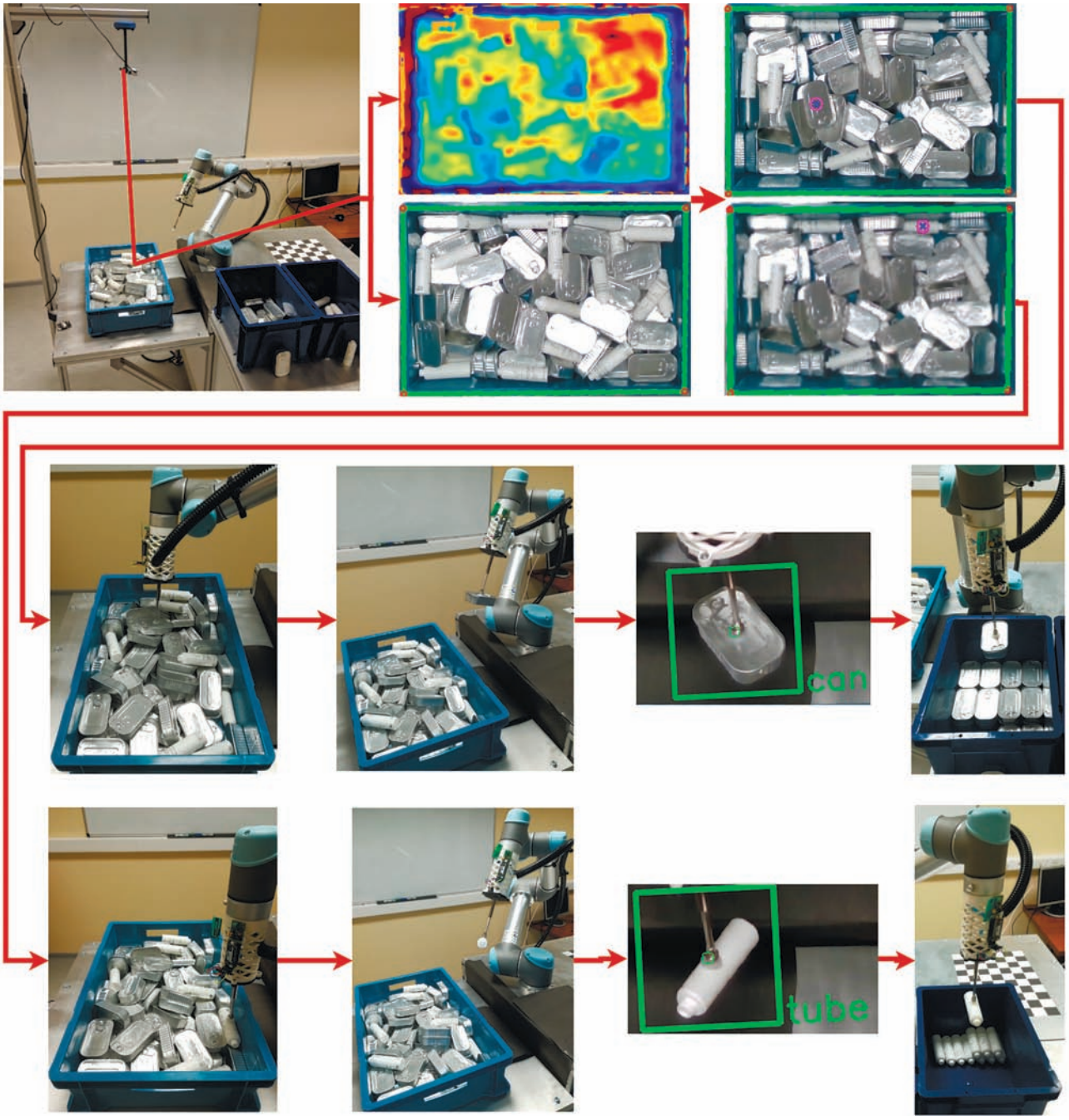

Fig. 2
Operation flow of the demonstration

container borders) to reduce processing amount. Next step localises completely unobstructed objects that can be picked up by the robot. The challenge of the task arises because of the random object position and orientation, and the background consists of similar objects. In the next step, the object is classified and moved to the desired location according to its result, and is placed there. Operation flow of this example is illustrated in Figure 2.

