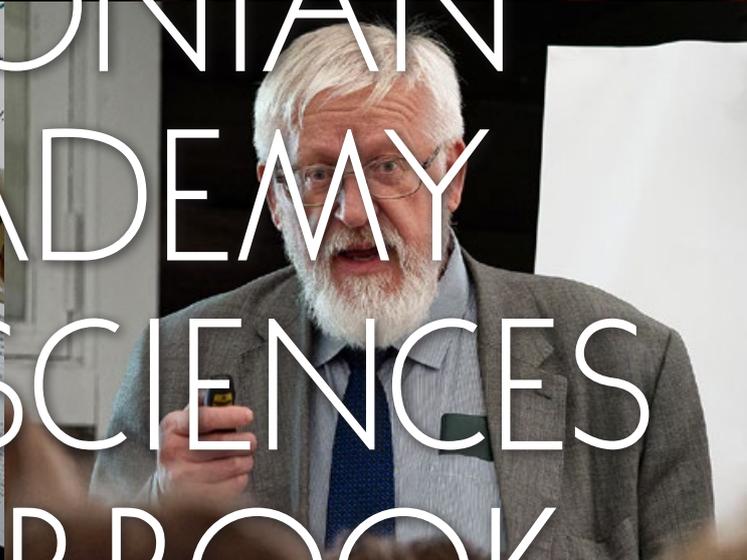
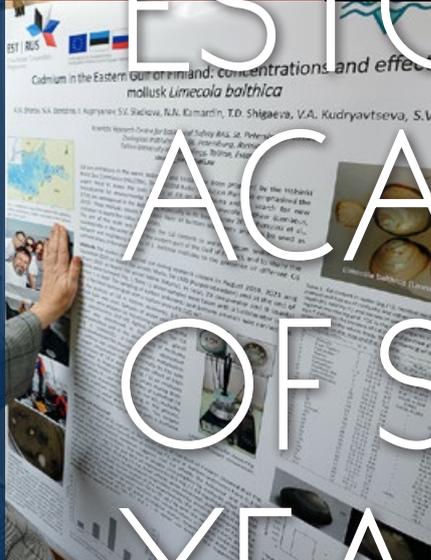
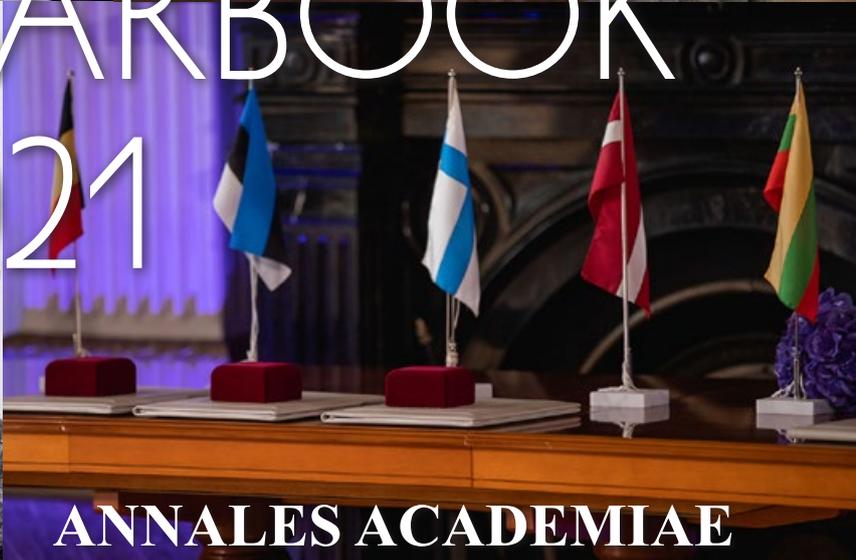


EESTI TEADUSTE AKADEEMIA



# ESTONIAN ACADEMY OF SCIENCES YEARBOOK 2021



**ANNALES ACADEMIAE  
SCIENTIARUM ESTONICAE**

**XXVII (54)**





On the front cover:  
Some snapshots from Academy's activities in 2021

EESTI TEADUSTE AKADEEMIA

*Facta non solum verba*

ESTONIAN ACADEMY  
OF SCIENCES  
YEARBOOK 2021

WORDS AND IMAGES  
FACTS AND FIGURES

ANNALES  
ACADEMIAE SCIENTIARUM  
ESTONICAE

XXVII (54)

TALLINN 2022



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# FOREWORD

A year ago, it seemed we would soon be done with the coronavirus crisis and life would return to calm reality, and that by autumn it would all be like it was before February 2020. We did our work in that hope – largely remotely, on screens. We drafted recommendations for combating the coronavirus. We proposed ideas in the wake of which we were able to gain observer member status on the International Arctic Council. We thought about what direction the Academy could develop in and how to direct the process. We racked our brains about the right way to use European Union structural funds for the next seven years. We added our knowledge to the currents that are carrying us toward a green transition: high-quality renovation of buildings and the use of hydrogen technologies are both suitable for this purpose, and above all, so is a change of mindset. We took much larger role in inspiring talented students from all over the country to aspire to the shiny peaks of science. The Young Scientists Association and Academia Pernaviensis were keywords for these aims.

Academy members are listened to and their ideas are considered important. They are heard by people, from government leaders to the broad circles of society. In many cases we do not manage to speak and write as much as needed. Since August, we have been in charge of a weekly opinion column in *Postimees*, the title of which translates as “Through a Scientist’s Eyes”. In December, it transpired that a full one-third of the members of the Research and Development Council are now the Members of the Academy of Sciences.

In the international arena, we have emerged as one of the key architects of the science advice ecosystem being planned in the EU. One way we are doing this is by participating in the European Commission’s Group of Chief Scientific Advisers and another way is through chairing the European Science Advisors Forum. Usually we cheer the fact that Academy members are busy at different levels, but in November we were assigned yet another important function at the institutional level: being the host organisation of the European Members of the International Scientific Council.

Indirectly, these developments are also reflected in the Academy’s yearbook. Our colleagues speak out confidently here in assessing and interpreting key processes of the recent past, whether it’s the Academy’s contribution to the development of the international scientific landscape, analysing the role and function of the Estonian Research and Development Council or insight into how the long awaited the Estonian Research Agreement was forged.

Yet on 24 February [2022], Estonian Independence Day, we suddenly had to face the fact that our world is still stalked by an ancient evil. The horror of war was unleashed in the very heart of Europe, not very far from us. The world is no longer the same. Dealing with the consequences of that evil and helping our fellow man in every possible way has now become a permanent part of our lives.

But the truly great challenge lies in how to keep such horrors from recurring. I would go so far as to say that many of the problems of our time cannot be solved without the help of science. Shimon Peres once expanded on this idea, saying that without science it wasn’t possible to rid ourselves of poverty or achieve peace. Our foreign member Helmut Schwartz states it more strongly: without science, we won’t be able to build a future worth living in.

Tarmo Soomere  
9 March 2022



WORDS  
AND IMAGES

# MESSAGES FROM THE ACADEMY

## FROM BATTLING THE CORONAVIRUS TO THE THRESHOLD OF A GREAT WAR

*Tarmo Soomere*

The past year (2021) was the second year in which the functioning of the entire world, and naturally the Academy, was shadowed by the coronavirus pandemic. During that difficult time, the society was supported by many scientists who developed several vaccines. At the beginning of the year, there was a race to see who would be the first to chip in. The society responded with a new term: the vaccinated elite. The momentum dissipated almost entirely only a half year later and many considered it the right thing to do to refrain from vaccination or even speak out against vaccines. There were also those who thought that it was all a great hoax and conspiracy.

Complex problems can very seldom be solved in the manner of Alexander the Great by using a sword to cut the Gordian knot. Academicians and their colleagues fought on several fronts in this battle. Krista Fischer's skill in creating life-saving solutions from dull statistics provided strong support for the state in this struggle. Mart Ustav led research to produce a nose spray that could prevent infection from the coronavirus. Jarek Kurnitski tirelessly spoke about the importance of ventilation in combating the coronavirus.

The situation on the epidemiological scene was also complicated by the fact that for the second year running the spring General Assembly meeting had to be replaced with the president's overview of the events of the previous year and an electronic poll to deal with the documents which had to be approved by the General Assembly by law. Fortunately, there are only a few of those: the management report and the financial statements of the previous year,



Photo: Peeti Kõik

Tarmo Soomere on 8 December 2021 at the General Assembly of the Academy of Sciences.



The year 2021 was characterised by hybrid meeting formats. For instance, the majority of Academy members attended the General Assembly of the Academy of Sciences on 8 December via Zoom and the Hall of Mirrors in Academy building remained rather empty.

the financial plan and budget for the current year, and a decision on the procedure for the remuneration of Academy members.

A whole year of battling the coronavirus made it clear that single actions, extensive restrictions and the vaccination of a large number of our fellow citizens were not enough to put the virus behind us. We need a significantly more broad-based approach, as well as an approach where passive avoidance of the virus (e.g. by wearing masks) or agreement to contribute to controlling the virus (by getting vaccinated) is supplemented by the ability to eliminate the virus. Thus, a political declaration of the Academy was born in spring 2021. Vaccination is naturally one of the main means of keeping the pandemic under control. This must be augmented by the responsible behaviour of both people and institutions. The situation would be much better if these two things were even further augmented by the removal of the virus from indoor areas through proper ventilation or the destruction of the virus, for example, by using ultraviolet radiation. We formulated this as a triple challenge: responsibility, vaccination and ventilation.

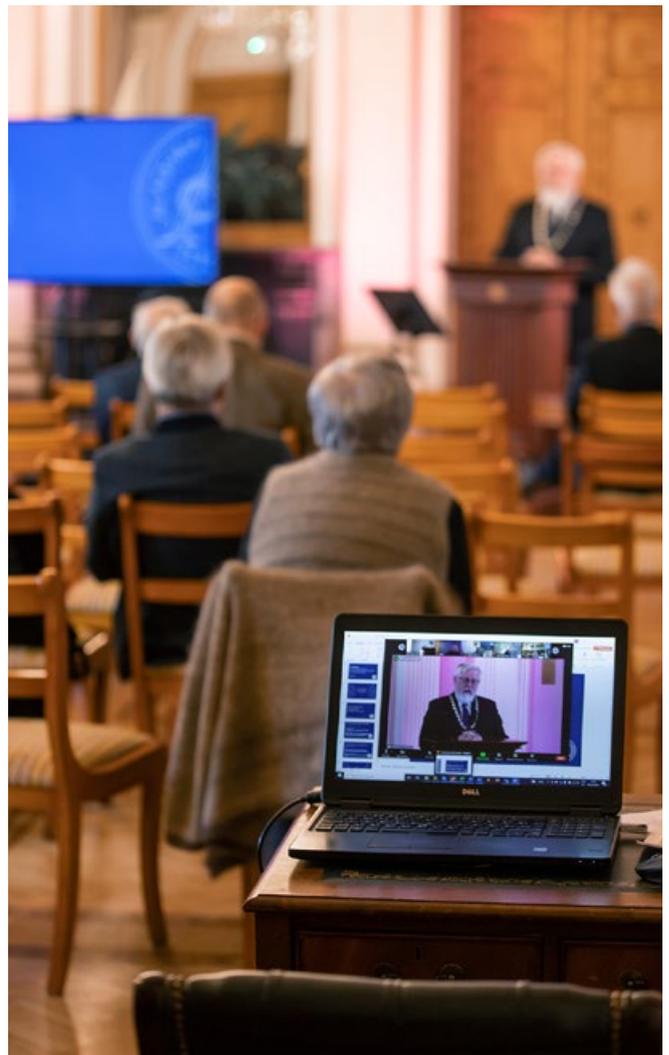


Photo: Reiti Kõkk x2

## *Responsibility, vaccination, ventilation: from virus prevention to elimination*

To summarise the situation in military terms: we are at war with the coronavirus. We have put up a valiant defence through passive methods, but more than one battle has already been lost. We face a triple challenge: we will prevail against the virus if we behave responsibly at the individual, employer, and state level, if we can ensure the vaccination of a sufficient number of our fellows and friends and if we modernise our ventilation systems.

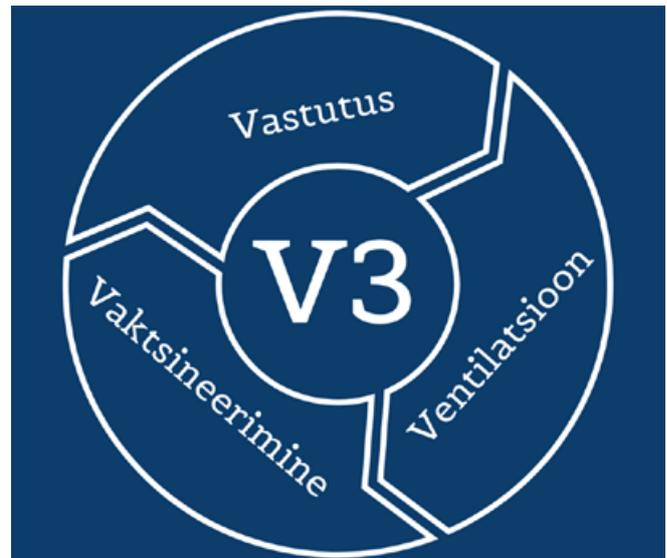
The prolonged limitations to our accustomed activities, social isolation, a standstill in multiple economic areas and loss of income for many of our inhabitants pose a major interruption to the functioning of our society and have decreased the quality of life and future outlook of many of our already vulnerable fellow citizens. Medically speaking, the elderly people in particular are in danger. Mental health issues pose a threat to various social groups. Medical and education workers shoulder a vast burden. Entrepreneurs must act under unpredictable conditions. Yet, the social impact of the pandemic is the heaviest for our youth. The education of school and university students may develop gaps, and the crisis significantly limits the opportunities available for youth about to enter the labour market.

The apparent economic impact of the restrictions may be surpassed by their social impact. Already, the restrictions have polarised and distressed society. In this situation, we need fast-acting measures to avoid overburdening the healthcare system and long-term solutions. The necessary decisions are threefold: responsible behaviour, vaccination, and the modernisation of ventilation systems.

**RESPONSIBILITY.** Estonia has chosen to tackle the pandemic chiefly through a framework of recommendations rather than orders or restrictions. Its success depends on a reasonable distribution of responsibility between individuals, employers, and the state.

Most of our fellow citizens act responsibly. Diligent mask use, physical distance and, if necessary, self-isolation curb the spread of the virus. Statistics from these recent weeks indicate that the individual responsibility-led measures have not brought the expected result. The escalation of restrictions puts additional pressure on those who have followed recommendations and whose quality of life has suffered as a consequence. Therefore, the proportion of those ready to dismiss the recommendations and restrictions may yet increase.

The role of employers should not be limited solely to tackling the economic consequences of the crisis. It is up to them to prevent and restrict the spread of the virus by



a smart organisation of work and protection of staff and clients alike (e.g., allowing remote work, online meetings, free protective gear, limiting contact, etc.). This view is supported by strategic business interests, as no short-term profit will outweigh a long-term recession.

The state's responsibility is not restricted to dealing with the crisis and its consequences; it has the mandate and the duty to prevent the excess spread of the virus and its unchecked growth. If the delegation of responsibility to individuals and employers fails to bring the desired results, the state must compensate it with stricter restrictions and coercive measures in the interest of society. Just like the state defends us against criminals, it has an equal responsibility to protect its people and providers of vital services against the reckless behaviour of the few.

**VACCINATION.** All viruses, including COVID-19, are engaged in a kind of never-ending chess game with humanity. The virus always plays white. There are three possible outcomes: victory, draw and defeat. The minimum goal is always to draw. Draws are possible by perpetual check. Vaccines provide the means for perpetual check.

Rapid vaccination increases the proportion of those whom the virus can no longer infect. The presence of a sufficient number of vaccinated individuals allows us to restore social interaction and to re-open society. In the opposite case, a long-term depression is inevitable.

Hopefully, there will be enough vaccine for everybody in the very near term. This does not mean that the pandemic will disappear on its own. If a critical proportion of inhabitants remains unvaccinated, the virus will be able to draw on a large resource to spread through. As it continues to circulate, it continues to mutate, until new strains are produced against which existing vaccines may no longer work. Therefore, taking part in vaccination means respon-

sible behaviour for the common good, and vaccine deniers pose less of a threat to themselves than to the entire society.

All vaccines approved for use in European Union are highly effective and guarantee nearly a hundred per cent protection against severe cases of the disease. Therefore, it is sensible to motivate those who doubt and mistrust vaccination, systematically debunk the arguments used by the opponents, and to reward vaccinated individuals through easing the restrictions.

**VENTILATION.** To win the war against the virus, we must deploy active means in addition to passive measures. To limit the likelihood of infection, the concentration of the virus must be systematically reduced: virus-laden aerosol droplets must be removed from closed spaces and virus particles must be physically deactivated.

In addition to regular airing, we must update the ventilation systems of our buildings. In our climate, large parts of the year are mainly spent indoors, in close proximity with many others. In a vast majority of cases, coronavirus infection occurs either through close contact with an infected individual or in spaces with insufficient ventilation. The virus spreads predominantly through the air and can remain active in aerosol drops exhaled by the host for several hours. Minuscule drops can spread far in airstreams and endanger many.

The concentration of the virus can be reduced using air purifiers that destroy viral particles using ultraviolet radiation at a particular wavelength. Since such equipment has seen very little use in Estonia and involves radiation, we must urgently take steps to ensure their safety, certify and deploy them.

High-quality ventilation is a long-lasting good. Air purifiers and virus-destroying equipment may provide effective solutions to future crises. The modernisation of ventilation systems of education and healthcare institutions or the construction of new systems is of the essence. It is an investment in our future, providing us with a beneficial indoors climate and a capability to stop the spread of other respiratory diseases in the long term.

Estonian Academy of Sciences

| March 2, 2021

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The General Assembly and the election of the Academy members had to be held as a hybrid event at the end of the year. A small number of Academy members were in the Academy auditorium and many participated via electronic means. The decisions made at the extraordinary General Assembly in the summer of 2020 have allowed us to deal with all matters related to the life of the Academy by electronic polls. As we hoped back then that the option to physically gather would soon be restored, a special procedure for electronic voting was not approved and a physical voting procedure seemed to be necessary. Technically, we had to agree that all of the polls would be electronic and secret. The statutes allow us to do this if at least a fourth of the Academy members attending the General Assembly meeting wish to do so. This approach was approved. The General Assembly agreed to replace a written list of the participants in polls with the number of the participating Academy members. This did not influence the voting results, as ballots don't have to be put in a box in the case of a physical election either. The important thing is how many Academy members participate and how many votes are gathered, but not exactly who participates. Nevertheless, it was right to gain the approval of Academy members before moving forward.

As a rule, the election of Academy members involves the two most popular candidates from the first round of voting being voted on in a runoff election (unless a need has arisen for an interim round if two candidates are not selected). There is a mandatory break after the second round. This time, the Department of Informatics and Engineering also requested a break after the first round. The source documents do not foresee such a situation. In line with good practice, the General Assembly usually takes into account the clearly expressed wishes of a quarter of the Academy members (or a department) in matters not regulated by the statutes and the law. Although all was settled in the end, the documents that regulate voting obviously need to be somewhat adjusted.

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One of the statutory tasks of the Academy is to contribute to the preparation of legal acts concerning research and development. The fulfilment of this task has mostly been limited to a few odd recommendations concerning the laws and regulations that are only marginally related to the academic landscape. This year, these included the details of supporting the FinEst Centre for Smart Cities, and adjustments to the provisions of the RITA programme (see page 49).

The Academy was last seriously involved in legislation four years ago (2018), when the Higher Education Act and

the legal acts of four public universities were prepared. Two years ago (2020), a process was launched that still continues and is expected to influence the entire Estonian science and higher education landscape for decades to come, although we do not yet know in which direction, i.e. the preparation of a new version of the Organisation of Research and Development Act was set in motion. This is not a minor adjustment, but a new full text which will also include the organisation of innovation. Academy members participated in the steering committee for the preparation of the act as well as in think tanks for the in-depth consideration of specific topics. We also invited a specialist from the Estonian Young Academy of Sciences to contribute in one work group.

The legislative intent completed in spring 2021 was at the request of the Board of the Academy thoroughly analysed by Martti Raidal, Mart Saarma, Jarek Kurnitski and Andres Metspalu. We deemed it reasonable to only regulate to the minimum level necessary and to create a flexible and facilitating framework instead of a prohibiting one. We decided that access to financing instruments should be linked to the quality of the research performed at institutions. We formulated three important topics for the Academy. Firstly, the entire research, development and innovation system should function in coordination, be reasonably dimensioned and be primarily aimed at increasing Estonia's competitiveness. Secondly, the act should facilitate the development of a career model for scientists. Thirdly, the scientific advice framework should be formulated at the level of a legal act. This would involve not who is asked for advice, but how it is decided who is asked, what kind of a mandate is given to advisors, how the advisory process is structured and what the liability of the parties is.

*The Academy is the only institution in Estonia that has a statutory mandate and thus an obligation to provide scientific advice.*

The latter topic is naturally related to the Academy of Sciences Act. The Academy is the only institution in Estonia that has a statutory mandate and thus an obligation to provide advice. We gladly fulfil this obligation. However, we could function considerably better if the main features of this process were stipulated by law, as in Spain, where decision-makers are obligated to ask for advice. This naturally does not create an obligation to act on the received advice in decision-making. Most of the Academy's recommendations have now been implemented. Some aspects

*For the first time, studying Estonian culture and society has been separately highlighted in an Estonian national research and development strategy.*

important to us (e.g. the stipulation of scientific advisory activities) are not covered in the current working version of the new act (as at the beginning of March 2022), but the act is not yet ready for a hearing in the *Riigikogu*.

Very good results were produced by a work group led by Marek Tamm aimed at developing the focus area of "Viable Estonian society, language and cultural space" agreed in the new Research, Development, Innovation and Entrepreneurship (RDIE) Strategy 2021–2035. The creation of that focus area was not easy even at the level of the Research and Development Council. It is, however, an iconic decision. For the first time, studying Estonian culture and society has been separately highlighted in an Estonian national research and development strategy. Three other Academy members also participated (Jaak Aaviksoo, Mart Kalm and Tarmo Soomere) and perhaps that was the reason the document prepared in this group was the first among five similar ones to be completed.

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Supporting the state and the society is one of the essential roles of the Academy. How we meet this challenge has been largely left for us to decide. The law only provides a few suggestions. In this context, talking to people and explaining to them what research results mean and how the results can benefit many people has grown increasingly important. For the first time, the annual conference of the Estonian Chamber of Culture was held essentially as a science conference in an Academy auditorium. For the second consecutive year, the winning lectures of the three-minute lecture series competition were broadcast by Estonian Television. The Viitna seminar series for the best student researchers and science fans continued under the auspices of the Academy. The comments and opinion pieces of Academy members are welcome on all the classic media channels. Jaak Aaviksoo became a permanent author on the news portal of Estonian Public Broadcasting. In August, a Saturday column in *Postimees*, "Through a Scientist's Eyes" was added to several similar long-established initiatives.

The success of initiatives of this kind can partly be measured by assessing the influence of people and institutions. On *Eesti Päevaleht*'s list of influential people, Krista Fischer seemed to outrank even Estonia's brightest star, Arvo Pärt. Although ratings of this kind clearly sell well,



## Partnerships with the Academy are increasingly sought.

they also reflect the growing influence of the Academy, apparent in the visibility and impact of our members. As William Locke has written: “All the things wrong with rankings matter considerably less than the plain fact that rankings matter”.<sup>1</sup>

Partnerships with the Academy are increasingly sought, not so much on a somewhat formal basis as in the case of associated research societies and institutions, but rather in terms of seeing increasing potential in our knowledge and in the skill to apply that knowledge, as in the lecture series “The Road to the Poska Academy” and the Academy members’ visits to the schools in their home towns.

The process of organising an association with the Estonian Young Academy of Sciences (EYAS) took almost a whole year. The agreement was signed at the very end of the year. As a partner, EYAS is significantly different from our ordinary partners. In Estonia, EYAS was founded separately from the Academy of Sciences. This has several advantages. It is very good for the voices of young scientists to be independent, as they are the ones who will live in the future we are all building together. The worries and challenges of the younger generation often differ from those prioritised by established scientists. Global experience shows that success favours those young academies of sciences which closely communicate with their more experienced colleagues, but are allowed to operate on the basis of their own beliefs and to rely on their own vision.

The think tank Academia Pernaviensis was launched quite a few years ago. The process has now reached actual cooperation between the Academy, the Faculty of Social Sciences of the University of Tartu and the Pärnu city government. Together we are striving to show Pärnu students how cool the world of science is and encourage them to take part in it. Besides promoting regional science activities, we are also supporting the participation of Pärnu students in the National Contest of Young Scientists. The first major events will take place in Spring 2022.

Some things still vex us. We almost had the opportunity to offer the state good short-term advice, but in a

considerably broader scope. Under the leadership of the Ministry of the Environment and the Economic Affairs Committee of the *Riigikogu*, the idea of sketching the basics of the national hydrogen strategy was launched in spring. Ideally, that would have included an overview of the current state of hydrogen-related technologies, opportunities for their use in Estonian industry, transport and the economy, the current cost of equipment, assessments of changes in such costs, and a forecast of when different aspects of hydrogen technology could become economically competitive, accompanied by a “map” of involved Estonian parties and their estimated ability to start using hydrogen technology. We would have identified the possible value chains and risks, threats and opportunities, in the style of classic SWOT analyses, and perhaps also sketched a palette of choices and prospective arguments, highlighted obstacles and put together a plan for a facilitating legal environment.

However, this is not how it turned out. At the beginning of summer, the Ministry of Economic Affairs and Communication decided that they would handle it on their own. The only thing we know about the road map – that was supposed to be completed by the end of 2021 – is that a relevant steering committee has been formed. But there is generally a silver lining in everything. Perhaps we would have had trouble performing that analysis. It is now more or less clear that other countries have heeded the starter pistol (in the form of both the green revolution agreement Green Deal and the Fit of 55 package) and are off and running. Here in Estonia, some more aware people are urging us to at least keep them in view.

We closely participated in the initiative of the Ministry of Foreign Affairs to apply for the status of an observer on the Arctic Council. The Arctic region is not too far from us. If we want to understand and forecast climate change and its impact on Estonia, we must definitely know what is going on in the Arctic region. Due to factors beyond our control, the process was suspended in autumn. With the wisdom of hindsight, it now seems that that was partly due to Russia’s plans to forcibly take over Ukraine. That left no room for the alleviation of tension in other areas.

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We received new tasks and responsibilities in the international arena. Usually, we are members and co-contributors of various networks and consortia of academies or experts, or one of our members is at the head of a network or institution, including Maarja Kruusmaa being one of the seven Chief Scientific Advisors of the European Commission, Jüri Engelbrecht being the president of the European Federation of National Academies of Sciences and Humanities (ALLEA), and Mart Saarma being the vice-president of the European Research Council (ERC).

1 Locke, W. 2011. The institutionalization of rankings: managing status anxiety in an increasingly marketized environment. – Shin, J. C., Toutkoushian, R. K., Teichler, U. (ed). *University Rankings: Theoretical Basis, Methodology and Impacts on Global Higher Education*. A book in the series *The Changing Academy – The Changing Academic Profession in International Comparative Perspective*, No. 3. Springer, Dordrecht, Netherlands, 201–228, p 221. doi.org/10.1007/978-94-007-1116-7\_11

Today, we as an institution preside over two important pan-European networks. In June 2020, we took over the presidency of the European Science Advisers Forum (ESAF). This is a network of the chief scientists of almost all of the European Union Member States, who cooperate with the chief scientists of other countries and regions, such as Scotland and Wales. In representing the ESAF, we became a member of a discussion panel in June 2021, where two of the five members were the heads of different European Commission Directorates-General. From the viewpoint of the European Commission, the ESAF is one of the most important branches of the growing pan-European national science advice ecosystem. An intensive discussion on specifying the role of the ESAF is currently under way (for more, see pages 89–94).

In November 2021, we started presiding over the European Section of the International Science Council (the ISC, previously the ICSU). As the ISC has grown very large as a result of the merger of two already large organisations – the ICSU and the ISSC (see pp 84, 86) – its regional associations are starting to play increasingly important roles. The new president of the ISC, Sir Peter Gluckman, is planning to launch such associations in South America and south-east Asia. For Estonia, the combination of two presidencies is a rare opportunity to encourage our sister academies to give ever better advice to their countries, share and gain the best experience and keep items important to us on the agendas of the meetings of the heads of academies. We put this into practice in the summer at the meeting of the presidents of the academies of sciences of the Baltic countries, Finland and Hamburg.

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We became a lot richer through our selections and recognitions: by three new Academy members, by three new Research Professors and by the knowledge accumulated by the Research Professors of the previous 2019–2021 period. We also awarded medals of recognition to those who contributed far beyond their employment contracts or job descriptions. Many people think that the most important recognition of the year in the area of science was the election of Mart Saarma as a foreign member of the Royal Swedish Academy of Sciences, as the third scientist of Estonian origin.

Time and again, it is good to emphasise that the Academy is only as strong as its elected members. In December, we received great additions to the family of the Academy. The elections were useful not only in gaining new Academy members, but also in terms of the process of introducing the candidates. A specific feature of the functioning of the Academy is that Academy members are primarily elected from amongst the candidates whom others consider worthy

of such recognition. Two public presentation series vividly showed the worthiness of the candidates from whom the members were selected. The elected members are the best of the best in their areas, with reputations that reach far beyond their fields of specialisation. Unlike previous elections, this time there was no fear of a deadlock or a risk of not being able to make a decision. It is good to think that the prior introduction of the candidates helped us make practical and fact-based choices. The Academy definitely became richer and – younger.

The known good qualities of the elected members were thoroughly described in the materials prepared for the elections. Experience has shown that the capabilities of the elected Academy members are not fully known at the time of elections. Now is the time to put these capabilities to use for both science and the general good. The first big test for the new colleagues was to write predefined-format opinion pieces for the “Through a Scientist’s Eyes” column in *Postimees*. Most of them excelled.

The Academy’s highest awards – the medals of the Estonian Academy of Sciences – are always bestowed on individuals on the basis of either great service in contributing to the development of Estonian science or contributions in fulfilment of Academy tasks. Unlike with medals awarded for great scientific achievements, the scientific degree or the level of citation is not very important here.

Jaak Aaviksoo and Mart Saarma were recognised for their long-standing contributions in representing academic thought in the Research and Development Council. There, they have systematically helped shape and direct Estonian science policy, have contributed the best specialised knowledge and scientific-political experience to the prime minister and the government, and have consistently contributed to making science and research an increasingly stronger foundation for the functioning of Estonia.

The Editor-in-Chief of *Postimees*, Marti Aavik, was recognised with a medal for his courage in engaging the Academy in the fight for the health of the Estonian people during the coronavirus crisis. A golden rule of scientific advice is that the advice has to be clearly explained to the public. This must be done via reputable channels that reach many people, while also making sure that the message is not oversimplified or tendentious. The council run in cooperation between the *Postimees* newspaper and the Academy of Sciences in the first two most critical months of the coronavirus pandemic in 2020 was one of the most extraordinary examples of the academic landscape and the private sector joining forces.

Academy members and academia generally can work up to their potential only when they are supported by high-class reliable professionals in technical aspects and paperwork. Tiina Rahkama, Board Secretary and Assistant to the

Secretary General, was recognised with an Academy medal for being a supporting pillar of the Board and the General Assembly of the Estonian Academy of Sciences for 35 years.

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The year 2020 saw the end of the Academy's previous development plan. A rather detailed overview of its fulfilment is presented in the materials of the extraordinary General Assembly meeting held in autumn 2019.<sup>2</sup> The situation has not significantly changed. Under the leadership of the Secretary General, a group of colleagues from the Board prepared a new development plan. I am grateful to the committee that put it together, the Board, which critically reviewed it, and the colleagues who sent their recommendations.

*Every idea and even every sentence in the development plan approved at the General Assembly meeting in December was backed by the work of specific people.*

The terms of reference of the new development plan somewhat differ from those of many other similar documents. The Academy does not have an executive body that can be tasked with the fulfilment of the wishes of the Academy members. Therefore, every idea and even every sentence in the development plan approved at the General Assembly meeting in December was backed by the work of specific people, either elected members or Office employees, who were willing to personally contribute to the achievement of objectives. The ideas presented in the plan also have at least minimal tangible support or resources which can be used in one manner or another. The plan contains no pipe dreams (see pages 14–15).

Preparation of the plan included negotiations with the Cultural Affairs Committee of the *Riigikogu* and the Ministry of Education and Research to simplify the Academy of Sciences Act. The current act contains several items that are generally no longer regulated by law; it also includes obviously obsolete provisions which are obstacles to smooth functioning. No changes are planned for the basic functioning of the Academy. Rather, we are striving to formulate the act in a way that allows the Academy to

<sup>2</sup> The programmed presentation of the presidential candidate Tarmo Soomere at the 25 September [2019] General Assembly meeting. The Estonian Academy of Sciences Yearbook XXV(52) 2019. Tallinn 2020, 87–90, [www.akadeemia.ee/wp-content/uploads/2020/05/ta-aastaraamat\\_veebi\\_2019.pdf](http://www.akadeemia.ee/wp-content/uploads/2020/05/ta-aastaraamat_veebi_2019.pdf)

function considerably more effectively, so as to ensure that if a need arises under the Organisation of Research and Development Act to use the Academy to support the state in any manner, our own act will not prevent this.

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Under the shadow of the coronavirus, we have to seriously contemplate how to preserve our status as a “collective brain of Estonia”, as a science journalist Margus Maidla has described our function. We can partly do this via properly organised and technically enjoyable broadcasts or virtual events. The organisation of these has been a huge burden for the Office. Such events are very complicated and need specific technical support, which often involves more than, say, catering. Thus, the nature of our expenditures is changing. As a result, it was decided that the technical aspects of the Academy's accounts will be handed over to a professional accounting firm and the position of financial manager will be created at the Academy's Office.

“Major construction” was the somewhat untraditional keyword of the previous year. The small courtyard building of the Academy complex was dismantled and completely remodelled by the beginning of 2022 thanks to an allocation from the ministry. Major repairs to the attic of the main building are next in line. The old partition walls have been taken down and the design of a new modern working environment is awaiting the formulation of the technical requirements for the renovation of the wooden stairwell. We will not receive a permit to use other rooms if the stairwell is not made fireproof.

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*Academies may not fight on the front-lines, but they must give their countries and governments the best advice.*

It was generally a bad year for interpersonal communication. The coronavirus pandemic acted as a motivator, a trigger and a weapon. Direct communication between the members has always been important at academies. It is always possible to hold more virtual meetings, but an academy should exist as an actual association of people. The elected leaders missed the feedback that has always come from the “reporting meeting” of the General Assembly held in spring. Quite a few problems that could have been solved in a few minutes with direct communication ended up as e-mails to the Academy members. It is interesting that at Board meetings people's main complaint was that there were so few physical meetings. Actually, there were none at all.

Should the need for physical distancing continue, we have to seriously contemplate how we can continue to function as a whole greater than the sum of its parts.

At the General Assembly meeting in December, I speculated about what the Academy's biggest challenge would be in the coming years. It then seemed that the biggest problem stemmed from the coronavirus pandemic. The overall challenge is the extensive polarisation of opinions, one of the manifestations of which is the anti-vaccination movement, accompanied by the fundamental protection of forests. Social sciences have strongly stated that society misunderstanding scientists' messages is not the main problem. Instead, the real problem lies in the decreasing trust in state institutions. People are reluctant to listen to what the state says.<sup>3</sup> I thought that perhaps the state could rely on the Academy in improving this situation and starting to regain public trust. This is at least a worthy goal for the Academy.

On the 104th anniversary of the Estonian Republic, on 24 February 2022, I found out how naive I had been in these thoughts. The Russian invasion and the current full-scale war in Ukraine is not just a gross violation of international law and the foundations of peaceful coexistence, but a horrible and increasingly brutal nightmare in the heart of Europe. Our presidency of the European group of the ISC and the ESAF gave us the opportunity to take several steps beyond a verbal condemnation of the aggressor. We called on the European academies and the chief scientists to advise their governments about the need to support the forces of those countries. By acting together, we can help Ukraine in the fight for their future, as well as ours, taking every opportunity to weaken the aggressor and gaining an acute understanding of processes which may lead to this type of an escalation.

The Ukraine war has clearly showed where the gaps in our knowledge and the challenges for academies are. Academies may not fight on the front-lines, but they must give their countries and governments the best advice. We need more knowledge in order to identify, monitor and forecast processes and decision-making chains in different cultures. We must learn how to respond proactively to prevent such terrible events before they happen. Let's hope that we will all see the time when the aggressors have been punished and the conflict has become a part of history.

6 March 2022

<sup>3</sup> Grundmann, R. 2021. COVID and climate: Similarities and differences. *WIREs Climate Change*, 12, e737. doi.org/10.1002/wcc.737.

## *Development Plan of Estonian Academy of Sciences for 2021–2026*

### **1. Introduction**

The development plan is based on the tasks assigned to the Estonian Academy of Sciences (hereinafter the Academy) by law and defines them in accordance with the main trends in society. According to law, the Academy represents Estonian scientists, providing scientists and their partners with a cooperation platform, contributing to solving social and economic development issues facing the country, and promoting innovation.

The changes that occurred in the Estonian society and the whole world during the period of the previous development plan 2014–2020 point to the need to provide science advice and science-based recommendations regarding health, emergence from the economic crisis, funding of science and innovation, etc. in a stronger and more operative way. It also emphasizes the necessity to be present at different levels of society, from giving science advice the government to increased visibility in society and the media.

### **2. Main trends**

#### **2.1. The Academy and Academy members**

- Members of the Academy actively express their views on the means and ways of addressing different issues faced by society, incl. in professional and social media and presentations related to their research fields.
- In selecting new Academy members, we are guided primarily by academic excellence of the candidates, their visibility in society and activeness in addressing issues related to their disciplines.
- We strive for a representation of as many different research fields as possible in the Academy membership in order to ensure broad-based competence of the Academy as a whole.
- We continue the established traditions and select, according to possibilities, outstanding cultural figures and society's opinion leaders for our membership.
- We involve more extensively the Academy's foreign members in the activities and programmes run by the Academy.
- Through developing the professional, technical and IT capabilities of the Office of the Academy, we ensure support for the activities of academicians and the performance of the Academy's essential functions at the contemporary level.

## 2.2. The Academy and the Estonian State

- We represent Estonian science and scientists in national research policy making, in discussions on funding research, development and innovation actions, as well as in establishing centres of excellence and national applied research funding programmes.
- We expand the participation of top scientists in the Academy's activities and in scientific advice activities, selecting them into positions of research professors, inviting them on the Academy's committees and involving their competence for better functioning of the society and in areas where professional advice is needed.
- We continue cooperation with the Academy's institutions and research organisations associated with the Academy and take action for more effective promotion of science in society.
- We develop versatile opportunities of mobility for researchers between research, business and public sector, by incorporating relevant principles in legislation as well as creating and launching the necessary measures.
- We maintain and strengthen relations with Estonian researchers working abroad and involve foreign researchers working in Estonia in analysing and solving issues that are important for Estonia.
- We are involved in organising competitions for national research awards and prizes, contribute to evaluation, involve top scientists in the field.
- We take care of enhancing the reputation and attractiveness of the career in researcher.

## 2.3. The Academy and Society

- We are involved in science-based policy making.
- We develop and expand scientific advice for the state and its institutions, involving members of the Academy and top scientists from universities, research institutions and companies, and from abroad if necessary.
- We initiate and support national development programmes aimed at addressing socially important issues, contributing to them by providing scientific expertise.
- We participate through our members in the work of national committees and company councils and recommend top scientists to join them.
- In possible crisis situations, we support the government in forming and organising the activity of working groups and advisory councils necessary for managing the crisis.

## 2.4. The Academy and International Partners

- We are strongly committed to representing scientific positions and science-based worldview, organising debates and expressing our views in the media.
- We strengthen the Academy's capacity in influencing societal trends, providing in-depth analysis on complex

and controversial issues and introducing the international experience of academies.

- We are present in different parts of Estonia, organising presentations by academicians and other top scientists in counties and companies, visiting schools, arranging lecture series.
- We present to the public the leading ideas of contemporary scientific thought and culture, involving for that scientific societies and associations of scientists active in Estonia.
- We continue publishing internationally recognised scientific journals.
- We organise debates and seminars focused on key issues in Estonian education, culture and history at the Academy and its associated scientific societies.
- We create opportunities for the best student researchers for direct contacts with top scientists.
- We represent cutting-edge knowledge and scientific culture through organising research competitions for students and schoolchildren, and through participating in their juries.

## 3. Synopsis

The Academy considers it important (i) to go beyond the classical framework of representing cutting-edge science and to address the society, (ii) to make its members and support structure capable of providing the best possible science-based knowledge to the country, (iii) to be present and visible wherever the voice of top scientists needs to be heard, (iv) to become a platform of sharing the best ideas from Estonia and (v) to amplify innovative ideas from the academic community in Europe and around the world.

## EUROPEAN GUIDELINES ON VENTILATION TO PREVENT THE SPREAD OF COVID-19

*Besides their main work, several Academy members have acted as experts and advisers on Estonian and international committees and councils. This is an example of such activities.*

*The Federation of European Heating, Ventilation and Air Conditioning Associations (REHVA) has in the past two years prepared European guidelines on ventilation. The guidelines were prepared as a result of the work of the REHVA COVID-19 Task Force, led by the Academy member Jarek Kurnitski.*

The European guidelines on operating ventilation systems of buildings and ensuring better air exchange during the COVID-19 crisis have been downloaded several hundred thousand times and have found practical use in nearly all of the European Union countries, as well as outside Europe. The extensive guidance material ([www.rehva.eu/activities/covid-19-guidance](http://www.rehva.eu/activities/covid-19-guidance)) consists of several parts and includes two ventilation calculators for determining the rate of ventilation necessary to prevent the risk of infection.

REHVA published the first version of its guidance material on 17 March 2020. It prepared the measures on the basis of airborne (aerosol-based) transmission of the virus, therefore contradicting the position at the time of the World Health Organisation and various other organisations. That launched a worldwide debate which together with research results confirmed the domination of airborne transmission both in close contact and otherwise. REHVA's guidance had a huge effect in Europe and the rest of the world: it was used by international specialists, translated into 13 languages and reached the work desks of many governments.

In March 2020, REHVA and Jarek Kurnitski were the first to rely on aerosol physics and experience from a previous virus, SARS-CoV-1, in claiming that infection through breathing in the fine particles or aerosols created when emitted droplets vaporise could not be excluded. Smaller aerosol particles of 5 to 10 microns are suspended in air and cover long distances, which is why the one to two metre distance is not sufficient: rooms also have to be well ventilated in order to avoid high concentrations of virus particles.

Stuffy and overcrowded indoor rooms with deficient ventilation are considered the most dangerous ones: many cases of infection in such places have been reported in research literature. A 0.1-micron SARS-CoV-2 virus particle (for reference: 1 m = 1,000,000 micrometres) is contained in exhaled particles with a diameter of 0.5 microns to 2 millimetres, but particles of over 100 microns do not enter the respiratory tracts of humans. The virus stays active for up to three hours in indoor air and for two or three days on surfaces, but as far as is known there have been no cases of infection with this virus from surfaces.

# REHVA COVID 19 GUIDANCE



Currently, the guidance material is version 4.1 and includes several annexes and a ventilation calculator prepared for assessing the risk of infection.

In Estonia, REHVA's guidance has been implemented in Regulation No. 8 of the Minister of Economic Affairs and Infrastructure (initial version from 7 April 2020 and the currently valid version from 29 November 2020) and in more in-depth guidelines of the Consumer Protection and Technical Regulatory Authority ([ttja.ee/ariklient/ehitised-ehitamine/ventilatsioonisustemide-too-viiruse-tokestamiseks](http://ttja.ee/ariklient/ehitised-ehitamine/ventilatsioonisustemide-too-viiruse-tokestamiseks)) and has launched a public debate about the need to improve the ventilation of school buildings.

In view of the possible new waves of the virus, TalTech has proposed the preparation of reports on the technical inspection of ventilation systems in order to certify the safety of buildings. The appropriate methodology has been developed and tested in cooperation with the Consumer Protection and Technical Regulatory Authority.



Photo: Reii Kõkk

Jarek Kurnitski.

# ACADEMY'S YEAR OF ELECTIONS

## THE ELECTION OF NEW ACADEMY MEMBERS

*Four new Academy members were elected in 2021. The conferences of Academy member candidates were held on 27 October and 2 November 2021.*

The election of new members is divided into three stages. First, the Board of the Academy considers which scientific fields require additional competence within the family of Academy members and is it time to make room for brilliant representatives within various fields of the creative arts. The titles of vacancies are worded in the divisions of the Academy quite broadly to make it possible for multiple top scientists or outstanding creative persons have a chance to apply. The Board may adjust the requirements a little based on the interests of the Academy as a whole.

Above all, the Academy determines the areas of specialisation of new members on the basis of Estonia's needs and any gaps in the competence of the Academy that need to be filled. The aim is to be prepared to give the state and its institutions good advice at all times. This kind of a starting point presumes that there are multiple outstanding scientists in the announced areas of specialisation in Estonia.

The titles and number of vacancies are usually announced half a year before the elections. The areas of specialisation are selected even earlier. The selection is usually made as a result of years of discussions, with an effort to maintain a balance between natural and social sciences. In 2021, the choice of areas of specialisation was clearly influenced by the conclusions drawn from the coronavirus pandemic experience: any threats to human health must be nipped in the bud and we need top-level knowledge and skills to do so.

Candidates can be submitted by Estonian universities, research institutions, learned societies, creative unions and

associations. Every Academy member also has a right to nominate candidates. The idea is simple: the selection is primarily made from amongst those whom others consider to be at the level of Academy members.

To be elected an Academy member, the nominee must receive 2/3 of the votes of the Academy members participating at the General Assembly.

Elections are generally held once every two or three years. Three years ago (2018), the Academy gained seven new members: Marco Kirm, Jarek Kurnitski, Kalle Kirsimäe, Anne Kahru, Tiit Tammaru, Anu Realo and Tiina Randma-Liiv. In 2020, another three were added: Krista Fischer, Veiko Uri and Elmo Nüganen.



Photo: Reiti Kolk

## New Academy members

Based on materials published on Public Broadcasting's portal Novaator

### Academy member in public health Maris Laan

The Academy member Maris Laan is Professor of Human Genetics at the University of Tartu. Her research is focused on how to have healthy babies and how people for whom for some reason this seems impossible – for instance, due to a faulty gene in the genome – can have healthy babies. In technical terms, reproductive genetics and genomics are the focus of her work. Specific research questions vary from the genetic causes of infertility and their possible effect on the next generation to analysing the placental genomes of pregnant women and studying the genetic factors of pregnancy-related complications and related predictive (prognostic) biomarkers.

Her major ongoing projects in cooperation with the Men's Clinic and the Women's Clinic of the Tartu University Hospital are related to studying the genetic causes of infertility in men and women and pregnancy loss, and the development of an early predictive test for a condition occurring in some pregnant women, preeclampsia (or a combination of high blood pressure and high levels of protein in their urine), and the assessment of its impact on clinical practice ("Maternal serum-based multimarker test for the assessment of the risk of developing preeclampsia: translation to the clinic" (ESTPRE study)). The symptoms of preeclampsia may develop very quickly and endanger the life of both the woman and the child. These research topics are important for the whole society and the related clinical cooperation is expanding to hospitals in Tallinn. Professor Laan has supervised the master's theses of 22 students and the doctoral theses of nine students.

Maris Laan is a member of the Estonian Research Awards Committee, the Council of the Institute of Biomedicine and Translational Medicine of the University of Tartu, the European Society of Human Genetics (ESHG), the Estonian Society of Human Genetics (EstSHG) and the European Academy of Andrology (EAA). Professor Laan was the president of EstSHG in 2017–2019. She contributed to the activities of ESHG as a member of the programme-organising committee of the European Human Genetics Conference in 2017–2021. She is a member of the EAA Continuing Education Committee and is the initiator and coordinator of the EAA genetics course. She has been a long-term grant application expert at the European Commission and for several international funds in Europe and beyond. She is also a substitute member of the Council of the Faculty of Medicine of



Photo: Hendrik Osula

the University of Tartu and the Evaluation Council of the Estonian Research Council.

In 2019, Maris Laan was awarded the Medal of the Baltic Academies of Sciences. In 2018, she was awarded the University of Tartu Badge of Distinction and nominated for the database of remarkable European female scientists, AcademiaNet. In 2010, Maris Laan was awarded the Research Award of the Republic of Estonia in chemistry and molecular biology. She has received the research grants Wellcome Trust<sup>4</sup> International Senior Fellowship (2004–2012, United Kingdom) and Howard Hughes Medical Institute International Senior Scholarship (2006–2011, USA) for establishing an independent research area at the University of Tartu.

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**What do you consider the most enjoyable moments of your life or career so far, and to what extent do these coincide with the reasons for which you were nominated as an Academy member candidate?**

I have to honestly say that the most enjoyable moments of my life so far are not related to my research. As with many people, they were the births of my children.

<sup>4</sup> Named after Sir Henry Wellcome, it supports the development of top-level health sciences – ed.

The most emotional moments for me in becoming a scientist have been connected to the steps of a young person on this bumpy and uncertain path that has always been haunted by the question “Is this truly me?” The opportunity to start doctoral studies at the University of Helsinki in 1993 was of great importance. I found myself studying medical genetics under the guidance of Professor Aarno Palotie and Professor Leena Peltonen-Palotie (1952–2010). I then spent my post-doctoral years – which still motivate me – at the University of Munich in the research group of Professor Svante Pääbo<sup>5</sup>.

Even events that at first seem random may be life-changing. I ended up in the area of reproductive medicine in 1999, because I was looking for professional employment in the US, where my husband was engaged in postdoctoral research. And the area captivated me for decades!

My career as a scientist would probably have been a lot more modest in Estonia if its beginnings in 2003 had not been bolstered by the research grant from the Wellcome Trust in the United Kingdom, received after tight competition. I so clearly remember the moment when I received the letter informing me of the positive funding decision for the project. It then hit me that I was about to create my very own research area at the University of Tartu.

The Research Award of the Republic of Estonia I received in 2010 was a great acknowledgement of the research I had launched. It gave me the strength and desire to continue. During the nearly 20 years of working in Estonia, enjoyable moments have included the publication of important research, my supervised students defending their doctoral theses, and presentations at important science forums and to wider audiences. It is good to feel that what you do and say counts. The biggest recent surprise, which left me speechless, was the Medal of the Baltic Academies of Sciences.

I don't believe that any of these events or any other event was the sole reason for nominating me as an Academy member candidate. As with other candidates, it was my whole career as a scientist and my overall independent research contribution.

### **What are the main challenges in your area in Estonia and in the world as a whole?**

My area of research is reproductive medicine and, more specifically, reproductive genetics. This covers the entire circle of life, i.e. the genetic factors which cause infertility, loss of pregnancy and other pregnancy-related complications, and the reproductive health of men and women.

There are multiple challenges. Up to 15% of couples do not succeed in having children and up to 3% experience

repeated pregnancy losses. It is thought that a large number of cases without clear causes – unexplained cases – are due to currently unknown genetic factors.

Reproductive health problems are very personal and emotionally difficult topics. We have also found that the genetic factors related to both infertility and pregnancy loss are very heterogenic. Epidemiological studies have shown that infertility and reproductive health problems more generally are related to a higher risk of other diseases.

Indeed, efforts to understand whether, and which, infertility-related genetic causes also pose risks of other chronic diseases will form one of the largest areas of activity in the coming years. One of the specific challenges in reproductive genetics is that the effects of the same genetic factor depend on gender and sometimes also stage of life. For instance, some aspects are only manifested in the development of the embryo.

We are gradually solving these mysteries both here in Estonia and across the whole world. We have common objectives: to improve the molecular diagnostics and prevention of reproductive disorders and to apply the knowledge of their aetiology in treating patients and developing cures.

### **How do you see the role of Academy members in the 21st century society and how visible should they be in everyday life?**

As top-level scientists, Academy members should be trustworthy sources of information and opinion leaders for society in their areas of specialisation. They should be people whom you can always turn to when you need evidence-based information and easily understandable explanations.

The Academy as a whole represents the Estonian scientific community and its diversity. It can transmit more influential and balanced messages to society, politicians and decision-making bodies than any individual scientist can.

The Academy definitely plays an important role not only in the Estonian scientific landscape, but also in having a say and exerting an influence on topics related to higher education. A large number of the Academy members are lecturers at universities and the Academy therefore influences a large part of society. Estonia currently has more than 40,000 students and nearly 400,000 people with higher education. The Academy connects the Estonian scientific community across areas of specialisation with the networks and experience of the scientists of other countries.

The visibility of Academy members in everyday life depends on the topics of discussion that are currently important in society. It is a pleasure to state that the visibility and activity, as well as the weight, of the messages of the Estonian Academy of Sciences in the Estonian society has grown significantly in the past 10 years.

<sup>5</sup> Svante Pääbo was elected a foreign member of the Estonian Academy of Sciences in 2019 – ed.

## **What does the title of Academy member mean to you personally and how will it change your life?**

Above all, being nominated as an Academy member candidate represents recognition and acknowledgement of the long-time research conducted by myself personally, our work group and close cooperation partners in general. The title of Academy member will bring greater attention and the responsibility to be a driving engine in my area of specialisation, both in research and in society.

I have always liked communicating with smart people. I am glad for the opportunity to get to know remarkable scientists of different areas of specialisation more closely, and to have access to their stores of knowledge and experience. New and innovative ideas are often engendered by contacts between different areas, broadening the way of thinking of scientists and the whole of society.

## ***Academy member in cultural history Marek Tamm***

The Academy member Marek Tamm is Professor of Cultural History at Tallinn University. His research is focused on Estonian medieval history, European medieval cultural history, cultural memory studies, historical theory and the history of historiography.

His current projects are related to the digital history of Livonia in the framework of developing the Tallinn University Centre of Excellence in Intercultural Studies, and to the analysis of cultural data in the framework of the European Research Area Chair for Cultural Data Analytics<sup>6</sup>.

Nine master's theses and two doctoral theses have been defended under Professor Tamm's supervision.

Marek Tamm is the editor-in-chief of the journal *Acta Historica Tallinnensia*, an editor of the journals *Vikerkaar* (in Estonian) and *Journal of the Philosophy of History*, Chair of the editorial board of Tallinn University Press, Chair of the Graduate School in Culture Studies and Arts, and Head of the Tallinn University Centre of Excellence in Intercultural Studies. He is a member of the Tallinn University Council, the board of the International Society for Cultural History, the board of the International Commission for the History and Theory of Historiography

6 The European Research Area (ERA) Chairs are established with the aim of helping countries of weaker research and innovation capabilities by providing the opportunity to employ remarkable researchers at institutions with indisputable potential for cutting edge research. This is an EU framework programme measure. Estonia was the most successful country under the ERA Chair measures in the previous framework programme. In total, Estonia has received 14 ERA Chair projects: seven at the University of Tartu, three at TalTech, two at Tallinn University and two at the Estonian University of Life Sciences. These generally involve large amounts of funding. Over a current four-year period (2019–2023), the Tallinn University ERA Chair is being financed with 2.5 million euros – ed.



Photo: Hendrik Osula

and the board of the Council of the Doctoral School, and a founding member of the Tallinn University Centre for Medieval Studies. Since November 2021, he has been a member of the Research and Development Council as a representative of the scientific community.

He was awarded the Tallinn University Badge of Merit in 2015.

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## **What do you consider the most enjoyable moments of your life or career so far and to what extent do these coincide with the reasons for which you were nominated as an Academy member candidate?**

Everyone who has experienced the pleasure of creating or discovering something new knows that life does not offer many things that are better. So, the most enjoyable moments of my life so far have definitely been related to the fruits of academic creative work and they are definitely linked to my nomination as an Academy member candidate.

## **What are the main challenges in your area in Estonia and in the world as a whole?**

It seems to me that the most important question is how to better understand the relationships between culture and nature, and how to establish human relationships with other forms of life on new foundations. This also requires the reinterpretation and expansion of the human image of history. Historians, including cultural historians, play a very responsible role in this.

## How do you see the role of Academy members in the 21st century society and how visible should they be in everyday life?

In my understanding, being elected to the Academy primarily means having earned a new and important social role. The Academy of Sciences is not a science establishment, i.e. no science is done there. It is a public institution, the main task of which is to offer the Estonian society and its leaders the best knowledge for planning the future and solving various problems. Individual visibility is definitely not of primary importance, while being prepared to speak up in public within one's competence certainly is.

## What does the title of Academy member mean to you personally and how will it change your life?

In the Estonian language, the word "akadeemik" (historically used to denote the Academy members – ed) has, due to the influence of the English language, undergone a certain devaluation, as all academic employees are now called academics (in many texts originating from English-language media channels – ed). I think it is important to retain the initial and actual meaning of this word: an elected member of the Academy of Sciences.

As bestowing the title of Academy member is decided by other Academy members, it is, above all, collegial recognition and, as it comes from the best in their fields, it is naturally very valuable.

## *Academy member in astronomy and astrophysics Elmo Tempel*

The Academy member Elmo Tempel is a Professor of Astronomy at the Tartu Observatory of the University of Tartu. His main areas of research include the evolution processes of galaxies, the mapping of large-scale structures of the universe, the links between these structures and the evolution of galaxies, and the determination of the origin of dark matter.

His current major projects are focused on galaxies in the cosmic web, the dark universe and cosmic superclusters, the giant voids in the universe and the gigantic radio galaxies located in them.

Six master's theses and three doctoral theses have been defended under Professor Tempel's supervision.

Elmo Tempel is a member of the 4MOST (4-metre Multi-Object Spectroscopic Telescope) and J-PAS (Javalambre Physics of the Accelerating Universe Astrophysical Survey) research groups, the review panel of Cycle 28 Hubble Space Telescope proposals, the Council of the Tartu Observatory of the University of Tartu, and the International Astronomical Union. He is a founding member of



Photo: Hendrik Osula

the Estonian Young Academy of Sciences and organises the annual Tartu–Tuorla cosmology seminars.

He was awarded the Research Award of the Republic of Estonia in exact sciences in 2017 and the Young Scientist Award of the President's Cultural Foundation in 2013.

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## What do you consider the most enjoyable moments of your life or career so far and to what extent do these coincide with the reasons for which you were nominated as an Academy member candidate?

From the science point of view, the moments when I can engage in a new and interesting scientific challenge or problem are the most enjoyable ones. I am happy that I've had the opportunity to deal with tasks that give me satisfaction. In order to be successful, you should be involved with topics that are of interest to you, both in research and outside research.

## What are the main challenges in your area in Estonia and in the world as a whole?

As science is international, the challenges are common to both Estonia and the world as a whole. Several new-generation observation instruments and telescopes are currently being designed. These will generate dozens of times more observation data as all of the current telescopes put together.

One challenge involves their effective use and the development of new algorithms and analysis methods suitable for astronomical metadata. An increasing amount of observation data is coming in and computers are getting better and better. In connection with that, the wishes and ambitions of scientists are also growing. In order to shift the boundaries of science, we always need more and better observation data and faster computers.

**How do you see the role of Academy members in the 21st century society and how visible should they be in everyday life?**

The society of this century should largely be based on a science-based view of the world. All scientists and particularly the Academy members should be strongly involved in this.

**What does the title of Academy member mean to you personally and how will it change your life?**

Becoming an Academy member is definitely a great recognition of my career as a scientist so far. It will not have a direct impact on my everyday life, but will certainly add responsibility and give me a stronger say on topics that matter to me, such as the dissemination of the science-based view of the world.

***Academy member in engineering and computer sciences Dmitri Vinnikov***

The Academy member Dmitri Vinnikov is Lead Research Scientist and Head of the Power Electronics Research Group at Tallinn University of Technology. His main areas of research include the synthesis and testing of diagram solutions for innovative energy-efficient DC/AC voltage converters. These involve highly demanding applications, such as in renewable energy production, electric transport, telecommunications and aviation.

Dmitri Vinnikov is an internationally recognised power electronics expert and an inventor who has made significant contributions to studying and developing innovative semiconductor converters used in the renewable energy sector.

His current projects are focused on the development of the power electronic systems of residential DC micro-grids, the charging infrastructure of electric vehicles and single-stage buck-boost partial power converters. At the Estonian Centre of Excellence for Zero Energy and Resource Efficient Smart Buildings and Districts (ZEBE), Dmitri Vinnikov coordinates the work of the research group on power electronics and consumption management.

Dmitri Vinnikov has successfully supervised 11 doctoral theses and six postdoctoral research projects.



Photo: Hendrik Osula

Dmitri Vinnikov is Chair of the Estonian Sections of IEEE (Institute of Electrical and Electronics Engineers, the world's largest organisation of engineering scientists and engineering area professionals), and the editor of the journals Open Journal of the Industrial Electronics Society, IEEE Transactions in Industrial Electronics and IEEE Transactions in Power Electronics, a member of the Steering Committee of the IEEE Journal of Emerged and Selected Topics in Industrial Electronics, a member of the Student and Young Professionals Activity Committee of the IEEE Industrial Electronics Society (IEEE-IES), a member of the Estonian Research Council Expert Committee for Natural Science and Engineering, and a member of the European Spallation Source (ESS) Accelerator (ACCSYS) Collaboration Board. He is a co-founder of the Estonian green start-up Ubik Solutions OÜ, and the inventor of the OptiVerter, a unique hybrid solar share-tolerant micro-converter technology.

In 2020 and 2021, Stanford University ranked Dmitri Vinnikov among the top 2% of the world's most influential scientists on the basis of the Scopus database. In 2017, TalTech elected him Scientist of the Year. He was elected an honorary doctor of Chernihiv National University of Technology in Ukraine in 2016. Dmitri Vinnikov was awarded the Research Award of the Republic of Estonia in engineering sciences in 2014 and was elected the 2009 Best Young Scientist by Tallinn University of Technology in 2010.

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**What do you consider the most enjoyable moments of your life or career so far and to what extent do these coincide with the reasons for which you were nominated as an Academy member candidate?**

For the past 20 years, I have actively worked on the development of industrial power electronic systems of different power levels and applications, from super-compact micro-converters of less than 1 kW for residential solar power systems to large converters of several hundreds of kW for railway and industry applications.

My most exciting and inspiring moments have included those when I see how a technology that has long been developed in a lab becomes an actual product and starts serving society and driving technological development.

**What are the main challenges in your area in Estonia and in the world as a whole?**

The energy revolution and sustainable power engineering are particularly hot topics not just in Estonia, but throughout the world. Power electronics and the efficient conversion of energy are keys to the green transition in the energy sector and the sustainable development of society. The power electronics sector has been growing at an extremely rapid pace in recent years partly thanks to the green transition-driven development of the industry and transport sector throughout the world.

New developments in power electronic systems must allow us to create smart future cities, smart power networks with flexible power transmission, and energy-positive buildings. Power electronic solutions also play an important role in the development of climate-neutral transport,

energy-smart industry, and the renewable energy systems operating in the free power market.

**How do you see the role of Academy members in the 21st century society and how visible should they be in everyday life?**

In the area of technology, an Academy member should be a visionary who directs technological development, one who feels responsible for it and can appreciate its broader impact. An Academy member also has to be an ambassador of science who uses the best knowledge to help society make properly contemplated and sustainable decisions of far-reaching impact.

An Academy member is undoubtedly also an advocate of higher education in a country, in order to ensure the consistency and high quality of the scientific community in areas important to the state.

**What does the title of Academy member mean to you personally and how will it change your life?**

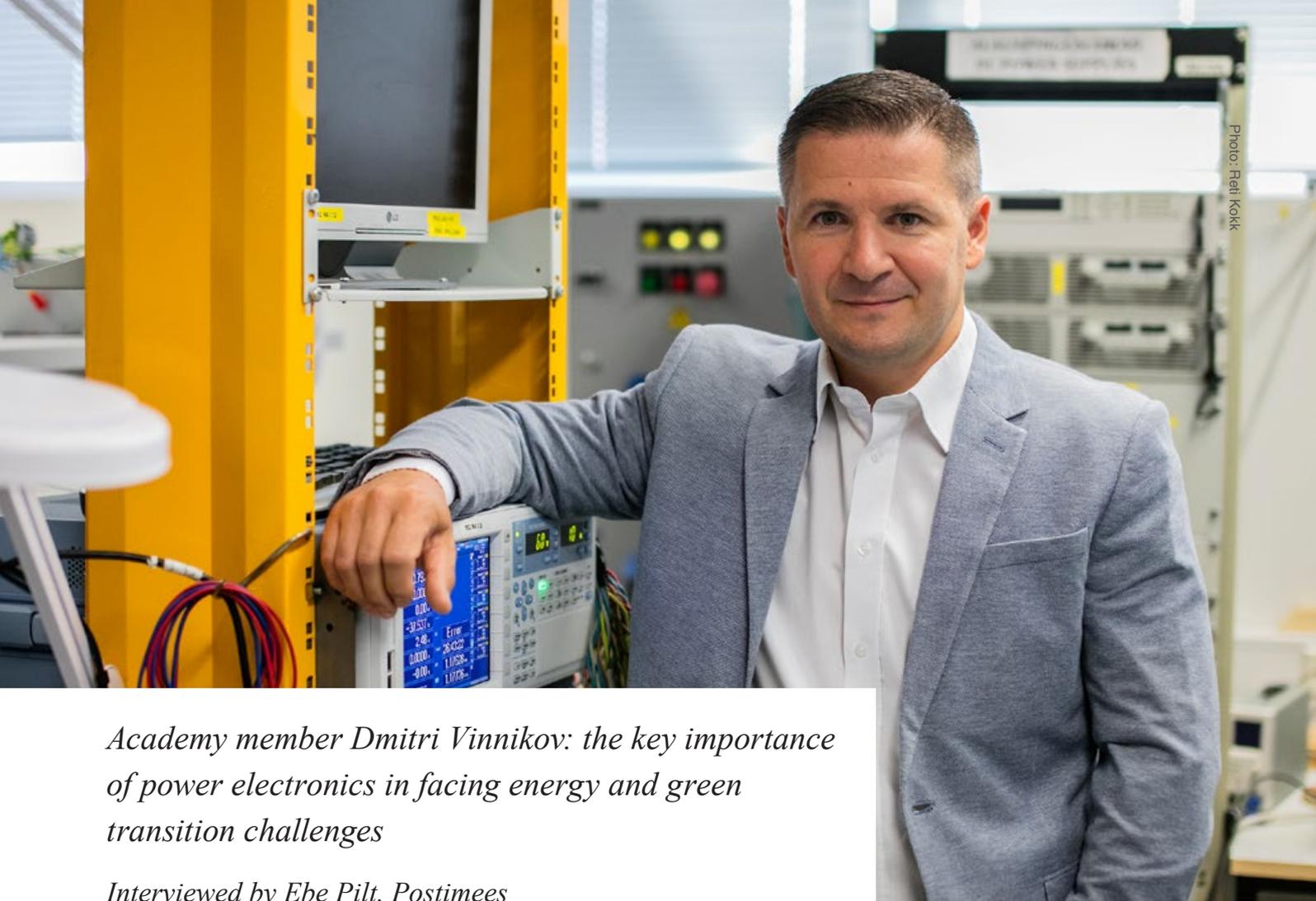
It is definitely a great recognition of my work so far, and it means greater responsibility towards society. I hope to contribute more to the development of both the Estonian state and the Estonian Academy of Sciences by offering new knowledge and experience in important areas related to the energy revolution and the green transition, such as energy efficiency, electric transport, energy independence and energy security.

Thanks to a strong international network, I will also be able to increase the visibility and research policy reach of Estonia's cutting-edge research all over the world.



Photo: Hendrik Osula

The Academy members elected in 2020 and 2021 were inaugurated at the Hall of Mirrors of the Academy of Sciences on 14 December 2021.



## *Academy member Dmitri Vinnikov: the key importance of power electronics in facing energy and green transition challenges*

*Interviewed by Ebe Pilt, Postimees*

*The TalTech Lead Research Scientist, Academy Research Professor 2019–2021 and head of the power electronics research group Dmitri Vinnikov was elected an Academy member in late 2021. Ebe Pilt met the new Academy member at TalTech to discuss current research projects, and a few other matters.*

**Power electronics is increasingly ubiquitous, involved in practically everything. But what is it, actually? Electricity generation, use, conservation or something else?**

In the big scheme of things, it's currently connected to our attempt to keep our environment cleaner. We are increasingly using electricity in place of other forms of energy. Often, though, electricity can't be used directly, since it has to be converted into movement, light, sound, heat or some other useful energy form. These different forms require different voltages, frequencies and amounts of current; in fact they may even need electrical current that changes in a precise manner. The function of power electronics is to convert existing electricity to the necessary form.

Power electronics and the engineering that goes into it have a major impact on our daily lives. Not a single economic sector or walk of life is untouched by it, from smartphones, pacemakers, kitchen appliances and lighting all the way up to automotive electrical parts and equipment

Power electronics is a branch of electronics that deals with the conversion and control of electrical energy through electronic converters. Their main active components, such as transistors and thyristors (semiconductor devices with two, three or four layers—ed), are combined with passive components: diodes, resistors, capacitors, transformers and so on.

needed for connecting wind turbines, solar panels and energy storage units to the power grid.

Electrical consumption around the world has grown continuously over the last half century. In recent years, it has approached 24,000 terawatt-hours a year. Power electronics handle over 70% of this energy. By 2030, the percentage is expected to top 80%.

Power electronics can be used to develop breakthrough technologies, increase the efficiency of systems, and make them more compact (so we use less land and resources) and more reliable (i.e. systems work even in severe conditions). All this significantly facilitates progress toward carbon neutrality.

It can be said with certainty that power electronics have become the engine behind the green transition and sustainable development.

### **Tell me a little about the history of power electronics.**

Power electronics can be considered to have begun in 1901, when the American electrical engineer Peter Cooper Hewitt (1861–1921) invented and patented a mercury arc rectifier used in converting high-voltage alternating current to direct current. The first rectifier based on this invention was built in 1902. Mercury alternators began to be used on electric railways, industrial electrical drives, trams, high-voltage direct current transmission lines and radio transmitters.

In 1933, a selenium rectifier<sup>7</sup> was invented, and was used in radio and television equipment. This was only the prologue to the real development, which started in 1957 with the American firm General Electric releasing the first silicon-controlled semi-conductor switch: a thyristor capable of handling high voltage and relatively high wattages.

From that point on, development yielded a number of rapid and powerful semiconductor devices, such as the MOSFET (metal oxide semiconductor field-effect transistor), in which conductivity is controlled by voltage, and the IGBT (insulated-gate bipolar transistor), which uses a small input drive to switch high voltage (thousands of volts) and strong current (1,000 amperes and more) in an output circuit.

Analogue and digital control systems in the field of power electronics have made strong forward strides. Power electronics appear to have quietly been applied in such wide uses that it can be considered the main technology on which modern life is based. Today, computer power adapters, battery chargers, home appliances, office and industrial equipment, railways, cars, watercraft, aircraft, generator equipment, distribution systems and much more are based on power electronics.

### **How did you end up in power electronics? What is most interesting and inspiring about it?**

My first interest in electricity developed in my childhood. I built torches from odds and ends to light my way home from school in the evenings. For a small boy it was fascinating to see the light come on when it was connected to a battery and turn off when the circuit was interrupted.

The torch was followed by much more complicated experiments with micro-motors, diodes, reed (herkon) switches (including reed relays) and much else. My first experience winding inductive poles and using transistors came with a radio receiver erector set. As my first practical assignment in power electronics, I built a colour music system with thyristors and home-made transformers.

<sup>7</sup> Hempstead, C. A., Worthington Jr, W. E. (eds). Encyclopedia of 20th century technology. Routledge 2005, p. 669: it was invented by Charles E. Fitts in 1933; most internet sources do not mention this information.

*A torch is the simplest example of how a flow of energy can be controlled as the consumer desires: the main function of power electronics.*

I get nostalgic now thinking back on how exciting that was. Actually it was far from simple building those things, especially considering that electronics components were so hard to come by in the late 1980s.

My career in my speciality started in 1993, when I started studying engineering at Tallinn University of Technology. At that time, students had to choose a major at the end of their first year. I'm very grateful to the former director of the Department of Electrical Drives and Power Electronics, Juhan Laugis, who helped me make the right decision.

The door to the world of applied power electronics was opened for me in 1999 by Jüri Holler (the current director of OÜ Energiatehnika), who was the main tutor for power electronics students at Tallinn University of Technology. Under his tutelage, I tried to apply my theoretical knowledge to develop commercial applications.

Since that time, applied power electronics has been a fixture in my life. One of my most exciting experiences was seeing the technology from my lab start making people's lives better: saving energy and promoting economic innovation. The key role that power electronics plays in society will only increase.

### **A home washing machine is powered by alternating current, while an electric car runs on direct current. What's the difference between them?**

Electricity is used as alternating or direct current: we need both kinds. Through the sockets in our homes and workplaces, we can use alternating current, which is universal. It changes its direction cyclically. In Estonia and a large part of the world, the cycles repeat 50 times a second. That is where the 50 Hz comes from, which is called the alternating current frequency.

Unlike alternating current, direct current flows in one direction. Its sources include batteries, super-capacitors, solar panels and fuel cells. Alternating current can be transformed into direct current using what is called a rectifier, one of the main applications of power electronics.

In many home appliances and equipment, electricity is transformed in several steps. For example, in a laptop charger, the alternating current from the socket is first turned into direct current and then from high direct current



Photo: Eero Vahamägi / Postimees Scanpix

Power Electronics Laboratory of Tallinn University of Technology: Saeed Rahimpour, Oleksandr Matiushkin, Parham Mohseni, Dmitri Vinnikov, Vadim Sidorov.

voltage to low direct current voltage so it can be used properly to power a laptop and charge its battery.

Energy losses always occur each time current is transformed. That is the precise reason that a charger becomes warm during operation. Some percentage of power always becomes heat during the process. Power electronics scientists expend a lot of effort to reduce these losses and make the process of current transformation more efficient.

**In the beginning of the era of electricity, alternating current was used in many places? It was practically the standard in the US. Thomas Edison championed direct current in the late 19th century, while Nikola Tesla believed that alternating current was the future. Edison became wealthy, Tesla remained poor. Yet the worldwide standard today for electricity transmission is alternating current. Why? Is it all about money or are other factors involved?**

The chapter in electrical engineering history known as the “war of the currents”<sup>8</sup> started in the late 1880s. Edison was developing a practical direct current-based energy system

<sup>8</sup> The war of the currents was a series of events surrounding the introduction of competing electric power transmission systems in the late 1880s and early 1890s – ed.

for homes, offices and entire city districts. Back then, the main problem with direct current systems was increasing and decreasing voltage. These operations are necessary to efficiently transmit electricity across long distances. Direct current-generating power plants had to be close to consumers, which was sometimes very complicated in cities. This required more power plants, more generators and more copper wires. Tesla introduced the idea of using alternating current, whose voltage could easily be raised or lowered using a transformer. By raising the voltage, alternating current could be transmitted with very low losses over much greater distances. At the other end of a long power line, a second transformer was used to lower the voltage to a level safe enough for everyday use. Since electricity could be transmitted over long distance, fewer and larger power plants could be used, and this made it cheaper to use them.

Thanks to the higher voltage, the alternating current grids used finer wires, which lowered prices. So these economic arguments made alternating current the winner of the “war of the currents”. Tesla, who was a brilliant inventor and great visionary but a poor businessman, didn’t reap any dividends from this and instead others profited from alternating current.

*Thanks to transformer equipment developed through power electronics, direct current voltage can be raised and lowered. Current can also be rectified and inverted.*

Thanks to constant progress in power electronics, direct current systems have become much more stable and new methods have been developed to direct renewable energy into power grids and for the transmission of power over long distances with low energy losses.

HVDC technology allows direct current to be used in very large energy systems. As a result, the full potential of renewable energy sources can be tapped, especially in remote places. HVDC transmission lines are used today to connect countries, islands or offshore wind farms with the mainland. This opens up new opportunities for energy trading as well. A good example is the undersea direct current cable on the seabed between Estonia and Finland, EstLink, which transmits 350 MW of power over a distance of 100 km. After the opening of EstLink 2 in 2014, the transmission capacity between the two countries more than doubled (from 350 MW to 1,000 MW in the Estonia to Finland direction and 860 in the opposite direction).

### **Does the future belong to alternating or direct current? Or do both have their role?**

Over the past century, alternating current has been in the dominant position, but developments in the last few decades have made it possible for direct current to make a comeback. It is generated in many renewable sources and used widely in consumer electronics, such as TVs, mobile

Power electronics can be found in many home appliances and systems, including heat pumps, air conditioners, refrigerators, washing machines, induction stoves and coffee machines. A good example of an application of power electronics in a household appliance is an inverter. Like rectifiers, inverters play an important role in the efficient conversion of electricity. They turn direct current into alternating current using semiconductor electronics and they are used to regulate electricity in the most efficient way possible. Inverters are used in many home appliances to regulate the speed of motors, such as the compressors of A/C units and heat pumps, and the spinning parts of washing machines.

phones, computers and LEDs. Thanks to power electronics, the rectification and inversion of current have become simple, efficient and reliable. This is the key to the flexible and energy-efficient control of many different processes.

Since an inverter requires direct current as the input, the alternating current from the wall socket must be rectified first. Despite the energy losses from the series of rectifications and inversions, it is still the most efficient and reliable way to direct electricity. Unlike during the war of the currents, the opposing technologies have turned into a cooperative hybrid.

Scientists and engineers don't criticise one or the other but use the best of both worlds.

### **Your work for the green transition and energy reform involves a great responsibility to society. How do you see that responsibility?**

Power electronics is one of the key technologies for energy conservation and for actually making the transition a reality. It plays an exceedingly important role in energy generation, storage, transmission and distribution, as well as in consumer applications. Power electronics scientists and engineers work every day to make power electronics devices lighter, cheaper, smarter, more efficient and more compact.

For the last 20 years, we at Tallinn University of Technology have been working on developing various energy-saving power electronics system and getting them adopted in industry. In 2000–2012, our main focus was on achieving energy savings in rail transport (trams, electric trains and so on). For example, we developed new traction and auxiliary power converters for Tallinn trams, and took out several patents on the inventions.

From 1999 to 2004, our technology was used to renovate 28 trams in Tallinn. Trams with innovative digital control methods coupled with the newest transistors and patented schematics for drive systems and auxiliary power converters have resulted in astonishing energy savings, up to 45%. Travel has also become more comfortable for passengers, since the acceleration and braking have become more fluid. The overall noise level has dropped thanks to power electronics, which involves very few moving parts. By 2010 we had developed an auxiliary power converter for electric trains, which had a new type of schematic and was marketed by TET Estel AS.

Since 2012, we have mainly focused on developing power electronics devices for renewable energy: converters for solar panels, hydrogen fuel cells, storage batteries, small wind turbines, and the like. One such device is a microconverter for solar panels; it has a completely new operating principle. What makes it special is its ability to take the maximum energy from the solar panel even if the panel is partially covered with snow, dust, leaves or bird

droppings. This technology was later given to the green tech start-up Ubik Solutions OÜ to be marketed.

I am very happy to see how research and industry in Estonia can work together, maintaining development and momentum toward a carbon-neutral energy sector.

### **Power electronics at today's Tallinn University of Technology**

The power electronics research group at Tallinn University of Technology is the largest applied power electronics research centre in the Baltic states. Since 2010, we have been members of the ECPE (European Centre for Power Electronics). It is an industry-led development organisation with the mission of promoting power electronics innovation, research, specialised education and the spread of ideas throughout Europe. We are also members of the ZEBE, the Estonian Centre of Excellence for Zero Energy and Resource Efficient Smart Buildings and Districts. Our function at ZEBE is to develop direct current technology for household use and to develop other power electronics systems that contribute to highly energy-efficient buildings.

In addition, we are engaged in many other domestic and international development projects, where we develop electric car chargers, direct current micro-networks for domestic households, solar energy systems integrated with buildings, power semiconductor converters for supercapacitors, fuel cells and electrolyzers. We create power electronics stems for other scientific organisations as well, such as CERN (*Conseil Européen pour la Recherche Nucléaire*) and ESS (European Spallation Source).

In the research group, we have succeeded in fusing our knowledge and experience with top-of-the-line equipment. We are engaged in regular cooperation with Estonian and other European industrial enterprises. This provides our students and young researchers with particularly valuable experience in the field of analysis, computer simulations, experimentation, data processing, measurement, prototyping and production.

### **What is the central idea or physical principle behind replacing a large, heavy transformer with a small, compact device? Or behind turning direct current into alternating current with a small box without any moving, clattering or humming parts?**

The measurements and weights of transformers operating on alternating current are directly dependent on their operating frequency. The ordinary 50 Hz transformers are big and heavy. Their magnetic cores are usually made of steel sheets, which adds even more weight. Such equipment generates a 50 Hz hum, which is within the range of human hearing (20 to 20,000 Hz).



Photo: Eero Vabamägi, Postimees/Scanpix

Power electronics helps make such transformers much smaller and quieter, enabling much higher operating frequencies to be used. For example, new laptop chargers work at frequencies over 100,000 Hz, which allows the transformers to be miniaturised 30-fold. As a result, modern USB-C power adapters are very lightweight, small and quiet. In the last 10 years, phone and computer chargers have become smaller and smaller. All of this is thanks to advances in power electronics and semiconductor devices.

### **What are the latest developments in power electronics?**

The latest advances have led to the rapid development of electromobility, for instance cars, bikes, scooters, trucks, planes and ships powered by electric drives. This directly supports the Fit for 55 greenhouse gas emission reduction goals in the European climate package. The general goal is to reduce GHG by 55% by 2030 and reach climate neutrality by 2050.

Step by step, electric vehicles have become more affordable for ordinary people. It's exciting to see how the latest developments in power electronics have led to incredible acceleration specs in electric cars. The Tesla Model S Plaid can go from 0 to 100 km/h in about two seconds (i.e. the best performance of all vehicles in production.)

Power electronics is also prominent in recent aviation, providing impetus to the principle of MEA (more electric aircraft) planes. An example is the Boeing 787 Dreamliner, in which the number of electrical systems has tripled. A number of hydraulic and pneumatic systems are now powered by electric drives controlled by power electronics. These innovations create greater fuel savings, better reliability and easier maintenance.

**If we dream very big, how do you see our smart world of the future? What will power electronics allow us to do?**

The latest solutions in power electronic systems will make possible smart cities of the future, smart power grids with flexible energy transmission and energy-positive buildings. One of the most important future-oriented developments today is direct current power systems for households. Studies show that compared to the current alternating current systems, 20% energy savings will be possible.

One of the new exciting technologies is Power-to-X, where energy from the sun and wind will be used to produce hydrogen and methane (Power-to-Gas) or methanol and ammonia (Power-to-Liquid). The gas or liquid can then be piped to consumers through current pipelines, offering them pure carbon-neutral energy.

Synthetic fuels will power the transport sector (cars, planes, ships and trains), heating in residential areas and much more. Renewable energy sources make it hard to forecast future energy productivity. At the same time, energy consumption is still growing. The limited supply of wind, hydro and solar energy coupled with high consumption means an energy deficit with high prices. That's why, in the winter just ended in Estonia, we experienced prices per KWh that were ten times what they were previously.

Along with the use of heat and battery storage, the new technology will offer renewables-based and intrinsically somewhat unstable energy systems the additional stability and energy security they badly need, avoiding price shocks and deficits during peak consumption periods.

A direct current energy system will help improve energy security, and allow for more flexible regulation of consumption and trading of energy. It will make homes better adapted for the future and more compatible with the general goals of energy transition.



Photo: Reiti Kokk

Tiit Tammaru and Tarmo Soomere at the signing of the agreements concluded for opening the positions of research professors on 18 January 2022.

## RESEARCH PROFESSORS FOR 2022–2024

*On 14 December 2021, the Board of the Estonian Academy of Sciences elected three new research professors for 2022–2024.*

Professor of Urban and Population Geography at the University of Tartu, the Academy member **Tiit Tammaru** focuses his research on changes that take place in cities with regard to labour markets, housing and everyday movements, seeking answers to various pressing questions. Will the arrival of new technologies facilitate the movement of workers to increasingly better-paid jobs, or will we see a growth in inequality, where a large number of people fall into poverty while others are successful? How do changes in the labour market influence the choice of living places and will the segregation of cities into wealthier and poorer districts continue? Will the green transition and the increasing popularity of environmentally friendly modes of transport contribute to the improvement of the standard of living of all citizens or will a new kind of inequality emerge



Recent research professor Tanel Tenson and the Rector of the University of Tartu, Academy member Toomas Asser.

in cities? This research will give us a better understanding of how to improve city planning (see the interview with the Academy member Tiit Tammaru on pages 33–37).

Professor of the Technology of Antimicrobial Compounds at the University of Tartu **Tanel Tenson** studies chronic bacterial infections and their treatments. Antibiotics are a cornerstone of modern medicine. They are used to control infections caused by bacteria. Unfortunately, antibiotics are not always effective. One area of concern is the spread of antibiotic resistance, i.e. the emergence of bacteria against which the currently known antibiotics are of no use. Besides the spread of resistance, it has been noted that chronic infections are often very difficult to treat. With such infections, bacteria remain in a dormant state and do not respond to antibiotic treatment. The planned studies aim to identify the specific traits of such resistant bacteria and how we can fight these pathogens.

Tenured Full Professor at Tallinn University of Technology **Tõnis Kanger** aims his research at making chemical synthesis more environmentally sustainable. To do this, he uses catalytic reactions which take place more selectively and generate fewer unwanted side products. The purposeful design, synthesis and application of catalysts in the synthesis of bioactive compounds – including oli-

gosaccharides, important components in breast milk – are the main results of this research. This is basic research, and the direct application of the results will take time. The pharmaceutical industry may benefit the most from the future application of the developed methods. Of the areas of the chemical industry, fine chemistry and the pharmaceutical industry produce the most waste. While in petrochemistry the production of one kg of products generates about 100 g of waste, the pharmaceutical industry generates up to 1,000 times more. In other words, the production of one kg of useful products generates up to 100 kg of waste. Even small changes in the synthesis of bioactive compounds have significant effects on the impacts on the environment. The main focus of research is to develop new catalysis methods and to understand their functioning mechanisms.

The position of research professor allows recognised scientists who lead research at research and development institutions or universities and supervise doctoral students to reduce their teaching and administrative loads and to focus more on scientific research in their specialities. Research professors present overviews of their work performed in the previous year at annual public conferences.

The position of research professor was established in



Tõnis Kanger receives a research professor contract from the president of the Academy Tarmo Soomere.

2002. In seven election rounds, a total of 21 scientists have been elected to this post. Four of them have been Academy members at the time of election and another five have later been elected Academy members.

#### PREVIOUS RESEARCH PROFESSORS:

2019–2021

**Andres Merits**, Professor of Applied Virology at the Institute of Technology of the University of Tartu

**Dmitri Vinnikov**, Lead Research Scientist at the Tallinn University of Technology Department of Electrical Power Engineering and Mechatronics

**Toomas Rõõm**, Research Professor at the Institute of Chemical Physics and Biophysics

2016–2018

**Anne Kahru**, Research Professor at the Institute of Chemical Physics and Biophysics (now an Academy member)

**Kaupo Kukli**, Lead Research Fellow at the Institute of Physics of the University of Tartu

**Rainer Kattel**, Professor at the Tallinn University of Technology Ragnar Nurkse Department of Innovation and Governance

2013–2015

**Rein Ahas**, Professor at the University of Tartu

**Anu Realo**, Senior Research Fellow at the University of Tartu (now an Academy member)

**Tõnis Timmusk**, Professor at the Tallinn University of Technology

2009–2012

**Pärt Peterson**, Professor at the University of Tartu

**Martti Raidal**, Lead Research Fellow at the Institute of Chemical Physics and Biophysics (now an Academy member)

**Tiina Nõges**, Senior Researcher at the Estonian University of Life Sciences

2006–2008

**Ilmar Koppel**, Extraordinary Professor of the University of Tartu (an Academy member at the time)

**Malle Krunk**, Lead Research Scientist at Tallinn University of Technology

**Ülo Niinemets**, Professor at the Estonian University of Life Sciences (now an Academy member)

2003–2005

**Agu Laisk**, Professor at the University of Tartu (an Academy member at the time)

**Raimund-Johannes Ubar**, Professor at Tallinn University of Technology (an Academy member at the time)

**Asko Uri**, Senior Research Fellow at the University of Tartu

## *Human geographer Tiit Tammaru: spatial segregation is promoted by Estonia's unwavering belief in free markets*

*Interviewed by Jaan-Juhan Oidermaa, Estonian Public Broadcasting, Novaator*

Spatial segregation has slowed down as the standard of living has risen in Estonia, but Tallinn is still a European leader in terms of the extent of urban spatial segregation. Thinking about the future, we should be vigilant about the undesirable side effects of immigration and the adverse effects of the green transition as well.

**Looking back at the last two years, there's no denying the effects of the pandemic. The difference between deaths and births has not been this large since the early 2000s but, if rumours are to be believed, the pandemic restrictions have accelerated return migration to Estonia. Will we ever be able to say for sure how COVID has influenced Estonia's long-term demographic processes, and when?**

Many people are racking their brains on this subject. As someone who studies migration, I can say that the pandemic has significantly decreased mobility. When we gaze into the future, it becomes clear that in Estonia's case the pandemic has supported changes that were already happening in one way or another.

In the big picture, the most important trend is that the population is ageing. The migration patterns of the young and the old are very different. For younger people, the city exerts more of a pull: cities have universities and many ways to spend leisure time. For older people, these factors lose importance. There are also more and more professions that don't require employees to be physically present all of

the time. In general, the ageing of the population is leading people to leave large cities, and this is not happening only in Estonia but all over the world.

COVID provided own a small boost to this fundamental change. Above all, the migration of middle-aged and elderly people to cities has decreased. Yet COVID has also caused people in their 30s and 40s to leave cities. A major question is whether the additional factor of COVID has had only a temporary effect or whether it is a long-term phenomenon. It seems to me that it is the latter.

Statistics Estonia has developed an app that allows people to compare themselves to their peers. Among other things, it reveals that while the IT field is not represented at all among the list of professions of the 40+ age group, the profession is in the top five for younger generations. Because of this, Bolt is thinking about where to put their programmers. One possibility would be for them to work remotely. Maybe the younger generation will move to the countryside in greater numbers than before. Instead of livestock and farming, people in villages will work in IT.

**Real estate sites suggest that there has never been as much interest in country properties. A cynic might say that the antidote to concentration in the capital region and suburban sprawl has been found. How could migration to the countryside be supported?**

A qualitative change has certainly taken place. If we look into the past, Estonian cities and towns saw a great deal

of growth in the Soviet era, but mainly from immigration. Estonians didn't move from the countryside to the city in massive numbers during the Soviet era; that happened only in the 1990s as the underpinnings of society and the economy changed. As a phenomenon, urbanisation continued to increase even in the 2000s. Since then, a change in the trend has gradually been seen. Tallinn is still the main destination, but its importance has decreased a little.

Looking at Estonian settlement hierarchically, we see that small towns are still losing population. However, in rural areas not in the orbit of an urban region, the immigration balance is still close to zero. I haven't yet managed to study the details of this geography, but we can highlight the islands of Saaremaa and Hiiumaa, Lääne County, and a number of rural regions in Võru and Valga Counties.

Talking to local enthusiasts and young families there, I've found it interesting that local infrastructure isn't a huge factor in making the decision to relocate. Estonia is, after all, small. Two things are important for Estonians: power and the internet. If a school is also close by, that's considered a positive factor, but it doesn't have central importance.

**This suggests that younger people moving to the countryside are already busier and even if they lead a kind of semi-nomadic existence rather than becoming permanent residents, rural areas are gaining vocal advocates. But what will become of Tallinn if the leading citizens move away? Relocation to nearby rural municipalities is an example of increasing spatial segregation.**

Cities are currently changing and so are rural areas. Overall, Tallinn's population is still growing through migration. Rural areas are seeing slight growth, but small towns and county centers are still losing people. Emigration is becoming much more important: it is rising to the forefront and impacting the segregation process. New arrivals can be divided into two categories: most are arriving from the

*In short, seasonal inhabitants could be a boon to the countryside, encouraging investments that improve the quality of life.*

east. They often settle in areas already inhabited by speakers of their own languages, such as in Tallinn's concrete residential areas. At the same time, those coming from the European Union and elsewhere from the west tend to move to the city centre or North Tallinn. The general composition of the neighbourhoods is thus starting to change as a result.

Secondly, it seems that more affluent, younger and more progressive people are moving to the countryside. In the city, we can term the process "Kalamajasation", with the same groups becoming concentrated in the Kalamaja district. To determine whether gentrification is also taking place in the countryside, I intend to use a research grant to take a closer look, but it is quite possible that this is the case. People are changing their permanent places of residence, with younger families moving to the countryside more than they did 10–15 years ago. Another major process is the buying of second homes, which is also drawing more affluent people to the countryside. It is often asked whether this sort of move to the countryside for a few months has a significant impact. Yes, it does create a certain demand for a better supply of electricity, better internet access and good roads. In short, seasonal inhabitants could be a boon to the countryside, encouraging investments that improve the quality of life.

Owning a second home has a fairly significant influence. The character of rural areas is changing and traditional agriculture is declining. It is in part being replaced with eco-conscious young people who want their own vegetable gardens, but do not really identify with traditional farming values. This can change the visual character of the land.

**In a study of yours published last year, you concluded that Estonia had no need for extensive labour immigration, but that we should be flexible in this regard. What does this mean, and what kinds of people will we need to improve our economy?**

We currently tend to think about the labour market from the perspective of the present, but actually we don't know what kinds of jobs we will need even in the next five years, much less 10 or 20 years down the road. Thus, if we make a decision now about what types of skills we need in our permanent population, we may find ourselves with unemployment 20 years from now. Whenever migration policies are designed based on the labour market, the result is usually higher unemployment among immigrants.

A book by Saskia Sassen published in 1990, *The Global City*, was influential; in it, she compared professional and spatial changes in Tokyo, London and New York. Her main argument was that big cities attract the successful – the current example would be IT specialists – which is a positive trend. But this also creates demands for low-wage jobs. The affluent want to go out to bars and films, and they need cleaning staff and gardeners, but the locals don't want to do lower-paying work. The end result is professional polarisation.

In Estonia's case, the solution might be to automate these low-paying jobs as much as possible. We see how automation is taking place in shops, but we should increase

*In Estonia's case, the solution might be to automate these low-paying jobs as much as possible.*

the trend even further so that it penetrates more sectors. For example, in the construction sector, we operate according to the logic of the last century. It would be great if we could find a way to 3D-print houses.

It's worth noting that the immigration situation in Estonia isn't all that bad and the migration policy is working. It is important that immigration not increase. The average education level of immigrants is actually even higher than that of the locals: a unique situation. The problem is whether they can find work commensurate with their education, since often value is not placed on their

education. Another problem is their integration into society. People from the east generally integrate into Estonia's Russian-speaking community. It is easier to enrol their children in Russian-language schools.

**Looking at Tallinn, more than 40 per cent of the inhabitants speak a native language other than Estonian. Indeed, mobile positioning data show that they spend a large part of their time in different places than Estonians do. In what sorts of places should the state and local governments invest to generate the greatest spatial integration?**

We could consider four walks of life: home, school, work and leisure time. Schools would be the area the public sector could directly impact the most, where the political choice is the clearest. At the same time, politicians have to follow the electorate's wishes; not much has changed in this regard over the years.

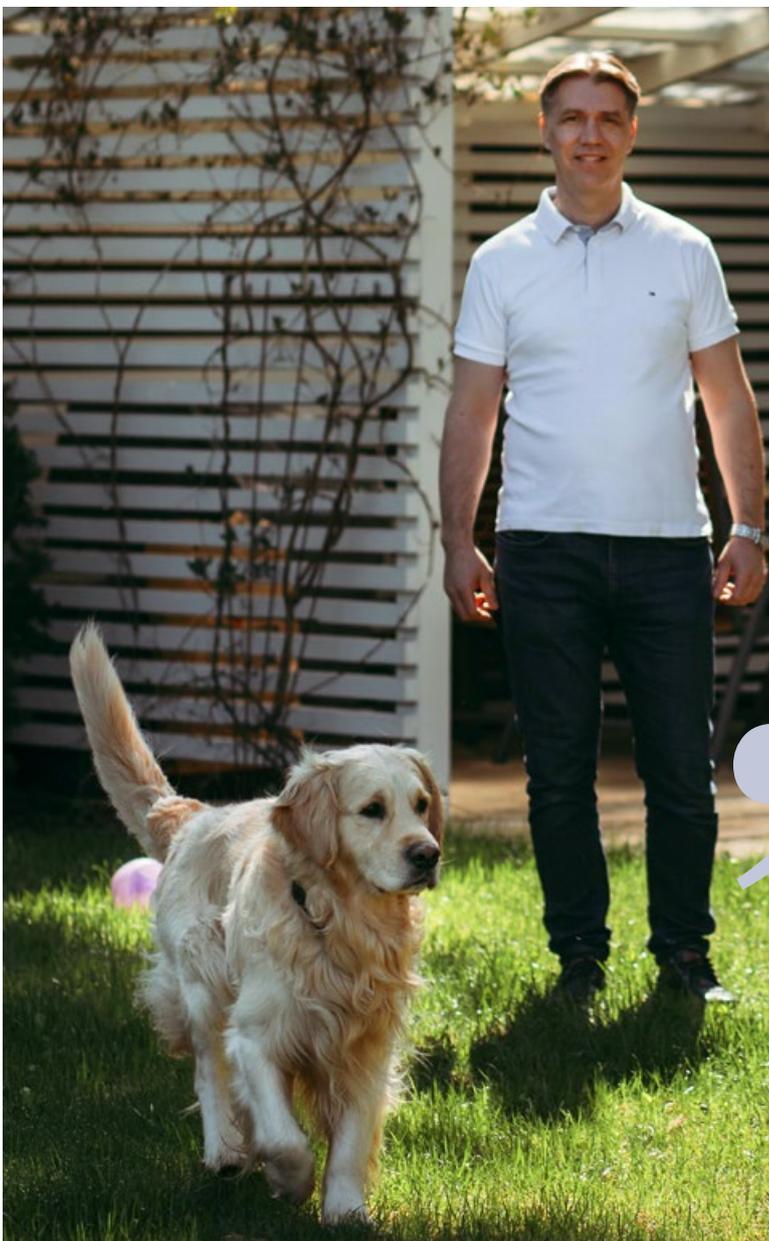
Free time is an interesting case since, unlike other areas, it is fairly unstructured. Based on research into integration, free time activity is the first indicator of how much people really want to interact with each other. If there is interest, generally it manifests in mixed couple relationships and cohabitation. Our research shows that, instead, leisure time currently tends to encourage people to socialise with people who are like them.

Again, the state has the most leverage in areas where children are involved. Language proficiency improves most through play and shared activities, which is why we should think about how to create extracurricular opportunities, for example football and choir practice. There are no political barriers between children of the kind we see in the case of schools or parents.

*Free time activity is the first indicator of how much people really want to interact with each other.*

Tiit Tammaru with dog Robi.

Photo: Jaana Ojamae





*As we are in the vanguard in Europe in terms of a liberal mindset and we're a pro-market people, like the US and the UK, we rank high among the European cities in terms of spatial segregation.*

**When I talk to my peers who were born and raised in Estonia, they sometimes remark, when looking at ever-rising real estate prices, that Estonian policymakers are still worshipping at the shrine of the market economy because of the success story of the 1990s. Can the state, without engaging in dumping, make housing more affordable in order to reduce spatial segregation? What instruments could it use?**

Soviet society and Soviet cities were very distorted in some ways. We passed through some phases of urban development only after the Soviet era ended. Since the income gap has closed somewhat in the last five or six years, the rate of spatial segregation has also slowed. Workforce shortage is partially responsible for this trend, as it forces employers to hike wages for lower income earners. Estonia's income tax reform, which also mainly helped out lower-income people, may have also played a role.

We are still among Europe's leaders in terms of spatial segregation. As we are in the vanguard in Europe in terms of a liberal mindset and we're a pro-market people, like the US and the UK, we rank high among the European cities in terms of spatial segregation. In other European countries, housing is seen as a slightly different kind of

commodity than shoes or bread, and thus the public sector can intervene more often in housing.

Above all, new housing is responsible for differentiation. Thinking back, if we had been able to renovate our existing housing stock, that would have reduced differentiation and spatial segregation immediately, because the differences in residential space would be much smaller. The state would not necessarily have to invest. Unlike, say, France, the Visegrád<sup>9</sup> countries have not spent a penny on this; instead, they have supported the rise of strong associations of people living in flats. For larger buildings, fairly low payments into a renovation fund are sufficient to renovate the buildings. That definitely winds up being cheaper than it would be five years from now.

Building government-subsidised flats in Helsinki turned out to be triply successful. The state can take out low-interest loans and lend the funds to local governments. The latter get an income stream from rentals. Unlike privately owned companies, there's no pressure on governments to quickly get to the break-even point. The tenants pay a little less. The public sector should not shy away from making such investments. In Estonia, this usually leads to people crying "dumping", but everyone can assess their own risk tolerance and how fast they want to earn a profit.

Spatial segregation can also be reduced through spatial planning. If new buildings are scattered around town in different places, then children of more affluent and poorer families will still end up meeting in playgrounds, kindergartens and schools. Research shows that this will

<sup>9</sup> The Visegrád Group, or the Visegrád Four, is a regional alliance of four Central European countries (the Czech Republic, Hungary, Poland and Slovakia) – ed.

encourage poorer families to place more value on success and education. In addition, wealthier areas are usually more demanding about the quality of education. In poorer areas, parents' role is greater, since the environment does not provide as much support.

**Turning to the modern keyword “green transition”, and considering that you will also be studying its influence as a research professor at the Academy, what should we keep in mind in implementing the Green Deal? The idea of Tallinn as a 15-minute city indirectly refers to a reduced need to get from point A to point B.**

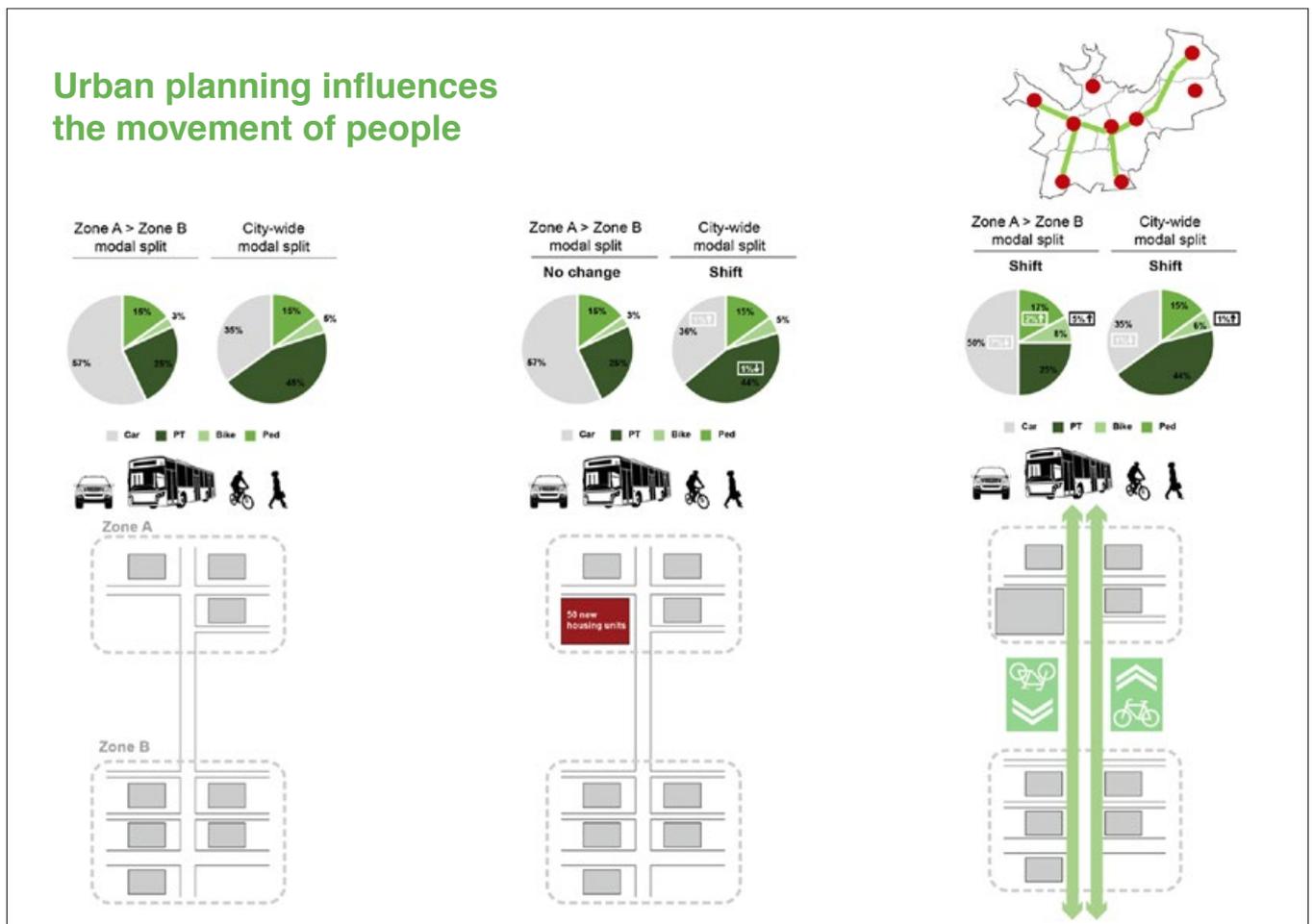
From time to time, I find myself reading the classics. Based on the best knowledge of the time, Clarence Perry aptly summarised the essence of a neighbourhood in 1929. A “neighbourhood unit”, he said, has to be compact and safe, and everyone should be able to get to essential places in five minutes. Most important, children should be able to get to school without crossing a single major thoroughfare, The street grid and flows of traffic must be planned accordingly. So the 15-minute city has actually always been a part of urban planning.

If we look at the idea of proximity to home from the perspective of segregation research, things start looking

more multifaceted. When services are offered in specific places, we bring different people together. Bringing them all closer to home leads to segregation of the activity spaces. Since homes tend to be segregated by ethnicity, language and income level, the city becomes even more spread out.

The green transition principle of reducing the need for transport may therefore conflict with the goal of reducing inequality. For example, research on schools and homes shows that spatial segregation can start becoming self-perpetuating. Parents' choice of residence influences the choice of schools for their children. But if the parents see that the school is segregated, they will start choosing segregated places to live. The same could happen to jobs and leisure activities. The more affluent will start doing business closer to home and then the poorer people will do business in their own neighbourhoods.

So when we think about the 15-minute city, we shouldn't focus only on making things less car-dependent and promoting pedestrian areas and bike use, but also public transport. People must retain the possibility of covering longer distances to keep their activity spaces from narrowing too much. Even if people are residentially segregated, there should still be places where inhabitants of Kalamaja and Lasnamäe could meet up for common pursuits.



# HISTORICAL VIEW

## THE STORY OF THE BIRTH OF THE NATIONAL AGREEMENT ON RESEARCH FUNDING

*Andres Koppel, Chairman of the Board of the Estonian Research Council 2012–2020*

The development of the Estonian science and research policy has been repeatedly highly rated by the outside world. Besides the results of the work of several specialised evaluation groups, this is confirmed by the fact that the journal *Nature* has on several occasions considered the level of Estonian research notable compared to that of other countries freed from communism.<sup>10, 11</sup>

The Academy member Jüri Allik has thoroughly assessed the level of Estonian research using bibliometric indicators and has repeatedly demonstrated the miraculous growth in the effectiveness of the work of our scientists.<sup>12, 13</sup> Another fact that confirms the international competitiveness of our research is the success of Estonian scientists and research-intensive undertakings in the European Union framework programmes for research and technology development.<sup>14</sup>

The high assessments are certainly pleasing to everyone, particularly politicians and high research officials, who take them as confirmation that Estonia's research policy

has mostly been on the right track. Unfortunately, our scientists do not agree with such high assessments very often. On the contrary, the deficiencies in the research system are much more visible from the inside. I think that I am not mistaken in believing that in answer to the question of what scientists themselves consider the biggest problem in our research policy, we would mostly receive the answer: “deficient funding”.

Facts show that research funding has, indeed, been a big problem for a long time.<sup>15</sup> Why has it been this way? Considering the good reputation of science in society and politicians' decades-old rhetoric in support of science, the deficiency in the resources allocated to science by the public sector seems incomprehensible.

### **Gap between strategies and reality**

The big picture and development of Estonian research, development and innovation are directed by national strategy documents (for the sake of brevity, I shall hereinafter call these research strategies). The “grand plans” that bear the title “Knowledge-based Estonia” are in terms of both their method of preparation and level of approval the best of all the possible options that could be implemented. Estonia has now had four research strategies, prepared by a broad-based group of experts of high status and long-term experience, and the circle of groups involved in the

10 Schiermeier, Q. 2009. Eastern Europe: Beyond the block. *Nature*, 461(7264), 590–591. <https://doi.org/10.1038/461590a>.

11 May, M., Brody, H. 2015. Nature Index 2015 Global. *Nature*, 522(7556), S1, [doi.org/10.1038/522S1a](https://doi.org/10.1038/522S1a); Central and Eastern Europe, *Ibid.*, S18–S19, [doi.org/10.1038/522S18a](https://doi.org/10.1038/522S18a).

12 Allik, J. 2016. Scientific publications: Estonia's rise to the top of the world. – *Estonian Research 2016* (ed Raudvere, K.), 27–32, Estonian Research Council, Tartu.

13 Lauk, K., Allik, J. 2019. The health of Estonian research in the middle of 2018. – *Estonian Research 2019* (ed Raudvere, K.), 39–44, Estonian Research Council, Tartu.

14 Koppel, A. 2019. Research and Development Expenditures: Expectations and Reality. – *Estonian Research 2019* (ed Raudvere, K.), 9–19, Estonian Research Council, Tartu.

15 Here and hereinafter the word “research” or the acronym R&D is used for research and development.

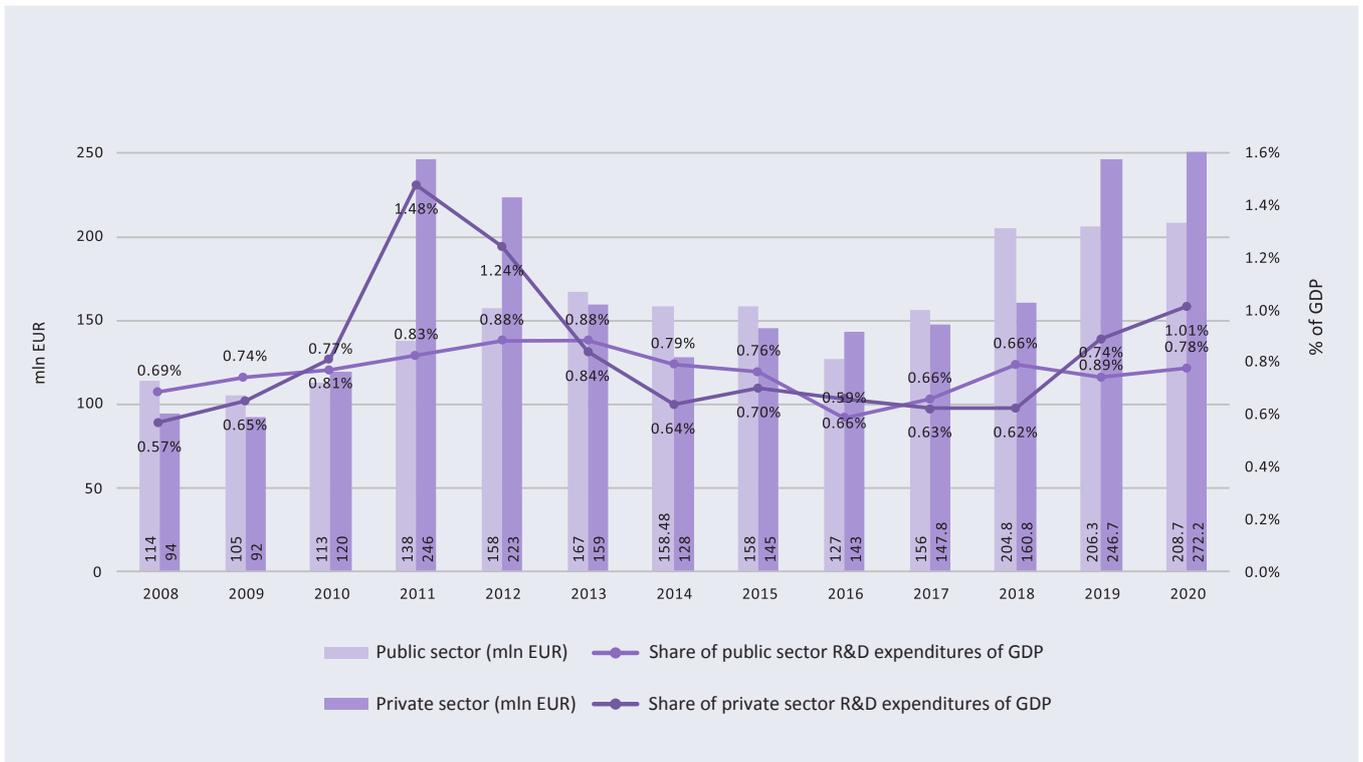


Figure 1. The volume of R&D expenditures in Estonia and the share of GDP in 2008–2020. Source: Statistics Estonia.

preparation of the documents has increased over time. The first three strategies were approved by the *Riigikogu*, i.e. those were documents of very high status. “Knowledge-based Estonia 2007–2013” foresaw a rapid growth in the volume of research and development (R&D), to 3% of the gross domestic product (GDP) by 2014 (with the volume of private sector R&D making up 1.6% and public sector R&D 1.4 % of GDP).<sup>16</sup> Unfortunately, this did not happen during the period of that research strategy or the subsequent one. “Knowledge-based Estonia III for 2014–2020” again established a 3% funding objective, this time by 2020, with the public sector contributing 1% and the private sector 2%.<sup>17</sup>

Contrary to expectations, there was no growth in R&D expenditures in proportion to GDP. Quite the opposite, they consistently decreased as at 2013 (Figure 1). A small amount of growth beginning in 2017 did not lift expenditures to the level of 2011–2013 by 2020. In Figure 1, a separate explanation is offered concerning the great leap in R&D expenditures in 2011 and 2012: it was related to the oil sector investments made in Ida-Viru County.