ARTIFICIAL INTELLIGENCE

A deep convolutional neural network (CNN) is used to sort objects. In order to train the classifier to recognise new classes of objects, new training datasets must be prepared. CNN-based YOLO [5] classifier could be used to provide object localisation and classification in one step, however this approach requires more complex and more numerous annotated

training data than separate classification networks. To acquire such data, synthetic annotated data generation technique is developed where images of pile is generated from several images of object [2].

Typically, AI algorithms run on PC-based workstation with GPU accelerator (graphical card). To reduce latency, power consumption and overall costs necessary, PC-based computation could be replaced by a System-on-Chip (SoC) based embedded system, which incorporates a processor and field-programmable gate arrays (FPGAs). Due to its parallel nature, FPGAs are suitable to accelerate the required AI algorithms, while the processor manages scheduling, communications, and high-level control.

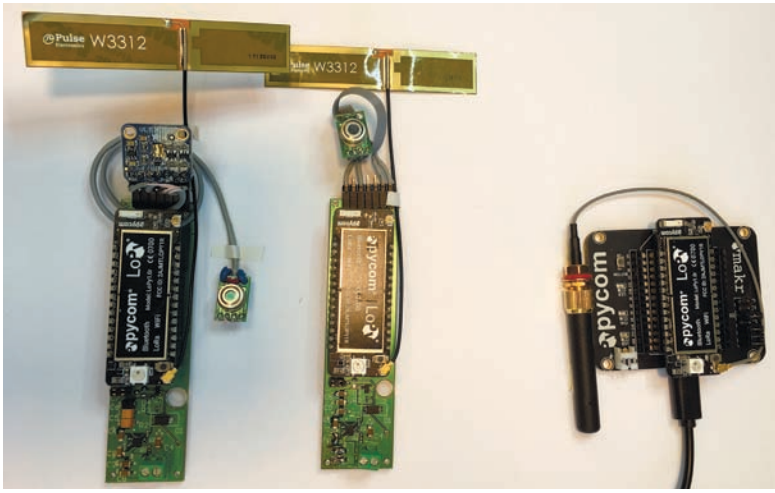

Fig. 3
Internet of things network *subsystem*

INTERNET OF THINGS NETWORK

Certain tasks for smart manufacturing require some specific information about environment and objects characteristics such as temperature, etc. This information cannot be acquired by 3D computer vision therefore the use of additional sensors as shown in Figure 3 and actuators has to be involved in order to enhance capabilities of the proposed system. For this purpose, the IoT network for auxiliary sensors and actuators has been developed, which provide necessary data acquisition and transmission capabilities to ROS framework. The IoT network is implemented using smart sensor-actuator nodes connected to the control system by the IoT network gateway. A smart sensor-actuator node includes a few sensors and / or actuators and a microcontroller with a radio transceiver. IoT network gateway has the serial wired connection with the control system and has wireless connections (Wi-Fi, BLE, LoRa) with sensor-actuator nodes. Each node has IoT network unique address. IoT network gateway is communicating with sensor-actuator nodes using their unique addresses.

EXPERIMENTAL SETUP AND DEMONSTRATOR

The core component of the demonstrator of the proposed system is UR5 collaborative robot from Universal Robots with controller CB3. It consists of six rotating joints, payload is five kg, reach is 850 mm and repeatability is +/– 0.1 mm. 3D computer vision is based on Intel RealSense D415 camera. It is active IR stereo camera with depth resolution up to 1280 × 720, 90 Hz frame rate, and depth range 0.16–10 m. For CV and AI processing algorithms computer based on Intel Core i7 CPU with NVIDIA GeForce GTX 1050 Ti 4 GB GPU is used. IoT network is created using PYCOM LoPy modules. Sensor nodes include VL53L0X distance sensor and the infrared thermometer MLX90614 sensor. IoT network gateway is connected to USB port of computer. LoRa communication protocol is used for data exchange in IoT network.