Truth be told, the large gap between the national plans for research funding and the reality has not been a

problem only in Estonia. The European Council approved the European Union strategy for the subsequent ten years in Lisbon in 2000. According to the strategy, Europe was to become the world’s most competitive and dynamic knowledge-based economy. Increasing R&D expenditures to 3% of GDP was established as an important mechanism to achieve that goal. A large number of the European Union Member States adopted that goal in their national development strategies. Unfortunately, this goal was not reached in 10 years and the deadline was thus postponed for another 10 years. It should be noted that although the 3% target was the most common level, some countries set their aim higher (Sweden and Finland at 4%, and Austria at 3.75%) and some lower (Holland and Luxembourg at 2.5%, Spain, Ireland and Romania at 2%, and Italy and Latvia at 1.5%). An interim assessment showed that none of the countries reached their target by 2016. Germany and Denmark were quite close, falling 1.75 (and Romania 1.52) percentage points short (Figure 2).<sup>18</sup>

16 Knowledge-based Estonia. Estonian Research and Development and Innovation Strategy 2007–2013. Ministry of Education and Research, Tartu.

17 Knowledge-based Estonia. Estonian Research and Development and Innovation Strategy 2014–2020. Ministry of Education and Research, Tartu.

18 By 2020, most of the European countries had considerably increased their R&D expenditures from 2016 (Figure 2). The target level had been reached by Belgium (3.62%), Germany (3.13%) and Denmark (3.03%). Sweden was in the second place after Belgium (3.53%), but fell short of its 4% goal. The 1% level of public sector expenditure had been surpassed by Denmark (1.18%), Norway (1.06%) and Germany (1.02%). Sweden (0.98%), Austria (0.97%) and Finland (0.94%) had come close to it. Estonia’s expenditures had grown to 1.79% in four years (public sector 0.78% and private sector 1.01%). Source: Statistics Estonia, 14 December 2021. More detailed data: [www.etag.ee/tegevused/uuringud-ja-statistika/statistika/teadus-jaarendustegevuse-rahastamise-yldpil/](http://www.etag.ee/tegevused/uuringud-ja-statistika/statistika/teadus-jaarendustegevuse-rahastamise-yldpil/)

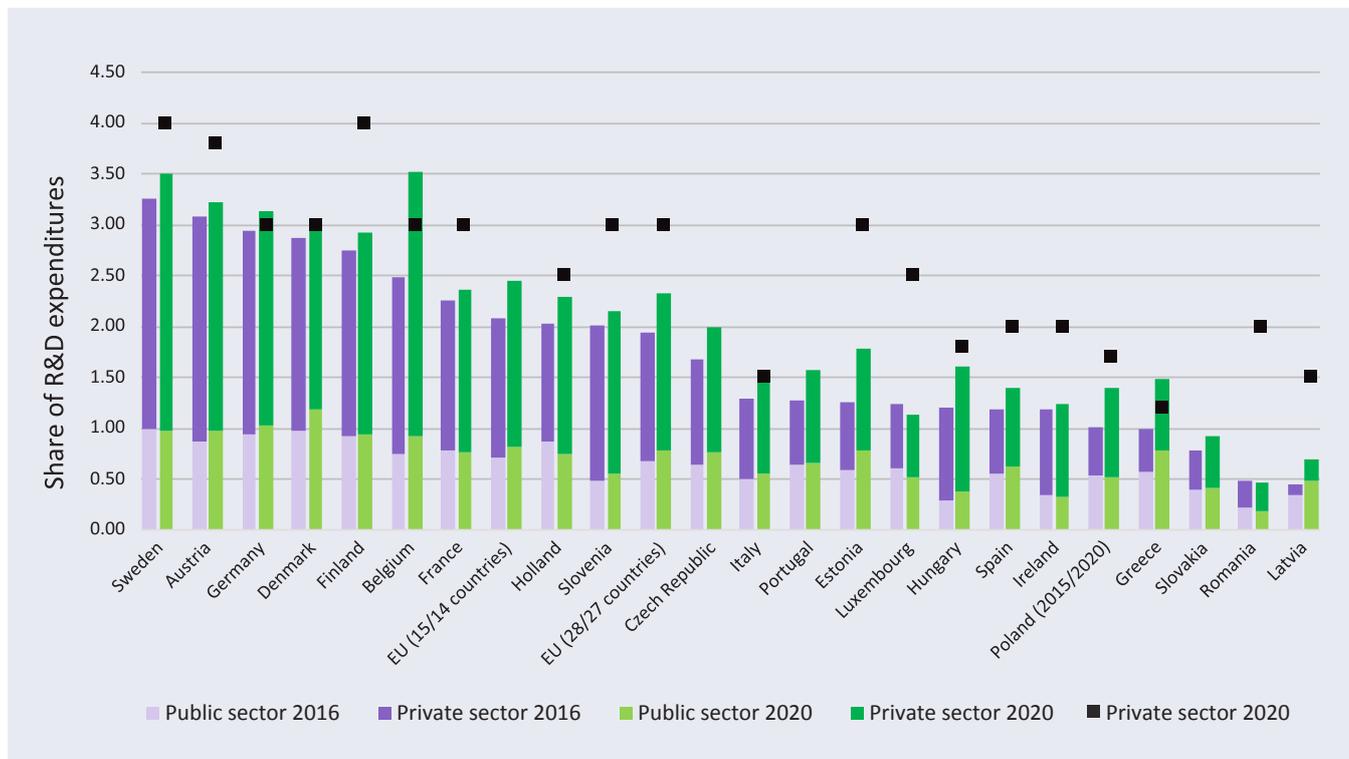


Figure 2. Research and development expenditures as a share of GDP in European countries in 2016 and 2020, and the funding objectives established by the countries. Sources: the OECD, Statistics Estonia, the European Commission and the Estonian Research Council.<sup>19</sup>

This figure clearly demonstrates a fragile aspect of the European research scene: the Member States' vastly different abilities to financially support their research activities and scientists and, even more dangerous, their different levels of commitment to doing so. For a long time, some countries have used European Union support not to enhance their financial contribution, but to replace their own efforts with external assistance. The differences between stronger and weaker countries are not decreasing, but increasing.

At first glance, this may seem distant from the topic of this article. However, it is unfortunately very relevant. Chronic insufficiency in research funding and the absence of prospects to improve the situation in the open research scene will inescapably cause countries that do not sufficiently support maintaining their R&D systems damage that cannot be easily remedied: intellectual and then economic degeneration.

### A path towards positive changes

As most European countries had struggled with achieving the funding objectives they had established for themselves, Estonia, during its presidency of the European Council in 2017, deemed it important to emphasise the importance of research and innovation and the need to finance research.

At the top-level international conference “European Research Excellence – Impact and Value for Society” held in Tallinn on 12 October 2017, Prime Minister Jüri Ratas symbolically bestowed on the representatives of different sectors of the research system (politicians, researchers, financiers and journalists) the Tallinn Call for Action.<sup>20</sup>

This document again emphasises the importance of research and innovation. In order to ensure the well-being of the European population in future and to cope with new and unexpected global problems, all of the participants in the research and innovation system were invited to jointly take action to increase research and innovation funding and consider the impact of such investments.

Upon delivering the Tallinn Call for Action, the prime minister said: “Investing in research and innovation is definitely not a luxury, but an unavoidable prerequisite of ensuring competitiveness. Knowledge, creativity and the willingness to act are the main sources of Europe’s strength and wealth. If public sector expenditures on research and innovation stagnate or are cut, Europe will not be able to continue to lead the world as a creator of bright new ideas and an applier of new knowledge.”<sup>21</sup>

<sup>19</sup> Koppel, A. 2019. Research and Development Expenditures: Expectations and Reality. – Estonian Research 2019 (ed Raudvere, K.), 9–19, Estonian Research Council, Tartu. [www.etag.ee/tegevused/uuringud-ja-statistika/statistika/teadus-ja-arendustegevuse-rahastamise-ylpilt](http://www.etag.ee/tegevused/uuringud-ja-statistika/statistika/teadus-ja-arendustegevuse-rahastamise-ylpilt)

<sup>20</sup> Tallinn Call for Action 2017. Seize the opportunity now: Research and innovation matter for the future of Europe. Statement of the Estonian Presidency of the Council of the EU [www.hm.ee/sites/default/files/tallinn\\_call\\_for\\_action\\_2017.pdf](http://www.hm.ee/sites/default/files/tallinn_call_for_action_2017.pdf) (20 January 2022).

<sup>21</sup> Koppel, A. 2019. Research and Development Expenditures: Expectations and Reality. – Estonian Research (ed Raudvere, K.), 9–19, Estonian Research Council, Tartu.

We have to admit that in a situation where Estonia was struggling more than others with the fulfilment of the objectives it had established for itself, calling on other countries to increase research funding demonstrated rather strong self-confidence. It required quite a strong belief that Estonia itself would soon do so.

Regrettably, Estonia's research budget grew very little in 2017. The budget grew somewhat in the subsequent year, but that was not enough to make qualitative changes in the system.

The average salary of Estonian researchers dropped from year to year compared to the average Estonian salary. While in 2010, it was 135% of the average Estonian salary, it was 103% in 2016, 108% in 2017 and 113% in 2018.<sup>22</sup>

The continuing stagnation of research funding naturally caused deepening resentment among the scientific community. It became ever clearer that the gap between public rhetoric and development documents and funding decisions in the budget was unacceptably large. The Research and Development Council's recommendation to the prime minister to ensure state funding for R&D at the level of at least 0.81% of GDP before the adoption of the next budget strategy was presented as a great victory in spring 2018, but to the scientific community it felt like sprinkling salt on an open wound.

At the Paide Opinion Festival in the summer of 2018, the leading figures of the political parties again discussed the role of research and the matters of funding. All of the speakers agreed that funding needed to be increased, but no one was able to propose ways of doing so. The majority of the participants in that discussion held that if their party came to power in the next elections, in 2019, they would increase funding.

In early autumn, after the Opinion Festival, I met the ex-minister Jevgeni Ossinovski, who had taken part in the event.<sup>23</sup> We discussed the paradox described above: why no government has been able to ensure the research funding objective established in the strategy and what should be done to change the situation. As someone who knows the political world from the inside, Ossinovski suggested that the situation had reached a point where politicians were ready for an all-party agreement. Less than two months later it turned out that he was right. Figuratively speaking, the gun was loaded for a social agreement on research funding by autumn 2018 and only someone to pull the trigger was needed.

It was Mailis Reps, the Minister of Education and Research, who pulled the trigger at the fifth research policy conference "Science as Estonia's Driving Engine" held at the conference hall of the *Riigikogu* on 10 October 2018. At the opening of the conference, the minister openly talked about the paradox and formulated the need for a social all-party agreement in front of a highly respected audience more clearly than anyone had ever done before.

A quote from the press release of the Ministry of Education and Research of 10 October 2018: "I believe that all present agree that effective science requires money and the current funding of research and development in Estonia is not sufficient," said Reps. "As a state, we have assumed the obligation to invest 2% in defence expenditures, so why not assume a similar obligation to invest in science. As a result, we would protect our country, our people, our economy and our culture. What the agreement should actually look like is a matter of discussion, and I am now tossing this matter out for discussion."<sup>24</sup>

### How much is enough?

Another memorable part of that conference is worth recalling. One of the main speakers was Marek Tamm, Professor of Cultural History at Tallinn University<sup>25</sup>, who addressed the topic "What kind of science do we need?", discussing the role of social sciences and humanities on a broader scale and in Estonia. After his presentation, another discussion on the funding situation followed. Kristjan Vassil, Vice Rector of the University of Tartu, asked the presenter to talk about a situation where all those concerned – citizens, politicians and scientists of a country – were of one mind (that science should be supported more), but nothing happened or very little happened and very slowly.

Marek Tamm's reply, which drew spontaneous applause from the audience, was concise and to the point: "Yes, in literature, this is called a tragedy: a situation where there is a desire, but there are no means. I have no rational explanation for this. Orwell's term of 'doublethink' comes to mind." Marek Tamm got into an exchange with the Chancellor of the Ministry of Education and Research, Tea Varrak, who, clearly irritated by the presentation, asked: "20 million is too little? How much is enough?"<sup>26</sup> Marek Tamm's reply was again concise: "One percent. I agree with Minister Reps on the need for social agreement, so that we do not have to haggle and ask how much is enough in the future."

22 Estonian Research Council (ETAg), Statistics Estonia, data as at 2 December 2021, calculations by ETAg, [www.etag.ee/tegevused/uuringud-ja-statistika/statistika/eesti-teadlased](http://www.etag.ee/tegevused/uuringud-ja-statistika/statistika/eesti-teadlased)

23 As the Minister of Education and Research, J. Ossinovski made a decision in 2014 which proved very important in shaping Estonia's research policy in the future: he formed a small work group tasked with making proposals to make research funding more systematic. Those proposals, including the alteration of the ratio of base funding and research grants, have mostly now been implemented.

24 Minister Mailis Reps: The lack of a social agreement is a sore point for Estonian science. Press release of the Ministry of Education and Research, 10 October 2018.

25 Elected as an Academy member in December 2021 – ed.

26 A reference to the decision of the Ministry of Education and Research and the government to increase the research budget by 20 million euros.



The Agreement on Research Funding, at the invitation of President Kersti Kaljulaid, was signed in the Presidential Palace in Kadriorg. From the left: Toomas Tamsar, Els Heinsalu, Tarmo Soomere, Toomas Luman, Mait Klaassen, Jüri Ratas, Kersti Kaljulaid, Kaul Nurm, Kaja Kallas, Kristina Kallas, Jevgeni Ossinovski, Helir-Valdor Seeder, Mihkel Kangur, Züleyxa Izmailova.

### **The social agreement was born in two months**

After the end of the conference, when most of the participants had gone down to the lobby for coffee, we stayed at the door of the conference hall to exchange our impressions of the events with Marek Tamm and the entrepreneur and Chair of the Council of the University of Tartu, Ruth Oltjer. The message of the day was clear: a social agreement had to be created. The minister had just given the audience this task, albeit in a somewhat abstract way. As no one had done anything like that before, no one could possibly know what such an agreement would look like. So as not to let the matter become politicised and to avoid losing time, we decided then and there to become the midwives of the agreement.

For my journey back home to Tartu, I was offered a ride by Kristjan Vassil, who instantly took to the idea. Thus, the social agreement conception group was born out of citizens' initiative. Everything proceeded quite fast from there. The first version of the text of the agreement and the accompanying explanation were completed for discussion by the conception group by the morning of 12 October.

After a few days of polishing, we thought the text good enough. I asked Jevgeni Ossinovski, as an expert, to assess it. His opinion was that after a few minor corrections the document was appropriate.

We divided up the lobbying tasks, agreeing on who would negotiate with which groups involved in the agreement. Right from the start, we were convinced that for the venture to be successful, President Kersti Kaljulaid had to be invited to be the patron of the venture.

We discovered from the very first moment that the composition of the spontaneously created conception group was fortunate. Our ties allowed us to promptly contact all of the planned groups involved in the agreement. We worked with great enthusiasm and kept each other constantly up-dated on things. E-mails were answered in just a few hours. Ruth Oltjer, who had and has a high reputation in the world of business, politics and science, had ties that were of particular value.

We commenced negotiations on 16 October. These went unexpectedly smoothly, with the Estonian Academy of Sciences and the Estonian Young Academy of Sciences



Prime Minister Jüri Ratas signing the Agreement on Research Funding.



The President of the Estonian Academy of Sciences Tarmo Soomere signing the Agreement on Research Funding.

taking only one day to give their consent to joining the agreement. At first, we were not quite sure how the entrepreneurs would take it. Therefore, we were greatly relieved by Ruth Oltjer's news that both business organisations of key importance<sup>27</sup> agreed in principle, but needed a few days for internal approval. Estonian universities needed a more detailed explanation, but we reassured them through additional e-mails and they soon agreed to join the agreement.<sup>28</sup>

27 The Estonian Chamber of Commerce and Industry, and the Estonian Employers' Confederation – ed.

28 One of the rectors had doubts as to whether including innovation in the wording of the agreement would mean that no additional money was needed, as the state's expenses for innovation would perhaps be high enough to exceed the desired 1% when taken together with research.

The Office of the President of the Republic confirmed that the president had agreed to be the patron of the agreement on research funding. Regrettably, she was about to embark on a long trip abroad and therefore the opportunity to conclude the agreement was postponed to December instead of the initially planned end of November. The presidential adviser Heido Vitsur was the contact person for the conception group at the Office of the President, ensuring a well-functioning information channel and providing good advice on several aspects of the agreement. While it was originally planned that only the representatives of the political parties represented in the *Riigikogu* would sign the agreement, Estonia 200, the Estonian Greens and the Estonian Biodiversity Party were included upon the president's recommendation.

However, the postponement in concluding the agreement created a threat that no one could have foreseen. Public discussion about the underfunding of research had so inflamed the scientific community that in the struggle for an increase in research funding many influential scientists started to speak up and write in public, and the scientific community started to organise itself in order to achieve its objectives, led by younger top-level scientists. At the beginning of December, the top Estonian scientists formed the Estonian Chamber of Research,<sup>29</sup> which published an abrasive memorandum and was ready to call on scientists to join protest activities. The aim of the Chamber of Research was quite similar to that of the proposed agreement on research funding, but the result would at best have been a one-time increase in funding, not the conclusion of a long-term agreement.

The agreement conception group became anxious. There was a risk that if the events organised by the Chamber of Research heated up the public space enough for the politicians to feel cornered and lose their nerve, the social agreement on research funding that had been within reach would not see the light of day. We decided that we could not publicly disclose the agreement on research funding too early, as that could put pressure on the political parties or attract the usual multitude of proposed amendments, which would derail the venture. We therefore started to placate the members of the Chamber's initiation group. We asked them to wait until the agreement had been signed before they launched any major action. That worked. However, not all of the infuriated scientists believed that the agreement on research funding was a genuine initiative and some saw it as a suspicious attempt to silence the scientists.

From then on, the fate of the agreement is well known. On 19 December 2018, the president invited the signatories, influential science leaders, the conception group and journalists to Kadriorg, where the president gave a sincere introduction and the agreement received 13 signatures.<sup>30</sup> The original paper copy of the prepared agreement actually contained 14 names. Chairman of the Estonian Conservative Party (EKRE) Mart Helme refused to sign at the last moment and stated in justification that the 1% objective was too modest. In EKRE's opinion, twice that percentage should have been agreed on instead.<sup>31</sup>

29 Himma, M. 2018. Scientists founded an organisation to push policy towards research basis. *Novaator*, 04.12.2018, novaator.err.ee/882063/teadlased-asutasid-organisatsioon-eti-suunata-poliitikat-teaduspohisuse-pole.

30 The full text of the agreement: [/et.wikipedia.org/wiki/Eesti\\_teaduslepe](https://et.wikipedia.org/wiki/Eesti_teaduslepe)

31 As historical irony, it is interesting to note that a few months later Mart Helme became the Minister of the Interior and his son Martin Helme, the next Chairman of EKRE, became the Minister of Finance, under whose leadership the ministry traditionally considered even 1% to be too much.

## What happened after the conclusion of the Agreement on Research Funding?

The conclusion of the Agreement on Research Funding was a surprise to many people. It relieved tensions that had been hounding the scientific community for years. Somewhat unexpectedly, there were also those whose attitude to the venture remained reserved for various reasons. Scepticism along the lines of "politicians have promised things before and nothing has changed, so it's not likely to be different this time", which stemmed from the long period of hopelessness, was quite common. A respected colleague thought that such an agreement was not needed, as all of its provisions are included in the National Research Strategy. Another colleague thought that the delicate pre-election period had been taken advantage of in preparing the agreement and the promises of the politicians had been used to place them in a corner where they could not refuse to sign. In his opinion, the preparation of the agreement was almost unethical. A high research official was instead worried about the Minister of Education and Research: how would the minister conjure up the significantly increased budgetary funds.

In order to take advantage of the positive atmosphere created by the conclusion of the Agreement on Research Funding and to help politicians take action as soon as the financing cycle of the following year, the Estonian Research Council assumed the role of coordinator in the week after the conclusion of the Agreement and invited the representatives of all of the groups involved in the Agreement and the ministries shaping the research and innovation policy to an ad hoc work group. In two months, the work group compiled a thoroughly discussed set of proposals and submitted it to the Ministry of Education and Research and the Ministry of Economic Affairs and Communication so that the government would have a substantive basis for preparing the next budget strategy.

After a short period of hope-filled anticipation, in spring the optimistic scientific community and officials were hit with a cold shower. It turned out that the newly formed government, all of whose coalition members (except for the ministers representing EKRE) had signed the Agreement on Research Funding, had to grapple with short-term problems and so was unable to keep the promise given by the heads of the parties, and the 1% objective was again left out of the state budget.

That was followed by articles, memoranda and public protest actions by the disappointed scientific community. On 30 May 2019, scientists and students gathered in Tallinn and Tartu to hold a funeral for Knowledge-based Estonia.<sup>32</sup> It seemed that the Academy member Martti Raidal had been right when he had tried to curb the optimism of an author

32 Scientists gathered for the funeral of Knowledge-based Estonia. *Novaator*, Science, 30.05.2019, novaator.err.ee/947069/teadlased-kogunesid-teadmistepohise-est-imatustele

of an article after the conclusion of the Agreement with his prediction, which basically said: “Do not rejoice over the Agreement. You’ll see; nothing will change. They have broken their promise before and the same will happen this time.” There is no room here to describe all of the expressions of resentment, but the optimism that had arisen at the end of the previous year was replaced by general dejection. The conception group of the Agreement also expressed their disappointment and called on the government to adhere to the Agreement.<sup>33</sup> An assessment committee made up of the top scientists of the Estonian Research Council published a memorandum,<sup>34</sup> which I was able to personally hand to Prime Minister Jüri Ratas during his visit to the Research Council at the beginning of June 2019.

A year after the Agreement on Research Funding had been signed, in *Novaator* Marju Himma analysed what the Agreement had changed. She found that, on the one hand, it had changed everything, and, on the other hand, it had changed nothing. The scientific community was consolidated and discussions on the organisation of funding had been set in motion. Politicians had not kept their promises on the Agreement, but she held that the universities had also acted selfishly in squabbling over scant resources.<sup>35</sup>

The attitudes to science were radically changed by the COVID-19 pandemic, which shook the world in the early spring of 2020. It quickly became clear that in order to cope with unforeseen crises we needed knowledge, not opinions and arguments. Scientists came to society’s aid in fighting the coronavirus and alleviating its consequences in Estonia. This again confirmed the general belief that when trouble grows too great, people turn to scientists.

The first clause of the Estonian Agreement on Research Funding was implemented, and at a record pace. While the Agreement had prescribed that public sector funding for research and development and innovation would, starting with the 2019 budget, be increased to 1% of GDP within three years, the government now decided to do it in one step.

The conception group again addressed the public in order to express their gratitude to politicians for the fulfilment of their promise, but mainly in order to remind the other involved groups that now they also needed to keep their promises.<sup>36</sup>

In public, the clause about the public funding of research and innovation at the level of 1% of GDP became the most widely known aspect of the Agreement. In reality, all of the groups involved assumed extensive obligations with the aim of promoting Estonian research and innovation. While it is the politicians’ task to ensure sufficient public sector funding for research, the tasks of the other groups are much more complex. Deciding on the allocation of money from the state budget is a matter of (difficult) political choices, but when the choices are made, matters that follow are no longer complicated, witnessed by what happened during the COVID-19 pandemic in 2020. The fulfilment of the promises made by research institutions, researchers and entrepreneurs is much more complex. This fulfilment requires that a number of problems be solved. There are many research institutions and even more scientists with divergent interests. The interests in and capabilities of participating in research and innovation vary widely. The fulfilment of the promises made in the Agreement on Research Funding means constant work for very many people.

### In conclusion

As a document and a process, the Estonian Agreement on Research Funding is – to the best of the knowledge of the author of this article – unlike anything to be found anywhere in the world. This is another example of the advantages of a small dynamic society: if problems grow extremely pressing, we can pull ourselves together and agree on solutions.

The aim of the Agreement was to reach something that previous efforts, including national development strategy documents, had not achieved: to create trust between the groups involved in the research and innovation system and the representatives of society. That meant rising above the level of legal or technical documents, to the level of morals, because the Agreement on Research Funding involves giving one’s word of honour. Such a social agreement is an extreme method for solving a big social problem, which can only be implemented when other possibilities have been exhausted. Such a method entails a great risk, as the word of honour of the leaders of society is put at stake. If this vow is not kept, there are no longer any means for creating trust and the results of the subsequent alienation are difficult to imagine. Fortunately, all went well.

It will probably not be possible to repeat this kind of social agreement method to achieve the security of funding for research or any other area. Hopefully, this will not be necessary, the 2018 social agreement on research funding will remain in force and the fruits of the established consensus will become visible. Funding research and innovation, as well as higher and general education, as a prerequisite to Estonia’s success must be fundamental for all future governments.

33 Vassil, K., Koppel, A., Oltjer, R., Tamm, M. 2019. The Government must find a way to fulfil the Agreement on Research Funding. *Postimees*, 31.05.2019, 126 (8633), 16, arvamus.postimees.ee/6696072/teaduslepe-teksti-koostajad-eesti-teaduslepe-on-kehtiv-ja-valitusus-peab-leidma-viisi-selle-taitmiseks

34 Eesti-Teadusagentuuri-hindamisnõukogu-avalik-pöördumine.pdf (etagee) (4 June 2019).

35 Himma, M. 2019. A year from the signing of the Agreement on Research Funding – what has changed? *Novaator*, Science, 19.12.2019, novaator.err.ee/1015642/aasta-teaduslepe-allkirjastamisest-kas-ja-mis-on-muutunud.

36 Koppel, A., Oltjer, R., Tamm, M., Vassil, K. 2020. Promises await fulfilment. *Postimees*, 13.10.2020, 238(7249), 15, leht.postimees.ee/7084542/teaduslepe-algatusruhm-lubadused-ootavad-taitmist

The Agreement on Research Funding triggered changes which helped the research system survive a crisis situation that had accumulated over the years. We will be able to see the fruits of the good developments resulting from this years from now.

This is unfortunately not the end of problems with research policy. It is easy to predict that when Statistic Estonia draws up summaries of the 2021 research expenditures, the public sector contribution will not reach 1% of GDP in this year or in years to come. In preparing the budget of the largest financer of research, the Ministry of Education and Research, the maintenance costs of research support structures (the Estonian Academy of Sciences, the Estonian

Research Council, academic libraries, scientific collections, databases, the promotion of sciences, etc.) are also conditionally included under research expenditures. For the purposes of statistics, including international comparisons, these do not constitute research expenditures. Furthermore, research and higher education and their financing function as communicating vessels at the largest Estonian research institutions: universities. When one of these withers, as has now happened with the underfunding of higher education, the shortcoming is inevitably compensated for from the resources of other vessels. It is clear that higher education and research must be handled together and the search for their optimal funding model must continue.

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## THIRTY YEARS OF THE RESEARCH AND DEVELOPMENT COUNCIL

*Jaak Aaviksoo, a member of the Research and Development Council in 1993–2007 and 2011–2021*

The impact of research and development (R&D) on the overall development of countries became clearly noticeable in the decades after WWII, primarily due to the armament programmes of the great powers and increasingly as an effect on general industrial competitiveness. It is therefore natural that when Estonia regained its independence a need arose for a state institution to direct research and the related technological development. For that purpose, the government of Edgar Savisaar established the Statute of the Estonian Science Council in July 1990 and appointed the members of the Council in December of the same year.<sup>37</sup> The Council had 18 members, with the President of the Academy of Sciences as its chair and the Minister of Economic Affairs as its vice-chair. As was characteristic of the period of transition, the government still saw the Academy of Sciences as the central science organisation, while the Council included numerous representatives from new institutions: the Union of Scientists, the Science Foundation and the Informatics Council.

In December 1993, the government of Mart Laar appointed a new temporary Council of 17 members (including eight Academy members),<sup>38</sup> who proposed that the Prime Minister act as the chair. The Council's central task was to prepare the draft Organisation of Research Act (ORA), which was adopted by the *Riigikogu* in December 1994.<sup>39</sup> As was characteristic of the period, the draft act was compiled in direct cooperation between the Council

members and primarily reflected the political positions of the Council. That ensured that the draft act was processed quickly, but lowered the legal and technical quality. The Act placed great importance on the principles of academic freedom and the autonomy of research institutions, as well as bottom-up initiative. At the same time, the Act primarily regulated the academic science of the public sector, leaving the broader scientific-technical innovation of the private sector and society almost untouched, although it stipulated the reorganisation of the Science Council into the Research and Development Council (RDC).

The Act tasked the RDC with presenting proposals to the government to reorganise the research structure pursuant to the Act within five months. The government approved the statutes of the RDC in February 1995<sup>40</sup> and its 20 members in March 1995.<sup>41</sup> The RDC had a vice-chair and a secretary elected from amongst its members, and its technical needs were fulfilled by the Government Office.

In connection with significant changes in the organisation of science (including the reorganisations arising from the Academy of Sciences Act,<sup>42</sup> the adoption of the University of Tartu Act<sup>43</sup> and the Universities Act,<sup>44</sup> etc.) and based on the need to extend the regulation of the Act from the organisation of research to the regulation of research and development, the Organisation of Research and Development Act (ORDA) was prepared on the basis

37 [www.riigiteataja.ee/akt/828122008001](http://www.riigiteataja.ee/akt/828122008001)

38 [www.riigiteataja.ee/akt/13105763](http://www.riigiteataja.ee/akt/13105763)

39 [www.riigiteataja.ee/akt/28724](http://www.riigiteataja.ee/akt/28724)

40 [www.riigiteataja.ee/akt/29114](http://www.riigiteataja.ee/akt/29114)

41 [www.riigiteataja.ee/akt/29375](http://www.riigiteataja.ee/akt/29375)

42 [www.riigiteataja.ee/akt/113032014015](http://www.riigiteataja.ee/akt/113032014015)

43 [www.riigiteataja.ee/akt/119122019017](http://www.riigiteataja.ee/akt/119122019017)

44 [www.riigiteataja.ee/akt/119032019097](http://www.riigiteataja.ee/akt/119032019097)



RDC meeting on 25 February 2014. Facing the photographer (from the left) Allan Martinson, Mart Saarma, Mati Karelson, Richard Villems, Volli Kalm, Toomas Luman, Jaak Aaviksoo, Andrus Ansip.

of the Organisation of Research Act and was adopted by the *Riigikogu* in March 1997.<sup>45</sup>

The adoption of these acts completed the process of building the Estonian research and higher education system, in which the various compositions of the RDC (and the coalition parties represented in these by ministers) played an important or even a decisive role. The principles applied in the ORA and the legal acts regulating higher education adopted with the RDC's contributions – academic freedom, the autonomy of research institutions, the Academy of Sciences as a personal academy, the evaluation of research, the open competition-based funding of research, the filling of researcher positions through public competitions, etc. – are still in place and are expected to be included in the new version of the ORDA currently being prepared without significant changes.

That period of the RDC's activities was, among other things, characterised by the existence of a permanent secretariat which provided constant technical support to the Council's activities and monitored the implementation of adopted decisions. It can be said in retrospect that as the active legislative period ended the operating activity of the RDC also decreased, probably partly because the units created at ministries under the new act took over a large part of the RDC's activities. As the administration grew more professional, the research political influence of the RDC decreased.

The government that came into office after the 1999 elections considered increasing the broader socioeconomic effects of R&D as one of its goals, including through stronger political direction of the area. Relying primarily

on the structure and experience of an institution similar to the Finnish RDC, an amendment to the act was adopted in March 2001,<sup>46</sup> reducing the number of members of the RDC to 12 and eliminating the positions of vice-chair and secretary. The new smaller composition of the RDC was appointed for three years in accordance with the act in October 2001.<sup>47</sup> It included an equal number of representatives from the government, academic institutions and the business sector (four members from each). It was also decided to strengthen the role of the Ministry of Education and Research and the Ministry of Economic Affairs and Communication in the preparation of agenda items.

This step was taken in the hope that the stronger representation of the business sector on the Council would ensure the greater representation of the interests of the Estonian economy in relevant research policy decisions, as in Finland. This expectation has unfortunately not yet been realised. The representatives of the business sector have for various reasons not been able to clearly formulate their expectations of the organisation of R&D in Estonia, much less convince the government to support such expectations. Furthermore, the ability of the Ministry of Economic Affairs and Communication to develop and implement an appropriate innovation policy has remained significantly more modest than expected. It is also obvious that the development logic of the business sector has not forced a large part of the business sector to focus enough attention on development activities, as a result of which the R&D volume of the private sector still remains significantly below the desired level. At the same time, there has been

45 [www.riigiteataja.ee/akt/73465](http://www.riigiteataja.ee/akt/73465)

46 [www.riigiteataja.ee/akt/72859](http://www.riigiteataja.ee/akt/72859)

47 [www.riigiteataja.ee/akt/623854](http://www.riigiteataja.ee/akt/623854)



RDC meeting on 1 March 2016 (from the left: Oliver Väärtnõu, Jaak Aaviksoo, Henry Kattago and Taavi Rõivas).

a remarkable development of the Estonian start-up sector, which largely relies on the IT-based innovations of business models and processes that are not reflected in the classic R&D model.

2004 saw the first joint Estonian and Finnish RDC meeting: an iconic benchmark in the activities of the RDC (and in the light of Estonia's accession to the European Union). Similar meetings were also held later (in 2008 and 2012), but besides largely declarative statements these have not had a direct practical impact on R&D cooperation between Estonia and Finland. It's true that there have not been any notable ideas which the RDCs (or governments upon their recommendations) could implement. Informally discussed ideas – to create a joint funding channel or open the national funding channels partly to the scientists of the partner country – have for various reasons not got past the discussion phase.

The second period of RDC's activities can be provisionally considered to have ended in 2004, when Estonia joined the European Union. While the first period (1990–1997) was mainly focused on drafting legislation, the second period produced an integral science organisation in Estonia, in which the RDC had a general balancing role.

From the creation of the RDC in 1990 until the implementation of the RDC's new statutes and the relevant information system in 2005, the RDC held 40 meetings, i.e. an average of 2.7 meetings a year.

The third period of activity was characterised by focusing on European Union structural funds, research and

innovation framework programmes and synchronised Estonian research, development and innovation strategies (the RD&I Strategy), including the preparation of strategies. For instance, in 2006 the RDC's central topic of discussion was the RD&I Strategy for 2007–2014, which was discussed at all four RDC meetings and approved on 8 November 2006. The important decisions concerning the resources of structural funds were made on a political level, in the coalition council and the government, and the role of the RDC remained largely secondary. Considering that structural funds were used (and are still used) to finance a large part of Estonian research and development, the RDC's influence on national research policy decisions has generally remained modest.

In the years following the adoption of the RD&I Strategy (2007–2012), the RDC's activities were less intensive, with a total of 12 meetings held, i.e. two meetings a year on average. The agenda items were mostly informative, primarily concerning the implementation of the development plan and the state budget funding for RD&I.

In 2012, the terms of reference for the RD&I Strategy for the subsequent European Union financing period (2014–2020) were discussed and the strategy “Knowledge-Based Estonia 2014–2020” (KBE III) was approved in June 2013.

The commissioning of a report on the network and fields of activity of universities and other Estonian research institutions, including vocational higher education providers, in 2014 was an important decision that influenced the RD&I Strategy. The RDC discussed the report prepared



RDC meeting on 1 October 2019. Academy members from the left: Tarmo Soomere, Mart Saarma and Toomas Asser.

by the RDC member Gunnar Okk in August 2015 and several R&D institutions joined universities on the basis of the report, but most of the recommendations made in the report have still not been implemented, regardless of the RDC's repeated relevant decisions and the work of the task force formed on the basis of the report. The RDC discussed the results of the work of the task force in May 2018, acknowledged the information and decided to return to the matter of the consolidation of institutions in a year's time, in May 2019, but the discussion has so far not taken place.

The discussion of the thematic objectives of the area-specific R&D support measure (RITA<sup>48</sup>) in the RDC in 2016, where support for five areas was agreed on, drew public attention. The thematic objectives of the second application round of the same measure were decided by the RDC in 2017 (five main objectives and six back-up objectives). The RDC's funding decisions regarding specific projects have drawn criticism both from the RD&I community and several members of the RDC and hopefully a more suitable format will be found for making such decisions.

48 A programme supported by the European Regional Development Fund that aims to increase the role of the state in the strategic management of research and the capabilities of R&D institutions in carrying out socially relevant research. Technical details: "Operational Programme for Cohesion Policy Funding 2014–2020", priority axis 4 "Growth-capable entrepreneurship and RD&I supporting it", measure 4.2 "Enhancing the local socioeconomic impact of the RD&I system and smart specialisation", and activity 4.2.1 "Strengthening area-specific research and development" or state R&D support (RITA) – ed.

The RDC's third period may be provisionally considered to have ended as the new government came to office in 2016. At its first meeting after the new government came to office in January 2017, the RDC discussed its work organisation and decided to make it more efficient, increasing the RDC's role in the strategic direction of RD&I, including in financing decisions. At the same meeting, the Council discussed the proposal to commission an RD&I system assessment report, and the decision to commission the report from the European Commission was made in September 2017.

The RDC's work has intensified since 2017 and it has convened four or five times a year as agreed in the work plan. The RDC's meeting in June 2018 had a significant impact: it was decided that the main focus of the new development plan that was being prepared at the time must be aimed at growth in productivity and added value in the short-term, medium-term and long-term perspective by facilitating the increase of private sector RD&I investments.

That decision, just like several subsequent decisions adopted by the RDC (particularly after the completion of the European Commission's report which highlighted the weak link between Estonian R&D and the country's socioeconomic needs), has strived to increase links between R&D and other areas of society. Relevant decisions that have found broader resonance in society include the alteration of the proportions of the areas of research financed by the Estonian Research Council and the distribution of additional funds (40% to academic research (Ministry of Education and Research), 40% to applied research (Ministry of



The last RDC meeting on 21 September 2021 before the election of new members. From the left: Toomas Asser, Toomas Luman, Andres Sutt, Jaak Aaviksoo, Kaja Kallas, Liina Kersna, Mart Saarma, Oliver Väärtnõu, Tiit Land, Tarmo Soomere and the Head of the Government Office Strategy Unit Henry Kattago. Absent from the photo: Keit Pentus-Rosimannus, Maive Rute, Toomas Tamsar, Arto Aas and Gunnar Okk.

Economic Affairs and Communication) and 20% to other ministries for area-specific research). The RDC made an important decision to take the recommendations made in the European Commission's report into account in the preparation of the new Research and Development, Innovation and Entrepreneurship (RDI&E) Strategy,<sup>49</sup> but the impact of that recommendation has been rather modest.

In December 2020, the previous members of the RDC decided to commission an analytical report on the strategic management of RD&I and the role of the RDC therein. The author of this article was appointed to prepare the report and this article is largely based on the materials of the report.

Recommendations made in the report:

1. The RDC's formal status and competence as an advisory body to the government of the Republic acting on the basis of the ORDA does not need to be changed: its influence should be increased primarily through closer cooperation with partners and by increasing the substantive capability needed for that, not by granting it binding decision-making rights.

2. Considering international practice, the broader impact of R&D and the central role of innovation in the development of a country, the renaming of the RDC as the Research and Innovation Council (RIC) should be considered.
3. It would be expedient to also formulate the RDC's objectives and terms of reference in the act. The definition of the RDC's tasks could also be expanded, putting the discussion of RDI&E development plans and programmes and other strategic matters in a central place.
4. Upon a new government coming into office, consideration should be given to the government issuing multi-year activity guidelines to the RDC on the basis of the government's activity programme.
5. The composition of the RDC should be streamlined; the number of members should be 12–15 or lower.
6. In order to empower the RDC, strategic management needs to be strengthened, for which purpose consideration could be given to the appointment of the vice-chair of the RDC by the chair or the Prime Minister with authority defined by him/her. The said position would significantly contribute in the periods between the meetings.

<sup>49</sup> [https://www.hm.ee/sites/default/files/taie\\_arengukava\\_kinnitatud\\_15.07.2021\\_211109a\\_en\\_final.pdf](https://www.hm.ee/sites/default/files/taie_arengukava_kinnitatud_15.07.2021_211109a_en_final.pdf)



The The first (hybrid) meeting of the RDC's new members on 23 November 2021.

7. In order to increase the influence of the RDC, more focus needs to be placed on strategic matters, avoiding interfering in the decision-making competences of ministries and ensuring higher quality and timelier preparation of discussion points, including by forming ad hoc work groups.
8. Discussions based on reports commissioned in strategic RDI&E matters should be introduced as a work format for the RDC.
9. A secretariat with at least one full-time employee is needed for the substantive functioning of the RDC.

The RDC has discussed the report and taken most of the recommendations made in it into consideration. The decision has in essence also been reflected in the appointment and work organisation of the current composition of the RDC.

In conclusion, most developed countries have created structures with tasks similar to those of the RDC for the broad-based organisation of R&D, although the specific formats vary substantially. International practices also give rise to the observation that the functioning and influence of the RDC depends not so much on particular formal

rules, but primarily on the substantive motivation and commitment of the partners who participate in its activities and, above all, on the chair's attitude and perception of the RDC's ability to contribute to the achievement of the political objectives of the government. I can confirm this conclusion on the basis of my personal experience.

In Estonia, one positive aspect of the RDC's activities is the relative stability and evolutionary nature of research policy, to which the discussions held in the RDC with various parties have definitely contributed. In connection with this, we can also state that changes have largely corresponded to changes in society. This has been manifested in the RDC's activities in different periods and we can hope that the increasingly perceived need to increase the social impact of the activities of the Academy of Sciences will find an appropriate outlet through the activities of the renewed RDC.

# THE ESTONIAN ACADEMY OF SCIENCES IN THE INTERNATIONAL ARENA IN 1991–2021

*Jüri Engelbrecht, Adviser on International Relations at the Academy*

Throughout time, scientific research has been international. The aforementioned Act stipulates that “The principal mission of the Academy [...] is to help resolve issues relating to the development of Estonian research and the social and economic development of the state” and also emphasises the development of international academic cooperation. It is clear in today’s world that the development of a country depends on international cooperation in very many areas of life.

The author of this article has been involved in the activities of the Academy since 1990. The following overview of the Academy’s international activities is given primarily from a substantive viewpoint. The Academy’s yearbooks<sup>50</sup> contain chronological facts. Recollections of the early years of independent academic foreign relations have been written down by the Academy member Dimitri Kaljo.<sup>51</sup> It is important to note that the Academy was developing international cooperation independently of the then central government even before Estonia regained its independence in 1991. This is evidenced by cooperation agreements concluded with several sister academies, as well as many Estonian scientists’ personal contacts and cooperation with colleagues from other countries. The first such cooperation agreements were concluded with sister academies in Poland (1987), Switzerland (1989), Sweden (1989), etc.

It is clear that a small country lacks the resources, particularly the population, to engage in many areas of research. International cooperation is therefore aimed at significantly expanding the amount of knowledge and creating opportunities for young talents, as well as sharing experience on an international level. Looking back at the past 30 years, despite Estonia’s limited possibilities, we have managed and Estonia has been visible in the academic world, which also has an effect on overall visibility as a partner in several forms of cooperation.

Below is an overview of links with international research organisations.

The International Science Council (ISC) is a leading organisation that represents scientific activities. The organisation was founded in 1899 as an association of academies.

After several changes, it obtained its current format in 1931, including both area-specific global professional associations and national members, particularly academies. However, under the acronym ICSU (International Council of Scientific Unions), it primarily united related areas of natural sciences. A parallel organisation was therefore founded in 1952, the ISSC (International Social Sciences Council), which united relevant areas of the social sciences. Some national members were represented in both organisations. It was only natural that these two organisations merged under the original name of the International Science Council (2018).

The Estonian Academy of Sciences joined the ICSU in 1992 and actively participated in the recent merger process. The Academy has taken part in several ICSU programmes. In a purely organisational context, the Academy member Jüri Engelbrecht was a member of the General Committee of the ICSU (elected in 1996), and the Estonian Academy of Sciences holds the presidency of the European group of the ISC from 2022 to 2024 under the leadership of Tarmo Soomere. The Academy has supported the connections of the Estonian research community with the professional associations included in the ISC and has paid their membership fees using a targeted allocation from the Ministry of Education and Research since 1998. The annual report provides an overview of the work of the bodies (mostly national committees or research societies) that represent Estonia in international professional associations.

Estonia’s representatives are also often elected to the governing bodies of international professional associations, which indicates the prominence of our scientists. Participation in the work of the ISC (see, for instance, the materials of the latest General Assembly of the ISC, held in 2021) creates direct contacts with international trends. Besides making scientific research more efficient (climate research, natural diversity, the impact of the COVID-19 pandemic on the consistency of the society, etc.), the ISC has also focused on scientific advisory activities and on increasing trust in applying research results. The Academy’s recent experience here has made a strong contribution to the activities of the ISC, particularly in furthering the cooperation of the European group (for more details about the Academy’s participation in shaping research policy, see below).

The Interacademy Partnership (IAP) is another important global organisation. It was founded in 1993 as a global

50 The Estonian Academy of Sciences Yearbook – *Annales Academiae Scientiarum Estoniae*, II (1996) – XXVI (2020).

51 D. Kaljo. The early years of independent foreign communication: some memories. – The Estonian Academy of Sciences. Years in the Academy. Tallinn 2008, 103–111.



Jüri Engelbrecht is chairing the General Assembly of ALLEA in Madrid in 2008. Queen Sofia of Spain is seated in the middle.

network of academies and obtained its current format in 2016, uniting several networks under the auspices of the IAP and also involving associations of academies of medical and technical sciences. The aim of the IAP is to provide advice to decision-makers in three areas: science, health and policy. One of the objectives is to increase the capabilities of academies, particularly in developing countries. Although the IAP's reports are exemplary (see [www.interacademies.org/science-advice/reports](http://www.interacademies.org/science-advice/reports)), there are certain overlaps in the activities of the IAP and ISC, not to mention the overlapping memberships. The Estonian Academy of Sciences therefore supported the proposal of their Swiss colleagues to discuss the possible merger of the ISC and IAP.

Academies focused on humanities and social sciences gathered under the auspices of the International Union of Academies (*Union Académique Internationale*, UAI) in 1919. The objective of the UAI is to promote joint research. Beginning in 1998, we were represented at the UAI by the Academy member Peeter Tulviste, and our current representative is the Academy member Jaan Undusk.

The Academy's ties with European research organisations and sister academies in Europe are very strong thanks to the hard work of many Academy members. The European Federation of National Academies of Sciences and Humanities (ALLEA – All European Academies) was founded in 1994 with the aim of connecting academies all

over Europe. The objective is to independently address research strategy and policy on the European level, relying on scientific excellence and standards of ethics (i.e. policy for science).

As a founding member, the Estonian Academy of Sciences has actively participated in the work of ALLEA. The Academy has initiated an analysis of the research strategies of small countries and has taken part in the work of the Ethics Committee of ALLEA. In 1998, the Academy organised an international science conference, “Science and Society”, which involved many member academies of ALLEA and was the first step in generalising scientific advice experience. Jüri Engelbrecht was elected the President of ALLEA for the period 2006 to 2011, i.e. two consecutive terms of office. A report of his activities is included in a compilation of essays.<sup>52</sup>

ALLEA has stayed in close communication with the European Commission, and ALLEA's assessments of the Commission's framework programmes and strategy documents have expressed the positions of academies. The activities of the Research Ethics Work Group have continued (with participation by the Academy member Ene Ergma). The Academy is currently represented in the said

<sup>52</sup> Engelbrecht, J., Mann, N. 2011. *The Sum of the Parts: ALLEA and Academies*. ALLEA, Amsterdam, 164 pp.



Conference “Advisory role of academies in the information-rich society” (2018). From the left: Henry Kattago (Director of the Strategy Unit of the Government Office), Siim Kallas (Vice President of the European Commission in 2004–2014), German Ambassador Christoph Eichhorn and Hanno Tomberg (Member of the Management Board of the Foundation Archimedes).

work group by the Academy member Raivo Uiibo. This is where the preparation of the Code of Conduct for Research Integrity started in Estonia (the Code was approved at the Academy in 2002). The European Commission ordered an updated Code from ALLEA,<sup>53</sup> compliance with which is important in all scientific research conducted in the European Union.

ALLEA has focussed on science education and regional research cooperation, as well as on the foundation of young academies of sciences and the dissemination of experience. Estonia created its Young Academy of Sciences in 2017. At the same time, there was also a clear need for research results to reach policy-makers, i.e. “science for policy”. For this purpose, the academies of the European Union countries founded the European Academies’ Science Advisory Council (EASAC). Estonia became a member of EASAC in 2004 (the current representative is the Academy member Jaak Järv).

EASAC operates in three main areas: energy, environment and biosciences. The reports of the three panels connected with these areas are recognised as the summaries of the development prospects of various areas compiled by

the best European experts. The Academy member Tarmo Soomere is a member of EASAC’s Environment Steering Panel and the Academy member Enn Lust is a member of the Energy Steering Panel.

There was a clear need to develop a common approach with regard to the provision of science advice to the European Commission. Jüri Engelbrecht’s ideas as the former president of ALLEA to unite the potential of European academies bore fruit in 2016. Namely, the European Commission launched the project Science Advice for Policy by European Academies (SAPEA), initially under the Framework Programme Horizon 2020, aimed at preparing the best evidence basis for the European Commission’s science advice needs. SAPEA is a consortium of five networks: ALLEA, EASAC, Euro-CASE (Council of Academies of Applied Sciences, Technologies and Engineering), FEAM (Federation of European Academies of Medicine) and Academia Europaea (a pan-European academy of sciences). SAPEA is part of the Scientific Advice Mechanism (SAM), which also includes the European Commission’s Group of Chief Scientific Advisors, one of whom is Maarja Kruusmaa. We should also mention the European Research Advisory Board (ERAB) which provided advice to the European Commissioner for Research, Science and Innovation in 2001–2007, and one of the members was Jüri Engelbrecht.

<sup>53</sup> ALLEA 2017. The European Code of Conduct for Research Integrity. Berlin.



Conference “Advisory role of academies in the information-rich society” (2018). From the left: Jorge A. Huete-Pérez (Vice President of the Nicaraguan Academy of Sciences, and the first Vice Rector of the University of Central America), Anne-Marine Coriat (Wellcome Trust), Edwin Kreuzer (President of the Hamburg Academy of Sciences), Andres Metspalu (Chairman of the Council of the Estonian Centres of Excellence in Research) and Oliver Väärtnõu (AS Cybernetica; Member of the Research and Development Council).

The European Science Advisors Forum (ESAF), founded in 2014, is also an important advisory body. The forum is an informal person-based network which since 2020 has been led by Tarmo Soomere. Through SAPEA and ESAF, Estonian researchers can forward their opinions for the purpose of formulating the European Union’s research policy. The ESAF General Assembly “From local advice to global benefit” was held as a hybrid event in Tallinn in 2021 (see pages 92–94).

The Academy’s experience and ideas in organising science advisory activities have earned recognition at several international conferences. On the initiative of SAPEA, the Academy organised the conference “Crossing Boundaries: New approaches to science for policy in Europe” (13 October 2017), which discussed topical issues of research policy. That was followed by the conference “Advisory role of academies in the information-rich society” in Tallinn on 22–23 October 2018. This inspired many European academies to reflect on the issue. In a sense, this conference was continued in “The role of academies in sustaining European knowledge societies in times of crisis”, a conference organised by the Torino Academy of Sciences and ALLEA (Torino, 7–8 November 2019). The Academy has also shared the experience on giving

science advice and science advice systems at many meetings around the world, recently by Tarmo Soomere at his meetings in the United States, Australia, Argentina and many other countries. Support from the ambassadors of the Republic of Estonia and the ambassadors of foreign countries in developing academic ties and mediating information have been laudable.

The European Science Foundation (ESF) has played a major role in coordinating direct scientific research in Europe. The Academy, together with the Estonian Science Foundation, became a member of the ESF in 1999 and has actively participated in the ESF’s projects and in the development of research policy documents. Of these, analyses of the Rules for the Evaluation of Scientific Results and the role of academies in scientific research are worth mentioning. The ESF has brought together academies and organisations that financed research, called “research councils” in many countries. The latter, however, decided to create a separate organisation and thus since 2011 an organisation called Science Europe has united organisations that finance research in Europe. Many academies, including the Estonian Academy of Sciences, have left the ESF. The successor of the Estonian Science Foundation, the Estonian Research Council, is a member of Science Europe. The ESF



The signing of a cooperation agreement with the Chinese Academy of Sciences on 26 May 2000. The President of the Chinese Academy of Sciences standing in the middle, with Jüri Engelbrecht to his right and Richard Villems to his left.

also included the European Marine Board and the European Polar Board, which became independent organisations after changes in the structure of the ESF. The Academy is actively participating in both (Tarmo Soomere and Rein Vaikmäe, respectively).

The European Research Council (ERC) has a very important place in the European science landscape, financing leading-edge research in Europe through extensive grants on a bottom-up initiative basis. The Academy supported the idea of creating the ERC during numerous discussions, which culminated in the foundation of the ERC in 2007. The first ERC Scientific Council was elected from amongst the top European scientists, and Jüri Engelbrecht also took part in the work of the nomination committee. The Academy member Mart Saarma was a member of the ERC Scientific Council in 2011–2017 and the Vice President of the ERC Scientific Council in 2015–2017.

Through its members, the Academy has participated in many international research projects and in the preparation and coordination of research cooperation. The Academy members Ene Ergma and Ülo Jaaksoo participated in the preparation of the Cooperation Agreement for Space Policy with the European Space Agency (ESA), the Academy member Leo Mõtus participated in the Estonian National Commission for UNESCO, and the Academy member

Mihkel Veiderma participated in the Estonian National Committee of the World Energy Council (WEC).

The Academy has participated in the EURAXESS network (see page 151) together with the Foundation Archimedes and Estonian universities since 2008. The Academy has coordinated or is coordinating various international projects: a USA–Estonian oil shale project (the Academy member Mihkel Veiderma), the Consortium of European Taxonomic Facilities (CETAF) (the Academy member Urmas Kõljalg), Thesaurus Linguae Latinae (Professor Janika Päll), the European network Complexity-NET (the Academy members Leo Mõtus and Jüri Engelbrecht), etc.

The Academy has concluded cooperation agreements with many academies for promoting researcher exchange. As at December 2021, there were 27 bilateral or trilateral cooperation agreements in force. Cooperation is coordinated by the Academy's Council for International Exchanges. While exchanges were previously mainly organised on the basis of individual applications, the current focus is more on projects (with Hungary, the Czech Republic, Poland, etc.).

Cooperation with the neighbouring countries Latvia and Lithuania intensified immediately after Estonia regained its independence and annual meetings of academies have



A meeting of the presidents of the Estonian, Latvian and Lithuanian Academies of Sciences in Tallinn in September 1995. From the left: Benediktas Juodka, Tālis Millers and Jūri Engelbrecht.

allowed us to exchange experience. Estonian–Latvian–Lithuanian conferences on intellectual cooperation are of great value. They were first initiated in 1936 and were revived by the Latvian Academy of Sciences in 1999. The Finnish Academy of Sciences has joined the three partners. The last conference held by the Estonian Academy of Sciences in 2021 also included the Hamburg Academy of Sciences, which is interested in cooperation in the Baltic Sea region.

In order to facilitate contacts of young scientists, the Academy has a cooperation agreement with the Lindau Nobel Laureate Meeting, which organises meetings between Nobel laureates and young scientists every year. At these meetings, young scientists gain valuable experience in direct discussions with top scientists. The Academy has also organised conferences for young scientists studying abroad in order to strengthen ties with talented young scientists and pave the way for them to return to Estonia.

A quarter of a century ago, the author of this overview wrote in the foreword to the 1996 yearbook: “Joining the European structures requires persistent and consistent work, but we also need time to participate in the intellectual life of Europe as an equal partner.” I am pleased to say that we have succeeded in doing so at the levels of both the Academy and the Academy members. We are visible thanks

to our research results, we are represented in European and global research organisations, and Academy members have held or are currently holding important positions in international research structures (see details in the yearbooks<sup>54</sup>). Besides the aforementioned research policy conferences, Academy members have also organised many specialised international science conferences.

Academies bring together the representatives of various areas of science. Their discussions and viewpoints are necessary in determining the nature of global problems and proposing solutions.<sup>55</sup> The same goes for the Estonian Academy of Sciences, whose international activities have definitely made Estonia more prominent than its small size would seem to warrant. Indeed, this is the role of research diplomacy and the Academy has fulfilled this role substantively.

Note: The author thanks Mrs Ülle Raud for compiling the factual information used in preparing this overview.

<sup>54</sup> The Estonian Academy of Sciences Yearbook – *Annales Academiae Scientiarum Estoniae*, II (1996) – XXVI (2020).

<sup>55</sup> Engelbrecht, J. 2021. *Complexity in Social Systems and Academies*. Cambridge Scholars Publishing, Newcastle, 201 pp.



The confirmation of international cooperation between the Baltic academies in Tallinn in 1998.

### Cooperation agreements with foreign academies of sciences and other organisations

<b>1987</b>	The Polish Academy of Sciences	<b>1998</b>	The Association for the Advancement of Baltic Studies
<b>1989</b>	The Swiss Academy of Sciences, the Royal Swedish Academy of Sciences, the Royal Swedish Academy of Engineering Sciences	<b>2000</b>	The Ukrainian National Academy of Sciences, the Chinese Academy of Sciences
<b>1990</b>	The Hungarian Academy of Sciences, the Academy of Finland, the Bulgarian Academy of Sciences, the Baltic academies of sciences	<b>2001</b>	The Spanish National Research Council
<b>1991</b>	The Baltic academies of sciences, the Royal Society of London, the British Academy	<b>2002</b>	The National Academy of Sciences of Belarus, the Berlin-Brandenburg Academy of Sciences and Humanities
<b>1992</b>	The delegation of the Finnish academies of sciences, the Norwegian Academy of Science and Letters	<b>2004</b>	The Royal Flemish Academy of Belgium for Science and the Arts, the Italian National Research Council
<b>1993</b>	The Russian Academy of Sciences, the Russian Academy of Medical Sciences, the Slovakian Academy of Sciences	<b>2005</b>	The Montenegrin Academy of Sciences and Arts
<b>1994</b>	The French Academy of Sciences	<b>2008</b>	EURAXESS – Researchers in Motion
<b>1995</b>	The Israel Academy of Sciences and Humanities, the Royal Swedish Academy of Letters, History and Antiquities	<b>2011</b>	The Executive Secretariat and Foundation of the Lindau Nobel Laureate Meetings
<b>1996</b>	The Czech Academy of Sciences, the Macedonian Academy of Sciences and Arts	<b>2012</b>	The Academy of Sciences of the Republic of Bashkortostan; the Tajik National University; the Tajik Academy of Sciences, the Georgian National Academy of Science
<b>1997</b>	The Slovenian Academy of Sciences and Arts, the Austrian Academy of Sciences	<b>2016</b>	The Romanian Academy of Sciences, the Azerbaijan Academy of Sciences
		<b>2017</b>	L'Oréal Baltic / UNESCO
		<b>2019</b>	The Academy of Sciences and Humanities in Hamburg, the Sudan Academy of Sciences

## 33 SPEECHES IN PAIDE. TARMO SOOMERE: THE ROLE OF GOOD ADVICE IN THE FUTURE

Dear listeners, and all companions on our journey! “Wisdom should be deemed greater than silver, dearer than loads of gold.”<sup>56</sup> That message from Estonian epic hero Kalevipoeg (Kalevide) channelled to us by Friedrich Reinhold Kreutzwald (1803-1882) 150 years ago is set in an interesting context. It was at the moment that the hero and his entourage – unlike Estonia’s Antarctic research vessel *Admiral Bellingshausen* – turned back from the road leading to the end to the world. To wit: he turned back for home, having attained wisdom. It was as though Kalevipoeg, long before Tolkien, had discovered that “a tree grows best in the land of its sires”.

Estonians have always had great faith in education and wisdom, or that is often how we like to think of ourselves. At least so it seems. To which Benjamin Disraeli<sup>57</sup> would say that “what we call public opinion is generally public sentiment”. René Descartes (1596–1650) would note somewhat sarcastically but accurately enough today: “Common sense is the most fairly distributed thing in this world: because everyone thinks he is so well endowed.”

Education and wisdom are two different things. Education can be measured – from the hours of sitting in classrooms and at computers, all the way up to certificates,

diplomas and degrees and microdegrees and standardised test scores.

Wisdom can’t be measured quite so easily. To paraphrase Heraclitus in a wording borrowed from Mart Raukas<sup>58</sup>: lots of knowledge and an abundance of education and culture don’t automatically make anyone smarter.

Peter Drucker, the father of knowledge-based management theory, wrote that whatever can’t be measured can’t be improved. This assertion certainly doesn’t apply to such important aspects as values, principles or statesmanship. Yet it is good to be able to measure complex things.

If something can’t be directly measured or seen, be it wisdom, foolishness or the Higgs boson, we can often describe it in a different way, one that *can* be measured. We can try to gauge their influence on a third set of things: phenomena or people. And thinking along these lines, we can measure the existence or influence of wisdom – and even better its absence – based on how a wisely-managed company or municipality or country built on the use of wisdom is faring.

In continuing to elaborate on this topic, it quickly becomes clear that our country has been endowed with an unusual surfeit of both education and wisdom, if we compare ourselves to the rest of the world. We are world

<sup>56</sup> Friedrich Reinhold Kreutzwald. *Kalevipoeg*, closing part of the 16th canto.

<sup>57</sup> Benjamin Disraeli (1804–1881) British statesman, two-time UK premier, one of the founders of the modern Conservative Party.

<sup>58</sup> Mart Raukas. Meeting the classic. *Postimees*, 12.09.2020, 212(7223), Opinion. Culture, 563, 5, leht.postimees.ee/7059583/mart-raukase-esse-kohtumine-klassikaga.

leaders in two measurable forms of wisdom: our school-children's PISA test scores; and the clout and visibility of Estonian science and research.

The former is a well-known and oft-advertised result. The latter is something that specialists mainly know. There are approximately 10 million authors of research articles. In 2017, research conducted by scientists at the Estonian Biocentre was placed among the Breakthroughs of the Year as picked by *Science* magazine. It's like being in the top ten of the world's sports events and athletes.

It is not the only brilliant achievement, and not simply a flash in the pan. My colleague, the Academy member Jüri Allik has looked into the matter in more detail. Let us take the influence of scientists among the 50% most successful countries in the scientific field. It measures how much others use the findings of a given scientist or group. We are more than 50% above average on this scale. On the absolute scale, we are among the major research countries, namely in the top dozen.

Getting personal, things are even better. In 2018, seven of our scientists were among the most influential 3,600 and in 2019, nine (plus one visiting scientist) were among the world's 6,000 most influential scientists. If we weren't punching above our weight, we would have one or at best two colleagues among those ranks.

The tip of the pyramid has a broad base as well. For quite some time, more than 50 of our researchers have been among the top 1% in the most citations – the very end of the apex. Roughly double what one would expect based on our size. Though we have grown used to seeing ourselves as a young kitten just finding its legs, others see us as a tiger. Small but extremely diligent.

This painting has a clear real-world dimension, one that is both economic and related to people's perceived wellbeing. The exertions of the last decades have helped Estonia approach the world's 60 most affluent countries. The average person in Estonia is living better than people have ever lived in Estonia before. Of course, our delicate self-concept is still scored by our neighbours doing even better. Although there is in fact a pretty big fly in the ointment here. In terms of units of economic development, GDP, we are approaching our Scandinavian neighbours at a snail's pace. Czechia is still far ahead and our regional neighbour Lithuania, whom we have long considered ourselves to be superior to, is breathing down our necks<sup>59</sup>. The fact that we are closing fast on Italy has to do more with temporary troubles there and doesn't make us feel much better.

<sup>59</sup> See e.g., Müller, M. 2021. Expressing opinion in public debate. The Estonian Academy of Sciences: Words and Images 2020. Tallinn, pp 71–76, [www.akadeemia.ee/wp-content/uploads/2021/10/estonian-academy-of-sciences-year-book-2020i.pdf](http://www.akadeemia.ee/wp-content/uploads/2021/10/estonian-academy-of-sciences-year-book-2020i.pdf).

On the face of it, there's no reason why it can't get even better for us. Analyses from the World Economic Forum tell us that the quality of Estonian higher education and institutions (20th in the world) is significantly better than our wealth would suggest (in the low 40s ranked by per capita GDP).

A closer look reveals some weak spots. Estonia's weakness is – surprisingly, given the foregoing – its low number of diligent bright minds, and an inability to retain them. Based on the presence of active scientists and engineers, we were in the bottom 100 of the 140 countries surveyed, and in fact we are in the bottom decile in regard to intellectuals of various capabilities. Our ability to draw and retain talented people fell to the bottom of the top hundred about 3-4 years ago – the bottom third in the world.

These observations do not hint at something; they say it right to our face. Not whether we are rich or poor. We are, after all, very rich. Not in terms of what is under the ground but what is above the ground and in people's minds. It says we don't know how to make use of that wealth. Articulated from the perspective of economists, it might seem like bureaucrat's cant, but it should still be alarming: productivity per employee in the processing industry is a smidgeon better than in Latvia or Lithuania, but two or three times lower than in Italy, Spain or our northern neighbours, and as much as five or six times lower than in Switzerland.

We often try to excuse ourselves by citing our small size – we say we should be measured in proportions, based on what we do, or can do, per individual. The World Economic Forum's statistics are unsparing. Even in proportional terms, we have no cause to rejoice. If we compare our GDP to purchasing power and look at it per employee and per hour worked, we are still somewhere in the lower left or right corner of the graph. We are trailing far behind Netherlands and Denmark, and somewhere between Hungary and Chile. Our GDP has been steadily converging with the EU average, but this is due more to setbacks in Italy and stagnation in Scandinavia.

To oversimplify a little, there is a clear and recurring pattern in how Estonian society and government function. It is not all that unusual or unique in the world, but it does have considerable braking effect. And that is the fact: we know what is wrong, but we can't get ourselves together to change the situation. More specifically: we can't make full use of our advantages. Even more specifically: we have wisdom in spades, but can't apply it.

Estonia's small size is largely responsible, as our colleague in public science and governance, the Academy member Tiina Randma-Liiv, has demonstrated. Realising the changes often means someone has to be criticised and someone gets hurt. Like the heads of the Health Board in the pandemic last autumn. A small country doesn't have

many people, the relationships between them are relatively strong and because of that, criticising one's own people is much harder than in large countries. Bill Gates captured the essence of the problem when he said: "Be nice to nerds. Chances are you'll end up working for one."

Science and scientists are one of the central stewards of knowledge. Above, we discussed the quality, visibility and prestige of Estonian science on the world stage. My colleague, the Academy member Mart Ustav dropped a painful truth bomb – although somewhat exaggerated and a bit unfair: "We can say with the utmost confidence that Estonian science is of absolutely no use to the Estonian state or the economy for getting people to live better<sup>60</sup>."

Thomas Babington Macaulay<sup>61</sup> asserted that "the best government is one which desires to make the people happy and knows how to make them happy". Of course, happiness does not lie in economic success. But it does upset the sense of contentment if one's neighbours are doing better.

The economic development workgroup led by Erkki Raasuke<sup>62</sup> discovered close to five years ago that better use of the brainpower already vested in Estonia would significantly boost progress towards making our lives better. In figures: it would add at least 1.5 percentage points to GDP growth. Expressed in a third way: economic growth would be roughly 50% faster.

This is not some new, unfamiliar conclusion. Instead, it is a reasonable reflection of the answer that must be given to a simple question: Why is our productivity so low? The answer is, after all, simple: The work we perform is too basic.

The OECD is aware that it is no longer of importance today what kinds of products a country produces but rather what sorts of activities the state performs in its production chain. And this is not rocket science, either: The founder of the modern study of history, Henry Thomas Buckle<sup>63</sup>, was aware a century and a half ago that in ancient times, the wealthiest countries were the ones that were naturally best-endowed, while in his own time, they were the ones in which people were the hardest-working.

Now it should be said: the ones where the people are the smartest. The world is changing and this is also dictating how science and brainpower are taking shape as the engines driving the economy, society and our whole way of life.

Not too long in the past, conceptually speaking, the room next door to the scientist was occupied by an inventor, and an engineer was across the hallway. The three of them worked on a cool new product for the factory across the street. All three were paid from the revenue. No one got paid if one of the three was incompetent.

Things are different now. The scientist works at, say, a university and sprinkles his findings out into the wide world in the form of research publications. Others fish for good ideas in some distant bight of the boundless ocean of research. If someone feels a tug on their line, engineers and visionaries turn it into a cool product or start-up and sell it. Tax revenue pays for the science.

It is easy to conclude from this that society now has a moral right, and politicians a downright duty, to have a say as to how much and what kind of research – and the accompanying brainpower – is funded. If you feel the urge to applaud, hold your horses. Because there is a deeper side to this apparently simple facade. As a marine scientist, I know about the frequent applicability of the saying: still waters run deep. There is also a much deeper concern here. The benefit from science and society is now diluted in both the production chain (in space, as it were) and time.

In such a mechanism for the use of brainpower, other laws – just as universal ones – come into effect. In one way, Estonian writer Mihkel Mutt is right: information lying around everywhere makes people lazy and complacent. On the other hand, life itself shows that generally it's not the smarter people who reach out to seize markets or reap a bigger profit; instead, it is the ones who were smart enough to be first on the scene. Whoever markets a popular product before the others. Whoever knows important things before the others.

Information that was fished out of the internet ocean of knowledge, purchased from a university under contract or retrieved from publications is generally common knowledge already. This means that bringing a winning product to market is more of a game of chance – a lottery with a slim chance of winning.

In principle, the solution is simple: better new knowledge must come into existence within the company itself. In other words, the more successful a company is generally depends on the greater number of better minds working inside the company. Estonia is not in the best of shape in this respect. The number of scientists and engineers in the private sector fell markedly in the period of 2011–2014. In some respects, it may be a problem that exists on paper, but even now we do not see massive numbers of scientists migrating to the private sector or public administration.

As to what is wrong with this picture and where should we be heading, a simple comparison will show. The lion's share, at least 5/6 of scientific accomplishments – basically,

60 Lehepuu, G. 2020. Academy member Mart Ustav: "Estonian science is of absolutely no use to the Estonian state or the economy". *Eesti Ekspress*, 28.10.2020, 44(1612), 30–31, [ekspress.delfi.ee/artikkel/91480960/akadeemik-mart-ustav-eesti-teadusest-ei-ole-eestiriigile-ega-majandusele-mingisugust-kasu](https://ekspress.delfi.ee/artikkel/91480960/akadeemik-mart-ustav-eesti-teadusest-ei-ole-eestiriigile-ega-majandusele-mingisugust-kasu)

61 Thomas Babington Macaulay (1800–1859), British historian and (Whig) politician credited primarily for building the Western education system in India.

62 Raasuke, E. (head of workgroup) et al. 2016. Report of the economic development workgroup. 10.11.2016, 71 pp, [www.akadeemia.ee/wp-content/uploads/2022/03/raasuke\\_majandusarengu\\_raport.pdf](http://www.akadeemia.ee/wp-content/uploads/2022/03/raasuke_majandusarengu_raport.pdf)

63 Henry Thomas Buckle (1821–1862), English historian.

new information – comes from public sector research institutions. This is not our competitive edge. It is instead a tragedy, which confirms what Mart Ustav said.

In countries whose standard of living we envy, things are different. The contribution of the public and private sectors to research in Europe is roughly 50/50 and in the US, 2/3 comes from private sector research institutes.

To the extent that the quality of research can be measured at all, the numbers show that private sector research is even higher in quality<sup>64</sup>. One of the winners of the Nobel prize for medicine last year (2020) was from the private sector. It is no wonder that the US literally rules the world in terms of technology and industry.

Something else that is integrally tied to Kalevipoeg's statement on wisdom I started with is what the cuckoo said to him in the closing stanzas: "Happiness flowers in one's own land / Profit grows best at home!" Estonia is an odd country in this view. We have wealth. A great deal of wealth. Inside the earth, above the ground and even more, in our people. We have become great in spirit. In science and culture, music, theatre and many other fields. But we export pellets, and recently we were still exporting electricity generated from oil shale.

We should be exporting the brainpower that we literally have in great quantities. The brainpower that gave us Skype and which we have forged into a digital society. Brainpower that is able to replace expensive lithium and very specific graphite in phone and electric car batteries with sodium produced from table salt, and electrodes made from Estonian peat<sup>65</sup>. Brainpower that is able to launch vaccines and antiviral nasal sprays with nearly non-existent funding. Brainpower that has the potential to conquer the world in myriad of other ways. Talking about this brainpower, we often fall as silent as partisans being interrogated, or we limit ourselves to boring press releases.

It's easy to talk about but very hard to achieve a situation where brainpower moves beyond the walls of academia and into the economy, becoming an economic engine – which would be the logical role of brainpower in the present age. Many signs indicate that the necessary processes have started taking shape. Universities hold one of the keys. As we know, universities have three missions. One is teaching, through which new knowledge is injected into society. Another is research, which ensures that the teaching is not only in line with the laws of nature but is also the best possible and is forward-looking.

64 Ahmadpoor, M., Jones, B.F. The dual frontier: Patented inventions and prior scientific advance. *Science*, 357(6351), 11.08.2017, 583–587, [www.science.org/doi/10.1126/science.aam9527](http://www.science.org/doi/10.1126/science.aam9527), [science.sciencemag.org/content/357/6351/583/tab-pdf](http://science.sciencemag.org/content/357/6351/583/tab-pdf)

65 Estonian Academy of Sciences. Energy security and security of supply from table salt and peat, *Sirp*, 19.02.2021, 7(3829), 13, [sirp.ee/s1-artiklid/c21-teadus/teaduse-aastapreemia/](http://sirp.ee/s1-artiklid/c21-teadus/teaduse-aastapreemia/).

The third mission is in serving society. This is not the performance of applied work for money, or selling knowledge to society for which society has already paid. It is an intervention into everyday life. Each time you see something that isn't right, come and fix it. It's the ability to see where something is wrong, where there's a problem, and to come to help. It doesn't matter whether it's in the capital city, a region or far away on an island. As Aldur Vunk recently noted<sup>66</sup> at the anniversary of the University of Tartu Pärnu College: even back in the days of chivalry, it was known that whoever had more brains would be sure to win the war.

Getting the brainpower from one's own people is one thing. Generating brainpower from elsewhere is the other half of the tandem. The idea of research in this context is to teach our own people to effectively introduce the intelligence of the whole world. The smarter we are, the stronger we are. When broad-based top science is behind the process, we can also create the new knowledge that is required.

Linking up scientific achievement with industry has already been initiated. In very many ways, these two camps are being nudged to talk to each other, put their heads together and join forces. At state level, an innovation system is being launched.

The word "innovation" needs to be clarified. It isn't a parasitic expression. Although it is often used to conceal incompetence. It has a clear meaning, which Peter Drucker articulated eloquently. Knowledge is the source of wealth in the modern age. If it is harnessed for solving known problems, processes will become more efficient, and production cheaper and faster. Innovation will happen when new knowledge is applied to new challenges. Put simply: when new, cool products are made or some problem previously thought to be impossible is solved based on cutting-edge science. For example, enhancing the value of wood so that the environment remains clean and the forests are quickly replenished.

This thought underscores that an additional universal law is being written: that states, regions and entire continents are now only as strong as how efficiently they are able to obtain the best available knowledge from their brightest sons and daughters. Not just for developing industry or the economy but also as one component of political decisions. It doesn't matter on what level. Whether it is articulating the best available knowledge for government leaders or for making key decisions for some municipality, city or region. This might be a cellulose plant, nuclear power plant, new port or wind farm.

66 14.05.2021 University of Tartu Pärnu College 25th anniversary event. See Raagmaa, G., Rätsep, C. 2021. University as a cluster of brilliant ideas. *Postimees*, 28.05.2021, 119(7433), [arvamus.postimees.ee/7258506/regionaalareng-debatt-parnu-kolledzis-kuidas-viia-akadeemilise-maailma-tarkus-ettevotetesse](http://arvamus.postimees.ee/7258506/regionaalareng-debatt-parnu-kolledzis-kuidas-viia-akadeemilise-maailma-tarkus-ettevotetesse)

It's the direction in which all of Europe is heading: that the inputs into all political decisions include, alongside other arguments, the best knowledge in the field directly related to a given decision. At the same time, it is a direction where progress is not that easy, although it is extremely necessary. Especially in international relations. In Mihkel Mutt's words:<sup>67</sup> "A small player must signal its presence so that it doesn't get on the big ones' nerves but is still noticed. It will get on others' nerves a little regardless, because the existence of small players is intrinsically annoying for big players."

Obstacles along this road are classic in the sense that they were articulated by ranks of intellectual giants on whose shoulders we stand to see further. The obstacles are not dictated by laws of nature. Rather, they are located inside of us. They are largely bound up in our attitude and striking glancing blows in the wrong place. As the Finnish wise man instructed Kalevipoeg before the latter drew the comparison between brains and gold, how can one lead along the road of wisdom if one has got rid of one's advisors? This is a paraphrase of a much older piece of wisdom from the Book of Hosea:<sup>68</sup> "My people are destroyed for lack of knowledge."

We all want to be smart, and good advice can sometimes seem odd or impossible. In the words of Bernard Le Bovier de Fontenelle: It is not easy to persuade people to use their brains instead of their eyes. Or they might simply not like the adviser or the advice itself. As Erica Jong<sup>69</sup> wrote: "Advice is what we ask for when we already know the answer but wish we didn't." And also, "it's easier to fight for principles than live up to them" (Alfred Adler)<sup>70</sup>.

Estonia's big opportunity in this aspect of the functioning of modern society is a well-known fact: we are a small country where almost everyone knows everyone. In the sense of locating and using good advice, small size has tremendous advantages. The best knowledge is usually just a few phone calls away. It isn't necessary to build expensive, complex and cumbersome structures. Often, it is enough to quickly confer with those who know. With the wise, not with the cunning.

It isn't always possible to go for maximum benefit. Much more often, a small country will have to engage in damage control. That is how it is in environmental conservation and climate issues, and many other aspects of life in society. Experts are worth their weight in gold then. According to the definition posited by the great physicist Werner Heisenberg: "An expert is someone who knows

some of the worst mistakes that can be made in his subject, and how to avoid them."

We don't have to have wild heaps of information for this purpose. Nowadays, it is all easily accessible. As Estonian President Lennart Meri said: "It isn't the amount of information that is of determining importance for making the right decisions, but its quality." All indications are that we have both of these parameters. Above all, we have people who are able to say which of the facts retrieved from the internet are correct.

As a result, we might think of the "Estonian Nokia" from an unorthodox viewpoint. Not as a country that has come up with a gizmo or cool app. But instead, a country where the best available knowledge is used in all fields and in all decision-making processes. A country where the maxim of Bernard Beckett has been discarded in the dustbin of history: "A society that fears knowledge is a society that fears itself." A country where the latest knowledge and asking for consultation for this purpose is an inseparable component of governance and leadership. A country where a significant export article is knowing how to create and organise mechanisms for this type of governance and leadership. A country where statesmanship is measured by the words of American writer Maya Angelou (1928–2014)<sup>71</sup>: "Then, when you know better, do better."

The journey in this direction does not have to be started with grand vision documents filled with lofty rhetoric. Instead, we could abide by the words penned by poet Hando Runnel 40 years ago: "Even small streams at some point become rivers, / even momma's boys grow up to be men. / Who loses hope, loses all, / who plays until they win, remains unbeaten." Remember the famous words of Thomas Jefferson: "Only aim to do your duty, and mankind will give you credit where you fail."

31 May 2021, *Paide*

33 speeches was part of Paide Theatre's action series PAIDE 3000 which mapped the life of a city and a community in the 21st century and asked what is and what could be the role of art and artists in the midst of all that. Together with the Paide people, scientists, politicians, civil society activists, urbanists, designers, architects, artists and many others, the Theatre is looking for opportunities to spark the imagination of a city – the city of Paide.

67 Mihkel Mutt. The trap of a small nation. *Postimees*, 29.05.2021, 4(7434), Opinion. Culture, 599, 5, arvamus.postimees.ee/7259151/mihkel-mutt-vaikerahva-loks-22

68 Old Testament, Hs 4:6.

69 Erica Jong (nee Mann; 1942), American writer, satirist and poet.

70 Alfred Adler (1870–1937), Austrian physician, psychotherapist, founder of the school of thought of individual psychology.

71 Cited in: Roos, J., Ollino, M. 2021. A South African woman living in Pärnu: Racism is sometimes more than just hatred. *Pärnu Postimees*, 22.05.2021, 97, 6–8, parnu.postimees.ee/7253874/parnus-elav-louna-aafrikanna-monikord-on-rassism-enamat-kui-ainult-viha

# COOPERATION

## “SCIENCE IN THREE MINUTES” — A CONTEST WHERE YEARS OF RESEARCH HAVE TO BE SUMMARISED IN THREE MINUTES

*Piret Suurväli, main organiser*

Talking about your research relevantly and understandably within only three minutes is quite difficult, but this is the format of the Academy of Science’s contest.

“The real point of giving a three-minute lecture is not in giving the lecture or doing so in exactly 180 seconds. The point is to learn how to cope with unusual situations laden with responsibility, situations where you have to formulate your position in a short, clear and precise manner, no matter what the circumstances.” (Opening words from Tarmo Soomere)

The contest was born in 2015 and has now been held five times.

In 2021, everything was a little different: no festive gala evening with a full crowd, friends and instructors all there. Through the entire process –trainings and the finals – the participants were broke down into smaller groups. The participants knew the exact times of their training sessions and the times of their performances at the final gala. We strictly adhered to the principle of dispersion, but still people formed wonderful groups of friends who wanted to have a good time after the exhausting day of the finals and maybe play the piano in the Academy hall.

Eighteen doctoral students or fresh doctoral degree holders from nearly all of the higher education establishments

in Estonia took part in the contest. The Academy contest is usually preceded by pre-contests at schools and two practical training sessions held by the Academy before the final gala (at the end of 2020 and at the beginning of 2021).

We added a new item to the 2021 contest. From now on, the Academy training will also include – in addition to an inspirational lecture by the President of the Academy, Tarmo Soomere (and perhaps lectures by other Academy members) and practical and individual audio-video training – training of science journalism, where participants are taught to write popular science articles. This time instruction was given by Jaan-Juhan Oidermaa, one of the leading journalists of Estonian National Broadcasting’s science portal *Novaator*. Before the gala, all the young participants had to complete articles based on their doctoral theses and the articles had to be published on *Novaator*. The feedback was great: young people liked the substantive training and how the writing focus was honed, the important aspects were highlighted and expressions were chosen. Quite a few presentations got complete makeovers in the process of writing the article based on it. *Novaator* was also pleased: they got 18 young researchers to complement their circle of contributors and the content seemed like it would be interesting to readers.

Jaan-Juhan Oidermaa made his selection of whom to acknowledge on the basis of the articles. His TOP 5 were Fred Puss, Triinu Tapver, Mai Simson, Dagni-Alice Viidu and Janika Raun.

The jury gathered on 5 February and made different choices. Let us not forget that by the time they arrived at the Academy hall, all 18 young people had already won in terms of increased self-confidence and experience.

The jury’s selections: Dagni-Alice Viidu, Jako Siim Eensalu, Mai Simson, Mariann Proos and Reet Kasepalu.

After the TV director and computer graphics specialist Erle Veber had made the presentations of the five young



The programme host of the Estonian Public Broadcasting Joonas Hellerma led the gala evening and measured the time of the lectures.

participants into concise video clips and these were broadcast in spring on the “Terevisioon” TV programme and on *Novaator*, the public could also choose their favourite. Reet Kasepalu from Tallinn University won that honour.

At the end of November, a new group of talented, smart and beautiful young people gathered at Heimtali for the 2022 competition. We shall see what new quality awaits us.

The “Science in Three Minutes” contest is co-financed by the TeaMe+ programme.

### Closing words from Tarmo Soomere

At times, the jury felt overwhelmed by a cascade of fireworks. Eighteen different characters, eighteen different approaches, eighteen different dresses or suits, eighteen different beginnings, eighteen different endings. By the time the presentations were over, at least half of the jury thought that it would be best to leave the decisions up to someone else. Looking at it from a five-year perspective, there has been amazing progress in speech techniques, and in how the presenters communicate with audiences. We were simply fascinated. The competitors offered logical presentations, great articulation, intriguing beginnings, sometimes shocking endings, engaging parallels and apt metaphors.

But things can’t all be good. This technical perfection somewhat distracted from the substance of the speeches. Nearly everyone clearly formulated their problems so that they were understandable to mere mortals, as well as presenting solutions to problems and the prospects of solving the problems in the near future. About half of the presenters did not make their individual contributions clear to the listeners. This is a relatively important component even if formulated in a foreign language. It should also be pointed out that PowerPoint is actually the devil’s work. But as Martin Luther once nicely put it: if Satan has stolen something

from the beauty created by God, we have the right to take it back at any time. PowerPoint must be used with great care to make sure it does not devour the presenter’s message. This happened a couple of times today. The jury did not see a problem there. However, it was a problem for the TV audience when the texts and the visuals did not match.

Reasons for choosing the five winners:



### Mariann Proos, University of Tartu

A very precise beginning without any distractions. Concise and to the point. It’s clear that this is your speciality. You used that strength. It was the analysis of the word “feel” that appealed to many. The importance of differences in the meanings of words is something that we do not always appreciate. You managed to include quite a few of your results in exactly 180 seconds and clearly explained their significance.



**Mai Simson**, Estonian Academy of Music and Theatre  
A powerful beginning. You made clear to everyone that money is important and that our banknotes bear the images of leaders from different fields. The graphics were very surprising and very effective. You presented very exciting and easy-to-understand facts, and established clear parallels, including interesting and outstanding results from your area of specialisation. You demonstrated good music science, with one small drawback: the explanation of good music science could have been done in about 20 seconds. Even the performing arts specialists at your university do not fully understand what good music science is.

**Jako Siim Eensalu**, Tallinn University of Technology  
This was a classic presentation of a technical problem. It was a clear explanation if a tad monotonous. You used great graphics, which showed the contribution of the work group, and demonstrated what it would mean to the world if we could use the surfaces of windows, as well as the surfaces of roofs to collect solar energy. The jury noted that it was very clear what the work group had done and why it was needed, but you did not explain your specific contributions. But still, it was a good presentation.





**Reet Kasepalu**, Tallinn University

You are such a good teacher: I felt like I was back in a schoolroom and happy to be there. The introduction was very engaging. You used a non-standard format that was very suitable for this auditorium and jury. Students making equal contributions is extremely difficult, but it can be measured. Our big problem in teaching is that we can measure a teacher's working hours and a student's classroom hours, but we have a long way to go before we can measure what the student has learnt in a particular lesson. Measuring whether students contribute equally is one step towards using big data for monitoring and improving the learning process. As some great man has said: what you cannot measure, you cannot mend.

**Jaan-Juhan Oidermaa (Estonian Public Broadcasting and Novaator), instructor of writing science articles:**

"If all doctoral students or new doctoral degree holders could produce similar results, Estonian research communication would be in great shape."

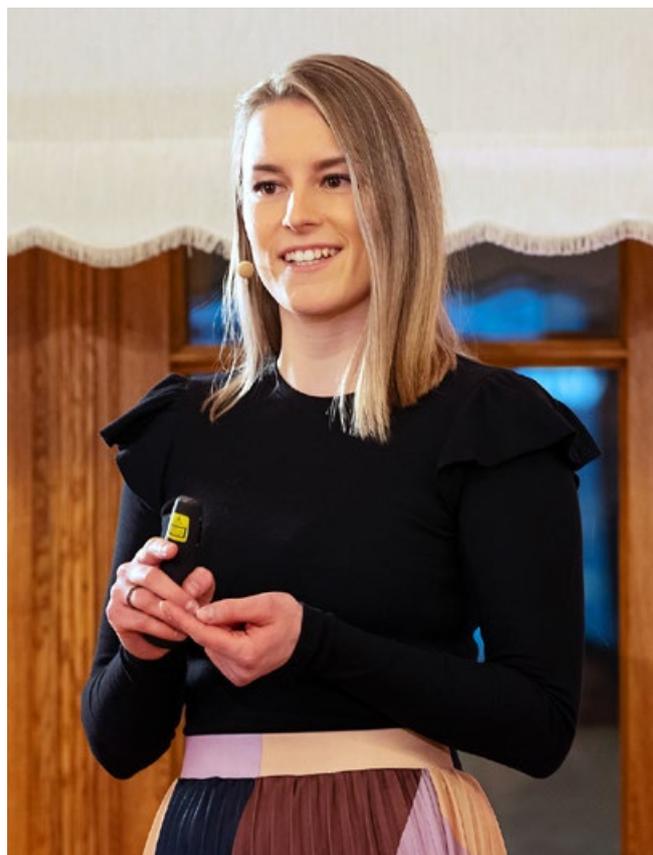


Photo: Meeli Kuitim x5

**Dagni-Alice Viidu**, University of Life Sciences

A cow as a pet is something of a curiosity for city folks here in northern Estonia. However, a cow as a pet is a part of the definition of being Estonian, as cows have always been part of the Estonian family. You may call another animal your brother, but the cow actually provides for the family. We don't know the language of cows and their range of expression is relatively small compared to other animals. It is a true challenge trying to understand the language, behaviour, attitudes and social structures of those large peaceful animals. Marek Strandberg once said that if humankind should disappear, only two groups of creatures would not fare well: parasites and domestic animals. Saint-Exupéry said through the mouth of a fox that you become responsible for what you have tamed. We are responsible for domestic animals, perhaps a little less than for our fellow humans. You pointed out the essential point that many problems stem from people not having enough time for those who feed us. You proposed several solutions that demonstrated a very positive, sustainable and future-oriented attitude.

Many thanks to everyone; we enjoyed this festive form of Estonian research communication!



**The jury (from left):**

KÄRT ANVELT – journalist

TARMO SOOMERE – President of the Academy of Sciences

LIINA KERSNA – Minister of Education and Research

HEITI HÄÄL – entrepreneur

LIISA PAKOSTA – Gender Equality and Equal Treatment Commissioner

REIMO SILDVEE – host and chief editor of the morning programme “Terevisioon” on Estonian Public Broadcasting

MART KOLDITS – director and head of the Von Krahl Theatre

**PARTICIPANTS 2021**

**NELE TABA**

University of Tartu, molecular and cell biology

**Future nutrition decisions with regard to health**

**MARGE SASSI**

Estonian Business School, management studies

**Creativity and strategy in the Estonian creative sector**

**JANIKA RAUN**

University of Tartu, human geography

**Who visit Estonia?**

**DAGNI-ALICE VIIDU**

Estonian University of Life Sciences, Institute of Veterinary Medicine and Animal Sciences

**A farm created by cows**

<p><b>HANNA JUNTI</b> Estonian Academy of Music and Theatre, Department of Drama</p>	<p><b>Time and movement director in the theatre</b></p>
<p><b>REET KASEPALU</b> Tallinn University, education sciences</p>	<p><b>What actually happens during group work?</b></p>
<p><b>JAKO SIIM EENSALU</b> TalTech, chemical and materials technology</p>	<p><b>Transparent solar battery windows</b></p>
<p><b>KAISA ROOTS</b> TalTech, molecular medicine</p>	<p><b>About <i>Helicobacter pylori</i> strains circulating in Estonia</b></p>
<p><b>HEINO PIHLAP</b> Estonian University of Life Science, Institute of Forestry and Engineering</p>	<p><b>Use of machine learning in heating dwellings with air-to-water</b></p>
<p><b>MAI SIMSON</b> Estonian Academy of Music and Theatre, music interpretation</p>	<p><b>Every era has its own music</b></p>
<p><b>FRED PUSS</b> University of Tartu and Institute of the Estonian Language</p>	<p><b>A journey to Estonian surnames</b></p>
<p><b>KAIS ALLKIVI-METSOJA</b> Tallinn University, School of Digital Technologies</p>	<p><b>Estonian language skills through the eyes of a computer</b></p>
<p><b>TRIINU TAPVER</b> TalTech, Department of Economics and Finance</p>	<p><b>The success of actively managed investment funds: luck or skills?</b></p>
<p><b>STELLA POLIKARPUS</b> Tallinn University, education sciences</p>	<p><b>Assessment of situation awareness in a virtual simulation</b></p>
<p><b>ELIISE TAMMEKIVI</b> University of Tartu, chemistry</p>	<p><b>The glue of valuable pieces of art</b></p>
<p><b>MARIA SOONBERG</b> Estonian University of Life Sciences, Institute of Veterinary Medicine and Animal Sciences</p>	<p><b>Why does a cow get upset?</b></p>
<p><b>KAROLINA KUDELINA</b> TalTech, Department of Electrical Power Engineering and Mechatronics</p>	<p><b>Intelligent condition-monitoring methods of electrical machinery and drive systems</b></p>
<p><b>MARIANN PROOS</b> University of Tartu, Estonian and Finno-Ugric linguistics</p>	<p><b>Meaning as a tool for understanding the world</b></p>



Photo: Anvo Kaibe x11

## YOUNG SCIENTISTS ASSOCIATION IS BACK UNDER THE ROOF OF THE ACADEMY

*Terje Tuisk, Head of Development of the Academy of Sciences*

The Young Scientists Association (YSA) was founded at the Estonian Academy of Science as an initiative of the Academy member Anto Raukas on 22 November 1980. The heads of the Academy took attracting students to science very seriously already back then: the first conference was opened by the then President of the Academy, Karl Rebane, many Academy members and scientists were involved in supporting students, including the most important advocate and promoter of the YSA today, Professor Peeter Lorents.

After Estonia regained its independence, the activities of the YSA stopped for a few years. The hiatus ended in 2004, when the alumni of the YSA met with Peeter Lorents and re-launched the work. The YSA first operated at the Foundation Archimedes, then at the Estonian Research Council, and since 2021 it has again operated under the roof of the Estonian Academy of Sciences.

In Regina Hansen's article published in *Õhtuleht* on 25 November 2004 to celebrate the restoration of the Association, "The recess of the Young Scientists Association is over"<sup>72</sup>, the early years of the YSA are

<sup>72</sup> Handsen, R. 2004. The recess of the Young Scientists Association is over. *Õhtuleht* 25.11.2004, [elu.ohhtuleht.ee/166010/opilaste-teadusuhtingu-vahetund-sai-labi](http://elu.ohhtuleht.ee/166010/opilaste-teadusuhtingu-vahetund-sai-labi)





recalled by both its founders and alumni: Katri Raik, who is now the mayor of Narva, and Rein Ahas, who was just a young scientist at the time. The activities of the YSA have played an important role in the lives and future choices of the young people who have been involved in them. Today's YSA is naturally different from the Association founded in 1980, but the objectives remain the same: to draw young people from high-schools to science and to give them the opportunity to learn more about science under the guidance of top scientists. With the re-launch, nearly all of the traditional activities of the Association were restored: young people were brought together with scientists to experience how the research is done at a research institution, and the YSA's spring conferences and summer seminars. Instead of the spring conference, the Estonian Research Council (ERC) has since 2015 been holding the Student Research Festival, which is also the final round of the National Contest of Young Researchers, and in the course of which the ERC publishes a contest book that is essentially the equivalent of the compilations of theses published in the early years of the YSA. Currently, many schools have direct

ties with research institutions and dozens of scientists are supervising the research of students.

The tradition of the Viitna summer seminars has been unbroken since 2004, with the Estonian Academy of Sciences being the organiser since 2021. Every year, the seminar has an overall topic which the scientists of different fields approach from their points of view, e.g. religion, truth, beauty, balance, death and life. The topic of the seminar held in August 2021 was "Life". The approximately 60 students who gathered at Viitna learnt what mathematicians, chemists, physicists, biologists, archaeologists, and psychologists understand life to be. As is traditional, the President of the Academy of Sciences also gave a presentation. Students had the opportunity to think about life, analyse life and debate life with scientists.

The moments captured in photos vividly illustrate the vibe at Viitna.

# STUDY: "COMPLIANCE WITH THE PRINCIPLES OF THE EUROPEAN CHARTER AND CODE FOR RESEARCHERS AT ESTONIAN RESEARCH AND DEVELOPMENT INSTITUTIONS"

*Terje Tuisk, Head of Development of the Academy of Sciences*

In 2021, specialists from the office of the Estonian Academy of Sciences contributed to a study<sup>73</sup> on how well Estonian R&D institutions abide by the principles of the European Charter and Code for Researchers" (hereinafter *Charter and Code*).

Documents governing the European Research Area mention an open labour market for researchers as a one of the key priorities. The documents describe the principles for ensuring that researchers have the optimum working conditions, including both international and intersectoral mobility, valuing the societal engagement of researchers and making a researcher career appealing for the young. A goal of the document published by the European Commission in March 2005, the Human Resources Strategy for Researchers (HRS4R),<sup>74</sup> is to support the implementation of these priorities at research institutes.

The goal of the study was to determine:

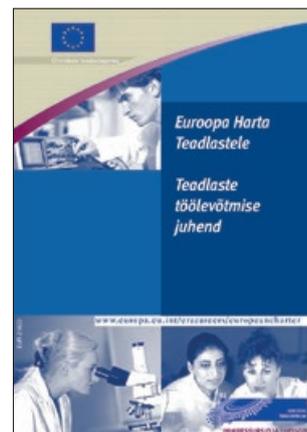
- whether Estonian research and development institutions abide by the principles of the Charter and Code, and if so, how.
- if not, why; and whether the limitations stem from intra-organisational arrangements or a broader context, the national policies etc.;
- what could be done to support Estonian research institutions in complying with the principles of the Charter and Code;
- how the principles of the Charter conform to the objectives and envisaged measures of the Estonian national Research and Development (RDI) strategy<sup>75</sup> and the Research and Development, Innovation and Entrepreneurship development plan,<sup>76</sup> and to what extent com-

73 Parre, K., Pevkur, A., Parder, M.-L., Espenberg, S., Roos, L., Kalev, L., Olm, M., Taru, M., Tuisk, T., Soomere, T. 2022. Euroopa teadlaste harta ja juhendi põhimõtete järgimine Eesti teadus- ja arendusasutustes. Tallinn: Tallinn University of Technology, University of Tartu, Tallinn University, Estonian Academy of Sciences, <https://doi.org/10.48726/3kp5r-va334>

74 *The Human Resources Strategy for Researchers*: [euraxess.ec.europa.eu/jobs/hrs4r](http://euraxess.ec.europa.eu/jobs/hrs4r)

75 The R&D and Innovation Programme for 2018–2021 in Estonian [www.hm.ee/sites/default/files/11\\_tai\\_strateegia\\_programm\\_2018-2021.pdf](http://www.hm.ee/sites/default/files/11_tai_strateegia_programm_2018-2021.pdf)

76 Estonian Research and Development, Innovation and Entrepreneurship Strategy 2021–2035, [https://www.hm.ee/sites/default/files/taie\\_arengukava\\_kinnitatud\\_15.07.2021\\_211109a\\_en\\_final.pdf](https://www.hm.ee/sites/default/files/taie_arengukava_kinnitatud_15.07.2021_211109a_en_final.pdf)



- pliance with the principles of the Charter and Code contributes to meeting the objectives of the RDI strategy with regard to human resources (or whether failure to follow a principle has hindered achievement of some human resources related objective of the RDI strategy);
- which bottlenecks could be solved by policy makers at the national level already now and which need additional attention.

The goal was to include in the study as many positively evaluated<sup>77</sup> Estonian public universities and research institutes, as well as state research institutes, as possible. Eleven of the 21 positively evaluated institutions took part in the study, i.e. all six public universities (the University of Tartu, Tallinn University of Technology, Tallinn University, the Estonian University of Life Sciences, the Estonian Academy of Arts, and the Estonian Academy of Music and Theatre), the Institute of Chemical Physics and Biophysics, the Academy of Sciences Under and Tuglas literature centre, the Institute of the Estonian Language, the Estonian Literary Museum and the National Institute for Health Development.

The study was conducted in line with the HRS4R methodology developed by the European Commission. First, a document analysis related to the topic was conducted at the institutions, along with focus group interviews and/or web-based surveys. Based on these, the problem areas related to the fulfilment of the Charter and Code principles were determined and a relevant overview and recommendations for each institution were compiled. In addition, the institutions' assessments were elicited on how to better provide national-level support for the development of these fields at the institutions, including policy on the development of human resources. Based on the results of the first stage, a general analysis of the findings was prepared, along with recommendations for policymakers on how the problem areas identified could be improved at the state level.

77 Regular evaluation, Estonian Research Council, <https://www.etag.ee/en/activities/rd-evaluation/>

**Findings.** In general, it can be said that, as would be presumed, the large research institutions (the University of Tartu, Tallinn University of Technology and Tallinn University) have more resources for establishing and implementing human resources policy and therefore are better poised to implement the Charter principles. Understandably, the smaller institutions had lower administrative capacity, which impacted the implementation of the Charter principles.

The most problematic areas found by the study were limitations arising from the shortage of funds and related problems in maintaining lasting employment relationships and the lack of social security. The lack of funding was the most polemical topic for study participants, as a great number of related concerns were cited. The same topic was noted as problematic by nearly all of the participating institutions. The lack of perceived social security was an irritant for both experienced and novice researchers, impacting the attractiveness of a career as a researcher and, consequently, the future of research as a whole.

To sum up, it can be said that, in the currently prevailing conditions, it is not possible to fully implement, or even implement a majority of, the principles of the Charter and Code at practically any of the Estonian research institutions.

In some aspects, progress is possible through fine-tuning or supplementing internal regulations and practices or by instituting additional ones. The implementation of additional Charter principles will require national-level decisions, changes and, in many cases, financial resources and other support as well.

The results of the analysis are not particularly surprising, but the results do reflect the situation during the study period (1 February to 15 June 2021) at the participating institutions. Summarised and generalised, they will hopefully yield benefits for every participating institution, and for Estonian research and society as a whole.

The study was organised under RITA action 4 “RDI policy monitoring”. The study was funded by the Estonian Research Council, with support from the RITA programme and was conducted by a team consisting of representatives from the Tallinn University of Technology, the University of Tartu, Tallinn University and the Estonian Academy of Sciences. For the full final report of the study, see [doi.org/10.48726/3kp5r-va334](https://doi.org/10.48726/3kp5r-va334).

## ACADEMIA PERNAVIENSIS

*On 6 October 2021, four institutions signed a memorandum of understanding aimed at promoting, guiding and organising science activities for the young people of Pärnu. The Estonian Academy of Sciences, the Faculty of Social Sciences at the University of Tartu, the Pärnu City Government and the non-profit association Academia Pernaviensis stated their desire to contribute to the development of regional science activities.*

*But what if the late Academy member and the Rector of the University of Tartu Peeter Tulviste (28.10.1945–11.03.2017) had met with the four institutions that revived the Academia Pernaviensis initiative? Academia Pernaviensis board member Margit Raid contemplates on that together with Gea Kammer and Ülle Sirk*

Dear Academy member Peeter Tulviste  
I’m writing to you almost 20 years after the two-word phrase “Academia Pernaviensis” crossed your desk. You’re remembered by many for your sincere, profound curiosity, always looking for meaning. I know that there is less room than ever before in today’s Estonia for the word “curiosity”. The changed learning environment in schools, and the role of knowledge and science in a world of snap decisions that don’t go beyond the headlines seems to require a pause and the courage to look at matters in depth, without appearing to pause.

I wonder whether the Academia Pernaviensis era at the University of Tartu might be just as full of challenges



as the unexpected pandemic spreading around the overly clockwork world. Is there once again a glimmer of a hope of bringing the world of science closer to societal decision-making, of plugging the digital era’s social and civil society interest groups into the equation: allowing them to have a seat at the round-table in a new way, and keeping the search for meaning and influence in a stable central position?



Photo: Hendrik Osula

From the left: the signatories were the dean of the University of Tartu Faculty of Social Sciences Raul Eamets, the member of the board of Academia Pernaviensis Margit Raid, Pärnu Mayor Romek Kosenkranius, and President of the Estonian Academy of Sciences Tarmo Soomere.

The word “cooperation” can be used as an equals sign.

On the 320th anniversary of the founding of the Academia Pernaviensis, 28 August 2019, we reinstated a round-table of the same name in the form of a civil society initiative. Since you wanted to create a crossroads of the local intellectual elite, cooperation networks and science in the larger communities in the counties, we hoped that the momentum would build. Pärnu College of the University of Tartu can, after all, be considered the symbolic successor of Academia Pernaviensis, and thus we signed the memorandum of joint intentions together with an Academia founder, Rein Veide-  
mann, and the head of Pärnu College, Garri Raagmaa. You might have responded: “A signature is not enough.”

In cooperation with the development director of Pärnu College, Gea Kammer, and your valued colleague Ülle Sirk, we set the goal of uniting and networking with, through discursive culture, scientists, intellectuals and cultural figures in the field of educational innovations, including scientists and presenters with backgrounds from Pärnu, popularisation of the history of science and life-cycle-based education.

And now you ask: “Were you able to generate curiosity again?”

I respond by referring to what I heard during nine meetings of Academia Pernaviensis.

At our first session, Peeter Järvelaid mentioned that this is the second try at reinstating the Academy. And now that it has taken the form of being able to unite intellectuals, and quality specialists who either have Pärnu roots or are friends of the city from near and far, it generates value for more than just Pärnu.

An academic network is a network of networks!

The author of the book *100 Years of the Estonian Language*, the linguist, professor of the history of Estonian language and dialects, and member of the Academy Karl Pajusalu opened the discussion, saying optimistically that we shouldn’t compare Estonian only to Russian or English but also to languages that have far fewer speakers than Estonian does. We should actually think of our language as a big world language, for among the about 7,000 world languages Estonian is about 200th in the number of speakers. “But when you think about how much literature we have published, how many language technology tools we have today, and how many Estonian-language articles there are on Wikipedia, our language is basically in the top 100.”

Inspired by the visionary Academy members Karl Pajusalu and Richard Villems, we asked a question as leaders of the Academia Pernaviensis: how can technology help disseminate the words heard in the sessions of Academia Pernaviensis?

After we had looked for Pärnu’s place on the communication map through Raul Rebane’s presentation, the world did in fact take a turn toward digital sociality, seminally and successfully in terms of the round-table.<sup>78</sup>

Of the 12 sessions that have taken place, 10 were in hybrid format, increasing our community to close to 400, and the main thing was supporting networking in the service of academic society rooted in education.

The professor and social sciences dean Raul Eamets, who has roots in Pärnu, and Dan Bogdanov, an IT scientist and the director of AS Cybernetica data security institute, asked us to ponder the future, putting the focus on education and fundamental rights in the new era and the use of technology to protect them. We asked Eamets, the leader of the Estonia 2035 strategy, whether and to what extent the remote learning period affected strategic trends in education. The discussion on the future of educational life was enriching and gratifying.

Dan, a bridge builder in the scientific world of the younger generation, told us how a back-to-the-roots mindset can be a foundation for daring to dream big and taking ideas global, by empowering life-cycle-based learning, supported by primary knowledge of one’s home region!

The member of the Academy Urmas Varblane introduced a provocative line of inquiry about the post-pandemic economy, in a source-based and meaning-making manner. By that time, the college was already closed for renovation. Garri Raagmaa expressed the change as follows: “By contributing to building a regional anchor community, we maintain the goal of developing a comprehensible college culture in Estonia. It is precisely the current era that

<sup>78</sup> <https://parnu.ut.ee/et/academia-pernaviensis>

guides us to find balance through shaping life-cycle-based education through new flexible educational formats. Our role in relation to education is to carry out science-based development cooperation between companies and organisations, because the future of local scientific institutes lies in networking.”

As you can see, honourable Academy member Tulviste, we have acted in an academic spirit, abiding by the rules of the new epoch, and breaking those rules, too! After all, the words “adaptation through cooperation” were heard at the session visited in spring by the rector of the University of Tartu, Toomas Asser. By breaking the rules, it is possible to let the academic culture of think tanks loose in digital

space, paving the way to new networks by sparking interest in more than one thousand contacts. Tactfully.

Thanks to you, Peeter!

Thanks to you, curiosity, historical heritage and the courage to take the reins of the future all live on in Academia Pernaviensis! Why else would we have started Pärnu College’s 25th anniversary festivities with a breakfast in your honour on the terrace of Ammende Villa, planning influential collaboration between the Academy of Sciences, the Pärnu city government and the college and initiators of the Academia Pernaviensis? The future doesn’t just happen by itself.

Thank you for inspiring us!

## MATTERS OF CONSTITUTIONAL LAW IN ACADEMY’S AGENDA

*Tarmo Soomere*

More than three years ago, on 20 December 2018, the Ministry of Justice decided to support the formation of the Constitutional Law Endowment at the Academy of Sciences in order to promote the teaching of constitutional law and research in constitutional law. Besides supporting the preparation of proper research articles and scientific cooperation, this kind of financing also opens the way to ground-laying activities, such as the publication of constitutional law textbooks and other study materials, the preparation of analyses and the organisation of lectures, discussions, conferences and research competitions.

The second yearbook of the Endowment was published in hard cover, with the original design and notably more numerous original writings. The primary sources of several contributions included the presentations made at the 36th Jurists’ Days, dedicated to the 100th anniversary of Estonia’s first Constitution (1920), as well as the constitutional review discussion held at the constitutional law panel during the Jurists’ Days. The translation of the first full commentary on the initially German constitution of 1920 by Eugen Maddison and Oskar Angelus was published for the first time, alongside several translations of writings that have significantly influenced constitutional law studies throughout the world.

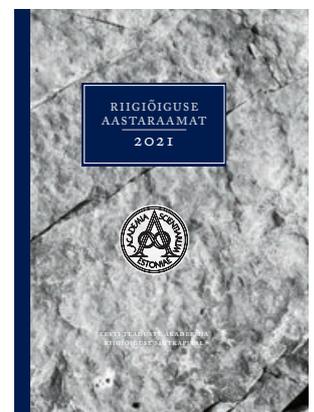
In cooperation with the University of Tartu, the Academy held the law and history conference “The Day of Ants Piip. A Hundred Years since Estonia’s Accession to the League of Nations”. Sources and documents related to the 1920 constitution were digitised and compiled, as were writings discussing that constitution which had previously

only been accessible in archives. At the request of the Minister of Justice, an expert opinion on the fulfilment of the general principles of the legislative drafting policy was prepared. That turned out to be rather critical.

The competition entry of the laureate of the Constitutional Law Endowment Special Prize, Birgit Aasa, “The Principle of Mutual Trust in EU Law: What Is in a Name?”, was also awarded first prize at the national student competition at the level of doctoral theses in the area of social sciences. This is the first known occasion when one paper has received two important awards in that competition.

The world of science contains areas in which countries have special obligations. We usually understand “national sciences” to mean the studies of the Estonian language, culture, literature, history and way of thinking. These should also include law. Inherently, every language contains a number of structures and meanings on which the legal system and legal practice rely and without which we cannot talk about truth or understand law.

Several aspects of constitutional law come into contact with the national obligations of the Academy of Sciences. For instance, the Estonian Constitution says that the government’s sessions are to be closed. Does this mean that scientists’ advice presented to the government’s sessions must not be made public? This simple question and many other issues that arose due to the developments of the past two coronavirus years require a systematic legal analysis.



# SCIENCE AFTERNOONS AT THE ACADEMY

In spring 2015, the Academy started its “Science and Society” series meetings, the aim of which is to provide an informal, academically free and inspired environment – in the form of a morning coffee or a science afternoon – to exchange thoughts on topics important to society, to formulate major tasks and construct the big picture, to find common ground with different parties, to create new cooperation opportunities and to test elegant solutions.

In 2021 the Estonian Academy of Sciences organised four science afternoons.

## **Science afternoon (XVII) “Scientists on the front line, or the challenges of security” was held on 3 June 2021**

The success of countries increasingly depends on how well they are able to apply knowledge from anywhere in the world. As carriers of knowledge, scientists have ended up on the front line of the battle for knowledge. The interest in interacting with foreign scientists is therefore growing, particularly in areas that may contain industrial secrets and information important for national security. Some risks are even present in international research cooperation, where research partners may hide their actual motives. Many researchers are no longer independent. In certain countries, it is an unwritten rule that scientists cooperate with the national intelligence structures. It is only reasonable to be well-informed about possible complicated situations. The science afternoon participants discussed these topics with the representatives of the Estonian Internal Security Service and explored ways to promote research without getting into dangerous intelligence games.

## **Science afternoon (XVIII) “About salt and the Baltic German food culture” was held in the framework of the Researchers’ Night Festival on 21 September 2021**

The first part of the science afternoon included a screening of the documentary “Pass the Salt”, which was followed by a discussion with experts. In the second part, a researcher from the Under and Tuglas Literature Centre of the Estonian Academy of Sciences and a professor at Tallinn University, Professor **Ulrike Plath**, and her students gave a presentation on the late 19th century Baltic German food culture. (see pages 82–83).

## **Science afternoon (XIX) “Green transition in European industry: from critical natural resources to green technologies” was held on 18 November 2021**

The focus was on the meaning of the green transition from the viewpoint of industry, and the role of science in supporting and clarifying it. (see pages 77–82).

## **Science afternoon “Talk to people: the message of scientists in difficult times” was held on 2 December 2021**

It has become clear in the course of the corona crisis that neither the virus itself nor other similar crises will simply disappear. We therefore need a considerably better understanding of where we are, how to explain the situation and how to construct messages that look into the future. The science landscape and the clarity of messages play an important role in this context. Specialists of different backgrounds and experience discussed how to better apply the abilities of scientists in handling this task. The discussion was held in cooperation with the Government Office.