For the tests pick and place task was implemented where two kinds of objects (tubes and cans), that are randomly distributed in container in multiple layers where picked from the container and sorted in two different boxes by industrial robot. Brief demonstration video about system action can be watched in this video: https://youtu.be/aovhtCX4aiM.

CONCLUSIONS

Robot Operating system framework enables creation of flexible and modular robot system. The proposed system was tested using different hardware of 3D cameras – Kinect v2, ZED, RealSense, as well as different industrial robots UR5 and ABB. Testing showed that adaptation to other hardware can be done in a short amount of time with minor configuration changes to the software.

The accuracy of simultaneous object detection and classification using artificial intelligence algorithm, which is trained fully on synthetic data, is currently lower than accuracy of algorithm based on separate localisation and classification modules; however, the large reduction in required manual work and further improvements in the realism of generated data would make this approach more appealing in the industry setting. Currently CV and AI require significant processing power. Therefore, future work involves CV and AI development for embedded systems such as SoC. Current wireless protocols enables creation of IoT networks with wide range of sensor / actuator devices for industrial setting, allowing collecting information and acting on objects and environment that is not possible by using only CV and robotic manipulator.

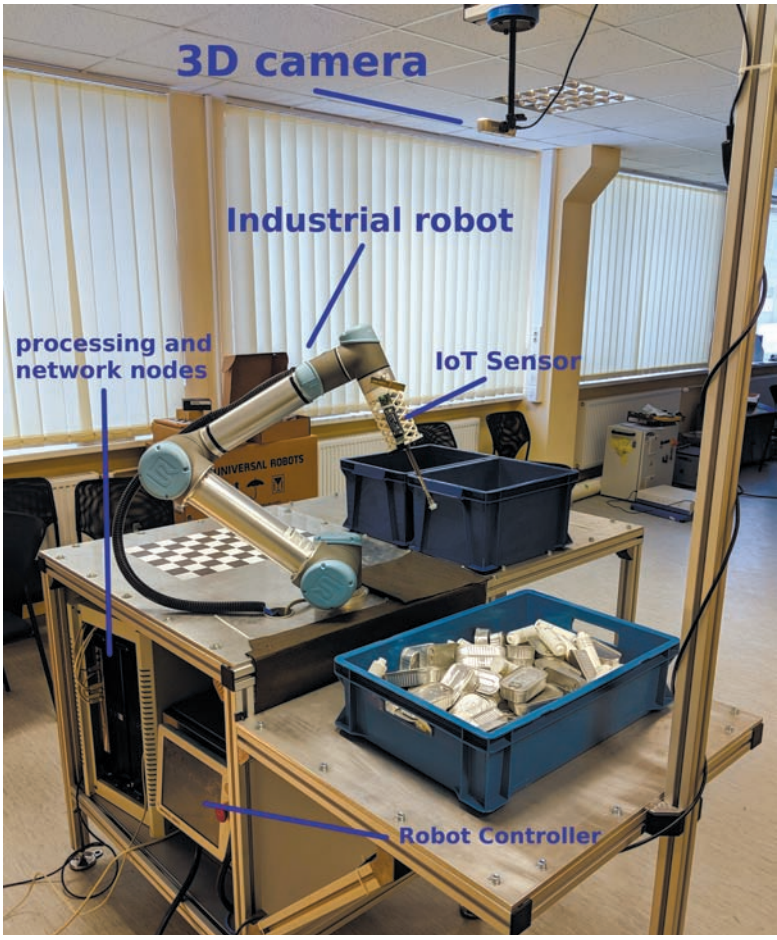

Fig. 4
Experimental setup for demonstration

ACKNOWLEDGMENTS

The described system is a joint work of Modris Greitāns, Jānis Ārents, Ričards Cacurs, Roberts Kadiķis, Kaspars Sudars, Uldis Grunde, Juris Ormanis, Elvijs Buls, and has been partially supported by ERDF project No. 1.2.1.1/16/A/002 Research No.11.

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AWARD OF THE L'ORÉAL BALTIC FOR WOMEN IN SCIENCE FELLOWSHIP

The award of the L'Oréal Baltic for Women in Science Fellowship promotes the contribution of women pursuing research careers.

The L'Oréal – UNESCO for Women in Science partnership was founded in 1998 to recognise and promote women in science. The Fellowship rewards both established women scientists for their outstanding achievements in the advancement of scientific knowledge and its benefits to society, and provides support to promising young women who are already making significant contributions in their scientific disciplines.

L'ORÉAL Baltic, the Latvian National Commission for UNESCO, the Latvian Academy of Sciences and honorary patroness of the fellowship Vaira Vīķe-Freiberga (President, Republic of Latvia, 1999–2007) started implementing the programme in Latvia in 2005. Since then, 42 female scientists from Latvia were awarded the fellowships for personal growth. In 2017, the project was expanded in the Baltic States, opening the opportunity to receive fellowships to Lithuanian and Estonian researchers and the L'Oréal Baltic for Women in Science Fellowship Programme is implemented in cooperation with the Lithuanian, Latvian and Estonian Academies of Sciences and National Commissions for UNESCO of these three countries.

In 2018, the fellowship "Women in Science" competition was entered by 47 applications from Latvia, 26 from Estonia and 26 from Lithuania in environmental sciences, physical sciences and engineering. On 5 June 2018 at the Award Ceremony of the L'Oréal Baltic for Women in Science Fellowship Programme honoured five talented women from the Baltic States Scientists were greeted by the Honorary Patroness of the Award – *Dr.* Vaira Vīķe-Freiberga.

L'Oréal Award Ceremony. The winners of the prize for year 2018. From the left: *Dr.* Giedrė Motuzaitė-Matuzevičiūtė Keen, *Dr.* Karin Kogermann, *Mg. sc. chem.* Margarita Baitimirova, *Mg. sc. ing.* Anda Fridriksone, and *Dr.* Ilva Nakurte

L'Oréal Award Ceremony. From the left: Latvian Academy of Sciences President Ojārs Spārītis, L'Oréal Poland & Baltic HUB CEO Wioletta Rosolovska, Estonian Academy of Sciences President Tarmoo Soomere, and patroness of the L'Oréal *Dr.* Vaira Vīķe-Freiberga

THE NOMINEES OF THE FELLOWSHIP 2018

***Dr.* Ilva Nakurte**, Assistant Professor at the University of Latvia, Faculty of Chemistry, and leading researcher at the Institute for Environmental Solutions, received the fellowship "For Women in Science" for the determination of pigments used in traditional textile dyeing processes using a chromatographic analysis method. The purpose of this research project is to develop methodologies that can be used for phytochemical screening of various plant pigments used in the traditional dyeing process using state of the art technology. In addition, the results obtained by studying intangible cultural heritage can provide the public with knowledge about Latvia's history and renewable resources.

***Mg. sc. chem.* Margarita Baitimirova**, University of Latvia Institute of Chemical Physics, has been awarded the fellowship for her study of the formation and characterisation of layered nanostructures containing graphene. The study is aimed at the creation of layered nanostructures based on the modern material graphene, to study the properties of the newly formed nanostructures and to test their potential use in opto-electric, thermal and electro-optical devices, as well as optical and biological sensors. Layered nanostructures of graphene / thermoelectric material can be used in thermoelectric devices that can generate energy from solar energy and/or temperature difference, for example between indoor and outdoor temperatures, i.e. gain energy from renewable resources, and, with such devices, turn pollution/waste heat into useful electricity.