## SCIENCE AFTERNOON (XIX) "GREEN TRANSITION IN EUROPEAN INDUSTRY: FROM CRITICAL NATURAL RESOURCES TO GREEN TECHNOLOGIES"

The green transition is a keyword that entered the public consciousness in 2021, and will probably stay there for decades. It is much more than a new set of rules to follow, wetland restoration, forest conservation, the reasonable use of meadows, the insulation of buildings, the purchase of energy-saving equipment and, where possible, getting people used to bicycle transport. It also involves a transformation in thinking and attitudes, a transformation that would give us the ability to live so that humankind as a whole does not put more pressure on nature than nature can tolerate. It is not detrimental to the economy, human health and the quality of life will improve and no one will be alone with their troubles.

It may seem that it is a mission impossible. Maybe. I would remind you what Clarke's Law says about possibility and impossibility: "When a distinguished but elderly scientist states that something is possible, they are almost certainly right. When they state that something is impossible, they are very probably wrong." I would also remind you that the Earth is not an isolated system. The Sun will supply us with energy for a very long time to come. That energy is sure to be sufficient for a green transition. We just need to be able to store solar energy and convert it to a form that can be used where and when needed.

It is likely that the realisation of the green transition will be shaped by how fast we can reconfigure our industry. This is the place where innovation is actually needed: the capability of doing new things by completely new means that top-flight science offers us. The Academy's 19th science afternoon, "green European industry: from critical

natural resources to green technologies" focused on a small number of the problems that have arisen.

The focus was on the significance of a green transition from the standpoint of industry and the role of science in making sense of it and supporting it. We tried to define what a green transition meant for enterprise. We discussed how to achieve a breakthrough when it comes to the generation of energy and harnessing energy carriers. We tried to explain what decarbonisation is and whether we can tax high-carbon products at Europe's borders. We talked about the growing need for natural resources, particularly metals, and Europe's strategic dependence in this field. We tried to understand and articulate what a green transition means for societal development and how it could influence people and even frighten them.

The exchange of ideas was introduced by President Tarmo Soomere, with selected ideas that he laid out at the investing conference in August 2021, "A Different Paldiski 2021. The Green Transition in A Green Rural Municipality" (see pages 78–80). The keynote<sup>79</sup> was delivered by Maive Rute, the Deputy Director-General of the Internal Market, Industry, Entrepreneurship and SMEs. Her presentation was followed by one from Anneli Akkermann, from the *Riigikogu's* Economic Affairs Committee. Dr Rutt Hints of TalTech made an attempt to articulate what the finite nature of natural resources meant. Her presentation (see pages 80–82) pointed out that natural resources would not run out simply or rapidly. What will run out first is

<sup>79</sup> The presentations can be streamed on demand on the Academy's website: [www.akadeemia.ee/sundmused/teadusparastlouna-xix-euroopa-toostuse-rohepoore-kriitilistest-maavaradest-rohetehnoloogiateni/](http://www.akadeemia.ee/sundmused/teadusparastlouna-xix-euroopa-toostuse-rohepoore-kriitilistest-maavaradest-rohetehnoloogiateni/).

the convenient and cheap extraction of natural resources. Tiit Tammaru from the University of Tartu pondered how the transition to cohesiveness could be measured. Another University of Tartu academician, Enn Lust, delivered – by video bridge – an inspiring lecture about everything that was being prepared for production. The vice rector for a green transition at the University of Technology, Profes-

sor Helen Sooväli-Sepping, impressed on everyone the fact that a green transition above all means a change in mindset. The event then continued with a conversation in a pleasant and uninhibited atmosphere on what Estonia could contribute to structuring new industrial capacities: batteries, hydrogen technology, strategic natural resources, vaccines, semiconductors or cloud technologies.

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## *The energy of the future as a combination of smart production, smart use and efficient storage*

*Tarmo Soomere*

We tend to project our current hopes, dreams and concerns on to the future. It usually takes some problem to get us to think in a different way. Humans are rational creatures, but if they feel good, they rarely think, according to an old adage. Another saying is that happy people have little interest in the meaning of life or other eternal topics – to say nothing of a green transition. Stanisław Jerzy Lec has remarked that people like ideas that don't force them to think.

It is becoming increasingly clear that we have a problem. For some time, an existential concern about humankind's future has been the fact that Earth's natural environment is not able to offer people enough benefits, ensure a liveable environment, absorb the waste our activities produce and continue to keep us supplied with the materials and substances we need for life, to say nothing of non-renewable natural resources.

A possible exit was agreed on at the EU level back in December 2019: the Green Deal or a green transition. It has become a much maligned and abused phrase. It is just like prime real estate before the Great Recession started around 2008: everyone sells it, no one has seen it, and no one dares propose a definition.

But a green transition is something specific. The framework agreed on at the EU level sees a green transition as a series of real-world actions. They are aimed at five connected objectives: 1) making Europe climate-neutral so that 2) the economy will grow, 3) public health will improve and living conditions will become more pleasant, while 4) simultaneously taking care of nature and 5) making sure that no one is left behind.

Incidentally, a climate-neutral economy means making arrangements to keep the level of greenhouse gases (including carbon dioxide) emissions within Earth's ecosystem's ability to absorb them. It also means at least maintaining ecosystem services, and if possible making them more abundant.

It is to such a green transition framework that the EU contributes and encourages member states to contribute.

Estonia has made quite rapid strides toward a green transition defined in this manner. The polluting and wasteful economy we inherited from the Soviet Union has nearly totally been eliminated. In the global view, there is a long way to go, because Estonia is still a contributor to waste and pollution. It's worth recalling the words of Nikolai Baturin: if you want to know where to go from here, you have to know where you are, even if the knowledge is painful. For example, we are 23rd in the world in per capita carbon dioxide emissions, and third in Europe. In two years, the situation has improved a little (the rankings were 15th and 2nd, respectively, in 2018), but it needs to improve much more.

The keyword "energy" recurs in quite a number of the entries in the list of EU green transition target fields. Sometimes it is found in the shadow of some other field. A good way to start is to look at which sectors are impediments to progress toward climate neutrality in terms of greenhouse gas (GHG) emissions worldwide.

If we visualise emissions as a dirty "pie" (befitting their hazardousness), these inconvenient obstacles can roughly be divided into four wedges.<sup>80</sup> One-fourth comes from agriculture and forestry. We can't wage an assault on agriculture, because we would simply starve. We have to accept this one-quarter for now.

The energy sector yields almost three-fourths of GHG emissions: 73.2% (2016). The largest components are energy use in industry – 24.2%, transport – 16.2%, and in buildings – 17.5%. The rest make up 15.3%.

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<sup>80</sup> See the graphic material in the article by Soomere, T. 2021. The green transition as a matter of the development of research and technology. *Postimees*, 24.04.2021, 94(7408), Opinion. Culture, 594, 2–3, [arvamus.postimees.ee/7232195/tarmo-soomere-rohepoore-kui-teaduse-ja-tehnoloogia-arendamise-kusimus](https://arvamus.postimees.ee/7232195/tarmo-soomere-rohepoore-kui-teaduse-ja-tehnoloogia-arendamise-kusimus)

This suggests an unexpected and somewhat unpleasant conclusion: a green transition is not a populist back-to-nature initiative. It is not more forest, meadow or restored wetland habitats. The energy sector is the biggest obstacle to climate neutrality and, thus, the greatest impediment to a green transition. It would be logical to devote greater scrutiny to this.

It is a global problem. Energy issues affect us all, because the precondition for the functioning of a modern society is a perfect energy supply.

Energy consumption around the world is increasing. This is because others want to live as well as we do. Even more important is the architecture of contemporary society: the greater information society's requirements are for high-quality energy to be available all the time, the greater the capacity reserves must be, and the greater the pressure on power plants, grids and the environment. The rapid development of an information society may thus, in the context of a green transition, be a serious problem. If we look at how much energy cryptocurrency requires, it might even be a dead end, though not without an escape hatch.

The situation is actually even more complicated than that. Those who are responsible for the energy supply are locked in a perpetual struggle with a three-headed dragon: the central triple challenge or triangle as Estonian TSO head Taavi Veskimägi called it.<sup>81</sup> First of all, there is the need to ensure the security of supply and energy security, i.e. quality energy at all times. Secondly, energy generation has to be clean and sustainable. Thirdly, the price of energy must be kept affordable for consumers.

There are no convenient solutions to such problems. Simply developing new technologies to solve the problems will usually lead to the next turn of the production spiral. New technology is generally cleaner and cheaper than the previous technology. For that reason, more people switch to it. As a result, energy consumption grows, as does the need for materials and the volume of waste and residues. In 1865, the British economist William Stanley Jevons noted that the more efficient use of coal led to a greater demand for coal. It's a phenomenon called the Jevons paradox.

The shadow of the three-headed dragon coupled with the warning of the Jevons paradox sends a clear message: we have to rethink how we supply energy to our contemporary society. Currently a large part of it relies on fossil fuel use, big energy and powerful transmission lines. New solutions could mean structural changes for the entire energy sector, the generation strategy and the consumption philosophy.

There are two fundamental options on the road to a green transition: 1) using less energy (because the greenest energy is energy not consumed or generated) and 2) being able to generate cleaner energy. In other words, two pillars: intelligent use and smart generation.

In one direction, Estonia has begun making headway: the comprehensive renovation of existing buildings, as the Academy member Jarek Kurnitski has recommended. We are several years ahead of most of Europe with our practical industrial solutions. But that involves far more than merely insulation and the replacement of heating systems. Local energy generation, energy storage and good ventilation are also components. Doing it properly will cut energy needs in half or more, consumption peaks will level off and energy deficits in harder times will decrease. The results will include a good indoor climate and viral illnesses spread by airborne transmission will be suppressed. This is thus a profitable way to make a green transition a reality.

Progress in the second of the two directions is not as brisk. Estonia is actually not doing all that well in renewable energy. There has been plenty of talk and plans. The pace of launching renewable energy has not caught up to the rate of the loss of fossil fuel sources. Estonia has quickly gone from electricity exporter to importer.

The main question in this context is not whether we are able to replace fossil fuel-based energy with renewable sources so that none of the components of the triple dragon suffers, but how.<sup>82</sup>

Blaise Pascal wrote that conclusions that people reach themselves usually are more persuasive than ones that occur to others. Thus, the central challenge for this transition that will affect all of society is not so much technical as social. The greatest concern on this road is people's attitudes, their expectations, hopes, fears and dreams. These tend to be entrenched and have a cumulative, mutually complementary nature. Trust is slow to develop, and quick to fade. If people have had their hopes dashed repeatedly, it is awfully hard to persuade them to try again.

The current situation in the energy sector is that the existence of regulated capacities makes it possible for unregulated capacities to be on the market. This could change in future. Estonian wind and solar energy will soon likely be sufficient, and even produce a surplus, but only during a few hours of the day. We need voltage at other times as well.

More generally speaking, in the interests of energy security and supply security, we must be able to produce and store energy in various forms. For example, a stack of firewood is a pleasing and efficient way to store energy. It doesn't need to be fed and doesn't require maintenance staff. That's not the case with

81 See the discussion between Hando Sutter and Taavi Veskimägi at the Academy of Sciences in: *The Estonian Academy of Sciences 2021. Words and Images 2020*. Tallinn, pp 50–70, [www.akadeemia.ee/wp-content/uploads/2021/10/estonian-academy-of-sciences-year-book-2020i.pdf](http://www.akadeemia.ee/wp-content/uploads/2021/10/estonian-academy-of-sciences-year-book-2020i.pdf)

82 It became clear at the end of 2021 that the hope that the market itself would regulate prices had led to huge fluctuations in the price of energy and had resulted in the average price growing exponentially.

electricity. Whatever comes out of a generator must be used in milliseconds. You can't warehouse it or turn it into kindling.

In our climate, we have windless periods in winter that can, in extreme cases, last up to three weeks. Such conditions frequently prevail across all of northern Europe. That confronts us with the task of storing energy for those periods. A rough estimate says we need a storage capacity of 4–10% of annual energy consumption. To some extent, the challenge is eased by our participation in major energy networks. But the coronavirus crisis showed that international ties can sometimes be fragile.

To risk being melodramatic, we can conclude that there are three key components to the use of future energy: 1) energy storage, 2) energy storage and 3) energy storage. The major carbon emissions and intense pressure on the environment from current forms of energy generation come not from the fact that we don't know how to generate energy more cleanly but from the fact that our ability to store fossil fuels or simply keep them waiting in the ground is much greater than our ability to store electricity itself.

Estonia has great potential to be a pioneer in the energy sector in future, but only if we use energy sources that we know how to store and if we can control the process of electricity generation from such energy carriers. The fuels can be in gas, liquid or solid form, including water flowing downhill. This aspiration is based on fundamentally new knowledge already created in Estonia. Our Elcogen solid oxide fuel cells are famous worldwide. We have the world's best super-capacitors (Skeleton) in production. They allow ultrafast-changing local loads to be neutralised and thereby optimise the power grid.

Another possibility is batteries. A working group led by the Academy member Enn Lust is a pioneer in the creation of sodium-based batteries that can reduce the cost of electricity storage substantially. Furthermore, limitations caused by the availability of a number of battery components and materials will be eliminated.

There are some possibilities in either building or promotion. Hydro pumping stations are capable of responding quickly to changing energy needs. Nuclear power plants would ensure electricity in cold, calm night-time hours. But nuclear power is not flexible.

Wind farms and solar plants are already affordable solutions for generating energy in Estonia, but only if they are supported by a storage system.

The logical role of wind farms in the current context is hydrogen production on an industrial scale, but there is no action plan for hydrogen energy and maybe vision is lacking, too. Even if it does not become a transport fuel, as Elon Musk currently believes it will, hydrogen is one of the few (maybe the only) energy carrier – not so much a fuel – that is also easy to create in large quantities and has

a high energy content. Hydrogen can also be ecologically clean, storable, transportable and quickly usable.

For that reason, it currently seems that storage based on hydrogen or hydrogen-containing compounds will be the linchpin of a climate-neutral energy sector, along with a wide array of components, from solar panels and heat storage on roofs to small nuclear power plants.

A key paradigm change lies in the fact that very likely the energy sector of the future will be a mass, Everyman phenomenon, not even requiring a stand of trees in the backyard, but existing in the garage, in the middle of the yard or in the driveway. This is simply because the energy density of renewable sources is quite small compared to fossil fuels. There is not much energy in one kg of moving air or the sunlight that strikes one square metre. Equipment for generating electricity from wind or sun has to be spread out. This is dictated by the laws of physics, and means re-conceptualising the nature and design of power grids.

This suggests three pillars of our vision of the energy sector of the future: 1) environmentally friendly, smart and dispersed energy generation, 2) storage that is just as smart, efficient and dispersed; one component of this is the adoption of easily storable and efficient energy carriers in transport and industry, and 3) smart consumption, spread out over time in order to reduce peak loads. Also required is a general reduction in energy consumption through smarter construction and faster data communication links. This sort of energy sector has a good chance to support energy independence, ease pressure on the environment and let us calmly move away from polluting energy sources.

*Based on a presentation delivered at the investment conference "A Different Paldiski 2021. The Green Transition in a Green Rural Municipality" (25 August 2021, near the Pakri lighthouse)*

## *Finite infinite mineral resources*

*Rutt Hints, Head of the Division of Mineral Resources and Applied Geology at the TalTech Department of Geology*

The increasing use of resources has led specialists and the general public to talk about this or that mineral resource running out in the near future. One way to forecast the future is to use global time series of mineral resource reserves and consumption.<sup>83</sup> Looking at these,

<sup>83</sup> Jowitt, S. M., Mudd, G. M., Thompson, J. F. H. 2020. Future availability of non-renewable metal resources and the influence of environmental, social, and governance conflicts on metal production. *Communications Earth & Environment*, 1, 13, doi.org/10.1038/s43247-020-0011-0.



Rutt Hints speaking at the Science Afternoon.

it's clear that the volume of mineral resource reserves has grown over time, together with the growth of consumption. The hypothesis that we can today predict the depletion of mineral resources is thus not confirmed. The contradiction between perceptions and facts stems from the definition of mineral resources. The nature of mineral resources is determined by demand. This forces humankind to use increasingly poor quality mineral resources.

On the basis of the above, we might claim that current speculations about the global resource deficiencies awaiting us are baseless. However, this is not the case. History shows that the problem lies in the cyclical nature of both demand and the entry of new resources into the market. As the research and development stage that precedes the excavation of a mineral resource is often more than 20 years long, supply lags behind rapidly growing demand for resources. Figuratively speaking: in order to satisfy the steeply growing need for metals presumably caused by the Green Transition, we should have started investing in the introduction of new resources about 20 years ago. Who could have predicted the Green Transition back then? The European Union and Estonia – which wasn't even a Member State – were wrestling with entirely different problems 20 years ago.

The forecast that the Green Transition of the economy entails extremely serious risks connected with the availability of resources in the near future is supported by several arguments. Firstly, green technologies and the changes required to minimise carbon emissions from transportation (or decarbonising transportation) are very resource-intensive. We also have to take into account that all of the major countries have established the goal of a transition to a carbon-neutral economy and the planned implementation period is 30 to 40 years. A simultaneous Green Transition

in the biggest economies of the world would mean an unprecedented growth in the demand for metals needed for various hi-tech equipment. For instance, the demand for lithium is predicted to grow by a factor of forty by 2040. The distribution of metal resources on Earth is very uneven and this increases the geopolitical risks connected with the availability of raw materials. In the light of the combined effects of all of these variables, bottlenecks in global supply chains and frequent price shocks in raw materials markets can certainly be expected in the near future.

What is the position of Europe and Estonia today? In Europe, the mining industry is a marginalised sector, a mere shadow of the days of glory of the beginning of the 20th century, when Europe was still the biggest mining region in the world. Today, the hi-tech industry here relies largely on imported raw materials. As a result, using local raw materials and vitalising supply chains will probably be key factors in ensuring the sustainability of production in the near future.

Estonia has resources that have been entered on the European Union's list of critical raw materials. These include raw materials which are critical to European industry and the import of which entails significant supply risks. These resources include phosphorus and rare earth metals in shelly phosphorite and vanadium in graptolitic argillite. Estonian phosphorite is a low-quality resource, but there is a lot of it. On the basis of historical estimates, our phosphorite resources may be the largest in Europe. Besides phosphorus, the Green Transition has also turned the focus to the potential of rare earth elements in these resources and their possible co-production in the excavation of phosphorite. The rare earth metals group includes 15 transition metals of the lanthanide series, plus yttrium and scandium. These metals are often discussed together,

as their chemical properties are quite similar. However, this is not specific enough to assess the economic potential, for the rare earth elements group contain raw materials of very different global market prices and demands. The most valuable ones are metals used to make permanent magnets, such as dysprosium, neodymium and praseodymium. The demand for metals related to permanent magnets is estimated to grow the most in the coming decades: by up to a factor of ten. This growth is driven by green technologies, primarily electric cars and wind turbines.

Is the production of rare earth elements from Estonian shelly phosphorite realistic? The phosphorites here are mostly enriched by medium rare earth elements and contain a relatively good ratio of metals necessary for the production of permanent magnets. On the basis of their name, we would also presume that these are rare raw materials by nature. However, in reality the production of these metals is limited by the scarcity of deposits. There are deposits on all of the inhabited continents and in many of these the content of rare earth elements in ore is higher than in shelly phosphorite. The global rare earth metals market is above all limited by the technological complexity of the valorisation of these metals. Since the end of the past millennium, China has been the master of the global earth metals market. In addition to excavation, China also has nearly 95% of the global capacity to enrich rare earth elements.

Estonia has an important advantage for launching the production of rare earth elements: one of the few rare earth metals enrichment plants outside China is located at Sillamäe. The plan is to establish a permanent magnet reprocessing and production unit at the plant, which currently belongs to Neo Performance Materials. As rare earth metals are considered to be critical raw materials with the greatest supply risk and their importance will only grow in the context of the Green Transition, it is not surprising that several new European Union initiatives aim to support the production chains of rare earth metals in Europe. There is talk of establishing requirements that industrial products and equipment produced in Europe contain raw materials derived from local sources.

On a broader scale, the growing demand is opening doors not just for the valorisation of primary raw materials, but also for the emergence of a circular economy-based raw materials sector in Europe, not just in terms of new mines, but also in terms of reprocessing waste rock from the oil shale industry, e-waste and other secondary raw materials. The launch of new industries naturally involves great challenges in obtaining investments, skilled labour and the consent of society and local communities. As the emergence of new industries is unrealistic both in Estonia and elsewhere in Europe without the consent of the public, there is a clear need to more substantively engage society.

The role of social scientists in speaking up in this area is becoming increasingly more important. Finland, which has stated in its development visions that mineral raw material-based industry and the production of products of high added value is one of the pillars of its economy, is a good example of what we could achieve with a sufficient consensus of the state, entrepreneurs and communities.

Considering the changes taking place in the world, Estonia needs a long-term strategic position on the use and valorisation of our local mineral resources, as well as a related new vision regarding sustainable economic development.

## SCIENCE AFTERNOON (XVIII) "RESEARCHERS' NIGHT: ABOUT SALT AND THE BALTIC GERMAN FOOD CULTURE"

On 21 September 2021, the Estonian Academy of Sciences invited upper-secondary school students, university students and others to participate in the 18th science afternoon held in the framework of the Researchers' Night Festival. As food was the main topic of this year's festival, it was also the focus of the Academy's event.

In the first part of the science afternoon, the participants were shown the documentary "Pass the Salt" ([www.imdb.com/title/tt11563234/](http://www.imdb.com/title/tt11563234/), CBC Docs, 2020), in which scientists studied salt, which has throughout time played an important role in the culture, cuisine and recently in the health behaviour of humankind. The screening was followed by a thematic discussion in which the nutrition expert Monika Jakobson and the cardiologist Martin Serg talked about salt consumption, nutrition and health and answered the audience's questions. The discussion was moderated by the Tallinn University science communication lecturer and science journalist Arko Olesk, who is currently Scientific Adviser to the President of the Republic of Estonia.

In the second part, a researcher from the Under and Tuglas Literature Center of the Estonian Academy of Sciences and a professor at Tallinn University, Professor Ulrike Plath, gave a presentation on the late 19th century Baltic German food culture. The discussion also touched upon applied research into the history of food being conducted with students at Tallinn University, in the course of which old recipes are (re-)interpreted, old technologies are tested and the history of flavours and flavouring is studied.



Photo: Aavo Kaine x3

From the left: Martin Serg, Monika Jakobson and Arko Olesk at the discussion after the film.



Ulrike Plath.

A great contribution to the success of the second part of the science afternoon came from the third-year history students of Tallinn University, who prepared and served Baltic German snacks and drinks for the event, using late 19th-century cookbooks. While sampling the snacks, the participants could listen to the students' short presentations on all of the dishes on the menu.

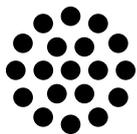


Baltic German food culture.

# INTERNATIONAL COOPERATION

## INTERNATIONAL ORGANISATIONS AND NETWORKS

Scientists are often like ambassadors of their countries to the academic world. Through their uniting organisations, they exchange information and ideas, promptly transfer competence and shape good practices. The Estonian Academy of Sciences represents Estonian science and scientists in the main pan-European and global science organisations. The respective membership fees are paid from the funds allocated to the Academy for that purpose from the state budget.



### **International Science Council**

The Estonian Academy of Sciences is a founding member of the **International Science Council (ISC)**. This organisation was founded in the summer of 2018, by combining the members of the International Council for Science (ICSU, founded in 1931), which united the associations of scientists engaged in classical life and natural sciences, and its sister organisation, the International Social Science Council (ISSC, founded in 1952), which united the academies of social sciences and humanities. Until 1998, ISC bore the name International Council of Scientific Unions (ICSU).

The Estonian Academy of Sciences became a member of ICSU in 1992. ICSU was one of the initiators of the sustainable development programme that has now gathered global momentum. The idea of the 17 Sustainable Development Goals is to advance our lives in a way that does not extensively exploit natural resources which ensure the sustainability of the economy and society, and

does not destroy the ecosystem services on which life is based. In Estonia, the Sustainable Development Committee established in the Government in 1996 ([riigikantselei.ee/et/saastev-areng](http://riigikantselei.ee/et/saastev-areng)) is responsible for this. The Committee was reorganised in 2017. The Estonian Academy of Sciences continues to participate in the work of the Committee.

The International Science Council represents both natural sciences and humanities. It has two types of members. On the basis of a territorial principle, ISC includes one academy or research council of natural sciences and one academy of social sciences and/or the humanities from each country. The other type of members are leading global research societies, regional associations of scientists and national research councils and foundations that support or organise research, for which the promotion and development of a science-based world view is an important effort. The central aim of ISC is to identify the key global problems facing science and society and to address such problems in cooperation with the scientists of all of the countries and areas of specialisation (see [council.science/](http://council.science/)).

One of the important work formats of ISC is regional sections. While in Europe such an association of academies (European ISC Members) has operated for years, the creation of similar associations in South America and South-east Asia is a priority for ISC's new president, Sir Peter Gluckman. These networks allow academies to coordinate their positions, consolidate their voices for the expression of the needs of entire regions and empower the academies of smaller countries to promptly respond to unexpected problems. The Estonian Academy of Sciences has held the presidency of the European ISC Members since 1 November 2021 (for the period 2022–2024).



The **Inter-Academy Panel (IAP)** was founded in 1993 as a global network of academies. It currently includes more than 130 national and regional academies. The purpose is to advise the general public and support decision-making bodies in relation to the scientific aspects of global problems in cooperation with member organisations (see <http://www.interacademies.org/>).

Several ISC and IAP member academies share the viewpoint of the Estonian Academy of Sciences that these organisations should merge or cooperate a lot more closely.



The **European Federation of National Academies of Sciences and Humanities “All European Academies” (ALLEA)** was founded in 1994 and unites both classical academies of natural sciences and academies of social sciences and humanities. The Estonian Academy of Sciences is one of the founding members of ALLEA. The purpose of ALLEA is to exchange information and experience to achieve the highest level of science, while maintaining high ethical standards, and to ensure the independent handling of matters related to science strategy and policies on a European level. The Academy member Jüri Engelbrecht was the president of ALLEA in 2006–2011. The Academy member Raivo Uibo is a member of the ALLEA Permanent Work Group on Science and Ethics (see <http://www.allea.org/>).



The **European Academies’ Science Advisory Council (EASAC)** was founded in 2001 and consists of individual members appointed by the academies of European Union countries. Estonia became a member in 2004. The purpose is to use the combined competence of the academies to advise top-level European Union bodies and politicians in making decisions that require independent scientific advice.

In other words, EASAC fulfils the role of an independent academic adviser in Europe, consolidating the top-level competence and experience of European academies.

Steering panels have been formed in three main areas (biosciences, energy and the environment). These handle socially important issues, analyse problems that arise and forecast developments and side effects. Through its members, EASAC stays in continuous dialogue with national policy-makers, striving to contribute to the making of science-based political decisions in Europe.

The Estonian Academy of Sciences is represented on the EASAC Council by the Academy member Jaak Järv. The Academy member Tarmo Soomere is on EASAC’s Environment Steering Panel and the Academy member Enn Lust is on the Energy Steering Panel. The Academy member Jarek Kurnitski represented the Estonian Academy of Sciences in EASAC’s Decarbonisation of Buildings<sup>84</sup> work group, the results of which were published in June 2021. The Academy member Ülo Niinemets was elected as an expert in the work group “Towards sustainable, flexible and regenerative agriculture in the European Union”.



The **International Union of Academies (Union Académique Internationale, UAI)** was founded in 1919. The Union is a global organisation of academies in the fields of the humanities and social sciences with the aim of promoting joint research (including joint projects) and facilitating the publication of research results. The Estonian Academy of Sciences became a member in 1998 and Estonia is represented by the Academy member Jaan Undusk (see <http://www.uai-iaa.org/>).

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For more than ten years (2000–2011), the Academy took part in the work of the European Science Foundation (ESF), founded in 1974. The European Marine Board and the European Polar Board are expert advisory panels that previously worked under the ESF. They are now independent institutions that provide area-specific advice to the European Commission. The Academy continues to participate in their work via contributions of the Academy’s Committee on Marine Sciences and the Polar Research Committee.

<sup>84</sup> See [easac.eu/publications/details/decarbonisation-of-buildings-for-climate-health-and-jobs/](http://easac.eu/publications/details/decarbonisation-of-buildings-for-climate-health-and-jobs/)

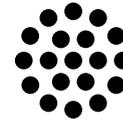


The **European Science Advisors Forum (ESAF)** was initiated in 2014 by Professor Anne Glover, who was then the science counsellor of Manuel Barroso, the President of the European Commission. The aim of ESAF is to allow the science advisors of European countries to exchange ideas and information on matters of pan-European importance before providing advice to their governments or the European Commission, to share experience and to promote a

culture of making political decisions based on science in the European Union.

The European Science Advisors Forum is an informal individual network of experts and scientists who are responsible for providing scientific advice or organising the provision of scientific advice on a national level. The Forum was convened by the EC Scientific Advice Mechanism unit. A large number of the members are leading scientists in their countries and the heads of academies of sciences and research councils. There are also some representatives of state governing bodies and university professors with relevant mandates. President of the Estonian Academy of Sciences Tarmo Soomere has been Chair of the Forum since 1 July 2020 (see [esaforum.eu/](http://esaforum.eu/)).

### *The Estonian Academy of Sciences organises the joint activities of European academies of sciences*



**International  
Science Council**

In November 2021, Estonia became the Chair of the European ISC Members for 2022–2024. The association was founded twelve years ago and includes 52 ISC members located in Europe. For the first five years (2011–2015), the work of the network was led by the Finnish Academy of Sciences, and for the subsequent six years (2016–2021) by the Swiss Academy of Sciences.

Estonia's election as the Chair of this association of academies is an important recognition of the quality and visibility of our science, research organisation and science advisory activities on the entire continent. This position gives us a unique opportunity to increase Estonia's clout in the international arena and to inject more wisdom into policy-making in Europe.

Being the Chair gives us an opportunity to obtain early information about opportunities, threats and risks that may potentially influence Estonia through a filter of academic quality control, as well as to inform Estonian policy-makers in order to prevent potential problems even before they arise. The role of Chair is a good opportunity to keep topics important to Estonia and other smaller partners on the agenda and to forward important messages via sister academies. The position of Chair also allows us to mediate information about Estonian scientists and their everyday work.

The Chair term is three years, i.e. 2022–2024. It is a logical continuation of the Academy members' contribution to the development of the science ecosystem of Europe as a whole. President Tarmo Soomere fulfils the role of the Chair and Dr Erle Rikmann fulfils the duties of the Head of the Secretariat.

The Estonian Secretariat of the European ISC Members works in close cooperation with the Ministry of Foreign

Affairs. The main tasks of the Secretariat are to coordinate the activities and events of the European ISC Members, to identify topics and tasks in the areas of work of the academies of sciences that require more detailed analysis and arrange their analysis, to organise the exchange of information between the ISC Secretariat and the local contact organisations, to ensure the representation of the priorities of European scientists in ISC's strategic plans and to facilitate the participation of European scientists in ISC's global activities and programmes.

The Annual Meeting of the European ISC Members held in June elected the president of the Finnish Academy of Science and Letters, Professor Anna Mauranen, and a member of the Council of the Royal Society of London, Professor Geoffrey Boulton, for their second terms of office on the Council for the coming three years. For the first time, the president of the Lithuanian Academy of Sciences, Professor Jūras Banys, a member of the Royal Netherlands Academy of Sciences and Arts, Professor Giselinde Kuipers, and the research director of the Italian National Research Council, Professor Mario Malinconico, were elected to the Council.

The ISC's strategic objectives for the coming years are to promote smoothly functioning cross-border research in the key areas of global challenges, to increase the extent and weight of evidence-based understanding and decision-making processes on all levels of public policy, including on the level of discourses and activities, to support the constant and consistent development of the research ecosystems of all the continents, and to support the protection of academic freedom and the principles of responsible research.

## DISCUSSIONS OF THE HEADS OF ACADEMIES

In 2021, the presidents of three partner academies visited the Estonian Academy of Sciences and a hybrid meeting of the heads of five Baltic Sea academies was held after the Baltic Conference on Intellectual Cooperation (see pages 100–102).

From 9 to 12 August, President of the Academy of Sciences and Humanities in Hamburg Edwin Kreuzer visited the Estonian Academy of Sciences with his spouse. On 11 August, they visited the Arvo Pärt Centre, together with President Tarmo Soomere, the Academy member Jüri Engelbrecht and the Academy's Head of Cooperation Ülle Raud. After the tour and the film "Muusikajanu" (Thirst for Music), the group met the composer and Academy member Arvo Pärt.

In the evening of the same day, Tarmo Soomere awarded the Honorary Medal of the Baltic academies of sciences to Edwin Kreuzer for promoting research cooperation between the Baltic academies of sciences and the Academy of Sciences and Humanities in Hamburg.

President of the Berlin-Brandenburg Academy of Sciences and Humanities Professor Christoph Markschies visited Estonia from 26 to 30 September. At a meeting at the Academy on 27 September, the parties agreed to renew the bilateral research cooperation agreement and discussed the future cooperation opportunities of the academies with the Academy member Jüri Engelbrecht.



President of the Academy of Sciences Tarmo Soomere with Edwin Kreuzer.



Photo: Prit Rohnmeis

President of the Berlin-Brandenburg Academy of Sciences and Humanities Professor Christoph Markschies, with a portrait of the architect of the building of the Estonian Academy of Sciences, Martin Gropius, on 27 September 2021.

At the Department of Baltic and Rare Books of the Tallinn University Academic Library, Professor Markschies met with Director of the Under and Tuglas Literature Centre of the Estonian Academy of Sciences and Academy member Jaan Undusk, Professor Kristel Pappel from the Estonian Academy of Music and Theatre, and representatives of the library.

On 30 September, Professor Markschies attended the opening of the display of a copy of Wilhelm Ostwald's Nobel medal at the Art Museum of the University of Tartu. The copy of the medal was ordered from the Berlin State Museum after a proposal made by Vice President of the Estonian Academy of Sciences Arvi Freiberg in the framework of inter-academy cooperation.

Professor Markschies' lecture "Research policy in Germany – what can we learn from the Estonian theologian Adolf von Harnack?" in the auditorium of the University of Tartu on 30 September was dedicated to the 170th anniversary of the birth of Adolf Harnack, a world-famous Baltic German church historian who was raised and educated in Estonia.

President of the Czech Academy of Sciences Professor Eva Zažimalová visited the Estonian Academy of Sciences on 1 November in the framework of the Czech parliamentary delegation's visit to Estonia. The meeting with President Tarmo Soomere, the Academy member Maarja Kruusmaa and Adviser on International Relations and Academy member Jüri Engelbrecht, was dedicated to the 25th anniversary of the research cooperation agreement between the Estonian Academy of Sciences and the Czech

Photo: Krista Tamm



Photo: Ülle Raud

President Tarmo Soomere, Academy member Maarja Kruusmaa, President Eva Zažímalová and Academy member Jüri Engelbrecht at the Estonian Academy of Sciences on 1 November 2021.

Academy of Sciences. The cooperation agreement, aimed at supporting cooperation between Estonian and Czech scientists, was signed on 10 May 1996.

During the visits of all three presidents, opportunities for further strengthening inter-academy cooperation and supporting young scientists in the Baltic Sea region were discussed. A researcher exchange programme, in the framework of the cooperation agreements between the Academy and its foreign partners, is one possibility. All Estonian scientists may participate in the programme. The financial amounts available are not big, but sometimes even a little bit helps. The reception expenses of visiting researchers are financed from the budget of the Academy of Sciences and the expenses of our researchers abroad are borne by the Academy's partners in the countries of destination. The work of the programme is directed by the Council

for International Exchanges of the Academy of Sciences, which is led by the Academy member Jüri Engelbrecht.

Research visits were somewhat limited in 2021 due to the travel restrictions established to prevent the spread of the coronavirus. In connection with this, a decision was made to extend the Estonian–Hungarian research cooperation projects for 2019–2021 until 30 June 2022 and the Estonian–Polish research cooperation projects for 2019–2021 until 31 December 2023. Luckily, the travel restrictions did not prevent the academies from making cooperation plans for the future. The application round for Estonian–Hungarian research cooperation projects received seven applications, of which five were supported. The 2022–2023 application round for Estonian–Bulgarian research cooperation projects received five applications, all of which were supported.

### *Meeting of the presidents of five academies of science of the Baltic Sea region*

Immediately after the Baltic Conference on Intellectual Cooperation, the heads of five academies of sciences from Baltic Sea countries sat down for a thorough discussion on 29 June 2021. The President of the Academy of Sciences and Humanities in Hamburg, Edwin Kreuzer, and the Secretary General of the Finnish Academy of Science and Letters, Anna Mauranen, joined the heads of the Lithuanian, Estonian and Latvian academies of science (Presidents Jūras Banys and Tarmo Soomere and Vice-president Ojārs Spārītis) virtually.

Various matters important to all of the academies were raised: above all, the tasks of science academies today, what they will be in the future and how academies can efficiently fulfil their roles both in their own countries and in the international arena. Cross-border and regional

cooperation is clearly of increasing importance. These aspects must therefore be fully examined.

The advisory roles of academies in the pandemic situation and in general are extremely topical issues for everyone. Finland has just developed a new scientific advice concept that supports the functioning of the state as a whole. The academy of science plays a key role in it. The parties acknowledged that participation in scientific advisory activities is a priority for all of the academies.

An important change has taken place in the science advice system of European academies. Instead of the European Academies' Science Advisory Council (EASAC), the European Young Academies Science Advice Structure (YASAS) has been invited to the pan-European consortium of academy networks, the Science Advice for Policy by European Academies (SAPEA). As a result, the voice of young researchers, which is extremely important for the future, will reach decision-makers in a consolidated form. The participation of young academy members both in the science advice system

and more broadly in international research cooperation must definitely be encouraged and supported. This can be done in the framework of the existing cooperation between academies. It would also be good to initiate a project with the European Union to intensify the mobility of young scientists from the Baltic region. The Estonian Young Academy of Sciences has recently associated with the Estonian Academy of Sciences, which makes supporting them much easier.

International cooperation is a priority for all the academies. The parties tested several ideas regarding how to make cooperation between the academies of sciences of the countries located around the Baltic Sea (Estonia, Latvia, Lithuania, Finland, Sweden, Norway, Denmark, Germany and Poland) closer and more efficient. Of course, a network that connects the academies of all these countries can be established in the long-term perspective. However, properly launching substantive cooperation is much more important.

Opportunities to promote cooperation between the Baltic academies of sciences in the framework of international grant schemes (Horizon Europe and the Joint Research Centre (JRC)) were discussed. Joint research in the areas of social sciences and the humanities plays an increasingly important role in this cooperation. The presidents deemed it important to formulate a shared position and adopt a joint

declaration. This idea was brought to life in the form of a joint declaration signed in Riga on 17 September.

The academies' cooperation through international organisations (ALLEA, EASAC, SAPEA, ISC, IAP, UAI, etc.; see the more detailed division on pages 84–86) is a direct extension of regional cooperation in the pan-European and global arenas. The European Academies' Science Advisory Council, which has for several years operated at the German National Academy of Sciences Leopoldina, will in the future probably be located at another academy.

It was decided that the statutes for awarding the medals of the Baltic academies of sciences created in 1999 need to be updated. In connection with this, it would be reasonable to create an honorary medal of the Baltic academies of sciences. The statutes have now been updated. The first new honorary medal was bestowed on Professor Edwin Kreuzer, the president of the Academy of Sciences and Humanities in Hamburg, who was recognised for his services in promoting cooperation between the academies of the Baltic Sea countries.

It seems that the hours spent together were considered a good investment, as it was unanimously decided that meetings of the heads of the Baltic academies will in the future be held at least two or three times a year.

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## IN SEARCH OF THE OPTIMUM APPROACH TO SCIENCE ADVICE SYSTEMS

*Tarmo Soomere, Chair of the European Science Advisors Forum (ESAF)*

Nearly to two years ago, a few days after midsummer 2020, the duties of the chair of ESAF were handed over to the Estonian Academy of Sciences. The baton may have been passed virtually, but the duties are very real and concrete. ESAF is a non-formal network that unites experts and scientists, one from every country or region, and is responsible for giving or arranging scientific advice at the state level. The idea of science advisors is simple: canvass the scientific and research landscape for the necessary information and articulate it in a suitable format so that it can be used as a component in government decision-making. There are a number of ways to implement this idea.

In English-speaking countries, such as the UK, Canada and Australia, scientific advisory systems are set up in a structured manner. European countries organise their scientific advisory mechanisms in disparate ways. In Ireland, the head of the national research council is also the country's chief science advisor. Germany relies on its Academy of Sciences Leopoldina. Slovakia has appointed a special

representative in the field of science. Estonia has built up a system of science advisors at ministries. There is nothing odd about these differences. Often the existing systems reflect skills and strengths that were considered important in the past. However, in the future we may need totally different kinds of competencies and channels. Since we do not know exactly what the future will bring, the variety in science advisory systems in different countries and regions tends to contribute to making Europe richer. After all, what matters is not the elegance of the system but the ability to tap into knowledge at the right time, before misfortune comes calling. In Estonia and many other countries, this role is fulfilled by the COVID science councils.

### **Preparations for coming up with formulas**

Many experts feel that just a few years ago the science advisory landscape in European countries was a big mess. Indeed, sometimes specific ad hoc panels of scientists and specialists in one country succeed even better than

the professional advisory system in another country. But what shouldn't happen is people from different fields creating pure cacophony.

Since science advisory experience in many countries is quite limited, it is important for know-how in this area to spread quickly. It would be good if cacophony could also be avoided in the context of recommendations issued by different countries. For that very reason, the European Commission has for some time been working on creating a pan-European science advisory ecosystem, where every country and level is a piece of the puzzle.

Estonian novelist Nikolai Baturin wrote: "If you want to know where to go, you have to know where you are." The European Commission's Joint Research Centre (JRC) led a systematic effort to analyse the science advisory systems in about 10 EU countries in 2020–2022. The ESAF and its chair, the Estonian Academy of Sciences, were naturally the main partners in organising an online seminar focused on examining the Estonian system on 9 March 2021.

With support from professionals, we tried to get a more or less complete picture of the different forms and formats of the science advice system, define the roles of the participating experts and officials, visualise the strengths of the whole system that could be promoted to others, seek out the weaknesses that need correction, and think about how our own working structure fits in with the choices made by other countries. Among other things, we tried to see what roles the different institutions play and how universities and research institutes interface with government departments and politicians.

An introduction to the topic was given by the JRC department head David Mair. An exchange of opinions was led by Renzo Tomellini, the Head of the Unit of the European Commission's Scientific Advice Mechanism. To kick off the discussion, Jüri Ratas, fresh off a stint as Estonian Prime Minister, analysed the needs for and possibilities of making use of science advice from the perspective of a senior politician. A member of the Estonian COVID science advisory council, Krista Fischer, reflected on the same aspects from the viewpoint of a scientist and scientific advisor. Tarmo Soomere was responsible for presenting the main features of the Estonian science advisory system. An expert with long-standing experience in the field, the Irish chief science advisor Mark Ferguson compared the features of the Estonian and Irish systems.

In the discussion that followed, the Estonian system was thoroughly deconstructed and there was an attempt to find elegant solutions that would work better. Our system of science advisors at ministries left a strong impression on our guests. Quite a few countries, including Belgium – which is quite successful by our standards – have studied how to apply the system in their own countries.

### **Lessons in providing sector-based advice**

The needs of modern-day countries for good advice are very different from one sector and field to the next. Some countries have established specialised advisory mechanisms in individual sectors. Systems for ensuring food security are quite substantial in several European countries. One of the role models for this approach is the Danish Centre for Food and Agriculture (DCA), which runs the country's biggest advisory system and provides consultation to the government on climate issues as well.

The online seminar organised in cooperation between the ESAF and the DCA on 16–17 March 2021 focused on the main science advisory principles that can be universally applied in every field. Prof Soomere provided a framework for the entire event in his introductory remarks, describing the work done by the ESAF. On the second day, he recapped the main lines of discussion, emphasising the words of Gerald Haug, the President of Leopoldina, who said that, besides their other duties, science advisors had to also get their partner politicians to be better listeners.

Director General of the DCA Niels Halberg explained that science advisory was just one component in making political decisions and that scientists and advisors should make a special point of resisting the temptation to force their positions on politicians. Our job is to give advice, and politicians' job is to listen and use the advice to make decisions. These roles must not be confused. To leave more decision-making freedom for politicians, Denmark has an agreement on a 30-day embargo period before advice given to politicians is released publicly.

Professor of Science Communication David Budtz Pedersen delighted listeners by announcing the advent of a branch of science that dealt with science advisory. It doesn't tell us whether the advisory activity that takes place in different countries and fields reflects fragmentation or biodiversity, but science advice does have to follow three central principles: independence, transparency (i.e. being available to the public), and understanding its responsibility. There are five other key aspects: the duty to report to society and colleagues, relying on knowledge from multiple fields, timeliness, scientific accuracy, and the ability to distinguish advice from interference in the decision-making process.

Belgium is one of the countries that has yet to formally launch science advice at the state level. A key player in this field and one of Belgium's research foundations, the Research Foundation Flanders (Fonds Wetenschappelijk Onderzoek – Vlaanderen (FWO)), has taken the lead on this topic, together with the Belgian Royal Academy of Sciences. The Second Binoculars Symposium ("Scientific forecast councils for government policy") focused on the experiences of the science advisory system in neighbouring countries. In the symposium, Tarmo Soomere introduced

the principles of the work of the ESAF and the most meaningful aspects that have come up in cooperation over five years. The central message was that both the transmission of consolidated information from scientists and experts to policymakers and the wording and choice of format must be specially customised for the needs of different fields and decision-making levels. It is quite natural for the advisory systems in different countries to be structured differently because they have to be perfectly aligned with the specific features of each country's system of governance.

### **Consortia of academies as accumulators of knowledge and wisdom**

The European Commission is advised by the Scientific Advice Mechanism (SAM). A panel of seven chief science advisors working in SAM compile recommendations in finished form. One of these advisors is our Academy member Maarja Kruusmaa. SAM also includes a consortium of academies: the Science Advice for Policy by European Academies, SAPEA, which is charged with compiling the source materials for recommendations on a project basis. The consortium includes four associations of academies of science (ALLEA and EASAC – see page 85), the Federation of European Academies of Medicine (FEAM), the European Council of Academies of Applied Sciences, Technologies and Engineering (EuroCASE), and Academia Europaea, which unites scientists and researchers all over Europe. The Estonian Academy of Sciences is represented by six members in Academia Europaea and in the two associations ALLEA and EASAC. The Young Academies Science Advice Structure (YASAS) has been invited to join the consortium. The SAM works closely with the Commission's JRC, which has as many employees as there are researchers in Estonia.

The fact that a good friend of our academy, ALLEA President Antonio Loprieno, rotated into the post of chairman of SAPEA on 15 June 2021 was like the finger of fate guiding us to discuss what the ESAF and the SAPEA could do together, and how. Since travel was still complicated, we had to settle for a web-based discussion on 17 June 2021. Even though being negative (for COVID-19) was a requirement for attending, we discussed only the positive, asking what the strengths of science advisory systems in different countries were. There was no point in presenting the weaknesses: if everyone's strengths were known, no doubt the weaknesses could then be eliminated. In line with this principle, there is no one-size-fits-all solution and the differences between systems actually make us richer. A pessimist might call this variation fragmentation but, in fact, when it comes to a pan-European science advisory ecosystem, diversity is an integral part and a basis of our strength.

After greetings delivered by Jacques Verraes – at the time in the role of the head of the SAM unit – and the European Commission chief science advisors Nicole Grobert and Nebojša Nakićenović, Antonio Loprieno reflected on how researchers could develop into science advisors. The chief science advisor of Wales, Peter Halligan, continued with an overview of the strengths of the British system and Enric Banda provided insight into the Spanish system, which works along similar lines as our Research and Development Council. Niels Halberg talked about the advisory system in Denmark for food and agriculture. Kristian Krieger provided a brief overview of the JRC's analysis in progress in regard to versions of the science advisory mechanisms in different countries.

A message that resonated was the need to meld the work being done at the EU level with the needs and accomplishments realised in just a few countries. In that context, the cooperation between the ESAF and the SAPEA seemed like a logical step toward a balanced and resilient science advisory ecosystem. Antonio Loprieno waxed somewhat poetic about the concept of a continuum of individual components in scientific advisory system.

### **Messages to the highest level of the European Commission**

The annual top event of the European Commission's science units is the research and innovation days. The developments, needs and future avenues of the science advisory system were covered at a mini-seminar held on 24 June, "Re-imagining science advice regarding policy after COVID-19. How to build a stronger, better-connected ecosystem in Europe". The deputy director general of DG-RTD, Patrick Child, and the director of DG REFORM, Natalie Berger were the in-studio members of an enjoyable and informative panel. Other participants, participating by video bridge, were the chairman of the Group of Chief Scientific Advisors of the European Commission's Science Advisory Mechanism, Nicole Grobert, and the former executive secretary of the ESAF, Anne-Greet Keizer, currently a researcher with the Netherlands Scientific Council for Government Policy, WRR. In other words, the panel represented the very cream of the European Union's science advisory field.

Chairman Tarmo Soomere, representing the ESAF, felt like a fifth wheel. It was not his everyday practice to be in a discussion at this level. But he quickly settled into the role when the topic turned to what the ESAF had been able to learn through its non-formal formats largely based on personal contacts. We now understand the paramount need to ensure that advisors have definite mandates. In other words, for giving advice to work in a reasonable manner, at least a modicum of legislative support is necessary. After all, it is far from clear whether advice given to governments must be announced to everyone right away.

The Danish experience suggests that it probably shouldn't be. The same is true in the Estonian context, where no less weighty a document than the Constitution says that Cabinet meetings are to be held in camera. Certainly advice that the government has not been able to review, for whatever reason, should be withheld. It is definitely not a good idea to put pressure on the Cabinet. Scientists' discussions and the resolution of disagreements should certainly take place, but these disputes mustn't spill over to cabinet meetings. There has to be room for research to develop and advice to change (sometimes it changes quite rapidly). Sometimes advice from small specialised work groups is better than from large systems. Certainly a clear distinction should be drawn between advice and lobbying. A scientific advisor must be prepared to clarify to the public the steps leading up to recommendations and decisions.<sup>85</sup>

### **From our neighbours to the COP26 climate change conference**

It is hard to say whether a science advisory system is more like a liquid that penetrates through the tiniest cracks and can even climb up the walls of a vessel, or a party crasher or freeloader. The truth lies somewhere in between.

For several years, the Institute of Economics of the Latvian Academy of Sciences has organised discussions that focus on different aspects of the economy of the future. The Fourth International Economic Forum in Riga ("Future Economy: globalisation challenges faced by Europe and the Baltics in the 21st century") on 17 September 2021 was expected to provide insight into the ESAF's activities and a vision for the future of the science advisory system. The first session of the conference was televised, which provided greater focus on the participating minister and diplomats than on the scientists. The cameras followed the presidents of the Baltic academies of science as they signed a cooperation agreement.

The ESAF chairman provided a summary of everything you have read to this point in this article, from how science advisory came into being at the Commission level to the eight cross-sector principles, and explained how the relationships between science and society have changed. In the old days, the audiences for scientists and faculty were like a sponge that absorbed the maximum amount of the knowledge presented. Now it's like an active environment that can react powerfully to statements: often defying the expectations of the person making the statements. What is increasingly more important is not exactly what we say but how it is interpreted. Climate problems and ways of alleviating them rank quite high among the science

advisory council's priorities, for good reason. Through a letter sent jointly by world leaders to the 26<sup>th</sup> climate change conference, the chief science advisors of many countries emphasised the message that things were already bad and that many countries could soon be dealt quite terrible blows by climate changes if left unchecked. Led by the chief science advisors from Nigeria, Seychelles, New Zealand, Italy, Canada, the UK and India, leaders were issued a reminder that it would soon be too late if the best available techniques are not used to apply strategies that keep the planetary temperature from rising more than 1.5 degrees above the pre-industrial era. We can only achieve this together, through cross-border scientific work, a strong effort by all of us, outside-the-box thinking and doing many things differently. The document, bearing more than 40 signatures,<sup>86</sup> was presented in the context of COP26 on the evening of 8 November. Naturally, the signatures of both the ESAF chair and the chair of the Group of Chief Scientific Advisors, Nicole Grobert, appeared on the document.

### **Expecting new winds: the annual meeting of the ESAF**

We delayed the annual meeting until the last moment hoping that an in-person gathering in Brussels might be possible. But the coronavirus pressure did not ease up – in fact it grew – due to which the seventh annual meeting of the forum, "From local advice to global benefit", was held as a hybrid event on 30 November and 1 December 2021.

The key developments and conclusions drawn in the field of science advice over the last couple years set the tone for the discussions: the undisputed success of temporary mission-based advisory councils, the advisors' mandate, timing the public release of advice and related legislative problems, the limited opportunities for efficient cross-border advice and international science advisory cooperation at the sector and EU levels.

There were more discussion topics than there was time. It was and still is certainly necessary to think about how the advice applicable in one country could be tied to advice that must be given to an entire sector, region or even continent. In general, governments mainly listen to their own scientists, but their knowledge comes from the global science landscape. (An interesting variation is in use in Ireland, where the chief scientific advisor is not allowed to use analyses by Ireland's own scientists in order to avoid conflicts of interest.) There is after all no national mathematics or pandemic specific to a single country. Most knowledge is inherently global but has to be applied to resolve problems that have arisen in a specific country or even in local areas.

<sup>85</sup> European Commission, Directorate-General for Research and Innovation 2021. European research & innovation days: conference report: 23–24 June 2021. Publications Office, data.europa.eu/doi/10.2777/593300

<sup>86</sup> <https://www.gov.uk/government/publications/statement-by-international-scientific-advisors-ahead-of-cop26>

Only a few colleagues were able to attend the ESAF annual meeting in Tallinn. From the left: Karin Kjær Madsen from Denmark, Tarmo Soomere, Ričardas Rotomskis from Lithuania. Frede Blaabjerg from Denmark is missing from the photo.



As a result, it is now time to focus on observing precisely such aspects and asking where the current problem areas are for scientific advisory. What can be done to quickly find the best advice? In terms of the ESAF, we should of course think about what the ESAF's role should be in the emerging cross-border scientific advisory ecosystem (e.g. the one the JRC and the SAM are currently trying to build for all of Europe).

As is common in the current era, it was not possible for the Estonian Parliament's Cultural Affairs Committee chairman, Professor Aadu Must, to weigh in, since he had come down with the coronavirus just a day before the gathering. This left more time for Jacques Verraes, the head of the European Commission's Scientific Advice Mechanism science policy, advisory and ethics unit, to deliver greetings, and for Tarmo Soomere to review the history and principles of the ESAF. The chairman of the Group of Chief Science Advisors of the European Commission's Science Advisory Mechanism, Nicole Grobert, provided a look at the functioning of the European Commission's chief scientific advisory institution. Jacques Verraes called on the ESAF to take on a significantly greater role and contribute to building a pan-European system of scientific advice. The change will however require a change in the statutes of the ESAF.

After the overview provided by the JRC work group (David Mair, Lene Topp, Lorenzo Melchor and Kristian Krieger) on the functioning of the European science advice systems, the participants discussed in smaller groups what types of concerns chief scientific advisors would like to share with their colleagues and what kind of support they want to receive from the JRC experts.

Professor Corien Prins, of the expert council WRR advising the Dutch government, summed up the lessons learnt from developments of recent years in the field of scientific advice, Tarmo Soomere gave an overview of basic concerns that have come up in the work of the ESAF and its members, and the representative of INGSa, Kristiann Allen, talked compellingly about how the INGSa works and its plans.



Photo: Aavo Kaine x2

The rest of the members of the ESAF attended the meeting via Zoom.

The discussion then turned to the best ways to direct the ESAF's development. From the broad spectrum of opinions, a key idea was that the value of the ESAF lay in its non-formal character, which allows non-traditional solutions to be used to share discreet but essential information. The representatives from the SAM felt that the ESAF should develop more traditional cooperation forms. Both camps had plenty of good arguments.

On the morning of the next day, the Finnish colleague Jaakko Kuosmanen gave an overview of how far Finland's new concept for the scientific advisory system had progressed. A decision was made to support the Finnish Academy of Sciences and Arts. The head of the Danish DCA, Niels Halberg, proposed possible forms of cooperation between (trans)national and sector-based advisory mechanisms. The JRC experts David Mair and Mario Scharfbillig discussed the fundamental meaning of values and roles in the science-based decision-making process. Krista Fischer talked about how fusing local data with messaging from elite science has helped Estonia in the battle against COVID, and the head of the RITA (see page 49) programme at the Estonian Research Council, Dr Liina Eek, described how the scientific advisory systems in Estonian ministries were launched. The presentations concluded with

the Lithuanian chief science advisor, Professor Ričardas Rotomskis, giving an analysis of the relationships between scientific advisory and innovation. Finally, participants

were urged to find out how extensive the mandates from their governments were in case it was decided to make major changes to the work of the ESAF.

**Excerpts from remarks delivered by Speaker of the Riigikogu (Estonian Parliament) Jüri Ratas at the ESAF-JRC online workshop of “Science for policy-making in Estonia”, 9 March 2021**

In his remarks, Jüri Ratas noted that the focus of the online workshop is a very important one: talking about practical solutions for how the scientific community, society and everyday life can function better together. After all, a political decision made without consulting scientists is probably not a good decision.

The use of evidence-based information should be a normal part of decision-making processes. For example, expert committees could be created for this purpose, something that has been done in many countries during the pandemic. Secondly, Estonia is a small country and informal consultation channels work well here. In number of fields, we have only a small number of experts, so good scientific advice is often just one or two phone calls away.

Although the pandemic has posed a very big challenge for all countries, it has also very clearly shown how important and indispensable good advice from scientists is. It became clear right at the beginning of the pandemic that decisions made simply based on everyday experience and common sense would not be of help to us in fighting COVID-19. As a result, countries have attained completely new levels in working together with science and shaping evidence-based policies.

Yet new questions have come up.

**First of all**, is it possible to get answers from scientists faster, and how? Modern life is very dynamic and fast-paced and the circumstances require quick reactions. There are situations where we cannot wait decades or even a single year for science to weigh in. Decisions must be made immediately and thus scientists' advice is needed immediately.

**Secondly**, where should the boundary between scientists' science-based advice and the political decision-making process be? In pandemic conditions, scientists can give recommendations for analysing risk factors, describe how the virus will act and propose possible measures, but scientists cannot take political decisions, considering the balance between fields related to the problem and the consequences of decisions. A values-based decision that takes all aspects into consideration can only be made by the government and politicians who have been given a mandate by the people.

**Thirdly**, what should a decision-maker do if scientists hold different opinions and advise different courses of action? Regardless of their reasons, perhaps the scientists have used different sources to obtain information and they find it hard to reach a common understanding and give the government uniform input. But if scientists are operating with the same background information, they have to be given the opportunity and time to reach a shared position so that decision-makers do not have to choose between different but equal scientific positions.

The COVID-19 crisis has shown that things that shouldn't happen do occur. That means we have to cooperate in preparing for the unexpected, considering the different characteristics of different stakeholders. **Policymakers** must realise that scientists cannot give ready-made answers; they can only give input or offer choices, and policymakers then have to add a values-based dimension. **Scientists** for their part have to learn how to present information to the public and politicians in a way that it can be used in practice. In the long run, the goal is to develop ways in which everyday life and science can work together successfully so that the forms of cooperation between scientists and decision-makers can be developed further.

To that end:

- 1) I encourage scientists to actively take part in public discussions, to express their opinions in writing and orally. In this way, we can get people, including decision-makers, used to evidence-based information. If people grow accustomed to using such information and start demanding it, that will help reduce misinformation and the proliferation of disinformation-based manipulations in society;
- 2) we must find more ways for both private enterprise and the public sector to harness science. Today more than ever, we expect scientists to provide new solutions to problems facing society;
- 3) our common challenge is to produce the next generation of scientists. We need outstanding young people who will develop the solutions to society's problems in future. Likewise, we need leaders orientated to practical solutions and ready to cooperate with international networks.

## L'ORÉAL-UNESCO BALTIC SCHOLARSHIP

*Estonian scientists who got awarded by L'Oréal Baltic's programme "For Women in Science" are working towards improving the living conditions of animals and creating materials that help humans.*

The 6,000-euro young talents awards in L'Oréal Baltic's programme "For Women in Science" went to the University of Tartu researcher Kaija Põhako-Esko and the doctoral student Mari-Ann Lind. They will use the scholarships to find new ways to help people and to improve the living conditions of animals.

Kaija Põhako-Esko, Associate Professor of Materials Chemistry at the Institute of Technology of the University of Tartu, intends to use the L'Oréal scholarship to develop novel materials for soft robotics equipment.

"Soft robotics involves equipment that is soft and compatible with the human body, such as cloth-like exoskeletons which help people with movement disabilities and are used in rehabilitation. Exoskeletons are also often used in sports and work environments to ensure safety and avoid injuries. I want to develop new materials. To do this, I will combine textile technologies and electroactive polymers, i.e. materials that change shape upon receiving electric signals. Textiles are an appropriate point of reference for developing useful and innovative soft robotics equipment, as we all wear textiles, and textile technologies have been honed to perfection over the centuries," Põhako-Esko explained.

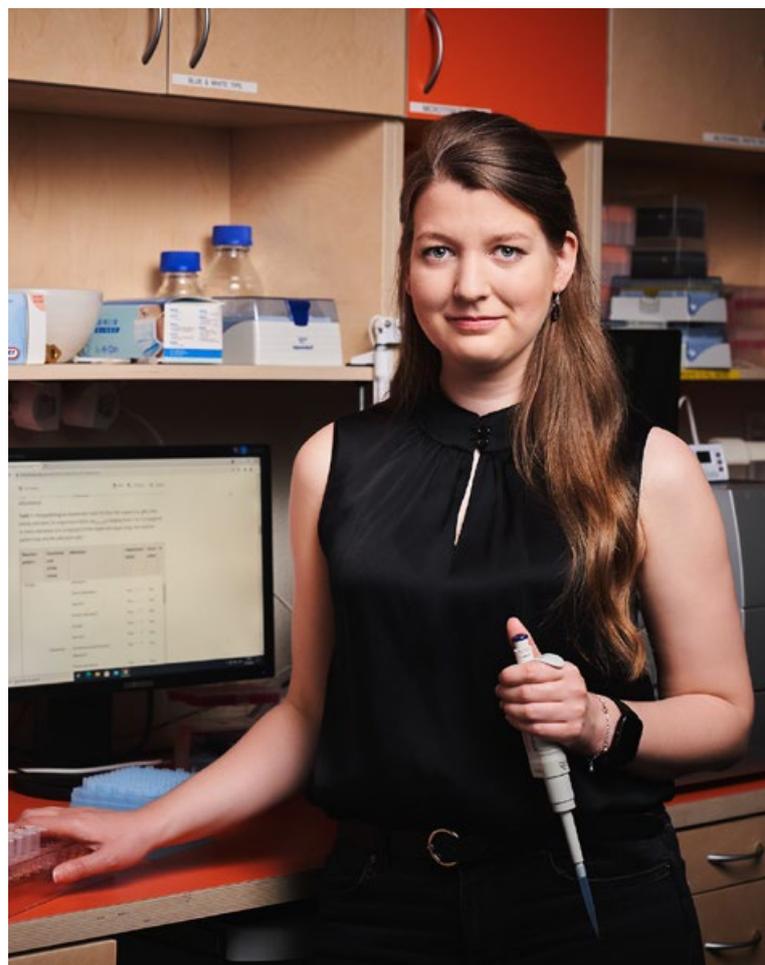
Mari-Ann Lind, a doctoral student in animal ecology at the University of Tartu, plans to use the scholarship to study the effects of anthropogenic pollution on plaice in the Baltic Sea. She believes that it is important to determine whether long-term pollution has caused fish to develop evolutionary cancer defence mechanisms, for instance whether their gut microbes help them to better cope with carcinogenic pollutants. "Earlier findings suggest that gut microbiomes and the formation of cancers may be mutually related. I want to find out whether such links exist. The results of the research will give us a better understanding of the effects of pollution on fish, which in turn will allow us to establish more efficient environmental measures and control the release of pollutants into the environment. Research into animal cancers can also offer innovative ideas for human medicine, such as for cancer treatment," said Lind.

According to President of the Estonian Academy of Sciences Tarmo Soomere, it is important to acknowledge talented young female scientists who are committed to finding novel and practical solutions for society.



Photo: Kaupo Kikkas x2

Kaija Põhako-Esko.



Mari-Ann Lind.

“A future worth living can only be based on balance and gender equality in all of the main aspects of the functioning of society. Supporting talented young female scientists is one of the most progressive and effective ways to achieve this balance. Highlighting bright female scientists inspires the entire society,” President Soomere explained.

L’Oréal Baltic’s initiative “For Women in Science” ([www.forwomeninscience.com](http://www.forwomeninscience.com)) is the only support programme in the Baltic region that, in cooperation with the Estonian National Commission for UNESCO ([www.unesco.ee](http://www.unesco.ee)) and the Estonian Academy of Sciences, supports the professional development of female scientists and the achievement of goals important to them. The Baltic

programme stems from the global “For Women in Science” programme, which was created by UNESCO and L’Oréal in 1998 in order to increase the number of female scientists and promote gender



## LINDAU FORUM 2021

From Estonia, Junior Researcher of Materials Science at the Institute of Physics of the University of Tartu Kristjan Kalam and Methodological Adviser on Treatment Guidelines at the Dean’s Office of the Faculty of Medicine of the University of Tartu Urmeli Katus attended the Lindau Nobel Laureate Meeting.

The 70th Lindau Forum took place from 27 June to 2 July 2021. The nearly 70-hour programme offered a wide range of discussions and talks with 74 Nobel laureates and nearly 700 young people from about 100 countries. Due to the COVID-19 pandemic, the meeting was held online. The topics discussed included future pandemics, gene alteration and modification, climate change, trust in science and the future of the Lindau Forum.

### Kristjan Kalam’s impressions

As a doctoral student, I was given the opportunity to take part in the 2020 Lindau Forum, but it was cancelled due to the pandemic and rescheduled for 2021. Until April 2021, there was hope that the event would, in compliance with all of the safety rules and distance requirements, be held in Lindau, on site for some and online for others. However, a couple of months before the forum, a decision was made to hold the event fully online.

Every five years, a “jubilee event” is held: a joint event for all of the disciplines in which the Nobel Prize is bestowed. And this was the 70th jubilee of the conference, i.e. a joint event. As it was an online conference, the days were filled with discussions from early morning till late evening. Many presentations were held at the same times in order to offer listeners from every corner of the world and every area of specialisation something that took place at times suitable for them. Therefore, I naturally didn’t take part in everything, which wasn’t possible.



Photo: Elisa Tammeorg

Kristjan Kalam.

The conference started with an opening ceremony on 27 June. In addition to the opening remarks, speeches and other formalities, the ceremony included a short film on the history of the conference and musical entertainment. The opening day ended on a work-related note: a panel discussion that focused on the insecurity of academic work. To my surprise, I discovered that our problems are the same as everywhere else: project-based and unstable funding, a lack of a sense of security and young people’s difficulties in combining work and family life, etc.

Countess Bettina Bernadotte delivering the opening remarks. The right side of the screen contains the chat window open to all of the participants during every presentation.

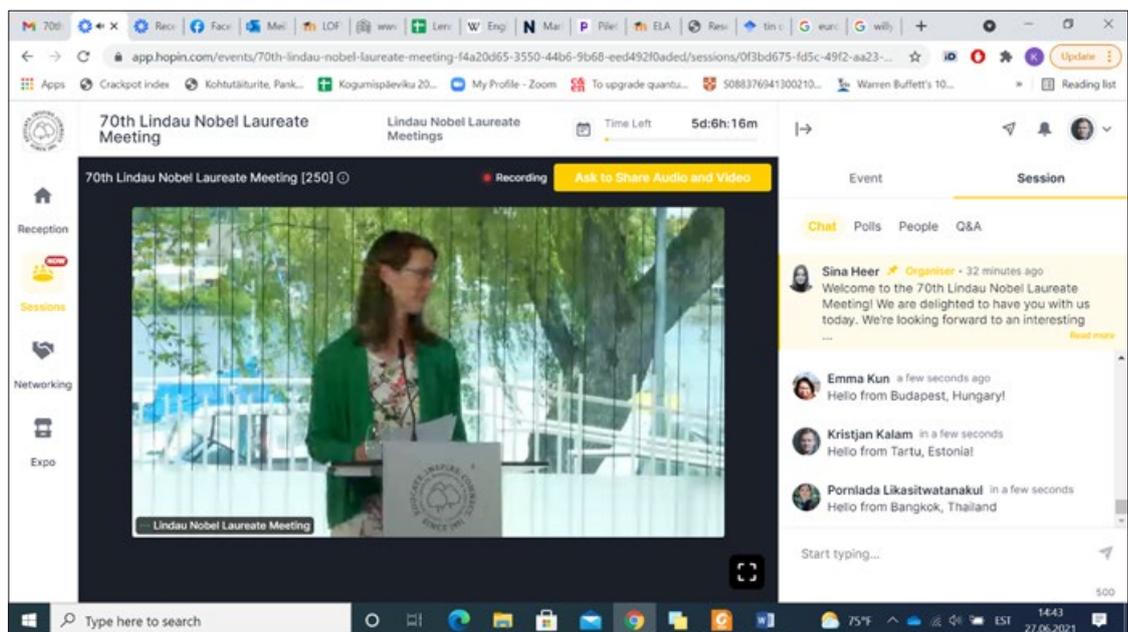


Photo: Lindau opening

28 June was the first full-length working day. I filled my morning with physics presentations. I listened to Didier Queloz talking about exoplanets, Klaus von Klitzing about SI systems and Joachim Frank and Stefan Hell about pushing the boundaries of microscopy. The afternoon offered free-format discussions, where young people could talk with Nobel Prize winners on any topics. I decided to ask each Nobel Prize winner I talked with how a successful young researcher could combine research with family life. Firstly, the topic is close to my heart, as I myself am trying to cope with it. Secondly, I wanted to conduct a little study, get as many answers as possible and compare them on a gender basis. I chose female scientists as the first ones to bombard with my questions, as they are scarce among Nobel Prize winners. Emmanuelle Charpentier and Françoise Barré-Sinoussi gave fine theoretical opinions on the topic, talking about flexible working hours and support systems, but admitted that they did not have any children. So, the opening score was 0:2 to the detriment of the compatibility of working life and family life. In the evening, I listened to Kip Thorne's presentation about the collisions of black holes.

By the end of the day or, to be more exact, by that night, I had obtained answers to my set questions from three male scientists who all had children and whose wives stayed at home when the children were young. In conclusion, I can say that in theory everyone thought that work and family life can be combined, but in practice women mostly still had to choose one or the other, while men did not have to choose.

29 June was similar to the previous day: I listened to exciting presentations and when I succeeded in engaging a Nobel Prize winner in a non-science conversation, I asked my pet question. People had started to consider it my trade-

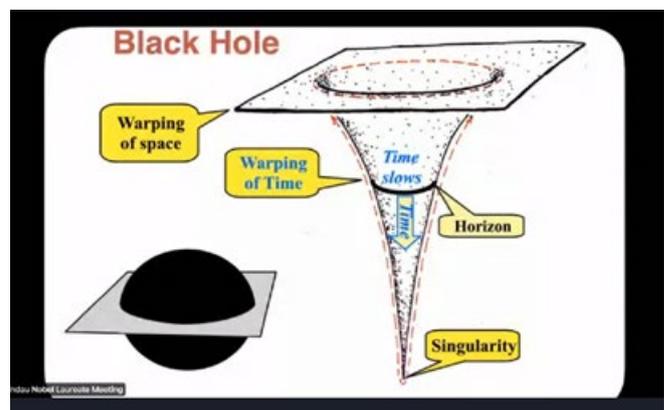


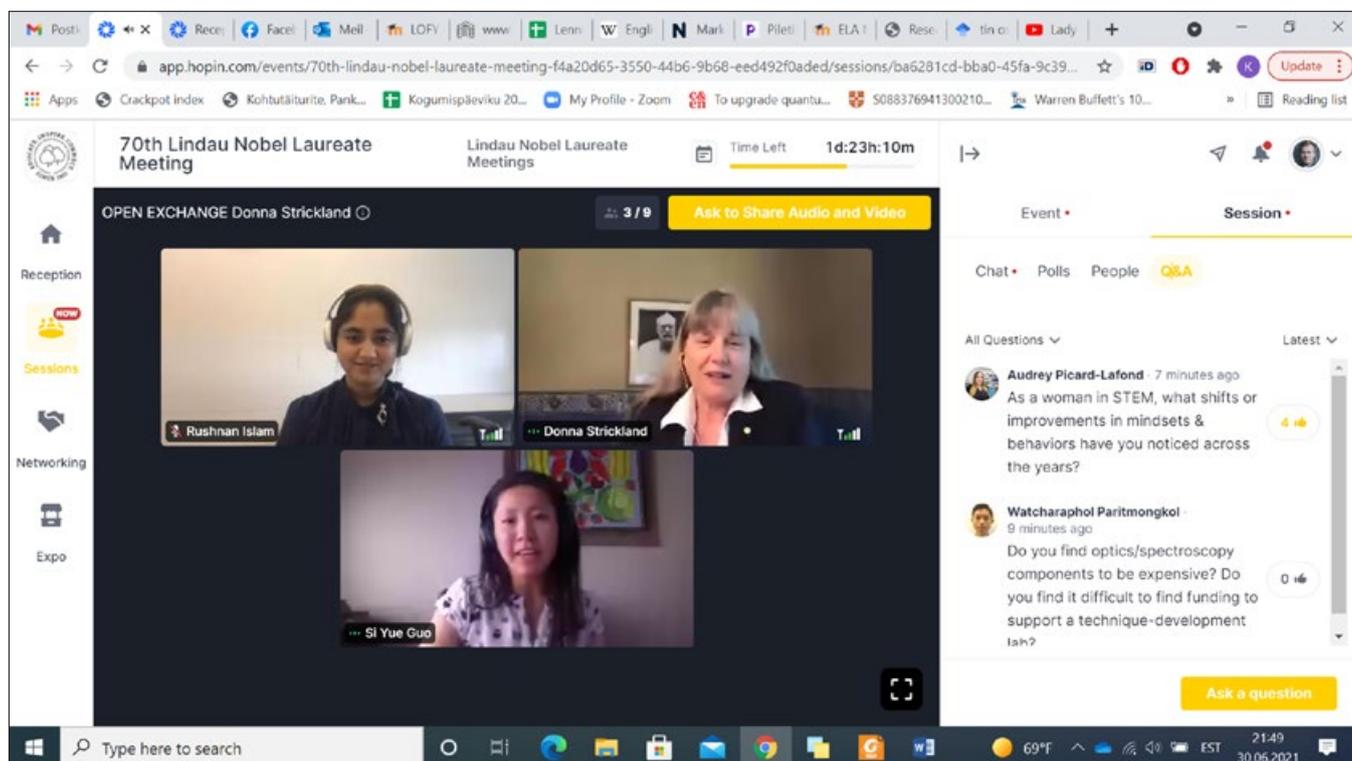
Photo: Kip Thorne

Visualisation of a black hole. The perimeter (the circle-shaped red dotted line) is very small compared to the diameter (the red dotted line running down from the flat part at the top to the singularity at the bottom).

mark. My enthusiasm on the topic clearly appealed to female scientists, but not so much to male scientists. This was very revealing and correlates with the answers I received.

On 30 June, I managed to include Elizabeth Blackburn and Donna Strickland in my sample. As mothers, they admitted that when their children were small they had to give up everything apart from work and family. Going to the theatre and restaurants and other such activities had to be forgotten for many long years. Donna Strickland said that she barely even went to conferences when she was young. They comforted me, saying that the busy time would pass, the children would grow up and there would again be time for other activities.

The conversation with Donna Strickland was very sincere and cool. She also said that she felt responsibility connected with her Nobel Prize. She was trying to take



A free-format conversation with Donna Strickland. In the chat window on the right, you can see that the question about how attitudes towards women in life sciences have changed earned many “likes”.

science to the public and use her “Nobel-voice” to make people understand the importance of science. Talking to politicians was of no use, she said, as politicians merely did what their voters wanted. Therefore it had to be explained to people why science was needed, so that they would demand it from politicians. Politicians would then, although indirectly, be under greater pressure to listen to scientists.

She was also asked what happened immediately after she won the Nobel Prize. She replied: “It was particularly crazy at first. On the first day, I received 1,500 e-mails, hundreds of phone calls, and photographers stalked me. I soon met all my idols: the Pope, the Apollo astronauts, Brian May and Steven Tyler.”

The most memorable conversation of the following day was with Steven Chu. He was asked how he found going from science to politics and back again. Chu replied that his path to politics was probably not a classic one. He never ran for any office, did not conduct a campaign, did not lobby or beg for votes. President Obama simply invited him to be the Secretary of Energy. When they talked and he saw that Obama understood things in the same way he did, he agreed to take the job. To the question of what was the biggest difference between science and politics, he replied: “People lie in front of a camera to please their voters. They know they are lying and they know their colleagues know. But they still do it, because it is standard behaviour in politics.”

To the question of how to convince funders to fund basic research, e.g. research into dark matter, we were told:

“You need to convey the excitement of discoveries. It is not nice to pretend that it benefits the national economy. But obtaining new knowledge about the universe is also important in itself; it is a part of human nature: to understand more about what is around us. Spending money on that is always OK. Besides, many times more is spent on very silly things. So there is no question of ‘oh, maybe we’d be taking money away from something important.’ Don’t worry, you won’t. Never feel ashamed to ask for money for your research. It is not right to demand of scientists that research immediately generate financial gain.”

2 July included a panel discussion and the closing ceremony. Let us end this overview with a thought from the last discussion on the topic of education. To the question of what should change in education, we received the reply: “We have to give people enough education for them to reach a state where they are not disturbed by the understanding that they do not understand. This is not currently the case. People feel irritated when they do not understand something and they therefore look for simple explanations which they can handle, but which are mostly incorrect.”



# INTERNATIONAL CONFERENCES AND SEMINARS

## Webinar “The Changing Arctic”

*Rein Vaikmäe, Science Adviser to President of Academy*

The webinar “The Changing Arctic”, held on 14 April 2021, celebrated the centenary of diplomatic relations between Estonia and Norway, as well as climate change-related cooperation in the framework of support from the European Economic Area and Norway.

Interest in the Arctic region has grown in the past decade in connection with global warming. The historical traditions of organising and participating in Norwegian and Estonian polar expeditions date back to the 19th century. Both marine countries are looking for new cooperation opportunities to continue polar exploration.

The webinar was opened by the President of the Academy of Sciences, Tarmo Soomere, and the Norwegian Ambassador to Estonia, Else Berit Eikeland. Presentations were given by the Estonian Minister of Foreign Affairs, Eva-Maria Liimets, and the Chancellor of the Norwegian Ministry of Foreign Affairs, Audun Halvorsen.

Estonian and Norwegian scientists gave short presentations of the results of their research so far conducted in the Arctic region (mainly in Svalbard) and plans for future research. The member of the Norwegian Academy of Sciences Professor Eystein Jansen spoke about climate change and arctic research in Norway. Professor Rein Vaikmäe talked about the exploration of the Svalbard glaciers in 1974–2017. The presentation of the researcher Marius Årthun from the University of Bergen focused on

the Atlantification of the Barents Sea. Bénédicte Ferré from the University of Tromsø spoke about the variability of methane emissions in Svalbard. Martin Liira, Senior Geologist at the Geological Survey of Estonia, spoke about methane in the geological sediments of the Svalbard fjords.

These were followed by presentations about the indigenous peoples of Siberia (Aimar Ventsel, University of Tartu), links between Arctic expeditions, climate change and the atmospheric processes of the Arctic region and Estonia (Erko Jakobson, Tartu Observatory), changes in the Arctic Ocean and the stability of the ice layer of Greenland (Kerim Nisancioglu, University of Bergen), arctic mushrooms (Leho Tedersoo, University of Tartu) and algae in the polar regions (Hanna Kauko, Norwegian Polar Institute). Malgorzata Smieszek from the University of Tromsø spoke about the evolution and impact of the Arctic Council and what can be learnt from governing the Arctic.

The event was moderated by the Academy member Maarja Kruusmaa. In the discussion following the presentations, the participants jointly stated the necessity of continuing the cooperation between Estonian and Norwegian scientists in the area of scientific research in the Arctic region.

The event was organised by the Estonian Academy of Sciences, the Academia Europaea Bergen Knowledge Hub and the Bjerknes Centre for Climate Research at the University of Bergen, on the initiative of the Norwegian Embassy in Tallinn. The broadcast was watched by several hundred people in Estonia and Norway. The webinar can still be watched at: <https://www.akadeemia.ee/en/events/webinar-the-changing-arctic/>.

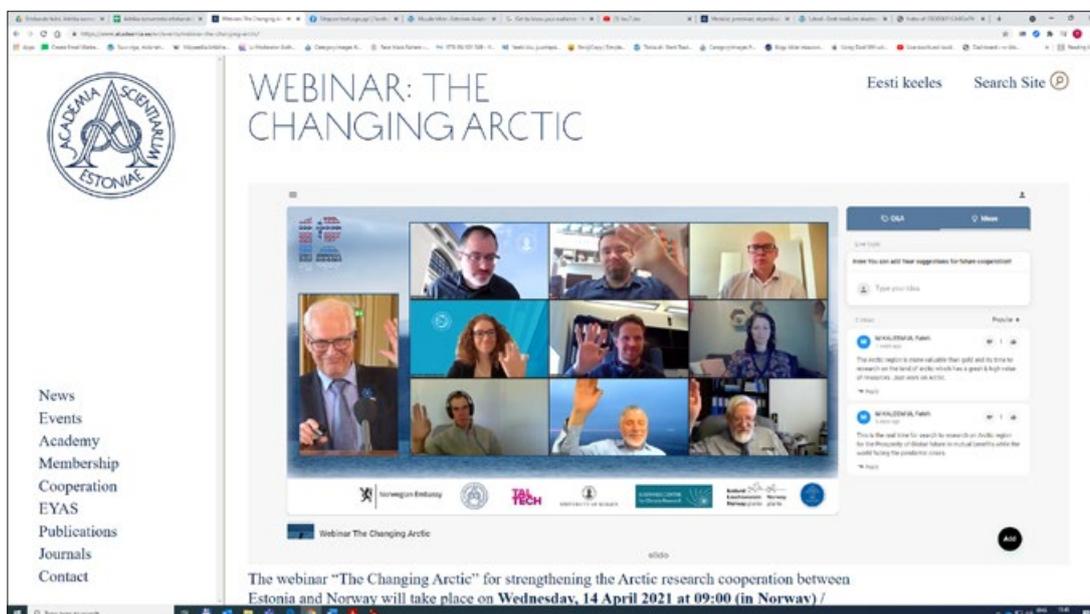


Photo: screenshot



## *The 17th Baltic Conference on Intellectual Cooperation*

*Jüri Engelbrecht, Academy member, Adviser on International Relations at the Academy*

Jüri Engelbrecht chairing a session  
at the BCIC Conference

The 17th Baltic Conference on Intellectual Cooperation was held in Tallinn on 28–29 June 2021. The conference was held as a hybrid event. Although the sessions were held in a hall at the Estonian Academy of Sciences, half of the presenters participated via the Internet and the entire conference could be watched online.

The history of the Baltic conferences on intellectual cooperation is long, dating back to the pre-WW II period, when the first conference was held in Kaunas in 1935. Before the occupations of Estonia, Latvia and Lithuania in 1940, six conferences were held, with the last one in Tallinn in 1940, interrupted as the aggression of the Soviet Union began.

Good ideas live on despite oppression. The Latvian Academy of Sciences restored the conference tradition in Riga in 1999, and this conference in Tallinn was the seventeenth. For the first time, the Estonian, Latvian, Lithuanian and Finnish Academies of Sciences welcomed the Hamburg Academy of Sciences, which considers cooperation in the Baltic Sea region important.

The Riga conference started the tradition that the conferences always have a focal topic and this was also the case in Tallinn. This year's topic, "Mathematics for Society", was doubtlessly important, not just because Galileo Galilei knew that God used mathematics in creating the world, and not because UNESCO proclaimed 2022 the Year of Basic Sciences, but because mathematics helps society to solve urgent problems. After all, the world has been suffering from COVID-19, important economic and social networks have collapsed, and humankind is facing many other acute problems.

The topic of the conference covered an analysis of the applications of mathematics in policy-making in general

and in resolving the COVID-19 crisis more specifically. A separate session focused on general applications of mathematics, discussing a selection of problems: the future of quantum computing, the currently rapidly developing complex systems theory, genomics and proteomics, as well as a look back at the development of navigation tables in seafaring. Experienced scientists from Estonia, Latvia, Lithuania, Finland and Germany gave overviews of the latest research. An understanding of the importance of mathematics definitely reached a wider audience. In other words, it pays to trust scientists.

In addition to the conference, an energy seminar was held at Tallinn University of Technology, attended by Estonian and German scientists. The seminar was aimed at the future: discussion topics covered the prospects of hydrogen energy, and the development possibilities of wind and solar energy as renewable energy sources. Ensuring the stability of energy systems was also raised as an important topic.

As is the tradition, a meeting of the presidents of the participating academies was held and the medals of the Baltic academies were awarded.

To conclude, here is a list of the organisers of the conference:

Eesti Teaduste Akadeemia  
Latvijas Zinātņu Akadēmija  
Lietuvos Mokslų Akademija  
Suomalainen Tiedeakatemia  
Akademie der Wissenschaften in Hamburg

The next conference, the 18th Baltic Conference on Intellectual Cooperation, will be held in Riga in 2023.



### **Concluding remarks by Tarmo Soomere at the Baltic Conference on Intellectual Cooperation, June 29, 2021**

This conference has provided us with an extremely dynamic array of ideas, concepts, results, applications and perhaps even ramifications based on excellent research. Even though we have enjoyed fantastic success stories in our everyday lives, they did not, strictly speaking, involve applied science.

Actually there is no division of science into fundamental and applied science, but there is a division into excellent and not excellent science. Some people even say that if you do only applied science there will soon be no science to apply. What we have seen has just been excellent science, ready to be applied and often with demonstrated capacity to benefit society. This is what people usually call applied science.

We have now had 86 years of intellectual cooperation between the Baltic states. This framework was distorted by a 50-year period of hibernation. Since this dark period ended, we have gathered 10 times and have issued 36 medals of the Baltic academies to highlight the best of our science, which enhances cooperation.

I believe it is clear that we wish to continue this cooperation. In this context, it is extremely necessary to bear in mind several new or emerging aspects. It has become almost a cliché to say that the competitiveness and prosperity of countries, nations, regions and even continents, and of course the quality of life nowadays, directly depend on the capacity of policy-makers to extract the best knowledge from the most educated and the most competent people. Moreover, we need to do more than simply extract this knowledge. Paraphrasing Thomas Babington Macaulay: the best government not only desires to make people happy,

but also knows how to make them happy. A foreign member of the Estonian Academy of Sciences, Helmut Schwarz, has said that without science we can't build a future which is worth living.

There are some obligations of scientists who belong to academies of sciences. These commitments can be expressed in very different ways. The former president of the Estonian Academy of Sciences, Karl Rebane, formulated it in a negative manner. He said more than 30 years ago that the ultimate goal of academies is to avoid making stupid strategic decisions.

This is pretty much still true today, and it's even more true than we would have imagined 30 years ago. Let us think about different career steps in science. The doctoral degree is a clear mark of quality, proof that a person is able to independently retrieve new and important knowledge and communicate it to others. This is the essence of science. A professor is a top scientist, and an established researcher with a long CV, including a demonstrated ability to teach, which is the main component of being a professor.

We might ask: what quality does being an Academy Member have? What extra assets are needed? What is the distinguishing feature? Is the Academy just a hall of fame, where Members just have their pictures hanging on the wall forever? No, it's not, according to the Academy Member Anto Raukas, who passed away just a few months ago. He said that an Academy Member is a cultural phenomenon. He or she has to have a very wide understanding of the world. In particular, this understanding has to be especially sharp in terms of passing or channelling knowledge to policy-makers.

We live in an extremely rapidly changing time. One of the features of this time is that we have to convince society that science is important, and not only in terms of producing results. People do not ask us how many theorems we have proved or how many equations we have solved. The society asks how we have made their lives better.

A new component of being a scientist is now being worked out in all European countries and in many other countries. In essence, it means giving the best science advice for making policy, for political decisions at all levels of society, not only for basic or higher education, and not only for research or for the economy, but in terms of running the entire country wisely.

It is clear that a small country cannot support all fields of science at high levels. The number of scientists in Estonia is smaller than the number of lines in the classification manuals of science. This issue is pretty much the same for all countries with populations below 20 million people. Small countries are only strong when they work together, supporting each other and offering complementary knowledge to each other.

There is a pressure of time that has been mentioned during the two days of this conference. Science is no longer a passive observer. Scientists are no longer just people who describe what is happening. They have gradually become people who can predict what will happen. It's therefore time for science to be proactive not reactive. It is now time for smart people to possess enough knowledge, experience and opportunities to change the world. It is our choice whether we change it for the better or worse.. These aspects will be discussed in detail in the follow-up of this conference: the meeting of the presidents of the five academies of science.

There has been one more massive change in the understanding of science, involving the potential to change

the world. If you understand things, you normally act differently than non-informed people do. Over the last almost 60 years the world has pretty much become binary. Almost every computation, analysis or forecast has been performed in base two. This is a very poor description of the world. We see now a much richer and more complex description of the world emerging. Its pioneer – the first martin or swallow, as we say in Estonian – is quantum computing, where you are not limited to zero and one. It is thus obvious that the world is becoming colourful again. This is very nice indeed.

Thank you very much for your contribution to this conference!

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*International seminar on science education: “Impact of research in science education. Addressing the need for a knowledge-based society”*

*Miia Rannikmäe, Professor at the University of Tartu*

Society is constantly changing. In the course of development, new scientific knowledge is gained and this, in turn, increases challenges to teaching and learning natural sciences. Teachers need support from scientists in acquiring contemporary scientific knowledge, as well as knowledge and skills related to different teaching methods and the assessment of learning outcomes.

Just as teacher education as a whole has to be based on science, scientific knowledge and understanding of the constant development of (and changes in) that knowledge are prerequisites in preparing the teachers of natural sciences. The successful, modern and relevant teaching of sciences requires a constant exchange of ideas with practising scientists, researchers and lecturers of natural science education, and teachers of natural sciences.

On 30 September 2021, an international seminar for science education experts, “Impact of research in science education. Addressing the need for a knowledge-based society”,<sup>87</sup> was held in the Hall of Mirrors of the Academy of Sciences in cooperation between the University of Tartu and the Estonian Academy of Sciences, and with support from the Horizon 2020 project SciCar. Scientists from six Estonian higher education establishments took part and



Do-Yong Park.

the seminar was introduced by President of the Academy of Sciences Tarmo Soomere.

The need for a change of paradigm in science education was the main topic of the seminar. This was discussed by a visiting professor at the University of Tartu, Jack Holbrook, and Professor Do-Yong Park from Illinois State University. There is more and more talk of STEM education in the context of science education.<sup>88</sup> One of the

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<sup>87</sup> [www.akadeemia.ee/en/events/impact-of-research-in-science-education-addressing-the-need-for-a-knowledge-based-society/](http://www.akadeemia.ee/en/events/impact-of-research-in-science-education-addressing-the-need-for-a-knowledge-based-society/)

<sup>88</sup> STEM – Science, Technology, Engineering and Mathematics. Krajcik, J., Delen, I. 2017. Engagement of students in STEM education. *Estonian Journal of Education* 5(1), doi.org/10.12697/eha.2017.5.1.02b



The seminar was moderated by Professor Miia Rannikmäe.

main definitions of STEM education is integration and the resulting interdisciplinary activities. The latter have grown into trans-disciplinary activities. In order to understand the need for integration in science education, we have to go back to the 19th century, when biochemistry became a distinct area of science, followed by molecular biology in 1930. These two new disciplines becoming “independent” is considered the beginning of the paradigm shift.

In Professor Park’s assessment, the association of natural sciences and technology with society started to strengthen in US science education after WWII. By the end of the 20th century, this had evolved into the new area of STEM education. However, STEM education reform and STEM education evolving into a uniform area and being nationally recognised took more than 20 years in the US. The Next Generation Science Standard<sup>89</sup> was published in 2013, triggering an actual paradigm shift in the area of science education in US schools.

According to Professor Holbrook, the transformation of the concepts of science education may be viewed as science-based and evidence-based changes. Research in science education has relied on the results of research in the areas of science, technology and philosophy. The key term here is scientific literacy and the definition of its dimensions on the basis of social challenges. Research in science education is focused on more than how to develop science knowledge. Opening up career opportunities and the related future needs of society are also important. This research



Jack Holbrook.

also supports the preparation of teachers of natural sciences so that society can benefit most from the paradigm shift.

A research-driven view of science teacher education was also emphasised in his presentation by Professor Jari Lavonen from the University of Helsinki. He analysed new areas in the basic studies of teachers of natural sciences, which are based on the results of research in science education. Above all, Lavonen focused on learning,

89 Next Generation Science Standards: [www.nextgenscience.org/](http://www.nextgenscience.org/)



Jari Lavonen.

Photo: Krista Tamm x3



Rahel Mamlok-Naaman.



Ron Naaman.

engagement and the cohesion of nature science studies. In discussing the knowledge of teachers, he addressed course-specific knowledge, the cohesion of teacher training programmes and the role of university-level education research. “Future studies”, which emphasise the development of cross-area and transferable competences, are considered extremely important in advancing the competences of teachers. These views form the basis for a paradigm shift in establishing the objectives of future science teacher education in Finland.

Professor Ron Naaman from the Weizmann Institute of Science in Israel<sup>90</sup> emphasised in his presentation that scientific research has an effect on science education. It is usually presumed in communicating with scientists that all of their activities are based on knowledge and are rational. Just like being a teacher, being a scientist naturally requires intellectual development but, more importantly, it requires passion. According to Professor Naaman, science requires three main abilities. Firstly, one needs to be curious enough to ask *how?* and *why?*. Secondly, one needs resilience and consistency in carrying out hard work until answers are found. Thirdly, one needs to know facts and the necessary methods to perform research that will yield significant results. Traditionally, the third component is emphasised in teaching natural sciences. This, however, separates science from society and makes the natural sciences taught at

school distant from the lives of learners. Professor Naaman illustrated the importance of all three components in science education and research with examples from his own research in chemical physics.

It is important how science teachers understand the results of education research. To be more precise, it should be determined whether these results remain distant from the practical work of teachers or whether teachers also understand the importance of paradigm shifts in education. Dr Rachel Mamlok-Naaman from the Weizmann Institute of Science emphasised that different approaches have led to the development of modern research tools to assess the results of learning natural sciences. These are important instruments for measuring students’ cognitive and affective skills, motivation, learning difficulties and misconceptions, as well as their understandings that differ from the ordinary. All of this is related to study programmes on a more general level, as it seeks to determine whether the material being learnt is important to students and relevant in the light of scientific and technological discoveries. Testing students is not sufficient to obtain answers. We need to constantly support the professional development of science teachers by, for instance, providing training that is in line with the modern paradigm. Such support allows teachers to better understand the objectives of study programmes, the methods and content of teaching, and the basis of assessment.

Helen Semilarski, a doctoral student at the University of Tartu and a biology teacher, gave an overview of her research into how research in education supports a

<sup>90</sup> Named in honour of the first President of Israel and a founder of the Institute, Dr Chaim Weizmann – ed.

practising science teacher. She stated that while interdisciplinary science studies may play a central role in promoting the 21st century skills of students,<sup>91</sup> students' self-perception of their sufficiency in these skills is usually low and that limits the application of their actual science competence. Based on her intervention study that aimed to promote students' understanding of the essential nature of science and to increase their awareness of science-related career opportunities, Semilarski said there was an important place for STEM education in an interdisciplinary approach to framework science topics across school levels and in moving towards a trans-disciplinary approach. A good example of this is “energy conversion”, an abstract concept that students find hard to understand. This topic would be easier for students to understand if it were applied to more than natural sciences and were more associated with everyday life.

Developing scientific literacy at all levels of education is and will continue to be the aim of teaching sciences. When we look at our average national results, our students score at world-leading levels in PISA tests,<sup>92</sup> but the number of students who have reached the highest PISA levels of proficiency<sup>93</sup> is small. The idea of the importance of understanding paradigm shifts discussed at the seminar is connected with the need to critically review the contents of science education (the necessary knowledge of facts, processes and methods) and to assign meaning to scientific literacy that corresponds to the modern paradigm, while emphasising the aspects of career awareness, the relevance of knowledge, and the trans-disciplinary nature of studies. The seminar emphasised the importance of research-based academic discussions as a basis for implementing such changes.

In the framework of 2022 as the International Year of Basic Sciences ([www.iybssd2022.org/en/home/](http://www.iybssd2022.org/en/home/)), we should determine how to increasingly motivate young people to choose STEM areas of specialisation in order to meet the future challenges facing society. The keywords are motivation, interest and relevance, for learners, teachers, scientists and society.

## *The 2021 Gulf of Finland Science Days “New start for the Gulf of Finland co-operation”*

In 2016, the ministries of the environment of Estonia, Finland and Russia signed a trilateral declaration under which they undertook to jointly protect the biota of the Gulf of Finland and to organise trilateral cooperation in this area. The Gulf of Finland Science days, a two-day international science conference, is part of the cooperation agreed on in the declaration in which the scientists and high state officials of the three countries discuss topics related to the environment of the Gulf of Finland and prepare development and action plans.

This cooperation has been going on for decades already before the declaration. The annual conference rotates between Estonia, Russia and Finland. Estonia's turn was in 2020, but in the epidemiological situation at the time no one even dared think of a physical meeting. In 2021, we managed to find a window of time when travel was possible and gatherings of a reasonable size were relatively safe.

The conference was held in Tallinn on 29–30 November in the premises of the Estonian Academy of Sciences as a hybrid event: some presentations were given via the internet and there was a live online broadcast from the conference. The participants in the conference received an extensive overview of the scientific research performed in the region of the Gulf of Finland in recent years, important results, trends and the current condition of the environment and biota of the Gulf of Finland. Various aspects of the research performed in the Gulf of Finland were addressed through 29 oral and 33 poster presentations.

The representatives of the ministries of all three countries gave overviews of the state of planning of marine areas, there was a lot of talk about the condition, quality and pollution of the water of the Gulf of Finland – chemical and plastic pollution, particularly microplastics and their impact on marine biota – climate change in the region, the effects of human activity and economic opportunities,

91 Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M. and Rumble, M. 2012. Defining twenty-first century skills. – Griffin, P., McGaw, B., Care, E. (reviewed). *Assessment and Teaching of 21st Century Skills*. Dordrecht; Springer, pp 17–66. doi.org/10.1007/978-94-007-2324-5\_2. See also “21st century skills”, [en.wikipedia.org/wiki/21st\\_century\\_skills](http://en.wikipedia.org/wiki/21st_century_skills)

92 Programme for International Student Assessment: a test with internationally comparable results, aimed at measuring 15-year-olds' ability to use their reading, mathematics and science knowledge and skills to meet real-life challenges. See also [www.oecd.org/pisa/](http://www.oecd.org/pisa/) and [en.wikipedia.org/wiki/Programme\\_for\\_International\\_Student\\_Assessment](http://en.wikipedia.org/wiki/Programme_for_International_Student_Assessment)

93 Descriptions of PISA levels of proficiency: <https://www.oecd.org/pisa/data/pisa2018technicalreport/PISA2018%20TecReport-Ch-15-Proficiency-Scales.pdf>





Photo: Aavo Kainne x2

Kevin E. Parnell.

e.g. aquaculture. Overviews were given of various technological solutions for cooperation in carrying our marine research in the entire region. Kevin Parnell’s presentation on the geomorphic perspective of the history of the planning of marine areas and changes in the paradigm ([www.youtube.com/watch?v=9NDW-OEWwUU](http://www.youtube.com/watch?v=9NDW-OEWwUU)) drew the most attention. The ideas highlighted in the presentation are described in greater detail in following Tarmo Soomere’s article.

*The conference programme and the recordings of the presentations on both days are available in the web.<sup>94</sup>*



<sup>94</sup> The Gulf of Finland Science Days 2021: [www.akadeemia.ee/en/events/the-gulf-of-finland-science-days-2021-new-start-for-the-gulf-of-finland-co-operation/](http://www.akadeemia.ee/en/events/the-gulf-of-finland-science-days-2021-new-start-for-the-gulf-of-finland-co-operation/)

Poster presentations also sparked a lively debate.

## *The magic of the rights of beaches*

*Tarmo Soomere*

Nature has been Estonia's most important ally for centuries. Regardless of the political situation, nature has given us food, a place to live, and heating materials, not to mention the hundreds of other little things that we enjoy or use.

A beach is a superb gift of nature. Richard Aldington thought that the value of a thing is determined by the enjoyment it can offer. A beach therefore has a huge value. Why else would ever more people and human activities converge on beaches?

Many people want to partake in valuable things. Unlike the sea and inland regions, beaches are not permanent or easily controllable. As long as the sea breathes, new beaches are always born, wrote Karl Ristikivi. As the average water level changes, beaches are reshaped. As a rule of thumb, a sandy beach shifts a hundred times faster than the water level changes. When the water level rises by a centimetre, both the waterline and the entire beach move by a metre.

This process has been observed without passion for a long time, monitoring shifting waterlines, assessing changing water levels and the nature of beaches, calculating the distance of buildings from waterlines to prevent them from toppling into the water during their expected lifetimes, adding certain buffers to allow for storms accelerating the process or pushing the water levels up.

The rules on how far from the waterline we can build must be established by the state. Individual citizens simply do not have the skills and information needed to assess when water will flood their homes. There are also places where even a high coast quickly crumbles, spilling large chunks of primeval forests into the sea.

It's a mechanistic and old-fashioned approach, people used to say. The concept of an integral management of coasts was born about 30 years ago. The idea was beautiful: to launch a dynamic decision-making mechanism which takes into account all of the important factors and knowledge, engages all the parties and offers them the best available information about the physics and dynamics of coastal areas, finding a balance between economic demands, environmental protection and social communication, preserving cultural values, creating recreation opportunities, and so on.

It soon turned out that the process was an ineffective one, where reaching a balance was an exception and it was generally not sustainable. Perhaps this would not have happened if the oceanic water level had stayed the same. But that was not the case. The rise of the water level, which had been about a millimetre a year for a century, tripled in the 1990s. This

means that in many places beaches have decreased by tens of metres in the 21st century alone. In quite a few places, water has started eating away at the foundations of houses.

The central problem here is not scientific. The key lies in the conflict caused by what some considered to be their inherent rights. Owners think that they have a right to protect their pieces of land from any external factors, including the undermining action of the sea. The state, on the other hand, has to ensure that the rights of the neighbours of the owners are also not violated and beaches stay integral wholes. For instance, if we start protecting a house built at the edge of a beautiful sandy beach with a stone wall against the waves, the beach itself and a part of the neighbour's plot often disappear. The functioning of beaches is sometimes disrupted along many kilometres. This is similar to primeval forests: if we fell too many trees, the remaining forest also loses a great part of its value.

In other words, the management of coastal areas involves a true conflict of values. On the one hand, no one should be deprived of the right to protect their property. On the other hand, every member of society has a right to enjoy what belongs to everyone. In Estonia, these include shore paths and the benefits of a beautiful coastline. These two aspects can easily co-exist only if the water level of the sea does not rise. From then on, they tend to become mutually exclusive.

The needed paradigm shift here is simple. It suffices to admit that sandy beaches cannot be protected with stone or concrete walls. These are used for protecting buildings or other objects of value in beach zones. Sandy or shingle beaches simply do not tolerate walls.

The actual question is the same as in the case of (primeval) forests: does nature and its parts have fundamental rights? Animals do. The idea of the inherent rights of nature has long existed among many indigenous peoples. For us, it was clearly stated by Thomas Berry (1914–2009).

In essence, this raises nature to its rightful place as an ally of humankind and a party with clearly defined rights. This idea has now been incorporated into the legal acts of 17 countries. New Zealand has gone the farthest by granting a passive legal authority to the Whananui River in 2017.<sup>95</sup> The river is represented by a Māori representative and a government representative. When they are of the same mind, balance is inevitable. Shall we follow their example? Or shall we all pay for the damage caused to beaches by our madness?

*The article was published in the "Through a Scientist's Eyes" column in Postimees on 11 December 2021*

<sup>95</sup> Brierley, G., Tadaki, M., Hikuroa, D., Blue, B., Sunde, C., Tunnicliffe, J., Salmond, A. 2019. A geomorphic perspective on the rights of the river in Aotearoa New Zealand. *River Research and Applications*, 34(10), 1640–1651, doi.org/10.1002/rra.3343

# BRIGHT MOMENTS – A SELECTION OF ACTIVITIES OF SCIENTIFIC SOCIETIES AND INSTITUTIONS ASSOCIATED WITH THE ACADEMY

The Estonian Academy of Sciences is associated with learned societies and research and professional associations whose activities and objectives are in accordance with the activities and objectives of the Academy.

The association is governed by a bilateral agreement which defines the objectives of cooperation, and the roles and responsibilities of both parties. As of 31 January 2022, 23 societies and professional associations, and eight research and development or cultural institutions are associated with the Academy.

The centenary of the **Academic Agricultural Society** was celebrated with a trip to the southern border of Estonia to visit Valga, a city in two countries. The day started with the participants paying their respects to the heroes of the War of Independence at the monument to the Battle of Paju,

lighting candles and observing a minute of silence. From Paju, the group moved on to the border town, where the guests were welcomed at the Museum of Patriotic Education by Major Meelis Kivi and Captain Valdeko Nielson. After a tour of the museum, the group stopped briefly at the War of Independence monument in the city park, where Major Kivi talked about events that changed the course of the War of Independence. That was followed by a festive lunch at the restaurant of the Hotel Metsis. Defying the hot weather, the group then went to the Valga Museum in the centre of the town, from where they embarked on a guided walking tour which took several hours and led the group to the house of the former Valga Secondary School for Girls, the monument to King Stefan Batory, the bust of the Olympic winner Alfred Neuland, the elaborate railway station building and other sights.



Photo: Aio Tanavots



Photo: Liina Raudvassar

A moment at the conference “Quo Vadis, Estonian Theology?”. In the front (from the left): Associate Professor Emeritus Peeter Roosimaa and Professor Urmas Nõmmik; in the back (from the left): Riho Altnurme, Randar Tasmuth and Jaan Lahe.

The **Academic Theological Society’s** event of the year was the celebration of its centenary with the conference “Quo Vadis, Estonian Theology?” at the great hall of the University of Tartu. The event also celebrated the 30th anniversary of the reopening of the School of Theology and Religious Studies at the University of Tartu, and the 10th anniversary of the web magazine *Church and Theology*.

The event of the year for the **Estonian Academic Oriental Society** was the 33rd Orientalist Day, held in Tartu on 25 September. Ten academic presentations discussed both the ancient and modern-day Middle East, Buddhism studies

and other topics. For the programme, see [www.eao.ee/xxxiii-orientalistikapaev](http://www.eao.ee/xxxiii-orientalistikapaev). The Orientalist Days have been held consistently since 1988.

The conference of the **Estonian Academic Society for the Study of Religions**, “From Alternative Facts to the Religion of Science”, held at the Von Bock house in Tartu on 3 December 2021, brought together a significant number of the members of the Society after the coronavirus pandemic. Nearly 30 listeners and discussion participants attended the conference in person and many participated via the internet.



Photo: Kristina Viin



Photo: Madis Arukask

Kristel Kivari speaking about giants of heavenly origin.

The participants discussed how various alternative approaches and conspiracy theories inevitably shape our reality and how the viewpoints presented in web forums, specialised literature and international politics are not merely pseudoscience that can be easily dismissed, but constitute an inevitable part of everyday life that needs to be studied. Discussion topics included the Para-Web Forum's alternative archaeology and history activities, which "study" giants (including Kalevipoeg) (presented by Kristel Kivari), the information space of alternative interpretations of the corona crisis in Estonia (presented by Marko Uibu) and Russia's strategic narratives and conspiracy theories aimed at the European Union during the COVID-19 crisis (presented by Vladimir Sazonov). At the informal gathering that evening, the senior members of the Society enlightened the younger generation about Soviet-era disintegrator processing and the infamous food supplement AU-8 produced by this processing.

The traditional summer bus tour of the **Estonian Geographical Society** is always eagerly awaited by the members of the Society, as well as by quite a few grandchildren and friends. This time, the tour went to Saaremaa on 10–12 August, with the Society's vice-president and a geographer from the University of Tartu, Taavi Pae, as the tour guide.

On the first day of the trip, we visited the Monument to the Letter Ö, erected upon the initiative of Taavi Pae. It is located on the border determined on the basis of Theodor Kaljo's master's thesis nearly a century ago: the point at which the letter Ö is replaced by the letter Õ in the pronunciation of Saaremaa people.

In three days, we did a tour of the whole of Saaremaa, visiting many medieval churches (in Pöide, Karja, Kihelkonna etc.) and old graveyards. Besides well-known places, such as the Kaali meteorite crater, the Sörve Visitors' Centre and the Panga Cliff, we also stopped at lesser-known monuments and beautiful sights, and visited the Arensburg Meridian marker in Kuressaare.



Photo: Tiit Vaasama





Photo: Hannes Rohtsalu

President of the Estonian Naturalists' Society Professor Urmas Kõljalg speaks at the opening of the Society's hall.

On 7 October 2021, the renovated first floor of the historical building of the **Estonian Naturalists' Society** was reopened. The festive gathering included speeches by the President of the Society and the Academy member Urmas Kõljalg, President of the Academy of Sciences Tarmo Soomere and Academy Secretary General Professor Jaak Järv, Mayor of Tartu Urmas Klaas, Director of the University of Tartu Library Krista Aru, Director of the Institute of Ecology and Earth Sciences of the University of Tartu Professor Maarja Öpik and the representative of the Environmental Investment Centre in Tartu, Gea Kiiver. The 25th Keeper of Estonian Culture of Biology Award was bestowed on the Society. Camerata Universitatis, the chamber choir of the University of Life Sciences, performed nature poetry songs.

The reopened premises are also home to the Tartu office of the Academy of Sciences and the offices of the Estonian Seminatural Community Conservation Association. The hall is used for the Society's general meetings and events of its subunits, and is open for events and other academic functions related to the activities of the Society.

The Naturalists' Society is grateful to all of the sponsors and supporters thanks to whom the historical building is kept in a dignified condition: the Estonian Academy of Sciences, the Tartu city government, the Ministry of Education and Research, and many other legal and natural persons.

The pan-Estonian Nature Observation Marathon has been held since 2018. It is a part of the annual nature festival – the largest amateur science project in Estonia – organised by the University of Tartu Natural History Museum and Botanical Garden in cooperation with the Naturalists' Society and other institutions promoting nature education across Estonia.

The project was initiated by Chief Expert of the Museum of Natural History Veljo Runnel, who is also Head of the Citizen Science Union of the Naturalists' Society. In the course of the Nature Observation Marathon, people wrote down the species they had observed within 24 hours in previously registered observation areas. The observations were entered into the PlutoF database, where they are publicly accessible (excluding species in the protected category I).

The 2021 Marathon was more successful than ever before: more than 7,500 observations were made in 41 observation areas. Over 2,000 species were identified and one species new to Estonia was found: the gall mite (*Fragariocoptes setiger*). Observations validated by specialists can be accessed on the Estonian biodiversity data portal at [elurikkus.ee/lvm/2021](http://elurikkus.ee/lvm/2021), and on the global data portal [gbif.org](http://gbif.org).



Photo: Veljo Runnel

Nature Observation Marathon 2021: amateur scientists in the Vanemuise observation area.



Photo: Screenshots 3x3

Juhan Aru at the filming of a video.



From Katrin Tiidenberg's video.

The most influential act of the **Estonian Young Academy of Sciences** in 2021 was the creation of videos encouraging people to get vaccinated against the coronavirus in order to support Estonia's fight against COVID-19. The video series produced under the leadership of Katrin Tiidenberg, and with support from the Estonian Research Council and the Academy of Sciences, included Tuul Sepp, Lili Milani, Katrin Tiidenberg and Juhan Aru as presenters, and Piia Jõgi, Deniss Sõritsa, Uku Haljasorg and Erik Abner as guests. They provide calm, friendly and science-based explanations of various points of concern and issues within the boundaries of their areas of specialisation. The aim is to support people's decisions, sense of security and understanding, and to eliminate the confusion that has emerged

regarding vaccination. The videos have found a broader audience via social media and on the notice screens of major universities, and have received a great deal of positive feedback. They were shared on Facebook accounts by President of the Republic of Estonia Alar Karis and the ministers Tanel Kiik and Liina Kersna.

For the first time in the history of the **Estonian Crop Research Institute** (ECRI), experimental fields were photographed during the vegetation period in 2021. In the framework of the plant biology infrastructure project TAIM, under the Estonian Research Infrastructure Roadmap, the Institute acquired a DJI Phantom 4 RTK drone, a Micasense RedEdge MX multispectral camera, and photo analysis



Tuul Sepp and Uku Haljasorg at the filming of a video.



Photo: ECRI x2



software. The acquired technical equipment allows ECRI to take aerial shots of fields as classic RGB photos and multispectral photos.

From spring to autumn in the first year (2021), the drone gathered an average of ~10 GB of images per field, a total of ~1.6 TB of images, shots from 20 fields, weekly images from six fields, and nearly 40 drone flight hours. The data gathered by the drone give plant breeders valuable and comprehensive information about the health of fields and plants.

In the framework of the international project “NOBALwheat”, the varieties and breeding stock of summer wheat were photographed from both near and far. In addition to the drone, a phenomobile also moved between experimental plots. The aim was to obtain additional information to characterise genotypes, in order to contribute to breeding varieties with better qualities.