***Mg. sc. ing.* Anda Fridrihsone**, researcher in Polymer Laboratory, Latvian State Institute of Wood Chemistry, received L'ORÉAL Baltic fellowship for her Research "Life Cycle Assessment of Polyols and Polyurethane Production Using Rapeseed Oil as a Feedstock". The objective of the Research project is to carry out a complete cradle-to-gate Life Cycle Assessment (LCA) for rapeseed oil polyols and polyurethane materials based on these polyols developed at Latvian State Institute of Wood Chemistry. The Research results will not only evaluate the environmental footprints of the developed polyols and polyurethanes based on rapeseed oil, but also contribute to regionalised (Latvia, Northern Europe) LCA studies as there is lack of these. Study will be beneficial for other researchers locally, for example, to evaluate the environmental footprint of biodiesel produced in Latvia, and for other researchers worldwide.

***Dr.* Giedrė Motuzaitė Matuzevičiūtė Keen**, Head of Bioarchaeology Research Centre of Vilnius University (Lithuania) researched human paleonutrition and the prosperity of agriculture in Central Asia. This study examines the evolution of human nutrition in prehistoric central part of the Tian Shan mountain range and its influence on the further spread of cereal crops across Eurasia. When analysing the context and environmental conditions of the site of archaeological research, we can look at the molecular level of the artefacts by applying certain scientific methods, thus opening up a much broader view of our past.

***Dr.* Karin Kodermann** (Estonia), Associate Professor and Senior Research Fellow, Faculty of Medicine, Institute of Pharmacy, University of Tartu received the fellowship for her research on enhancing the treatment of chronic wounds by designing and making smart nanofibre-based wound dressings.

More information
https://www.forwomeninscience.com/en/home

ACHIEVEMENTS IN LATVIAN SCIENCE, 2018

THE GRAND MEDAL IN SCIENCE

The Latvian Academy of Sciences Grand Medal, which is the highest award to Latvian and overseas scientists for outstanding creative achievements, has been awarded since 1993.

On 29 November 2018, the Grand Medal was conferred to Professor, *Dr. habil. med.* **Vija Zaiga Kluša**, full member of the LAS for achievements in pharmacology and higher education, as well as merits for the benefit of the Latvian Academy of Sciences.

Professor, *Dr. habil. iur.* **Kalvis Torgāns**, full member of the LAS was awarded the Grand Medal for the establishment of a modern civil rights school in jurisprudence of Latvia and a significant contribution to the introduction of theoretical knowledge in practice.

Professor, *Dr. habil. med.* Vija Zaiga Kluša

Professor, *Dr. habil. iur.* Kalvis Torgāns

TOP TWELVE ACHIEVEMENTS IN SCIENCE

Since 2002 in December of each year, the Latvian Academy of Sciences announces the list of the most significant achievements in Latvian science of the year. In order to win the title of the best achievement in science of the year the competition among researchers and research institutions has become more intense as the popularity and reputation of the contest organised by the academy has grown and so is the number of participants. In 2018, the top twelve achievements were selected from 51 eligible proposal.

Traditionally the achievements in science are divided into two groups – theoretical science and applied science; the achievements shortlisted for the winners group usually cover a vast scope of research areas in different sciences – ranging from solid state physics and IT technologies, biomedicine and genome research, pharmacy and chemistry to history, anthropology, literature, art history, music theory, etc.

THEORETICAL SCIENCE

An unusual DNA form with an unusual packaging and genome maintenance function has been discovered in human cells by the scientists of the Latvian Biomedical Research and Study Centre of the University of Latvia and Rīga Technical University.

Dr. biol. Kristīne Salmiņa, the LAS Academician *Dr. habil. med.* Jekaterina Ērenpreisa, *Dr. biol.* Tālivaldis Freivalds, *Dr. biol.* Tūrs Selga, *Mg.* Germanis Sorokins, Jēkabs Krīgerts (*Mg.* student).

The collective monograph Gothards Frīdrihs Stenders (1714–1796) un apgaismība Baltijā Eiropas kontekstā / Gotthard Friedrich Stender (1714–1796) und die Aufklärung im Baltikum im europäischen Kontext / Gotthard Friedrich Stender (1714–1796) and the Enlightenment in the Baltics

in European Contexts by an international team of scholars, philosophers and theologians, linguists, pedagogical historians offers the first interdisciplinary study of the great 18th century Baltic German enlightener Gotthard Friedrich Stender. The monograph has been compiled by the researchers led by Full Member of the LAS *Dr. philol.* Māra Grudule.
The Institute of Literature, Folklore and Art of the University of Latvia.

An overview of musical life during the decade after the WWII (1944–1953) and against the backdrop of political and social tensions in the Latvian Soviet Socialist Republic is revealed in the monograph *Mūzika pēckara staļinismā: Latvijas mūzikas dzīve un jaunrade 1944-1953* (The Music in Post-War Stalinism: The Musical Life and Progress in Latvia 1944–1953) by *Dr. art.* Arnolds Klotiņš.
The Institute of Literature, Folklore and Art of the University of Latvia.

The monograph *Jūgendstila arhitektūra Latvijā* = Art Nouveau Architecture in Latvia in Latvian and English by *Dr. arch.* Jānis Krastiņš provides data on the place and importance of the heritage of the Art Nouveau architecture of the early 20th century in the contemporary built up environment of Latvia.

Research and tools for developing the smart economy and society in Latvia are offered in the collective monograph *Simtam pāri. Viedā Latvija* (Beyond A Century. The Smart Latvia). Editor-in chief the LAS Academician, project manager of EKOSOC-LV *Dr. oec.* Baiba Rivža.

APPLIED SCIENCE

Novel energy efficient method for preparation of long afterglow phosphors on metals is developed at the Institute of Solid State Physics of the University of Latvia.
Mg. phys. Ivita Bite, *Mg. phys.* Guna Krieķe, *Mg. phys.* Aleksejs Zolotarjovs, *Mg. phys.* Katrīna Laganovska, *Bc. phys.* Krišjānis Auziņš, Virgīnija Vītola, *Dr. phys.* Krišjānis Šmits, *Dr. habil. phys.* Larisa Grigorjeva, *Dr. habil. phys.* Donats Millers, the LAS Academician *Dr. habil. phys.* Linards Skuja.

Neural Machine Translation System for small languages is a result of a fruitful collaboration between the IT company *Tilde* and the University of Latvia.
Dr. sc. comp. Mārcis Pinnis, *Mg. sc. comp.* Rihards Krišlauks, *Mg. sc. comp.* Matīss Rikters, *Bc. sc .comp.* Roberts Rozis, *Dr. sc. comp.* Raivis Skadiņš, *Mg. sc. comp.* Valters Šics, *Bc. mgt.* Artūrs Vasiļevskis, *Dr. sc. comp.* Andrejs Vasiļjevs, the LAS Corresponding Member *Dr. habil. sc. comp.* Juris Borzovs, *Dr. sc. comp.* Jānis Zuters.

The new concept nanogenerators for mechanical to electrical energy conversion has been worked out by the specialists of the Faculty of Materials Science and Applied Chemistry of Rīga Technical University and the Institute of Technical Physics.
Dr. sc. ing. Andris Šutka, *Dr. sc. ing.* Kaspars Mālnieks, *Dr. phys.* Artis Linarts, *Mg. sc. ing.* Linards Lapčinskis, *Dr. phys.* Juris Blūms, *Mg. sc. ing.* Ilgvars Gorņevs, *Mg. sc. ing.* Vilnis Jurķāns, *Mg. sc. ing.* Astrīda Bērziņa, the LAS Academician *Dr. habil. phys.* Māris Knite.