**The Estonian Learned Society in Sweden** celebrated the 102nd anniversary of the Estonian-language university with a festive gathering at the Estonian House in Stockholm.

The **Estonian Mother Tongue Society** managed to celebrate its centenary only on the third attempt, on 26 August 2021. Besides the members of the Society, invited guests from partner institutions and organisations took part in the event held in the White Hall of the University of Tartu Museum.

The event included three presentations: “A century of the mother tongue society” by Jüri Valge, “Finnish Linguists Building the Estonian Bridge” by Hannu Reme, and “About the Estonian Language against the Backdrop of the Typology of Uralic and European Languages” by Miina Norvik, Helle Metslang and Karl Pajusalu. The Society’s meritorious members and cooperation partners were acknowledged and certificates were awarded to the Society’s new honorary members: Auli Hakulinen, Hannu Remes and Jüri Valge. The chronicle “Mother Tongue Society 1920–2020” (717 pp), compiled with support from the Estonian Cultural Endowment, was presented.

The broadcast is available for streaming on the Mother Tongue Society’s YouTube channel.



Photo: Taave Vahemägi

From the left: Professor Andres Salumets, Deputy Head of Mission Mikael Laidre, and the board of the Learned Society: Piret Villo, Anu Mai Kõll, Sirle Sööt, Kristiina Rajaleid, Helena Faust, Ants Anderson and Ruth Rajamaa.



Photo: Edgar Saar x2



On 26 August 2021, the Mother Tongue Society’s members, partner institution representatives and foreign guests gathered to celebrate the centenary of the Society at the University of Tartu Museum. As the representative of the Academy of Sciences, the Academy member Urmas Varblane congratulated the Mother Tongue Society on its jubilee; greetings were acknowledged by the long-time chairperson of the Society Helle Metslang.

On 23 September 2021, the Estonian Retrospective National Bibliography Centre of the **Tallinn University Academic Library** presented the draft of the new bibliography “Estonian Foreign-Language Books, 1494–1830”.

Data on printed materials have been gathered for a long time and a bibliography has been compiled on the basis of the data by Helje-Laine Kannik, Kertu Maasik, Tiiu Reimo and Aira Võsa, edited by Tiiu Reimo and Aira Võsa. The compilers dedicated their work to the creator of the retrospective national bibliography programme, Endel Annus, who passed away 10 years ago.

The 2,870-page manuscript contains a full chronological list of the bibliography of foreign-language printed material published in and about Estonia, and an index volume. The use of the book is simplified by eight index sections (names, topics, titles, place names, organisations, places of publication, printers and printing houses, and languages) as well as the usual list of sources and reference materials, and a selected list of memory institutions.

The draft is ready for the design and layout. The intensive work of five years was supported by Tallinn University, the Ministry of Education and Research, the Estonian

Cultural Endowment and the Estonian National Culture Fund Foundation.

A member of the **Board of the Estonian Union of the History and Philosophy of Science**, Lea Leppik, actively participated in organising the annual conference of the University of Tartu Museum, “100 Years of Tullio Ilomets”, held on 18 November 2021 (on European University Heritage Day). Presenters included several members of the Union. Tullio Ilomets was a meritorious member of the Union, a long-time employee of the University of Tartu, the initiator of the idea of founding the University of Tartu Museum, a founder of the Tartu Academic Heritage Conservation Society, and a founder of the Cultural Heritage Research Workgroup at the Chair of Analytical Chemistry of the University of Tartu. The colleague award of the University of Tartu Museum, the Tullio of the Year, has been named after him. The conference contemplated the diversity of the heritage through the life of Tullio Ilomets.

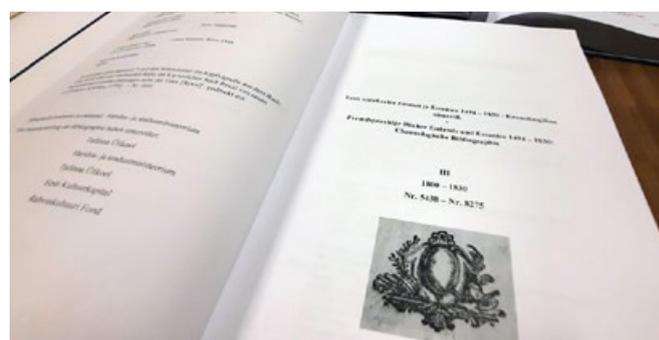


Photo: Jaana Tõnisson

The title page of the bibliography “Estonian Foreign-language Book and Estonica 1494–1830”.



Photo: kuvatoimimis UTTV videost

Conference “100 Years of Tullio Ilomets”.

# SCIENTIFIC JOURNALS AND BOOKS

## 70 YEARS OF PUBLICATION OF THE ACADEMY'S SCIENTIFIC JOURNALS

Soon after the foundation of the Royal Society,<sup>96</sup> a member of the Society, Henry Oldenburg, founded the periodical publication *Philosophical Transactions*,<sup>97</sup> which was printed in the name of the Society and in which presentations and discussions held at the Society were published. This is the first known periodically published scientific journal that applied the golden rule of scientific publication: the peer review of published works. The library of the University of Tartu has the second volume of the journal.

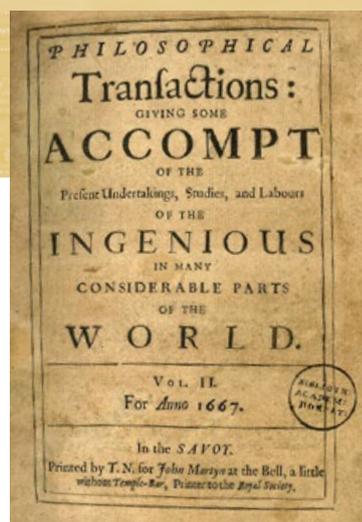
Since 1752, the journal has been published by the Royal Society, which is today the national academy of sciences of the United Kingdom. The two parts of the publication<sup>98</sup> are now published together with other journals<sup>96</sup> of this society of scientists. Scientific publishing can therefore be considered an important activity and has been an honourable aspect of academies of sciences for more than three centuries.

The Estonian Academy of Sciences has followed a similar academic tradition. The Academy Publishers published seven scientific journals in 2021.

<sup>96</sup> The Royal Society of London for Improving Natural Knowledge, the United Kingdom's national academy of sciences, was founded on 28 November 1660, [en.wikipedia.org/wiki/Royal\\_Society](https://en.wikipedia.org/wiki/Royal_Society)

<sup>97</sup> Philosophical Transactions, Giving some Account of the present Undertakings, Studies, and Labours of the Ingenious in many considerable parts of the World, [en.wikipedia.org/wiki/Philosophical\\_Transactions\\_of\\_the\\_Royal\\_Society](https://en.wikipedia.org/wiki/Philosophical_Transactions_of_the_Royal_Society)

<sup>98</sup> Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences: [https://en.wikipedia.org/wiki/Philosophical\\_Transactions\\_of\\_the\\_Royal\\_Society\\_A](https://en.wikipedia.org/wiki/Philosophical_Transactions_of_the_Royal_Society_A); Philosophical Transactions of the Royal Society B: Biological Sciences: [https://en.wikipedia.org/wiki/Philosophical\\_Transactions\\_of\\_the\\_Royal\\_Society\\_B](https://en.wikipedia.org/wiki/Philosophical_Transactions_of_the_Royal_Society_B)



Second volume of the journal  
Philosophical Transactions.

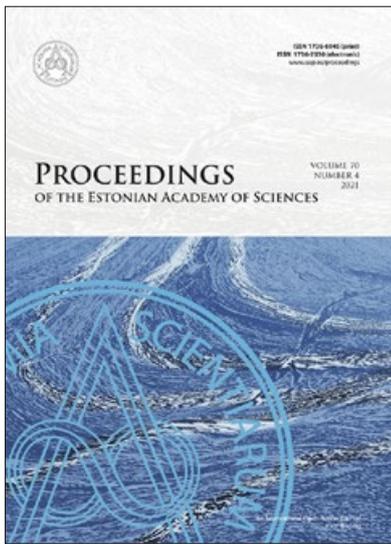
For two of these (*Proceedings of the Estonian Academy of Sciences* and *Estonian Journal of Earth Sciences*), these were the 70<sup>th</sup> volumes.

All of the articles published in the journals of the Estonian Academy Publishers have been internationally peer-reviewed. In accordance with the principles of open science,<sup>99</sup> the full texts of articles are posted on the internet in the same formats as the printed versions, and are freely available for those interested. This is possible due to the fact that the journals of the Academy Publishers have been published both in printed and electronic versions since 2008. The digital archive of the Publishers also makes research papers published in earlier issues of the journal available on the web.

It is very important for the publications of the Estonian Academy Publishers to be reflected in all of the major international scientific literature databases (see pages 153–154). All of the research papers published in these falls into category 1.1 of the Estonian Research Information System<sup>100</sup> classification. This highlights the gradually increasing international recognition of the activities of the Estonian Academy Publishers.

<sup>99</sup> [en.wikipedia.org/wiki/Open\\_science](https://en.wikipedia.org/wiki/Open_science)

<sup>100</sup> <https://www.etis.ee/Portal/News/Index/?IsLandingPage=true&lang=ENG>



The 70th annual volume of the journal Proceedings of the Estonian Academy of Sciences was published.

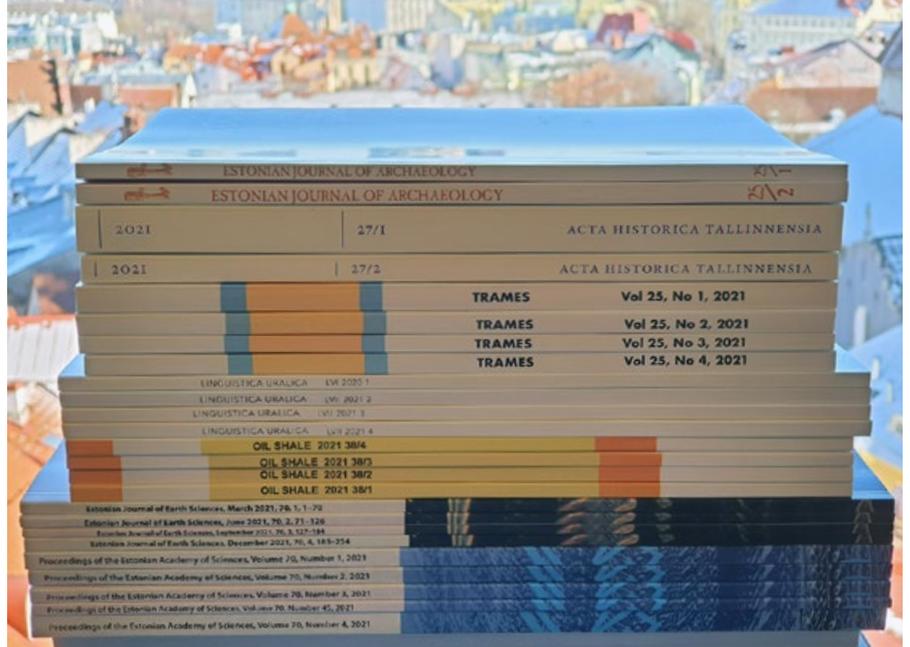


Photo: Piret Luukkainen

Journals of the Estonian Academy Publishers in 2021.

The publication of scientific articles has become a global and lucrative business. About half of the publications are from five international publishing houses: Elsevier, Springer, Wiley-Blackwell, Taylor & Francis and Sage. Besides the big players, more than a thousand smaller profit-seeking publishing houses are active in scientific publishing. These include many “spam” or even predatory publishers whose main aim is to earn maximum profits from minimal expenses, without paying any attention to the quality of the publications.

Our experience so far shows that the Academy Publishers can successfully compete with publishing houses that seek profits by replacing the goal of making a profit with the principle of serving society. In order to serve society in the best possible way, it is important that both the research community and research administrators support the Academy’s publishing activities and that the European Commission’s open-access science publishing initiative, known as Plan S, is implemented.<sup>101</sup> This naturally requires financial support, which the Academy of Sciences receives from the state budget, through the funds allocated for developing the research system via the Ministry of Education and Research. The publication of research papers prepared with the participation of Estonian researchers in the journals of the Academy Publishers is therefore free of charge for authors (and those financing them). The publication fees established for the contributions of foreign authors ensure public access to the published publications and cover the inevitable expenses related to the publication of articles, so Academy Publishers do not earn a profit.

Academy Member Jaak Järv  
 Editor-in-Chief  
 Proceedings of the Estonian Academy of Sciences



### Linguistica Uralica

Contemporary speakers of Finno-Ugric languages in Russia often borrow from Russian and there are frequent spontaneous switches between the languages. “Russian numerals in Moksha and Hill Mari” by Irina Khomchenkova and Polina Pleshak appeared in the December issue of Linguistica Uralica 2021. Moksha and Hill Mari are Finno-Ugric languages spoken in the Volga region of Russia. The two experienced young linguists from Moscow investigated, in a corpus-based study, the factors that influence bilingual speakers’ language choices in the articulation of numeral expressions, e.g. in the Hill Mari sentence *māñä marlan kenäm tōžem ändekš šüdäkändükš lušâ in semnadcatyĵ majân* “I got married in the year 1980 on May 17th”, where the first numeral appears in Hill Mari, but the second one in Russian. The authors determined the contexts in which the appearance of Russian numerals within Moksha and Hill Mari speech are preferred. Firstly, there is a strong tendency to use Russian numerals to express large

<sup>101</sup> en.wikipedia.org/wiki/Plan\_S

quantities. Secondly, the type of context plays a role: year, date and money > measure and age. Thirdly, the syntactic type of the numeral is important: ordinal > cardinal. Cardinal numerals (e.g. three children) in Russian influence both the number and case marking of the noun, but they only influence number marking in Moksha and Hill Mari. This makes a combination of a Russian numeral and a noun with genuine inflection difficult. Ordinal numerals (e.g. the third child) are like adjectives, and they do not influence the number or the case of the head noun. Thus a Russian ordinal numeral can more easily be combined with a genuinely inflected noun, e.g. in Hill Mari *первый sm'enämät nängeä* "And he is leading the **first** shift". So with cardinal numbers there is more actual code-switching, i.e. the whole noun phrase is Russian, whereas with ordinal numbers the integration of a Russian numeral into the syntax of the Finno-Ugric languages is quite common.

Gerson Stefan Klumpp, Editor-in-Chief

Khomchenkova, I., Pleshak, P. 2021. Russian Numerals in Moksha and Hill Mari. <https://dx.doi.org/10.3176/lu.2021.4.03>



### **Estonian Journal of Earth Sciences celebrated its 70th jubilee**

The Estonian Journal of Earth Sciences (henceforth referred to as EJES) was first published in 2007, but the Academy's oldest journal – the Proceedings of the Academy of Sciences of the Estonian SSR – started publishing articles about geology as early as 1952, and EJES therefore celebrated the publication of its 70th edition in 2021. The dignified history contains various divergences and name changes, and the publication of a total of nearly 1,300 scientific articles.

Today's EJES covers earth sciences on a broader scale, but writings about geology still dominate. This range is

evident from the 16 articles in the jubilee edition, which cover mineralogy and petrology, the geology of mineral resources, geochemistry, geophysics, hydrogeology and environmental geology, geotechnology, palaeontology and quaternary geology in Estonia and in neighbouring countries. In the past decade, more than half of the articles have had foreign co-authors and about a third have been written entirely by foreign scientists.

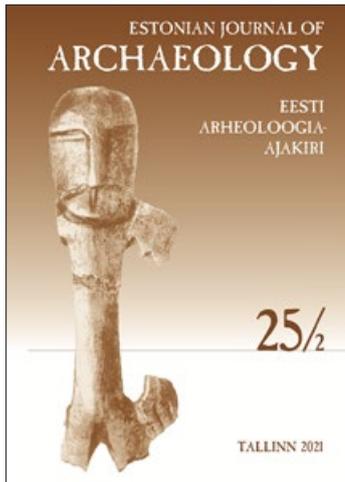
Of the 2021 articles of the EJES, several deserve special mention thanks to their high scientific level or practical importance, but we lack the space to present them all here. I choose to highlight a study of the Jõhvi magnetite-rich gneisses in the bedrock of Estonia by Professor Alvar Soesoo and co-authors (Soesoo et al., 2021), which is remarkable for several reasons. National studies of the Earth's crust, launched after decades of silence, are yielding new results that help determine the potential of our mineral resources. The Jõhvi magnetic anomaly and the magnetite-rich rocks of the area – our own iron ore – have been known for over 80 years (Linari, 1940), but much is still unclear about their properties and origin. Bedrock studies as a whole have been neglected in Estonia, and every new study that offers new factual material and contemporary interpretations is therefore a welcome addition to our fund of knowledge.

The authors of the article have skilfully combined earlier materials with today's research methods, from ore microscopy to mass spectrometry. New data about the mineral composition, main components, trace elements, rare earth metals and other properties of magnetite quartzites and gneisses have allowed researchers to determine the probable creation conditions of those rocks: temperatures between 650 and 750°C and pressures of 2.9–4.9 kbar, which correspond to a location in Earth's crust at a depth of at least 10–15 km. The results of the study conducted by Soesoo and co-authors allow us to compare the bedrocks of Estonia with their counterparts in the Fennoscandian shield area. Without these results, it is impossible to reconstruct the birth story of the Earth's crust in Estonia nearly two billion years ago, or to estimate the distribution of mineral resources deep in our bedrock.

Olle Hints, Editor-in-Chief

Soesoo, A., Nirgi, S., Urtson, K., Voolma, M. 2021. Geochemistry, mineral chemistry and pressure–temperature conditions of the Jõhvi magnetite quartzites and magnetite-rich gneisses, NE Estonia. *Estonian Journal of Earth Sciences*, 70, 71–93, [doi.org/10.3176/earth.2021.05](https://doi.org/10.3176/earth.2021.05)

Linari, A. A. 1940. A report on deep drilling near Jõhvi. *Proceedings of Tallinn University of Technology*, 15, 1–27.



### Estonian Journal of Archaeology

The jubilee 25th edition of the Estonian Journal of Archaeology (2021) proved to be very fruitful: 21 authors from Estonia, Russia, Latvia, Lithuania and England offered eight articles of interesting reading material dealing with subjects from the Bronze Age to the modern era, i.e. the 14th century B.C. to the 17th century A.D. The general approach could be characterised as the “reuse of archaeological findings”: most of the articles are a good example of how new information can be obtained from items and bones excavated a long time ago, sometimes even a hundred years ago. Such treatments include studies of the Jõelähtme and Rebala burial mounds conducted by Margot Laneman, an analysis of the Reznies burial mounds near the river Vāina (Daugava) by Andrejs Vasks et al., an attempt to find our earliest domestic hen by Freydis Ehrlich et al., etc. Indeed, to get closer to ancient humans and their societies, we do not always need to excavate new archaeological findings: “excavating” through our abundant archives is sometimes enough.

Among others, it is worth noting Marcus Adrian Roxburgh’s study of the metal composition of the copper alloy items of the Jäbara C burial mound (in Viru County) and of their spatial, temporal and typological distribution and origin. The Jäbara C burial mound was excavated in 1927 (by Marta Schmiedehelm) and it consisted of several parts: a cist and early *tarand*-graves at the south-western end and typical *tarand*-graves at the north-eastern end. A lot of grave goods were found in the burial mound, including items made of different copper alloys – bronze, brass and red brass – which for typochronological reasons were previously mostly associated with findings from the lower course of the river Visla from the early centuries A.D. Roxburgh conducted a more detailed analysis of the metal composition of the items, using a portable X-ray fluorescence (pXRF) spectrometer, which makes it possible to obtain exact information about the elemental compositions of metal objects without damaging them.

As the compositions of metal items from the southern coast of the Baltic Sea are known and any changes involve considerably better dating thanks to the presence of Roman coins, it was possible to better identify the types of grave goods from Estonia (Jäbara). For instance, it was determined that the composition of a serial bracelet corresponds to that of bronze from the pre-Roman Iron Age, while bracelets with end-knobs are made of pure brass, which is a copper alloy that only became widespread in the 1st century A.D. These types of bracelets were previously considered to be from the same time. While the “eye” brooches of the main series are made of brass, like the bracelets with end-knobs, the eye brooches of the Prussian series – a bit younger – are made of red brass, which became widespread in the Roman provinces only in the 2nd century. The article itself naturally contains many more important and exciting results.

Valter Lang, Editor-in-Chief

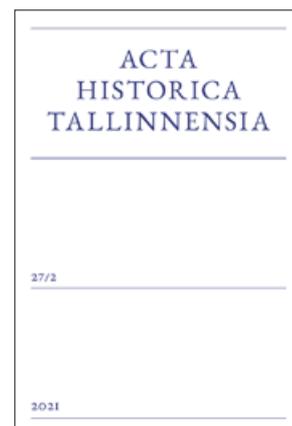
Laneman, M. 2021. The date of the stone-cist cemetery at Jõelähtme reconsidered, doi.org/10.3176/arch.2021.1.03

Laneman, M. 2021. Chronology of a group of stone-cist graves in northern Estonia: radiocarbon dates from Lastekangrud at Rebala, doi.org/10.3176/arch.2021.2.02

Vasks, A., Zariņa, G., Legzdiņa, D., Plankājs, E. 2021. New data on funeral customs and burials of the Bronze Age Reznies cemetery in Latvia, doi.org/10.3176/arch.2021.1.01

Ehrlich, F., Rannamäe, E., Laneman, M., Tõrv, M., Lang, V., Oras, E., Lõugas, L. 2021. In search of Estonia’s earliest chicken, doi.org/10.3176/arch.2021.2.04

Roxburgh, M. A. 2021. Time Machines: An exploration of Roman period copper-alloy objects in an Estonian *tarand* cemetery, using pXRF, doi.org/10.3176/arch.2021.2.05



### Special issue of *Acta Historica Tallinnensia* investigates the transnational history of Estonia

A voluminous thematic issue of the journal *Acta Historica Tallinnensia* was published in June 2021, and it explores the transnational history of Estonia. The guest

editor of the English-language special issue was Tallinn University Professor of Estonian and General History Karsten Brüggemann. Besides a thorough introduction written by Brüggemann, it includes contributions from six Estonian historians: Inna Põltsam-Jürjo, Priit Raudkivi, Aivar Põldvee, Aivar Jürgenson, Maie Pihlamägi and Magnus Ilmjärv. The articles cover topics from the Middle Ages to the mid-20th century and deal with the medieval cult of saints, the history of education in 18th- and 19th-century Estonia and Livonia, Estonian settlements in Abkhazia, labour relations between the two world wars in Estonia and the role of Baltic communists in the Comintern.

This issue is the first systematic attempt to interpret Estonian history from a transnational perspective. This is an approach that has emerged in international history studies in recent decades and that attempts to go beyond nation-state boundaries, introducing cross-border movements of ideas, people and things into the research focus. This is of course not unprecedented in historiography, since trans-regional and even global contexts have always been important in understanding the past of a small country, such as Estonia, more comprehensively. In recent decades, transnational history has been marked by historians' growing interest in trans-boundary processes (keywords: globalisation, migration and climate change). But the newfound popularity of the transnational perspective does not mean that earlier viewpoints – local, national and regional – are superfluous; instead, the transnational view complements existing ones and adds more diversity to our view of the past. As the six articles from contributors in this special issue compellingly show, a transnational perspective helps to better understand a number of different aspects of Estonian history, from the medieval times to the present day.

The issue, edited by Karsten Brüggemann, summarises the most important results of the Estonian Research Council-funded research project, which ran from 2015 to 2020.

All of the articles in the issue can be accessed free of charge on the journal's website, at [kirj.ee/acta-publications/?filter\[issue\]=439](http://kirj.ee/acta-publications/?filter[issue]=439).

Marek Tamm, Editor-in-Chief

### Oil shale

Oil shale is one of the most abundant fossil fuels in the world, but its use has been limited to direct combustion or oil and gas extraction. It is becoming increasingly difficult to meet society's growing demands for everyday products and materials in an environment that seeks to avoid oil-based processes. Instead of abandoning fossil materials, their efficient and clean conversion should be further researched. In the 3rd issue of *Oil Shale*, researchers from the Institute of Chemistry and Biotechnology



of Tallinn University of Technology have published an article “Aspects of kerogen oxidative dissolution in sub-critical water using oxygen from air”, which investigates efficient and environmentally friendly conditions for converting kerogen to various aliphatic carboxylic and dicarboxylic acids.

The authors demonstrate that in the temperature range 165–185°C and at an oxygen pressure of 20–40 bar, a large part of the organic matter in the shale can be converted into water-soluble compounds in a short period of time. A large fraction of the compounds obtained were identified as aliphatic dicarboxylic acids (DCA) and their further oxidation products. It was shown how various basic or acidic additives promote the oxidation of kerogen and alter the composition of the resulting product mixtures. Based on the product analysis and the distribution of organic carbon between the formed phases, the basic mechanism of the oxidative degradation of kerogen was evaluated and the origins of the released CO<sub>2</sub> were explained. The same method proved to be efficient with kerogens of different origins. The results presented expand the existing knowledge of kerogen conversion processes and kerogen's potential use as fine chemical substrates. The paper also extends the applicability of wet oxidation for the degradation of complex polymeric materials. The production of DCAs from polymerised materials, such as kerogen, could contribute to further diversification of the DCA market.

Andres Siirde, Editor-in-Chief

Kaldas, K., Niidu, A., Preegel, G., Uustalu, J. M., Muldma, K., Lopp, M. 2021. Aspects of kerogen oxidative dissolution in subcritical water using oxygen from air.  
doi.org/10.3176/oil.2021.3.02



### The most brilliant article in Trames in 2021

All of the articles published in Trames in 2021 were brilliant in their own way. The topics included Old Chinese, the persecution of Korean intellectuals, Islam and Christianity,

and the geopolitics of Russia. Still, the most brilliant of all was “Mazephishing: the Covid-19 pandemic as a credible social context for social engineering attacks” by Kristjan Kikerpill and Andra Siibak from the University of Tartu. Maze nets are complex underwater mazes of nets. The study is based on a content analysis of 563 international news media articles about cyber attacks and graphically shows how criminals skilfully use social contexts and impersonation to make their scams look more credible. Major themes used in scam messages include health information, personal protective equipment, cures, financial relief and donations. The most brilliant article in Trames in 2021 is not only novel and on a high methodological level, but also very topical. Its results can be used in any context in which the topicality and credibility of cyber attacks make their potential victims vulnerable.

Urmas Sutrop, Editor-in-Chief

Kikerpill, K., Siibak, A. 2021. Mazephishing: the Covid-19 pandemic as a credible social context for social engineering attacks, doi.org/10.3176/tr.2021.4.01

## STATE AWARDS AGAIN RECORDED IN ONE BOOK<sup>102</sup>

The state science, culture and sports awards and the F. J. Wiedemann Language Award were awarded differently this year. Earlier, when there was no coronavirus pressure in the world, the awards were bestowed in front of a big audience. This time, we had to avoid that. The laureates and their supporters gathered in three batches. We maintained the required distance. Both scientists and healthcare workers believed that in this way we had the best chance to stay healthy, while still partaking in festivities.

In bestowing the lifetime achievement awards, the Prime Minister referred to the great French mathematician Henri Poincaré, saying that science is built from facts, as a house is built from stones. But a collection of facts is no more science than a heap of stones is a house.

The functioning of a modern state is also built on facts. Disorganised information is not the basis for a successful state. Sensible decisions can only be made when we can use the most important available information presented in a comprehensible manner. In other words, in a science-based manner.

To paraphrase a simple definition of science: the big mission of scientists is not just to learn new and important

facts, but to organise the facts in a way that allows us to use the knowledge to learn new facts and for the benefit of society.

Science is never simple, because it involves looking for the best explanations for how our world works. Such explanations often include the word “truth”. Things connected with the word “truth” have many opposites. One of those is fiction, literary mystification, which is not necessarily untruth. Mark Twain wrote: “Truth is stranger than fiction, but it is because fiction is obliged to stick to possibilities; truth isn’t.”

The greatest scientific achievements seem to contradict common sense. But they are definitely right in their time and space, which change. Niels Bohr described such changes: “The opposite of a correct statement is a false statement. But the opposite of a profound truth may well be another profound truth.”

Therefore, it is no surprise that superb science often overturns things that we have been used to considering truths. Quite a few of this year’s laureates have done so.

It is appropriate to note that the 2021 lifetime achievement award in science was bestowed on two colleagues who work at different ends of the world of science. As a practising surgeon, Toomas-Andres Sulling has saved thousands of

102 Awards of the Republic of Estonia 2021. Tallinn, 2021, www.akadeemia.ee/wp-content/uploads/2021/08/ev-preemiad-2021\_kaanega\_veebi.pdf

lives. The Spanish studies specialist and literature scientist Jüri Talvet has been an ambassador of Estonian science and culture throughout the world for decades.

This year, the government decided to acknowledge the achievements of seven scientists or teams with the Annual Science Award. Each of these represents the best research papers completed and published in the preceding four years, 2017–2020. Five of the awards were handed out before Independence Day. The authors of two awarded research papers received congratulations and the state science awards book exactly half a year later, on 23 August.

The Medical Science Award was given to four scientists at the University of Tartu: the Academy member Eero Vasar (the head of the team), Mario Plaas, Mari-Anne Philips and Liina Haring. Their research paper is titled “Transition studies in neuropsychiatry: from genetically modified test animals to schizophrenia-spectre disorders in humans”. The work group explored the emergence of neuropsychiatric disorders in detail, measured the effects of antipsychotic treatment on infections and metabolisms, analysed whether diabetes medication should be added to treatments, and made considerable progress towards creating a possible cure for Wolfram syndrome, a rare serious genetic disease.

In the humanities, the government decided to bestow the award on Senior Researcher Epp Annus from Tallinn University for the research paper “Development of the philosophical-theoretical paradigm of social colonialism; studies of Soviet societies and cultures”. The laureate has created and developed an original definition of social colonialism, which means the subjugation of an independent country to a foreign power under the guise of ideology and an attempt to shape “social people” suitable to the colonis-

ing regime. Epp Annus has thus created a new paradigm for recent history, shifting the emphasis from occupation to colonialism and developing an extensive restructuring of a way of thinking.

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Just like truth or culture, science cannot be simply and clearly defined, as creativity is an integral component of all three. As a part of culture, science always contains a great dose of creativity. In connection with the Prime Minister’s message to the laureates of the Lifetime Achievement Awards before Independence Day, it is appropriate to recall the words of Henri Poincaré: “It is through science that we prove, but through intuition that we discover.”

For the second time this year, an overview of the awards listed above and close-ups of the laureates of the state education awards were recorded in one book. This book not only explains the dazzling brilliance of the most remarkable stars of Estonian science, language, culture, sports and education, but makes it more available to society.

Putting together such a compilation requires a lot of hard work: writing, editing and layout. While the success of many laureates is discussed by experts or professional journalists, the laureates of science awards traditionally describe their own achievements, because non-specialists can hardly be expected to explain work done at the cutting edge of world-class science. Writing is only half of the hard work. The editor and the layout artist must work together to ensure that every illustration tells a story and every symbol is in the right place and presented in the right style, because meaning may change if even a letter or a number is in italics or bold typeface, located on a line or higher or lower or if there is a Greek letter.



Photo: Reii Kook

# ACADEMY MEMBERS

The names are highlighted to distinguish heads of divisions, female scientists, prominent creative individuals and the deceased. More information at [www.akadeemia.ee/en/membership](http://www.akadeemia.ee/en/membership)

## Division of Astronomy and Physics

**Jaan Aarik**, Exact Sciences, 2013

**Jaak Aaviksoo**, Exact Sciences, 1994

**Jaan Einasto**, Astrophysics, 1981

**Ene Ergma**, Exact Sciences, 1997

**Krista Fischer**, Mathematics and  
Mathematical Statistics, 2020

**Arvi Freiberg**, Exact Sciences, 2009

**Vladimir Hižnjakov**, Physics, 1977

**Marco Kirm**, Exact Sciences, 2018

**Martti Raidal**, Exact Sciences, 2011

**Enn Saar**, Astronomy, 2010

**Peeter Saari**, Physics, 1986

**Mart Saarma**, Molecular Biology, 1990

**Arved-Ervin Sapar**, Astrophysics, 1990

† 01.12.2021

**Elmo Tempel**, Astronomy and  
Astrophysics, 2021

**Gennadi Vainikko**, Mathematics, 1986

**Richard Villems**, Biophysics, 1987\*

\* President 2004–2014

### Foreign members:

**Jonathan (John) R. Ellis**, Theoretical Physics, 2015

**Richard R. Ernst**, Physical Chemistry, 2002

† 04.06.2021

**Charles Gabriel Kurland**, Biochemistry, 1991

**Jaan Laane**, Chemical Physics, 1995

**Alar Toomre**, Applied Mathematics, 2012

## Division of Informatics and Engineering

**Olav Aarna**, Informatics, 1990

**Hillar Aben**, Mechanics, 1977

**Jüri Engelbrecht**, Mechanics, 1990\*

**Ülo Jaaksoo**, Informatics, 1986

**Maarja Kruusmaa**, Engineering, 2016

**Jarek Kurnitski**, Engineering, 2018

**Jakob Kübarsepp**, Materials Engineering, 2011

**Rein Küttner**, Engineering, 1997

**Ülo Lepik**, Mechanics, 1993

† 12.02.2022

**Enn Lust**, Energy Technology, 2010

**Leo Mõtus**, Informatics, 1993

**Arvo Ots**, Power Engineering, 1983

† 09.01.2022

**Tarmo Soomere**, Informatics and  
Engineering, 2007\*\*

**Raimund-Johannes Ubar**, Computer  
Science, 1993

**Tarmo Uustalu**, Computer Science, 2010

**Jaak Vilo**, Informatics, 2012

**Dmitri Vinnikov**, Engineering and  
Computer Science, 2021

**Andres Õpik**, Engineering, 2013

\* President 1994–2004

\*\* President 2014– ...

### Foreign members:

**Steven R. Bishop**, Nonlinear Dynamics,  
2012

**Gábor Stépán**, Applied Mechanics, 2017

**Michael Godfrey Rodd**, Process Control  
and Information Technology, 1995

**Esko Ukkonen**, Computer Science, 2015

**Margus Veanes**, Software Science, 2019

## Division of Biology, Geology and Chemistry

**Toomas Asser**, Medical Science, 2011

**Jaan Eha**, Natural Sciences and Medicine,  
2016

**Jaak Järv**, Natural Sciences, 1997

**Ain-Elmar Kaasik**, Neurology, 1993

**Anne Kahru**, Ecotoxicology, 2018

**Dimitri Kaljo**, Geology, 1983

**Mati Karelson**, Natural Sciences and  
Medicine, 2007

**Kalle Kirsimäe**, Geology, 2018

**Urmas Kõljalg**, Biosystematics and  
Ecology, 2011

**Hans Küüts**, Agricultural Sciences, 1994

**Maris Laan**, Public Health, 2021

**Agu Laisk**, Natural Sciences, 1994

**Ülo Lille**, Biotechnology, 1983

**Margus Lopp**, Chemistry, 2011

**Jüri Martin**, Ecology, 1990

**Andres Metspalu**, Biotechnology, 2010

**Ülo Niinemets**, Natural Sciences, 2013

**Anto Raukas**, Geology, 1977

† 19.04.2021

**Valdur Saks**, Biochemistry, 1993

**Raivo Uibo**, Medical Science, 2003

**Veiko Uri**, Forestry, 2020

**Mart Ustav**, Biomedicine, 2001

**Eero Vasar**, Medical Science, 2010

**Martin Zobel**, Ecology, 2010

### Foreign members:

**Ülo Langel**, Neurochemistry, 2015

**Pekka T. Männistö**, Pharmacology, 2012

**Svante Pääbo**, Genetics, 2019

**Matti Saarnisto**, Geology, 2008

**Helmut Schwarz**, Chemistry, 2002

## Division of Humanities and Social Sciences

**Jüri Allik**, Psychology, 2010

**Mihhail Bronštein**, Agricultural Economics, 1975; † 09.04.2022

**Mart Kalm**, Art History, 2010

**Valter Lang**, Historical Science, 2010

**Lauri Mälksoo**, Law, 2013

**Elmo Nüganen**, Dramatic Arts, 2020

**Karl Pajusalu**, Linguistics, 2011

**Arvo Pärt**, Music, 2011

**Tiina Randma-Liiv**, Social Sciences and Governance, 2018

**Anu Raud**, Art, 2016

**Anu Realo**, Cultural Studies, 2018

**Jaan Ross**, Humanities, 2003

**Huno Rätsep**, Estonian Language, 1981

**Hando Runnel**, Literature, 2012

**Marek Tamm**, Cultural History, 2021

**Tiit Tammaru**, Human Geography, 2018

**Tõnu-Andrus Tannberg**, History, 2012

**Jaan Undusk**, Humanities, 2007

**Urmas Varblane**, Economics, 2009

**Haldur Õim**, Humanities and Social Sciences, 1994

### Foreign members:

**Juri E. Berezkin**, Ethnography, 2012

**Cornelius Theodor Hasselblatt**, Literature and Culture, 2015

**Raimo Raag**, Linguistics, 2019

**Päiviö Tommila**, History, 1991

**Endel Tulving**, Psychology, 2002

**Jaan Valsiner**, Psychology, 2017



Photo: Reet Kõikk

The meeting of the General Assembly of the Academy on 8 December 2021 in a hybrid format.



FACTS  
AND FIGURES



# ACTIVITIES OF THE ACADEMY AND ITS MEMBERS

## GENERAL ASSEMBLIES

The General Assembly of the Academy was convened twice in 2021, on 21 April and 8 December.

### **21 April. An extraordinary General Assembly meeting (via an electronic vote) decided upon the following matters:**

- President Tarmo Soomere,
  - “Activities of the Academy in 2020” (see pages 130–134)
- Secretary General Jaak Järv
  - “Financial activities of the Academy in 2020 and the budget for 2021”
  - Deciding the remuneration for Academy members for the period of 1 May 2021 to 30 April 2022

The first General Assembly, which was to be held as the annual meeting of the Academy, was postponed due to the epidemiological situation. As the Academy of Sciences Act stipulates that the General Assembly discuss the Academy’s annual management report and the implementation of the budget, adopt the budget and the financial plan, and establish the procedure for the payment of remuneration to Academy members, an extraordinary electronic General Assembly meeting was held.

In order to adopt resolutions regarding the above issues, the Academy members were electronically sent President Tarmo Soomere’s overview of 2020, the Academy’s 2020 budget, a consolidated table of its implementation, the 2021 budget, the Academy’s financial plan for 2021, and the explanations of Secretary General Jaak Järv concerning the budget and the financial plan. Detailed data on the activities of the Academy in the reporting year were available from the electronic version of the *Estonian Academy of Sciences Yearbook XXVI* (53).

On the basis of the materials presented to the Academy members, the General Assembly voted electronically and adopted resolutions on the approval of the Academy’s 2020 management report and the budget implementation report, as well as on the approval of the budget and financial plan for 2021 (see page 173). The General Assembly decided to distribute the amount allocated for the remuneration of Academy members for the period of 1 May 2021 to 30 April 2022 equally among all Academy members.

### **8 December. A General Assembly meeting with the following agenda:**

- Awarding of the medal of the Estonian Academy of Sciences
- Academy member Enn Lust’s presentation “Electrochemical complex systems for accumulating and storing energy”
- Approval of the Development Plan of the Academy
- Election of new Academy members

The second General Assembly meeting was held on 8 December as a hybrid event. Members mostly participated via Zoom. The elected heads of the Academy (president, vice-presidents, Secretary General), some Academy members and the medal laureates gathered physically at the Academy building.

President Tarmo Soomere awarded the Academy medal to Academy member Jaak Aaviksoo and the Editor-in-Chief of *Postimees*, Marti Aavik.

Academy member Enn Lust gave a presentation on the topic “Electrochemical complex systems for accumulating and storing energy”.

Secretary General Jaak Järv presented the Academy’s Development Plan for 2021–2026 (see pages 4–5), which the General Assembly then approved.

The main emphasis of the agenda was on the election of Academy members. Universities, research institutions and Academy members had submitted a total of 23 proposals for 20 candidates for the announced four seats. As a result of a secret ballot held in the Election Runner environment, the following new Academy members were elected: Elmo Tempel in the field of astronomy and astrophysics (candidates Gert Hütsi and Elmo Tempel), Dmitri Vinnikov in the field of technology and computer science (candidates Alvo Aabloo, Peeter Laud, Dmitri Nešumajev and Dmitri Vinnikov), Maris Laan in the field of public health (candidates Helle Karro, Tuuli Käämbre, Maris Laan, Mall Heinsalu, Irja Lutsar, Pärt Peterson, Merike Sisask, Anneli Uusküla and Margus Viigimaa) and Marek Tamm in the field of cultural history (candidates Mare Kõiva, Marju Kõivupuu, Ene Kõresaar, Taavi Pae and Marek Tamm).

## **The President's overview of the Academy's activities in 2020, sent to the electronic General Assembly Meeting on 21 April**

Dear colleagues,

Around the same time last year, there was still a faint hope that the coronavirus pandemic would soon be history and that the spring General Assembly would not have to again be conducted with electronic voting. But no, the virus came back for another cycle, ruling out an in-person gathering this early spring as well. And so we will have to supplant the General Assembly with an electronic vote again. Last year's budget and budgetary compliance, this year's budget and the division of remuneration for Academy members need to be approved. We will conduct this procedure on the scheduled day of the General Assembly, 21 April, by electronic voting.

The technical arrangements for the vote are slightly different from the e-mail poll held last April and the hybrid meeting of the General Assembly held in December. We will apply the experience gained from organising those two events. Most importantly, all of our participating colleagues consented to a secret ballot on matters usually resolved by public vote. We will organise the fully electronic General Assembly meeting in a survey format. Like a year ago, there are three items on the agenda: (1) approval of the management report and the report on the implementation of the budget for 2020, (2) approval of the Academy budget and financial plan for 2021, and (3) deciding on the distribution of remuneration to Academy members.

Hopefully it is acceptable for the hearing of the report – a requirement in the Academy of Sciences Act – to be replaced by a review of the document you are currently reading. The idea of the Act is that all of our colleagues have access to an overview of our activities, whether in auditory or visual form. Decisions shall be adopted electronically via the ElectionRunner environment. All of our colleagues were able to manage the technical aspects of this environment back in the winter. We will follow the same principles as for the approval of the agenda in December 2020 and other such matters where we did not implement user authentication. On such occasions, it is sufficient for at least half of the members of the General Assembly to participate. A decision is considered adopted when at least half of the General Assembly vote in favour. Ballot papers will be e-mailed to all Academy members, along with instructions for using the environment. The number of members at the General Assembly will be determined in the usual manner. These arrangements are not the ones we would have preferred, of course. The point of the Academy is not to hold a General Assembly meeting from our arm-chairs at home. On the contrary, the Academy's purpose is

to work together and ensure that together we are stronger than we would be separately. We hope that by summer, it will be possible for us to meet in person again.

\* \* \*

The foreword to an overview of the Academy's activities, traditionally set out in the yearbook – the "white book" – states that 2020 was an unusual year. Indeed, the coronavirus pandemic made its brutal entrance into our lives. We could not have foreseen how the veritably kaleidoscopic whirligig of changes, restrictions and turbulent attempts to deal with the crisis, attitudes and opinions seen in 2020 would shake our foundations, how it would increasingly polarise society and fuel general tensions. People's reactions can best be described by the words "the year that didn't exist", which appeared after the date and year 2020 in quite a few letters sent from Australia. But that cannot be said of Estonia or the world of science and research. Quite a few aspects will probably go down in history.

The Agreement on Research Funding was technically implemented at a rate of 1% of gross domestic product (GDP). Ideally this is a decision of the same type as the one that pledges 2% of GDP for national defence: a decision that will be honoured in future, not rescinded and not dismantled anytime soon. This will allow quite a few bottlenecks to be resolved. As we know, the status and remuneration of doctoral students is a priority. This decision is a major challenge, because 60% of the money added flows to different ministries. Making judicious use of these funds is complicated. We now find ourselves at the absolute top in the European rankings of government funding for research. In this context, we may need to make out-of-the-box decisions. We should be prepared to invest that money in meeting the challenge of reasonable channelling in very many ways, but that requires cooperating with various ministries. As a quotation often attributed to Thomas Jefferson says: "If you want something you have never had, you must be willing to do something you have never done."

On the substantive side of things, it is significantly more important that society has realised the importance of research and research-based decision-making. One of the visible manifestations of this is the Estonian president's plaque recognising the contribution of men and women of science to the restoration and preservation of Estonian independence. At the other end of the spectrum, however, it seems that society is vocally and stridently, sometimes physically, demanding to see the minutes of scientists' discussions, accompanied by an explanation of what, why and on what basis researchers make recommendations to the government. The Academy did not take part at the crisis resolution on the government level but it did contribute as an institution and with the help of experts to a number of

aspects of managing and alleviating the pandemic. Public engagement and calming frayed nerves were important contributions.

\* \* \*

The Academy lacks a mandate for making political decisions but is bound by the duty to always give the best advice. In spring 2020, we fulfilled this obligation through a think tank launched in cooperation with the *Postimees* daily newspaper. The idea was proposed by Marti Aavik, who had just gone from being the director of Academy Publishers to the deputy editor-in-chief of *Postimees*. The think tank tried to bring order to the flood of information, highlighting aspects that had escaped notice or which could start to have a dramatic impact on our lives, raise problems that needed solutions, and rank the currently salient topics in order of importance. It convened virtually 19 times. Over a few weeks, close to one-third of the pandemic-related topics covered by the newspaper evolved out of those conversations and close to one-half of the editorials reflected the ideas voiced in those discussions. In total, 14 Academy members (Urmas Varblane, Eero Vasar, Tiit Tammaru, Jaak Vilo, Maarja Kruusmaa, Jarek Kurnitski, Jüri Allik, Anu Realo, Ülo Niinemets, Tiina Randma-Liiv, Lauri Mälksoo, Raivo Uiibo, Tarmo Soomere and Krista Fischer) and several experts (including the physicist Jaan Kalda and the managing director of the Employers' Confederation Arto Aas) took part. This type of communication of academic thought to the public is, as far as I am aware, unique.

In the context of brainstorming ways to fight against COVID-19, around 200 ideas for different studies or analyses were received by the Research Council over just a few days in April 2020. The topics ranged from the analysis of the virus and pandemic and the development of different kinds of technologies to the security of the food supply, public administration, the economy, the law, society, culture and psychology. They were analysed in terms of scientific calibre and feasibility by 11 of our colleagues and Professor Äli Leijen of the Estonian Young Academy of Sciences, from the field of educational sciences, where we ourselves have a dearth of competence. We promised that above all, as top experts with long experience in our fields, we would be able to cast aside ideas that didn't have any promise or were just pure fishing expeditions. We were also able to recognise which ideas were exceptional in quality and feasible. Over basically one long weekend (17–21 April 2020), a package of recommendations was put together, which the Research Council adopted for use. Once the initial uncertainty surrounding the pandemic had eased, an exit strategy had to be devised.

At the request of the prime minister, we worked with several colleagues non-stop from 22 to 24 April to supplement

and refine the whole country's exit strategy. This strategy was essentially a reflection of the action plan for easing restrictions. Thus, at the Board level, we put together a vision document concerning the direction in which the state's focus and investments should be directed during the economic recovery. The two central recommendations were focus on rapid data communication and a turnaround in energy policy. Along with an analogous document from the German National Academy of Sciences Leopoldina, it became a role model for many of our sister academies.

It is thus becoming a tradition for us to present some policy recommendations every year. At some point, it seemed that we might be facing the need to be much more responsive in our actions. As noted, over just a few days in spring 2020 – in fact, in just hours – we were able to generate input with strategic value through about ten Academy members working together. Over 20 of our colleagues contributed over two months. There is no reason to think that we would not be able to do the same in tackling some other problem. In summer 2020, the government toyed with the idea of establishing a global crisis monitoring, and/or early warning, centre at the Academy. It did not pan out at that time. Still, it would be a good idea to ask whether we should be prepared to adjust our statutes and the Academy of Sciences Act to ensure the possibility of responsive work on issues in the General Assembly's remit (e.g. policy recommendations).

In spring, the drafting of the new Organisation of Research and Development Act began. The current act has been in force for more than 20 years. This means that the new act will be the law of the land for the next couple of decades. At the request of the Board, Martti Raidal, Mart Saarma, Andres Metspalu and Jarek Kurnitski put together a preliminary list of the Academy's recommendations. Six colleagues will take part in the work groups of legislative intent. The Estonian Young Academy of Sciences expert on law, Helen Eenmaa, will provide support in dealing with the general aspects. A list of topics that need to be dealt with in the new Organisation of Research and Development Act and comments on them were mostly completed in January 2021.

\* \* \*

The year started in the usual fashion: the preparation of the new development plan was launched. With regard to the elections of Academy members planned for year's end, there was fierce discussion about what fields the Academy needed new members in. Everything seemed normal, positive in a routine way, even rosy. Until – paraphrasing the Academy member Elmo Nüganen's production of Lucy Kirkwood's play "Children" – the coronavirus came. Our Board meetings moved to Zoom. After the first Zoom

meeting, it seemed odd that, all this time, we had been travelling several hours from one city to another to sit at the same table for a few hours, although it is sometimes useful to read your conversation partner's body language and facial gestures.

It quickly became clear that it wouldn't be possible to convene the spring General Assembly meeting planned for 22 April. This did not interfere with the functioning of the Academy as an institution. A change made to the statutes allowed for obligatory decisions of the General Assembly to be made by electronic voting. These were: the position regarding the Academy's annual report on its activities and the report on the implementation of the budget for the previous year, the adoption of the budget and the financial plan for the current year, and the procedure for the payment of remuneration to Academy members. These decisions are generally made by open vote. It would be easy to organise a secret ballot electronically, but open voting is far from simple. It was finally done by e-mail. This was cumbersome, and borderline in terms of netiquette, but it worked.

As realists, we had to consider, in planning things throughout the year, that it was impossible or at least unreasonably risky to organise any major gatherings with only a few days or even weeks of prior notice. Thus it seemed wise to convene the General Assembly as fast as possible to ensure that the Academy as an institution continued to function in extraordinary conditions. The extraordinary General Assembly held in early July coincided with the trough of the first wave of the pandemic, when it seemed the virus had been defeated, there were no more than five daily infections, and the risks of in-person gatherings were low.

Changes to the statutes allowed the Academy to operate entirely via electronic media, if necessary. In the second half of the summer and in autumn, we felt confident enough to hold some hybrid events with several dozen attendees, such as Science Afternoon seminars on the future of the energy sector, the round-number anniversary of the Struve meridian arc, a discussion of the hydrodynamic and geological conditions at the site of the sinking of the ferry *Estonia*, an Endel Lippmaa memorial lecture and the Academy member candidates' conference. In this context, it was nice that the Academy auditorium had become a place for earnest and collegial discussion on strategic questions related to Estonia's future.

For the first time in the Academy's history, the winter (December) General Assembly meeting was held mainly via electronic channels, and the voting took place completely electronically. Technically speaking, it was a hybrid session: a small share of the Academy members were in attendance in the Academy's mirror hall, while a larger number used electronic means to attend. The presentations were delivered from the Academy's podium and medals

were handed out to the award winners in person. We gained some great new members. Nine candidates were nominated for three vacancies. Krista Fischer was elected an Academy member in the field of mathematics and mathematical statistics, Veiko Uri in forestry and Elmo Nüganen in drama.

There were also some sad moments. Four colleagues passed away: Ilmar Koppel early in the year, and a few weeks later Valdek Kulbach. In early spring, we bade farewell to Enn Tõugu, and in August to Tšeslav Luštšik.

\* \* \*

The Academy gave out recognition and its members received recognition. The tradition of Endel Lippmaa Memorial Lectures started three years ago and has gone from a merely academic event to one with a diplomacy dimension, which the president of the Republic also made note of in her speech on the 103rd anniversary of the Republic on 24 February 2021. The address delivered by the second laureate of the Lippmaa lecture and the memorial medal recipient Uffe Ellemann-Jensen made our small country a lot bigger and more important. We took time to say thank you.

We awarded four Academy of Sciences medals and two personalised Academy medals. All of this was to recognise our close confederates who had done much more than their employment contracts required. As an extension of the Academy's recognition, it was decided to institute a medal named after Edgar Kant in the field of social sciences. Like other medals named after individuals, it is awarded not more frequently than every four years.

The Paul Ariste medal was awarded to the illustrious art historian Jaak Kangilaski and the Karl Schlossmann medal went to Irja Lutsar, who served as the head of the scientific council on combating COVID-19. The Karl Schlossmann medal is the Academy's highest honour for Estonian researchers in medicine and related fields and the Paul Ariste medal has just as much weight in the humanities. The statutes of both medals stipulate that the recipient deliver a presentation at a General Assembly meeting or a public academic lecture within the following six months. Both recipients immediately did their duty. Jaak Kangilaski talked about how it had been possible to import Western art to the Soviet Union and Irja Lutsar delivered a topical presentation on "Brain and brawn during the coronavirus pandemic".

Academy medals went to Professor Maaja Vadi for her tremendous work in performing functions necessary to the Academy (including as a reviewer of researcher professors), Rait Maruste for bringing Estonian statehood documents to life in writing, Ambassador Riivo Sinijärv for his great leadership on the Endel Lippmaa lectures initiative, and Anne Pöitel in recognition for her contribution to developing and maintaining the Academy's international relations.

In reflecting on her recognition, Maaja Vadi made comments that I feel accurately characterise the Academy's developments in recent years. She thanked the Academy for how science has become visible. A scientist must be visible because an invisible scientist is of no use. This visibility promotes a certain way of thinking and helps people to cope better in a crisis. She stressed that it also contributes to the Estonian economy, i.e. small companies that may lack innovation capacity can work well with universities only if they believe that scientists are motivated.

\* \* \*

Early in the summer, we assumed the presidency of the European Science Advisors Forum. In cooperation with the European Commission Joint Research Centre (JRC, the in-house advisory body) we are trying to map the science advisory systems in different countries, share the best experience and practice, and avoid missteps. It is a relatively new field. At the same time, one of the pillars of the competitiveness of countries and regions is how quickly and accurately the highest levels of competence can be reached in the research landscape.

The meaning of a news item may become clear to us only years from now. The Academy member Maarja Kruusmaa was elected one of the European Commission's seven chief scientific advisors. This, one of the most noteworthy achievements of our science diplomacy, is a testament to her energetic multi-national activity, as well as the level of science advisory activities in Estonia. It marks only the third time there has been a representative from an EU 13 country. We see it as the next chapter that builds on such achievements as Jüri Engelbrecht's work as the President of ALLEA and Mart Saarma's work as the Vice President of the European Research Council (ERC).

\* \* \*

The Academy's website underwent a thorough makeover. The content, ideas and documents are the same but the look and features are different. Filling the updated website with good and abundant content was a way to be even more visible in a form that we ourselves choose. The document management system launched at the end of the previous year (2019) nearly completely replaced the information flow on paper. Easy access to necessary information ensures a common information space, nips disagreements in the bud and lets us concentrate on important matters.

The main outlines of the Academy's new development plan are down on paper and the text is being polished. It is based on the idea that the success and development of the Academy is due to the contributions made by Academy members. The development plan will thus be a reflection of what Academy members want to do. In other words,

once there is an idea and people available, the resources will no doubt be found. This notion is also reflected in the increase in the Academy's budget for 2021.

The presentation delivered by Governor of the Bank of Estonia Madis Müller at the winter General Assembly meeting contained a number of important keywords and issues. In his opinion, the Bank of Estonia and the Academy of Sciences play similar roles as advisers to the government and more broadly to society. He asked whether the Academy could formulate an institutional position on topical matters and try to present it in a public debate. This could have greater value and impact than the opinions of individual members. He also suggested it would be wise to ask whether the Academy could evolve into a leading organisation in the Estonian world of science, acting as a clearing house not only for the views of Academy members but for the entire scientific community in Estonia, and if it could offer a balanced, long-term view.

From the bank's viewpoint, it seemed to him that the Academy has increasingly assumed that role and become more visible in society. He also considered it an important challenge to respond to increases in research funding. This is an opportunity to expand activities, fulfil the Academy's statutory functions more broadly and make sure that the funding gets to where it is needed and is effectively implemented. The state investment programmes based on the European Union's new budget and recovery fund are a much broader challenge. They involve the potential for growing prestige and influence. We could also provide counsel on their use for research and science goals and encourage the setting of more ambitious goals in research and innovation, offering the government and other decision-makers maximum research-based support for deciding the priorities for state investments.

He also mentioned that it is interesting to note how the Academy of Sciences articulates its identity as an organisation. Is the Academy an umbrella organisation or a centre for excellence in research? How is it distinct from other research- and science-related organisations? What opportunities does it have to consolidate or specialise in certain fields? Is the status of being an Academy member a lifetime achievement award? Or could it be a boost for younger researchers to help them reach the top tier? Creating an Estonian Young Academy of Sciences is a praiseworthy idea. Could we consider more robustly integrating or merging these academies to be even stronger together?