Plant virus-based universal vaccine technology for the treatment of chronic diseases is the theme of the scientists of the Latvian Biomedical Research and Study Centre.
Dr. biol. Ina Baļķe, *Mg. biol.* Gunta Reseviča, Vilija Zeltiņa, the LAS Corresponding Member, *Dr. biol.* Andris Zeltiņš.

Role of peripheral innervation in wound healing is discovered at the Faculty of Medicine of the University of Latvia.
Dr. pharm. Vadims Parfejevs, *PhD*, Professor Una Riekstiņa, Professor Lukas Sommer (University of Zürich).

Sea buckthorn extracts are developed for the use in veterinary practice and farms for the improvement of animal healthcare at the Faculty of Veterinary Medicine of the Latvia University of Life Sciences and Technologies and the Institute of Horticulture.
The LAS Corresponding Member *Dr. sc. ing.* Dalija Segliņa, *Dr. sc. ing.* Pawel Gornas, *Dr. sc. ing.* Vitalijs Radenkovs, *Dr. med. vet.* Laima Liepa, *Dr. med. vet.* Ilmārs Dūrītis, *Dr. med. vet.* Inga Pigiņka-Vjačeslavova, *Mg. med. vet.* Evita Zolnere.

The original technology for the synthesis of nanoporous carbonaceous material from wood and its processing residues using thermochemical activation is found at the Latvian State Institute of Wood Chemistry.
Dr. habil. chem. Gaļina Dobele, *Mg.* Aleksandrs Volperts, the LAS Full Member *Dr. ing.* Aivars Žūriņš, *Mg.* Lilija Jašina, *Mg.* Ance Pļavniece, *Ing.* Dmitrijs Djačkovs.

Gunārs Krollis. *ROULETTE*
97 x 74 cm. Author's medium, digital print
2009/2018

Gunārs Krollis. *HAZARDOUS EQUILIBRIUM II*
97 x 74 cm. Author's medium, digital print
2009/2018

Gunārs Krollis (b. 1932) is a grand master of Latvian graphics arts of the second half of the 20th century and early 21st century. He had worked at the Latvian Academy of Arts as a Professor since 1987, as a Chair of the Etching workshop of the Graphics Division since 1990. At present, he is Professor Emeritus of the Latvian Academy of Arts.

As an artist, he masters drawing, linocut, etching, mezzotint, aquatint and other graphic techniques, mixing them, breaking borders and rules, predicting the outcome. He has great success also when painting with gouache and watercolour.

He has participated in more than 450 exhibitions in Latvia and overseas (Estonia, Russia, Lithuania, Norway, the Netherlands, Slovenia, Sweden, Poland, Egypt, Great Britain, France, Canada, USA, Japan, Austria, Jordan, China, Lebanon, etc.), and has had more than 40 solo exhibitions in Latvia and abroad. Professor Gunārs Krollis has received many awards for his outstanding works: the Prize for the best etchings at the Baltic Graphics Show in Falun, Sweden (1993), the Prize and medal at the International Graphics Biennale in Maastricht, the Netherlands (1994), Annual Awards in book design, Latvia (2005, 2006, 2007) to name just a few.

The artist has worked also in the field of book illustrations, and has designed and illustrated more than 200 books. He is an author of the graphic design of silver coins devoted to the Hansa City series (plaster pattern by sculptor Jānis Strupulis).

The series of eight artworks *Parallels* (2009–2018), which has been devoted to the Latvian Academy of Sciences, are based on the inspiration from works of the famous painter and genius scientist Leonardo da Vinci (1452–1519).

The structure of his works can be very complex, meaningful and rich in fine parts, but always well balanced, inspired by clear ideas, visually impressive, even decorative, emotionally powerful and exciting.