From the standpoint of organisational development, it is important to set a focus, and select the main goals and/or changes in society in which we see a need to participate and are able to contribute. This may require us to create or strengthen our analytical capability. It would be interesting to assess what the society's expectations are for the

Academy and economists, and to determine how the role of economics and social sciences would be expressed in the Academy's activities, or how much importance should be placed on applied research. Our common concern is how to most effectively organise the provision of advice to policymakers, right up to the *Riigikogu* and the government.

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Due to the coronavirus pandemic, a large number of the Academy's activities moved online. This placed an additional burden on the office. Instead of merely organising public address systems and catering, we had to arrange for professional audio and video production for dozens, sometimes even hundreds, of participants. Thus, the Academy's

Hall of Mirrors often looked like a TV studio and the office staff often had to act in the role of experts in dispersing participants. They managed these tasks very well. Their work ensured that the messages communicated in the Academy hall reached a much wider audience than our hall would have accommodated. Our heartfelt thanks go out to the office staff. Without them, a large number of our activities during the coronavirus would simply not have happened.

Wishing you all good health,  
Tarmo Soomere  
12 April 2021

# EXPERT PANELS AT THE ACADEMY

## COMMITTEE ON METEORITICS

Founded in 1954

Chair of the Board: Jüri Plado, PhD

The committee members, based on a resolution passed at the Academy of Sciences board meeting of 14 March 2017: Jüri Plado (chairman), Juho Kirs, Tõnu Pani, Ulla Preeden, Sten Suuroja, Reet Tiirmaa and Siim Veski.

In 2021, the committee focused mainly on interpreting results of previous fieldwork and preparing summaries. Argo Jõelegt and Kaidi Sarv (University of Tartu Department of Geology), in cooperation with the University of Texas at Austin, the Geopark Ries and Albert Ludwig University of Freiburg, continued the interpretation of seismic measurement data for refining the internal morphology of the craters of Ries (Germany, diameter 26 km, age 14.8 million years), Steinheim (Germany, diameter 3.8 km, age 14.3 million years), Dobele (Latvia, diameter 4.5 km, age  $290 \pm 35$  million years) and Kärddla (Estonia, diameter 4 km, age approx. 455 million years). Jüri Plado, Herbert Henkel of the Swedish Royal Technology Institute and Satu Hietala of the Finnish Geology Centre continued mineralogical studies of the Dellen (Sweden) crater and the preparation of a book summarising their findings. Jüri Plado and Satu Hietala documented the new finds of material from the Summanen crater (Finland, diameter 2.6 km, age unknown) from both the time of impact and following the impact.

Fieldwork was conducted in July in the main crater at Ilumetsa (diameter 75–80 m, age approx. 7000 years), where Jüri Plado, Argo Jõelegt and Anna Losiak (Institute of Geological Sciences at the Polish Academy of Science) established two excavations to determine the history of the structure and to search for melt grains. In September, Jüri Plado, Herbert Henkel and Satu Hietala studied the places where impact material was discovered at the Dellen crater (Sweden, diameter 20 km, age 85–145 million years) and mapped the strength of the magnetic field in selected places. In October, Argo Jõelegt and Kaidi Sarv measured the speed of seismic waves inside bore hole K1 in the Kärddla crater.

At the University of Tartu's Department of Geology, Juulia-Gabrielle Moreau continued working on her post-doctoral project. The findings were presented at the European planetary science congress (Moreau, J., Stojic, A. N., Jõelegt, A., Plado, J., Hietala, S. 2021. A shock-recovery experiment to study shock melting of troilite in ordinary chondrites. EPSC Abstracts, 15: European Planetary Science Congress 2021, Virtual meeting, 13–24 September 2021. Euro Planetary Society, 34. doi.org/10.5194/epsc2021-34).

The employees of the University of Tartu Natural History Museum, the University of Tartu Department of Geology and the TalTech Institute of Geology provided consultation to about 10 Estonian and Latvian citizens

on meteorite-related matters (whether possible incidental finds were of meteoric origin, i.e. whether round structures were possibly related to meteorite craters). However, no meteorites or craters were found.

#### COMMITTEE ON NATURE CONSERVATION

Founded in 1995

Chair of the Board: Urmas Tartes, PhD

The Estonian Academy of Sciences Committee on Nature Conservation did not see major changes in its membership in 2021. The board consisted of: the chair Urmas Tartes, PhD, and the vice-chairs Associate Professor Vilju Lilleleht, candidate of biology, and Heiki Tamm, candidate of biology (equivalent to PhD). At the end of the year, the workhorse of our committee, the secretary Vaike Hang, passed away. The committee continues to have the use of one small room in the Baer Building at Veski 4, Tartu at the Estonian University of Life Sciences.

Activities in 2021 were affected by the emergency situation caused by the pandemic and the committee did not meet publicly. Discussions were held regarding adding new members. However, the committee members pursued individual activities, and some of them also deemed it possible to document their activities under the aegis of the committee.

Marek Sammul served as the moderator of the Ida-Viru County climate council in December (see [elfond.ee/teoksil/ida-viru-noorte-kliimakogu](http://elfond.ee/teoksil/ida-viru-noorte-kliimakogu)).

With the involvement of Ingmar Ott, three articles were published in the *Postimees* newspaper concerning Vana-Koiola Lake. Ott also spoke on a podcast on the health of Estonian lakes (see [podcast.ee/innovaatika/innovaatika-17-eesti-jarvede-tervis-pole-kiita/](http://podcast.ee/innovaatika/innovaatika-17-eesti-jarvede-tervis-pole-kiita/)). He led the following projects:

- Modelling and forecasting the impact of climate change on the external and internal load of lakes and the stratification regime (27.06.2019–06.12.2021)
- Additional studies of Kavadi Lake, which forecast the impact of the fluctuation of the water level on the lake's function and ecological state (10.05.2021–01.11.2021)
- Environmental Agency public procurement “Jõgede, väikejärvede ning Peipsi järve hüdrobioloogiline seire ja uuringud 2020” (“Hydrobiological monitoring and studies of rivers, small lakes and Lake Peipus” (reference number 216510) part 2, and “Väikejärvede hüdrobioloogiline seire ja uuringud 2020” (“Hydrobiological monitoring and studies of small lakes”) (01.04.2020–08.03.2021)
- Study of the external load on the aquatic environment of Verevi Lake (22.04.2021–01.07.2022)

- Hydrobiological monitoring and studies of small lakes 2021 (06.04.2021–14.02.2022)

Two publications in which Ingmar Ott participated appeared:

Ott, I., Timm, H., Järvalt, A., Järvekülg, R., Kisand, A., Mäemets, H., Panksep, K., Pedusaar, T., Tammert, H., Tuvikene, A., Tuvikene, L., Tõnno, I., Vilbaste, S. 2020. Siseveekogud. Õpik kõrgkoolidele. (Inland bodies of water. Textbook for higher education institutions) Eesti Loodusfoto, 359 pp.

Maileht, K., Laarmaa, R., Ott, I., Laugaste, R., Rakko, A. 2021. Uued sinivetika *Gloeotrichia echinulata* leiud Eesti väikejärvedes: kas heitliku ilmastiku tagajärg? (New discoveries of the cyanobacterium *Gloeotrichia echinulata* in small Estonian lakes: consequence of unstable weather patterns?) *Eesti Loodus*, 8, 62–63.

In January and February, Urmas Tartes presented educational lectures on nature at nature evenings organised by the non-profit association Lilli, in Halliste and Abja. In June, he led insect field trips in Keila. In July, he delivered nature lectures in Valga and Anija, and in August he gave a public lecture in Võru and took part in an environmental-themed discussion on the temporary car-free riverside boulevard in Tartu. In September he gave a nature lecture at the Võru Upper-Secondary School, in October he organised a water-themed day of training at the Tõrva Upper-Secondary School nature camp, and in November, he presented a lecture on climate changes at an environmental education conference in Viljandi and lectures on insects at the Kilingi-Nõmme Upper-Secondary School. In December, he organised a training course on climate change for the Environmental Board's environmental education employees, and delivered an educational lecture on nature in Viljandi at *Väarikate Ülikool* (a lifelong learning format for people aged 50+) and a thematic day on Hiiumaa on the life of an entomologist.

Urmas Tartes published 11 articles on nature conservation themes in *Postimees* during the year. He also took part in the judging panel of the Vapramäe-Vellavere-Vitipalu foundation-organised photography competition “Märka mind!”, “Looduse aasta foto” (“Nature photo of the year”) and in the *Eesti Loodus* magazine photography competition, was a member of the Erik Kumari prize committee and continued to represent the Academy on the council of the non-profit association Loodusajakiri (a publishing NGO), besides consulting with Estonian Public Broadcasting on the finer points of the translation of nature films.

A significant number of his activities were on social media, aimed at shedding light on nature conservation, forest ecology and Earth's carbon and energy cycle. They helped people better understand the knowledge, values and influences prevalent in society.

## ESTONIAN POLAR RESEARCH COMMITTEE

Founded in 1993

Chair of the Board: Professor Rein Vaikmäe

The Estonian Polar Research Committee (EPRC) is an independent expert body based on the best available competence in the field of polar sciences. It keeps up to date with developments in the field around the world, designs the development strategy for Estonian polar research, provides consultation to the government when necessary and speaks on the international level, allowing Estonian polar researchers to use the international polar research infrastructure.

EPRC represents the Academy of Sciences on the European Polar Board (EPB). EPB is a non-government strategic council of experts that represents its member states' interests in planning scientific research carried out in the polar regions and develops the corresponding infrastructure. It also provides consultation to the European Commission on these matters. Since 1 January 2015 EPB has operated under the umbrella of the Netherlands Organisation for Scientific Research (NWO) in The Hague as an association of member organisations. The Academy of Sciences has been a member of EPB since 2001 and the Estonian Polar Research Committee acts as a contact with EPB.

As in other fields, the COVID-19 pandemic had an effect on EPB's plans: there were few public events and activities moved to virtual environments. The spring and autumn annual meetings of EPB and various committees' meetings also took place virtually.

The most important substantive matter tackled by EPB in 2021 was preparations for an international evaluation of its activities. An in-house evaluation was held first, with all EPB member states participating in it. The final report of the in-house evaluation will be ready by spring 2022, after which the international evaluation will be launched. Its results will form the basis for developing EPB's new activity strategy.

Another significant issue EPB was involved in in 2021 was launching, in the context of the new Horizon2020 project "EU-PolarNet 2", the implementation of the European polar research strategy developed in the framework of the Horizon 2020 project "EU-PolarNet – Connecting Science with Society". Estonia is represented in the project consortium by the TalTech Institute of Geology. The project's goal is to develop proposals for the European commission for preparing the themes of the research and development projects and project competitions in the climate and environmental field for the European Union's next Horizon Europe framework programme.

The Estonian Polar Research Committee continues to be active in introducing various world polar research findings in Estonia. The headline event of the year was a hybrid

conference called "Arctic climate change – our common concern", held on 14 April to mark the centenary of diplomatic relations between Estonia and Norway (see page 99). The conference was supported by the Estonian Academy of Sciences, the Norwegian Embassy in Tallinn and the foreign ministries of both countries. Presentations were delivered by Estonian polar researchers and, for Norway, by researchers from the Bergen branch of Academia Europaea, the Bjerknes Centre for Climate Research.

The process re-initiated by EPRC in late 2019 – for Estonia to accede to the Protocol on Environmental Protection to the Antarctic Treaty (the Madrid Protocol) – also made some slight progress in 2021. As at the end of the year, documentation had made it through the ministries' endorsement rounds and in December it once again became stalled in the Ministry of Finance. In spite of this, hopefully the procedure will be completed in the first half of 2022.

In 2019, the Ministry of Foreign Affairs re-launched an initiative to seek observer status for Estonia on the International Arctic Council (IAC). Several EPRC members were invited to become members of the committee being prepared. On 9 November 2020, Estonia officially submitted its application for International Arctic Council observer status. The IAC meeting of May 2021 did not manage to discuss the new observer member applications and the decisions were postponed to the next meeting of the IAC in 2023.

Estonia's participation in the work of EPB has given our scientists a chance to directly and influentially make their voices heard in preparing R&D strategies and specific science programmes in the field of European polar research. This opens the doors for our relatively few but active groups of researchers (at the University of Tartu, Tallinn University of Technology, Tallinn University, the Tartu Observatory, National Institute of Chemical Physics and Biophysics etc.) to take part in international cooperation in the field, and ensures logistical support and access to costly and unique infrastructure. Our active and constructive role in the work of EPB has helped build a positive image for Estonia in this internationally prestigious field. International visibility will hopefully help our scientists take part in new research and technology programmes in the polar research field, especially new projects planned in the context of Horizon Europe. In recent years, the list of scientists engaged in polar research has been supplemented by several active and promising young names, which creates an even more optimistic outlook for the future of the field.

## COMMITTEE ON ENERGY

Founded in 1998

Chair of the Board: Arvi Hamburg PhD

The purpose of the Committee on Energy is to serve as an impartial, competent expert panel giving recommendations and opinions to shape the country's science-based energy policy.

In 2021, interaction between members of the Committee on Energy and discussions of positions mainly took place via the internet. The main topic was whether the measures planned for a carbon-free economy would be effective at achieving the objective, and an assessment of probable impacts and risks. In the second half of the year, high energy prices, an analysis of the reasons behind the high prices and a proposal for potential alleviating measures to the *Riigikogu* and the Cabinet of Ministers were priorities.

The topics of the meeting of 4 May were the Estonian electricity system in the World Energy Council (WEC) Trilemma, Estonia's Nobel Science and Technology Centre, a hydrogen roadmap, a summary of 2020 and a 2021 action plan.

As a result of the discussion, positions were agreed on to ensure the operational continuity of the electricity system.

1. A carbon-free economy requires a review of documents that regulate the energy sector. In the energy sector, zero greenhouse gas (GHG) emissions (decarbonisation) will mean giving up fossil fuels or CO<sub>2</sub> capture and sequestration, with the option of later use in the circular economy.
2. Replacing fossil-fuel-based controllable power generation capacity with non-weather-dependent non-controllable capacity will require the existence of balancing energy in the electricity system, the use of storage technologies, a new control model for network operation and controlled consumption.
3. The main challenge is ensuring the security of supply (at a price consumers can afford) and energy security, including investments for preserving and developing domestic generating capacity.
4. The electricity market is distorted by political decisions (e.g. the CO<sub>2</sub> allowance price, renewable energy charges, pollution and resource taxes), and market signals have not triggered investments to establish new capacities.
5. The restructuring of the energy sector must be based on a systematic, scientific examination of socioeconomic, environmental and economic impacts which analyses the ecological footprint of the integral life cycle of various energy sources, energy media and materials.
6. Besides decarbonisation, decentralisation and digitisation, the future will also involve desynchronisation: leaving the Russian, Belarusian and Baltic (BRELL)

synchronous area and joining the continental European area. In addition to power generation capacities for covering consumer needs, frequency reserves and a much stronger connection to Central European power systems must be ensured.

The Committee believes that the Nobel Science and Technology Centre in Estonia is necessary to ensure the next generation of scientists, to demonstrate innovative products and services and as a repository for the technological legacy.

The Committee on Energy deemed it necessary to set up a work group to produce a vision document for the hydrogen roadmap. A proposal for the work group will be made to the Ministry of the Environment and the Ministry of Economic Affairs and Communications.

The topics discussed at the Committee on Energy meeting of 18 October were the power grid concept and services, the possibilities of nuclear energy use, the causes of climate impacts and the long-term perspectives for the energy sector. The provision of network services at reasonable prices and quality, investments and possibilities for partial compensation of network fees were discussed. The Committee stated its position that the efforts of the transmission grid operator Elektrilevi to improve the quality and price ratio of network service have been effective. The Committee on Energy also discussed the possibilities of using nuclear energy and its potential contribution to achieve climate neutrality.

The Committee reached the position that, in the context of the Green Transition, innovative energy generation and storage technologies with a very wide array of orientations had to be designed. It was found that the latest nuclear energy solutions and their applications could also be used in the Estonian energy sector. Economic and risk analyses of whether nuclear energy would be justified in Estonia should be continued, and a broader swathe of the scientific community – and the public – should be engaged in examining the prospects of nuclear energy.

A long-term view of the energy sector will be required: an analysis of how the current situation developed, proposals for improving the situation, and a vision for the future. The Committee on Energy concluded that the reasons for the rising prices of energy and fuel are, above all, related to a decrease in supply (controlled generation) and the political influence of the electricity market at a time of rising CO<sub>2</sub> prices, when electrical energy storage technologies have yet to reach market maturity. That is why peak loads on the electricity system are primarily served by natural gas-fired power plants. The Committee on Energy set out its proposals for domestic alleviation of the price rise and implementation of long-term measures in cooperation with EU partners.

The Committee on Energy introduced its positions and proposals at a discussion of this matter of significant national importance held at two plenary sessions of the Estonian parliament. The first was on 9 November, where an analysis of the energy economy, the security of the supply of electricity and the future vision were discussed, and the second was at the 14 December session, where measures for alleviating power and gas prices were discussed.

In coverage in the dailies *Postimees* (08 and 23 December 2021) and *Eesti Päevaleht* (14 December 2021) and the Estonian Television broadcast “First Studio” (16 December 21), we discussed desynchronisation, the security of supply, the energy economy in terms of regional development, the causes of the electricity and natural gas price increases, and a vision for the future of the energy sector.

The members of the Committee on Energy spoke at the Anto Raukas memorial seminar on 6 November, and participated in the Academy of Sciences Science Afternoon discussion on 18 November, “Green Transition in European Industry: from Critical Natural Resources to Green Technologies”.

#### COMMITTEE ON PHYLOGENY AND TAXONOMY

Founded in 2007

Chair of the Board: Academy member Urmas Kõljalg

The Committee on Phylogeny and Taxonomy (CPT) represents Estonia in the work of the Consortium of European Taxonomic Facilities (CETAF AISBL, [www.cetaf.org](http://www.cetaf.org)). CETAF coordinates research and development at archives related to biodiversity and earth sciences in Europe. In Estonia, the committee has essentially the same role as CETAF does in Europe. CPT coordinates the work of scientific research collections in Estonia, including digitisation of the collections.

Two CETAF AISBL annual meetings were held in 2021. The 49th annual meeting was held virtually on 19–20 May; the organiser was the Belgian Royal Museum of Central Africa (RMCA). The 50th annual meeting and the conference marking the 25th anniversary of CETAF were also held virtually due to the pandemic, on 17–18 November. The organiser was the Muséum National d’Histoire Naturelle in Paris. The public conference to mark the anniversary was titled “Close the Gap – the impact of taxonomy in the Anthropocene. Scientific and societal challenges in the biodiversity domain”. Estonia was represented at the CETAF meeting by the chairman Urmas Kõljalg and the deputy chairman Professor Olle Hints, who had voting rights. About 10 researchers from Estonia took part in the 25th anniversary conference. As travel was complicated at the time, international activities occurred online.

Estonia continues to take part in the work of CETAF ESG (Earth Sciences Group), the most important task of

which is coordinating developments in GeoCAsE, the data network for Europe’s geological collections. CPT is represented on this working group by Olle Hints. The developments of GeoCAsE software take place largely in the context of the DiSSCo Estonian research infrastructure roadmap project.

CPT works closely with partners of the Natural History Archives and Information Network (NATARC), the Estonian research infrastructures roadmap ([natarc.ut.ee/partners.php](http://natarc.ut.ee/partners.php)). FS members Urmas Kõljalg (University of Tartu), Olle Hints (Tallinn University of Technology) and Agu Leivits (Environmental Board) serve on the NATARC Council. CPT members take part in the work of the expert council on humanities and scientific collections based at the Ministry of Education and Research. The deputy chair of the council is Olle Hints. The function of the expert council is to make proposals to the government to improve and fund the work of the scientific archives.

#### COMMITTEE ON MARINE SCIENCES

Founded in 2007

Chair of the Board: Academy member Tarmo Soomere

The primary objectives of the Committee on Marine Sciences (CMS) are to represent Estonia and Estonian marine research on the European Marine Board and to serve as an advisory body within Estonia.

The activities of CMS in Estonia are aimed at representatives of Estonia-based competence in issues related to the sea and other large bodies of water and their ecosystems (e.g. scientific issues related to the various branches of oceanography and limnology, marine geology, coastal technology and science, hydrology, seabed and marine biology resources and their use, and the spatial planning of marine areas. Marine sciences are considered to include all of the branches of science mentioned above.

Active members: Tiit Kutser, Urmas Lips, Georg Martin, Tiina Nõges (deputy chairman), Kalle Olli (deputy chairman) and Alvar Soesoo.

During the pandemic, the committee convened only virtually. Committee members and others concerned were informed regularly via newsletters of the European Marine Board and other information about EMB’s own activities, documents, information gathering and feedback rounds, ongoing and planned major marine science projects, media events and new information materials. EMB’s plenary sessions took place in the form of electronic meetings; the spring plenary session was held on 26–27 May and the autumn one on 28–29 October. The CMS chairman Tarmo Soomere took part in the spring session.

The spring plenary concluded the term of Yves-Marie Paulet (Universités Marines, France) as an EMB executive

committee member and vice-president. Rosa Fernandez (CETMAR, Spain) was elected as his replacement. The temporary period of suspension of the membership of Klaipėda University in 2018–2020 ended in December 2020. The university has not applied for resumption of member status. As a result, Klaipėda University was removed as an EMB member. EMB had 25 members from 18 countries as of 31 December 2021.

Rebecca Zitoun (New Zealand/Netherlands) and Anjali Gopakumar (Italy/Australia) were elected Junior ambassadors of EMB. Their mission is to mediate EMB's activities to top specialists in marine sciences and the next generation of marine scientists. Liam Lachs and Alba González have concluded their two-year mission, and Alessandro Cresci and Natalija Dunić will continue for another year. The programme of the work group on mapping marine life and habitats was approved. It was decided to prepare a declaration of the importance of the ocean in terms of Earth's oxygen balance. After all, every other inhalation of oxygen originates in the ocean.

At the autumn plenary, Jeremy Gault (Irish Marine University Consortium, Ireland) was elected an EMB executive committee member and the deputy chairman for a second term. The programme of the work group focusing on the significance of the ocean as an oxygen source was approved.

In 2021, EMB published a number of overviews and policy documents. In Estonia, these documents were sent to CMS members and, where possible, to media channels. All materials are freely accessible on the EMB website. The materials are mainly intended for the European Commission, where they often influence which decisions are made and act as support evidence for funding scientific programmes.

While CMS is often focused on international aspects, this year CMS's emphasis was on Estonia's application for observer status on the International Arctic Council. At the behest of the Ministry of Foreign Affairs, CMS took part in the discussion and development of the materials for the application and the planning of subsequent steps. On 26 April 2021, Tarmo Soomere participated as a panellist in the international web seminar "Supporting sustainable development in the Arctic: Estonia's role in advancing collaboration in the Arctic", organised in cooperation with the Wilson Centre. Concerning this topic, Professor Soomere delivered a presentation at the behest of the Estonian *Riigikogu*'s Foreign Affairs Committee on the key role of the Arctic at a public session of the Foreign Affairs Committee on 28 January 2021.

Professor Soomere is an alternate member of the national geology service's advisory board. Deputy Chairman of CMS Professor Kalle Olli is one of Estonia's representatives in launching the Joint Programming Initiative (JPI: Oceans, Climate, Water).

Indirectly, Soomere took part in various forums, meetings, councils and committees as an Academy representative for planning science policy in this field. The Research and Development Council did not discuss matters in CMS's area of activity during the reporting year.

In cooperation with members of the Finnish Environmental Institute (Kai Myrberg and Ljudmila Vesikko), a trilateral cooperation conference, "The Gulf of Finland Science Days 2021", was organised. The main section, "A new start for Gulf of Finland co-operation", took place as in-person meetings at the Academy of Sciences premises on 29–30 November 2021. At these meetings, an important aspect is always the question of how top-flight science can be applied to deal with practical functions and policy planning needs. The conference was opened by Estonian MP Annely Akkermann. Three invited plenary presentations by scientists from Finland, Russia and Germany, 22 oral presentations and several dozen poster presentations were planned (see pages 105–106 for more).

An online "Intense Day on Marine Science and Applications" was also held as a seminar of the Taltech Institute of Cybernetics (5 March 2021), with three invited presentations (by Professor Hans von Storch, Professor Jüri Elken and Kristjan Tabri).

Tarmo Soomere participated in a public discussion on the restoration of the Narva-Jõesuu pier held at the Fat Margaret cannon tower of the Tallinn Maritime Museum on 26 November 2021, with the mayor of Narva-Jõesuu, Maksim Iljin, Speaker of the Estonian Parliament Jüri Ratas, the mayor of Narva, Katri Raik, and Director of the Maritime Museum Urmas Dresen attending.

As a member of the Science Steering Committee of Baltic Earth, Tarmo Soomere took part in the 15th meeting of the Committee held electronically on 11 May 2021. As part of this initiative, Tarmo Soomere and Urmas Lips were invited to serve as co-contributors of overview articles on Baltic Sea maritime sciences. Two of them have been published and a third has been approved for publication.

As CMS chairman, Professor Soomere represents the Estonian Academy of Sciences on the Environmental Panel of the European Academies' Science Advisory Council: he was also a founding member of the panel. One of its functions is to be a point of contact for EMB, contributing to an exchange of information between these organisations and the harmonisation of their work. EMB is one of the most trusted institutions advising the European Commission. It offers a balanced representation of organisations that fund science, scientific and research organisations and higher education. Senior Commission officials participate regularly at EMB plenary sessions, and often introduce the Commission's strategic decisions. Through EMB, Estonia has an opportunity to provide input into formulating

recommendations for making science policy decisions that impact the marine sciences in the Baltic Sea region and, to an extent, the whole world, and making Estonia's voice heard on the European level.

For more than 12 years now, CMS has represented Estonian marine sciences on EMB and top marine sciences competence in European academia. In Estonia, it has managed to maintain the visibility of marine sciences, limnology and coastal science for many years at a very high level.

#### STANDING COMMITTEE ON MEDICAL SCIENCE AND HEALTH STRATEGY

Founded in 2011

Chair of the Board: Academy member Eero Vasar

In cooperation with the medical school of the University of Tartu, the Standing Committee on Medical Science and Health Strategy has provided consultation to the Ministry of Social Affairs on R&D and innovation. Unfortunately, the pandemic had a negative effect on this function. Due to the pandemic, there has understandably been a priority shift at the ministry during the last two years.

In cooperation with the Academy president Tarmo Soomere, Chair of the Standing Committee Eero Vasar has contributed a number of opinions on salient topics in the *Postimees* daily newspaper.

#### COUNCIL FOR ESTONIAN CENTRES OF EXCELLENCE IN RESEARCH

Founded in 2012

Chair of the Board: Academy member Andres Metspalu

The Council for Estonian Centres of Excellence in Research sent a memorandum to Minister of Education and Research Liina Kersna on 14 June 2021 noting that it would be appropriate to use economic development measures above all for development and innovation, and centres of excellence measures to develop top science. It would be conceivable to also add the role of competence centre to the centres of excellence, but the implementation of the measures should be assessed based on the internal logic of the measures. Bundling incompatible measures purely for administrative reasons will not yield good results.

At a meeting of the Council for Estonian Centres of Excellence in Research on 22 November, the head of the research and development policy department at the ministry, Katrin Pihor, gave a thorough overview of research, development and innovation policy and the problems faced by centres of excellence in 2021 and years to come. Work is currently taking place to develop principles for state support of centres of excellence. Input on the efficacy of the centres of excellence measures will be accepted from December 2021 to July 2022. The analysis of centres of excellence includes observations on the impact of the support in Estonia and the Estonian science landscape, and on which of the objectives were fulfilled. In November 2022, the state support plan and the plan for the provision of service may be ready.

# NATIONAL RESEARCH AWARDS

The tradition of national research awards is over 30 years old, older than the second era of Estonian independence. On 20 August 1990, Prime Minister Edgar Savisaar signed a regulation instituting the research awards. This was a whole year before the restoration of independence. The first awards were handed out in 1991. Since the very beginning, the selection has focused on the most outstanding achievements.<sup>103</sup>

The Estonian state has delegated the issuing of the research awards to the Academy of Sciences. This function includes participating in drafting legal acts, announcing competitions, reviewing and registering applications, followed by a thorough analysis and tabling recommendations to the Cabinet regarding the final selection of award-winners. The Estonian Cabinet forms the corresponding committee.

Traditionally, two research awards are handed out each year for lifetime achievement in the field of research and development. Eight national research awards – the annual awards, as they are known – are handed out in different sectors for the best research completed and published in the last four years. There is also a discovery prize that can be awarded for a discovery that is paradigm-shifting or pioneering or leads to an innovative product with economic impact. If, in a given year, there are no research achievements that seem worthy, the committee can propose that any of these awards not be handed out that year.

## The 2022 recipients

The senates of four universities, four members of the Academy of Sciences, the board of the Estonian Literary Museum, the scientific councils of the Institute of Chemical Physics and Biophysics and the research council of the National Institute for Health Development submitted 33 nominations for the national research awards in 2022.

<sup>103</sup> Awards in the Republic of Estonia 2020, Tallinn 2020, p. 10. [https://www.akadeemia.ee/wp-content/uploads/2020/08/ev\\_preemaid\\_2020\\_veebi1.pdf](https://www.akadeemia.ee/wp-content/uploads/2020/08/ev_preemaid_2020_veebi1.pdf)

The national research awards committee declared all of the nominations to be eligible and registered them on 29 December 2021.

On 26 January 2022, the Cabinet decided to award two lifetime achievement awards and annual awards in eight fields. As an annex to the proposal, a brief comment was sent to the cabinet regarding each nominee, stating why the individual or group deserved the award. The award ceremony took place on 23 February 2022 in the Academy of Sciences Hall of Mirrors.

## LIFETIME ACHIEVEMENT AWARDS

**Ingrid Rüütel:** b. 3 November 1935, a senior researcher at the Estonian Literary Museum until 2021, and a senior researcher emeritus there since 2022.

Ingrid Rüütel is one of the founders of Estonian ethnomusicology, and a long-standing and influential leader and spokesperson in society. In her research, she has highlighted the peculiar features of runo song melodies and



Finno-Ugric folk music in general, created a typology and database of Estonian and Votic runo songs, has defined the various layers of Estonian folk songs and the role of ethnic relations in their inception, and has studied the ways in which folk culture and ethnic identity are expressed. Over the decades, as an active field researcher, she has collected and recorded thousands of folk songs, and has taken part in the production of several research films.

- 1996 state culture award for her role as the artistic director of the international folklore festival Baltika '96
- 1997 Order of the Estonian Red Cross 3<sup>rd</sup> class
- 1998 Jakob Hurt folk culture award
- 2005 Latvian Order of the Three Stars Commander Cross
- 2008 Order of the White Star 1<sup>st</sup> class
- 2015 lifetime achievement award from the folk culture endowment of the Cultural Endowment of Estonia

**Ene-Margit Tiit**: b. 22 April 1934, a University of Tartu professor emeritus, and a Statistics Estonia population statistics expert

Ene-Margit Tiit is much more than the founder of Estonian mathematical statistics, an educator of generations of statisticians, a founder of a corresponding school of thought, a developer of scientific terminology and a fervent and successful champion of statistical literacy among the public. Her research concerns the analysis of pressing societal problems, from divorce and poverty to the coronavirus pandemic. The jewel in the crown of her research is her



contribution to social sciences and governance theory, above all in establishing a statistical foundation for demographic research in Estonia. Her keen social sensibility has often brought her into the heat of public debate, but has also been able to create a sense of mission and scientific approach, helping to balance extremes.

- 1995 honorary doctorate from the University of Helsinki (the first female researcher from Tartu University to be awarded an honorary doctorate from a foreign university)
- 1997 Gerhard Rägo commemorative medal
- 2001 Order of the White Star 4<sup>th</sup> class
- 2005 recipient of the Tartu Star (recognition of the City of Tartu for exceptional services)
- 2006 honorary member of the Estonian Mathematical Society

## ANNUAL AWARDS

**Award in the field of exact sciences for the research cycle “Order and disorder in magnetics: nuclear magnetic resonance studies” to scientists at the Institute of Chemical Physics and Biophysics**

**Ivo Heinmaa**: b. 1953, a senior researcher

- 2011 annual award from the Estonian Physical Society

**Raivo Stern**: b. 1963, a senior researcher, and the director of the chemical physics laboratory

Determining the creation, details and effects of magnetic order is both the key for understanding high-temperature superconductivity and a way to more deeply comprehend order and chaos at the atomic and molecular levels and their roles in different states of matter and transitions between them. The recipients perform their work using nuclear magnetic resonance equipment in super-strong magnetic fields and at very low temperatures, thus looking inside material in a unique manner.

**Award in the field of chemical and molecular biology for the research cycle “Enzymatic degradation of recalcitrant polysaccharides”**

**Priit Väljamäe**: b. 1970, an associate professor of the Institute of Molecular and Cellular Biology

Polysaccharides, such as cellulose and chitin, are good alternatives to fossil fuels in many branches of the chemical industry. The degradation of these compounds is not completely understood, however. Priit Väljamäe focuses on the possibility of biorefining such “stubborn” substances,

using a precisely selected preliminary process and specific mutually competitive enzymes: biological catalysts.

**Award in the field of technical sciences for the research cycle “Additively manufactured electrical machines” to researchers from the Institute of Electrical Power Engineering and Mechatronics at Tallinn University of Technology**

**Ants Kallaste** (team leader): b. 1980, a tenured assistant professor

**Toomas Vaimann**: b. 1984, a member of the Estonian Young Academy of Science since 1 July 2022, and a senior researcher

**Anton Rassõlkin**: b. 1985, a tenured assistant professor

**Hans Tiismus**: b. 1989, a doctoral student and junior researcher

The recipients are developing additive layer technology as one 3D printing method for manufacturing various kinds of electrical equipment and components, as well as mathematical methods for the optimisation of technological processes and the construction of electrical machinery. The adoption and development of selective laser melting technology in Estonia is groundbreaking.

**Award in the field of medical science for the research cycle “Research on immune ageing and Covid-19” to professors of the Institute of Biomedicine and Translational Medicine at the University of Tartu**

**Pärt Peterson**: b. 1966

- 2009 National Research Award: an annual award in medicine for “Molecular mechanisms of central immune tolerance”

**Kai Kisand**: b. 1965, a professor of cellular immunology

- 2012 National Research Award: an annual award in medicine for “New mechanisms in the development of candidiasis”

As people grow older, they become less resistant to viral and bacterial infections and face an increased risk of contracting a chronic infectious disease. Pärt Peterson and Kai Kisand have shed light on changes related to the ageing of the immune system and their significance in the approach to health. The SARS-CoV-2 antibody test they developed has generated new knowledge regarding the spread of infection and age-dependent immune responses among both COVID patients and vaccinated people.

**Award in geology and biology for the research cycle “Lessons from the past: the post-glacial environment in a changing climate and growing human influence” to scientists from the Department of Geology at Tallinn University of Technology**

**Siim Veski**: b. 1964, a full tenured professor in general earth science, Head of the Division of Quaternary Geology

- 2000 Karl Ernst von Baer Prize

**Anneli Poska**: b. 1969, a senior researcher

This research cycle investigates very different facets of changes that occurred in the postglacial past of Estonia and Europe, from classical climate phenomena to descriptions of the patterns of the spread of the Plague and Estonian changes in microbiota identified by old DNA methods. The descriptions of postglacial changes in the Estonian and European climate and in life forms in ecosystems from soil to forest to lakes are groundbreaking.

**Award in the field of agricultural sciences for the research cycle “Plant adaptation to climate change” to scientists from the Institute of Technology of the University of Tartu.**

**Ebe Merilo**: b. 1970, an associate professor of plant biology

**Hannes Kollist**: b. 1970, a professor of molecular plant biology

Biochemical processes occurring in the guard cells around the stomata of plants regulate gas exchange, thereby also affecting drought resistance. The most outstanding contribution made by the recipients is a better understanding of the biochemical signalling pathways of the stomata affecting responsiveness to CO<sub>2</sub> and air humidity. This is a big step toward breeding higher yielding and more stress resistant varieties whose stomata react quickly and precisely to changing environmental conditions.

**Award in the field of social sciences for the research cycle “Transformation of Estonian society: analysis and reflections”**

**Veronika Kalmus** (team leader): b. 1973, a professor of sociology at the Institute of Social Studies at the University of Tartu

- 2017 University of Tartu award

**Marju Lauristin**: b. 1940, a University of Tartu professor emeritus

- 1995 Johan Skytte medal
- 1998 Order of the National Coat of Arms 3<sup>rd</sup> class
- 2000 Harmony (Koosmeel) award
- 2006 Honorary doctorate from the University of Helsinki
- 2006 Order of the National Coat of Arms 2<sup>nd</sup> class
- 2006 *Postimees* opinion leader of the year
- 2011 Aadu Luukas mission prize
- 2013 Annual award of the folk culture endowment of the Cultural Endowment of Estonia (Sustainability of the Estonian state and cause – past, present and future, for the study “Influence of the song and dance festivals on shaping and changing society’s values”)
- 2020 honorary citizen of Tartu and recipient of the Great Star of Tartu

**Anu Mäso**: b. 1977, an associate professor of big data at the Ragnar Nurkse Institute of Innovation and Governance at Tallinn University of Technology and a tenured associate professor in data studies at the Institute of Social Studies, University of Tartu

**Signe Opermann**: b. 1975, a research fellow in media sociology at the Institute of Social Studies at the University of Tartu

**Peeter Vihalem**: b. 1944, a University of Tartu professor emeritus

- 2006 Order of the White Star 4<sup>th</sup> class

**Triin Vihalem**: b. 1968, a professor of communication studies at the Institute of Social Studies at the University of Tartu

- 2018 University of Tartu Small Medal

This is a compelling example of how a work of research in social sciences can take on a national research dimension. It affirms that today’s Estonia is recognised by many other European countries for its active cultural participation in recognising the importance of culture and for the spread of various forms of cultural consumption and practice. It shows that cultural consumption can play a balancing role in society. The message to policymakers is that the central task of the state is to create a balance in society and to ease tensions.

#### **Award in the field of the humanities for research analysing the ethnic and cultural diversity of the Russian Empire (and the USSR) and Baltic history**

**Karsten Brüggemann**: b. 1965, a professor of Estonian and general history at the School of Humanities of Tallinn University, and the head of the Institute of History, Archaeology and Art History.

Karsten Brüggemann analyses how multi-ethnic countries have coped with their ethnic, cultural and historical diversity, looking at the historical mechanisms of central power and their asymmetric relations with peripheral reactions. He boldly questions the emphasis on a central Russian historical role in developments and cultural creation on Russia’s western periphery, examines the image of the Baltic countries as seen in the Russian-language centre and the operating strategies that stem from that image, and has successfully compiled and edited a voluminous general history of the Baltics that is currently the most comprehensive such work.

# ACKNOWLEDGEMENTS TO ACADEMICIANS AND FROM THE ACADEMY

## MEDALS OF THE BALTIC ACADEMIES OF SCIENCES

The medals of the Baltic academies of sciences were awarded to:

**Tiit Tammaru**, who has taken Estonian contemporary human geography to the highest peak of world science. In essence, his studies are a pure application of mathematics which makes processes and sub-currents that are usually hidden in society visible, perceivable and controllable.

**Andris Ambainis** – for top-level research focused on the development of new algorithms for quantum computers.

**Valdemaras Razumas**, who has made a major contribution to strengthening research cooperation between the Baltic countries as the President of the Lithuanian Academy of Sciences in 2009–2018, as the Head of the Lithuanian Research Council in 2018–2019, and as the Vice Minister of the Ministry of Education, Science and Sport of the Republic of Lithuania in 2019–2020.



From the left: Academy member Tiit Tammaru, President Tarmo Soomere and Andris Ambainis at the medal ceremony on 28 June 2021.

**Edwin Kreuzer** – for the promotion of research cooperation between the Baltic academies of sciences and the Academy of Sciences and Humanities in Hamburg.



From the left: Tarmo Soomere and Edwin Kreuzer at the medal ceremony on 11 August 2021.

## MEDALS OF THE ESTONIAN ACADEMY OF SCIENCES

The Academy's medals were awarded to:

**Mart Saarma** – for a significant contribution in representing the academic way of thinking on the Research and Development Council.



**Marti Aavik** – for a significant contribution in creating the joint Science Council of the Academy and *Postimees*, and in disseminating scientific information.



**Jaak Aaviksoo** – for a significant contribution in representing the academic way of thinking on the Research and Development Council.



**Tina Rahkama** – for being a support pillar for the Board and General Assembly of the Estonian Academy of Sciences for 35 years.



## RESEARCH AWARDS FOR UNIVERSITY STUDENTS

Since 2016, the Academy's Student Research Paper Contest has been merged with the National Contest for University Students, organised by the Estonian Research Council. The Estonian Academy of Sciences was represented on the contest appraisal panel by Marco Kirm and Lauri Mälksoo. Three Academy President's prizes – the  $\pi$ -prizes – were awarded. The laureates were announced on 15 December 2021.

The Special Prize for the Most Elegant Student Research Paper ( $\pi \times 1,000 = 3,141.59$  euros) was awarded to **Tiina-Erika Friedenthal** for the doctoral thesis "Quarrels and Disputes Regarding Theatrical Performances in Estonia and Livonia at the End of the 18th and Beginning of the 19th Century" (University of Tartu, supervisors: Associate Professor Urmas Petti and Associate Professor Liina Lukas).

The Special Prize for an Unconventional Student Research Paper ( $\pi \times 500 = 1,570.80$  euros) was awarded to **Mart Ratas** for the doctoral thesis "Numerical Analysis of Nonlinear Wave Propagation" (TalTech, supervisors: Professor Andrus Salupere and Professor Jüri Majak).

The Special Prize for Auspicious Scintillating Sparks ( $\pi \times 250 = 785.40$  euros) was awarded to **Paul Johannes Raud** for the bachelor's thesis "Deviation of Atoms in a Rain of Thoughts. Definition of Clinamen According to Lucretius and Gilles Deleuze" (Tallinn University, supervisor: Professor Daniele Monticelli).

The Constitutional Law Endowment Special Prize for research in the field of constitutional law (1,500 euros) was awarded to **Birgit Aasa** for the doctoral thesis "The Principle of Mutual Trust in EU Law: What Is in a Name?" (European University Institute, supervisor: Professor Urška Šadl).

## ESTONIAN ACADEMY OF SCIENCES FOUNDATION

The aim of the Estonian Academy of Sciences Foundation, established at the Estonian National Culture Foundation in 2006, is to support the research work of young Estonian researchers with doctoral degrees. Since 2009, the Tiit Talpsep scholarship has supported the research of master's and doctoral students in the field of molecular microbiology and virology. The scholarships are awarded by the Administrative Board, comprised of the Academy members Mart Ustav, Leo Mõtus, Jaan Ross and Peeter Saari.

The 2021 scholarships were awarded to the following young researchers:

- **Marju Raju** (Estonian Academy of Music and Theatre, Researcher, a founding member of the Estonian Young Academy of Sciences): the Young Scientist Scholarship (4,500 euros);
- **Silva Lilleorg** (University of Tartu, Junior Research Fellow): the Tiit Talpsep Graduate Student Scholarship (1,500 euros).

## ESTONIAN SCIENCE COMMUNICATION AWARD

The Estonian Science Communication Award has been granted since 2006. Its primary aim is to acknowledge remarkable members of the general public who have popularised science in Estonia, as well as to encourage the public to talk and write more about science. Funded by the Ministry of Education and Research, the prizes are jointly awarded by the Estonian Academy of Sciences and the Estonian Research Council. The competition was held for the 16th time in 2021. The appraisal panel, led by the Academy member Ene Ergma, selected the laureates from amongst 49 candidates.

The Tiiu Sild Memorial Lifetime Achievement Award for long-time systematic communication of sciences and technology was granted to the long-time astronomer of the Tõravere Observatory Tõnu Viik. Having worked in the field of astronomy for nearly 60 years, Viik has done cutting-edge science and has actively worked to make the Observatory known in Estonia and abroad and to ensure that people know how knowledge in astronomy helps us understand life on Earth.

The Grand Prize for the Best Communicator of Science and Technology was awarded to Jaan Aru, who is able to explain brain science grippingly to both kindergarten kids and ministries and to show that knowledge about the brain helps us to act more efficiently. The second place prizes went to the science journalist Jaan-Juhan Oidermaa, the computer science Professor Tanel Tammet and the materials scientist Andres Krumme. Motivational prizes were awarded to the promoter of linguistics Mari Uusküla and the author of popular YouTube videos Maxim Bilovitskiy.

The Grand Prize for Activities and Series of Activities Communicating Science and Technology was awarded to the curators of "Trinity – Art. Science. Science fiction", an eighth season summer exhibition of the Voronja Gallery's Tõnu Esko and Kaija Põhako-Esko, who succeeded in showing science from a new angle and in bringing it to people who otherwise would not have come into contact

with science. The second prizes were awarded to Riina Arvisto from the TalTech School of Technology for the “Young Engineer Programme” training series and to the GLOBE education and research programme, which has operated in Estonia for 25 years.

The second prize for science and technology communication via audiovisual and electronic media was awarded to educational chemistry videos that introduce natural sciences with the help of practical instructions made by the Science School of the University of Tartu and the teacher Joana Jõgela.

The second prize for science and technology communication via printed media was awarded to Ülar Allas for the article series “Viruses and Vaccines”. Allas was recognised for covering a topical subject and for his smooth and enjoyable style of writing. The motivational prize was awarded to Elo Reinik, who wrote “Fractal Geometry for Beginners or Weird Fractals”, a book that looks at the beauty of mathematics.

The Grand Prize for the best new initiative in science and technology communication was awarded to Kristel Leif, the leader of the team creating the first Estonian solar car, Solaride. The second place prizes went to the Facebook initiative “Ask the scientists all about the coronavirus” (the idea of Uku Haljasorg from the University of Tartu) and the Tick Web and Tick Map of the National Institute for Health Development and their inclusive science campaign “Post the Tick” (led by Julia Geller).

The prize fund of the competition was 26,000 euros. Everyone who has received an award or recognition at the competition has the right to use the “Nationally Recognised Science Communicator” logo.

The results of the competition were announced and the awards were handed out at the science communication conference “Alternative Methods in Science Communication”, held at the Swissôtel in Tallinn on 11 November 2021.

## L'ORÉAL-UNESCO BALTIC SCHOLARSHIP

The L'Oréal-UNESCO “For Women in Science” global scholarship programme was founded in 1998, and since then L'Oréal and UNESCO have jointly contributed to research by increasing the number of female researchers and promoting gender equality in research. The programme acknowledges female researchers and helps them reach their goals and present their achievements to a broader audience. (see more pages 95–96)

The scholarship programme was created in Latvia by the programme's patron, Vaira Vīķe-Freiberga, the President

of the Republic of Latvia (1999–2007). Today, it is jointly managed by the Estonian, Latvian and Lithuanian academies of sciences and the UNESCO Baltic states national committees, and is the only support programme in the Baltic region to facilitate the professional development of female researchers and the achievement of goals important to them.

Each Baltic state grants one scholarship in a competition to a female doctoral degree holder of up to 40 years of age for carrying out research in natural sciences, environmental sciences, physics or engineering. In addition, Latvia grants two scholarships and Estonia and Lithuania one scholarship each to female doctoral students of up to 33 years of age for completing research in the aforementioned fields.

In 2021, the recipients of the 6,000 euro scholarship of the L'Oréal Baltic programme were:

- Kaija Põhako-Esko (see more pages 95–96)
- Mari-Ann Lind (see more pages 95–96)

The applications submitted to the competition in Estonia were assessed by a committee composed of the Academy members Kalle Kirsimäe (Chair) and Krista Fischer, Professor Malle Krunk and the members of the Estonian Young Academy of Sciences Els Heinsalu and Karin Kogermann.

## SPECIAL PRIZES AT THE NATIONAL CONTEST FOR YOUNG SCIENTISTS

The Academy's award committee granted special prizes to the following works:

- Ingel-Ethel Kanistik (Tallinn English College, 9th grade), “The Effect of Probiotic Lactobacillus on the Infection Response Caused by *Helicobacter pylori*” (supervisors: Pirjo Spuul and Tiina Mägi).
- Maria Helene Tomberg (Gustav Adolf Upper Secondary School, 12th grade), “The Historical Truthfulness of the Tallinn Old Town and the Surrounding Area Depicted in Indrek Hargla's Historical Crime Novel “Apothecary Melchior and the Mystery of St. Olaf's Church”” (supervisor: Anu Kell).
- Riho Männik (Ruila Basic School, 9th grade), “Hobby Archaeological Findings from the Ruila Region” (supervisor: Ingrid Kitt).

The committee included the Academy members Jaak Järv (Chair), Marco Kirm, Kalle Kirsimäe and Valter Lang, and the members of the Estonian Young Academy of Sciences Kerli Mõtus and Karin Kogermann.

## RECOGNITIONS FOR ACADEMY MEMBERS IN 2021

- Jaak Aaviksoo was awarded the Academy of Sciences medal and was elected an honorary member of the Estonian Union of the History and Philosophy of Science.
- Jaan Aarik and Jaan Eha earned the Academy's expression of gratitude for their work in the L'Oréal assessment committee.
- Krista Fischer was awarded the University of Tartu Medal.
- Vladimir Hižnjakov was awarded the Badge of Distinction "100 Semesters at the University of Tartu".
- Anne Kahru earned an expression of gratitude for her work in the L'Oréal assessment committee.
- Mart Kalm was awarded the certificate of an honorary member of the Estonian Association of Architects for his long-time outstanding work in promoting and studying architectural activities in Estonia.
- Jarek Kurnitski was recognised by the Federation of European Heating, Ventilation and Air Conditioning Associations (REHVA) for his work as the leader of the COVID-19 expert group in preparing the European ventilation guidelines.
- Enn Lust was awarded the University of Tartu Grand Medal.
- Lauri Mälksoo was awarded the University of Tartu Medal.
- Ülo Niinemets was named the 2021 Scientist of the Year by the Estonian University of Life Sciences.
- Arvo Pärt was awarded the Grand Cross of the Order of Merit of the Federal Republic of Germany.
- Anu Raud's Centre at Heimtali was presented with the Grand Prize of the annual Deed of Culture 2020 award.
- Jaan Ross's translation of Theodor W. Adorno's "Philosophy of New Music" was nominated for the Cultural Endowment of Estonia's annual literature award among translations of thought-provoking works published in 2020.
- Mart Saarma was named an Honorary Doctor of the University of Tartu, and the Royal Swedish Academy of Sciences elected him a foreign member. He was also awarded the Academy of Sciences medal.
- Tiit Tammaru was awarded the medal of the Baltic academies.
- Tõnu-Andrus Tannberg was awarded the University of Tartu Medal.
- Mart Ustav was awarded the Badge of Distinction "100 Semesters at the University of Tartu", and his bronze footprints were added to the Tartu Pathfinders' Walk on the pavement outside of the Tasku Centre in Tartu.

# INTERNATIONAL COOPERATION

International cooperation within various organisations is an integral part of the Academy’s activities and communication network. Clause 2 (2) 2) of the Academy of Sciences Act stipulates: “In order to perform its functions, the Academy shall [---] develop international academic cooperation.” The Academy has traditionally represented and still represents Estonian science and scientists in a number of European and global science organisations (see pages 82–84).

## INTERNATIONAL PROFESSIONAL ASSOCIATIONS

The Academy continues to support the ties of Estonian scientists with international professional science associations (prioritising the professional associations that have joined the ISC) and international science organisations. Estonian scientists are represented in these by area-specific national committees and science societies. Since 21 January 2022, an ad hoc allocation from the Ministry of Education and Research has been used to pay the membership fees for the following international organisations:

<b>International organisation</b>	<b>Contact organisation in Estonia</b>
Consortium of European Taxonomic Facilities (CETAF)	Committee on Phylogeny and Taxonomy of the Estonian Academy of Sciences Contact: Urmas Kõljalg, <a href="mailto:urmas.koljalg@ut.ee">urmas.koljalg@ut.ee</a>
European Chemical Society (EuChemS)	Estonian Chemical Society Contact: Margus Lopp or Jaak Järv, <a href="mailto:info@keemiaselts.ee">info@keemiaselts.ee</a>
European Marine Board	Committee on Marine Sciences of the Estonian Academy of Sciences Contact: Tarmo Soomere, <a href="mailto:soomere@cs.ioc.ee">soomere@cs.ioc.ee</a>
European Physical Society (EPS)	Estonian Physical Society Contact: Kaido Reivelt, <a href="mailto:kaido.reivelt@ut.ee">kaido.reivelt@ut.ee</a>
European Polar Board (EPB)	Estonian Polar Research Committee Contact: Rein Vaikmäe, <a href="mailto:rein.vaikmae@taltech.ee">rein.vaikmae@taltech.ee</a>
International Astronomical Union (IAU)	Estonian National Committee on Astronomy Contact: Laurits Leedjärv, <a href="mailto:leed@aai.ee">leed@aai.ee</a>
International Association of Geomorphologists (IAG)	Estonian National Committee of IAG Contact: Tiit Hang, <a href="mailto:tiit.hang@ut.ee">tiit.hang@ut.ee</a>
International Federation of Automatic Control (IFAC)	Estonian Association of Engineers / Estonian Society of System Engineers Contact: Sven Nõmm, <a href="mailto:sven@cc.ioc.ee">sven@cc.ioc.ee</a>
International Geographical Union (IGU)	Estonian Geographical Society Contact: Hannes Palang, <a href="mailto:geograafiaselts@gmail.com">geograafiaselts@gmail.com</a>
International Mathematical Union (IMU)	Estonian National Committee for Mathematics Contact: Mati Abel, <a href="mailto:mati.abel@ut.ee">mati.abel@ut.ee</a>

International organisation	Contact organisation in Estonia
International Union of Geodesy and Geophysics (IUGG)	Estonian Geophysical Committee Contact: Piia Post, piia.post@ut.ee
International Union of Geological Sciences (IUGS)	Estonian National Committee for Geology Contact: Kalle Kirsimäe, kalle.kirsimae@ut.ee
International Union of the History and Philosophy of Science, Division of Logic, Methodology and Philosophy of Science (IUHPS/DLMPS)	Division of Methodology and Philosophy of Science of the Baltic Association for the History and Philosophy of Science at the Estonian Association for the History and Philosophy of Science Contact: Peeter Mürsepp, peeter.muursepp@taltech.ee
International Union of Pure and Applied Physics (IUPAP)	Estonian National Committee for IUPAP Contact: Marco Kirm, marco.kirm@ut.ee
International Union for Quaternary Research (INQUA)	Estonian National Committee for INQUA (ESTQUA) Contact: Tiit Hang, tiit.hang@ut.ee
International Union of Theoretical and Applied Mechanics (IUTAM)	Estonian National Committee for Mechanics Contact: Andrus Salupere, salupere@ioc.ee
Thesaurus Linguae Latinae (TLL)	Estonian Academy of Sciences Contact: Anne Lill, anne.lill@ut.ee

## EURAXESS

The Academy of Sciences takes part in the work of the pan-European information resources network EURAXESS, created by the European Commission. Its mission is to support the careers (including mobility) of scientists. The network provides advice to researchers who move between countries for work and their family members in solving administrative and practical problems.

In 2021, the activities of EURAXESS were affected by great substantive changes and the pandemic. On an international level, it was a year of changes in the network in connection with the beginning of a new research and innovation framework programme: the European Commission's expectations for the network were established and the leaders were replaced. The former main focus – supporting the relocation of researchers and their family members – was expanded to also include supporting the career advancement of researchers on a broader scale. The members of the EURAXESS network were able to participate in international online training courses. Important activities included mediating information from international organisations to Estonian research institutions, responding to enquiries and providing advice on practical issues. The most complicated type of advice involved helping foreign researchers cross borders during the COVID-19 pandemic: all of the consultation processes were longer than before (due to frequently changing requirements/restrictions).

## INTERNATIONAL EXCHANGE PROGRAMME

In 2021, the Estonian Academy of Sciences supported the visits of 16 researchers (114 days in total) on the basis of bilateral research cooperation agreements and the proposals of partner academies. Estonian researchers used the opportunities offered by the international exchange programme on 15 occasions (130 days in total). In connection with the postponed research visits in the past two years (due to restrictions aimed at preventing the spread of COVID-19), the academies decided to extend the Estonian–Hungarian research cooperation projects of 2019–2021 until 30 June 2022 and the Estonian–Polish research cooperation projects until 31 December 2023.

The Estonian Academy of Sciences and the Bulgarian Academy of Sciences will support the following research cooperation projects through academic researcher exchange in 2022–2023:

- *Experimental Study of diseases of honey bees (Apis mellifera L.) in Estonia and Bulgaria*  
Dr Risto Raimets, Chair of Plant Health at the Institute of Agricultural and Environmental Sciences of the Estonian University of Life Sciences  
Dr Delka Salkova, Institute of Experimental Morphology, Pathology and Anthropology with Museum of the Bulgarian Academy of Sciences

- *Production of composite materials with multifunctional properties: structural studies and application*  
Dr Valdek Mikli, Department of Materials and Environmental technology of the TalTech School of Engineering  
Dr Angelina Koleva Stoyanova, Georgi Nadjakov Institute of Solid State Physics of the Bulgarian Academy of Sciences
- *Religious definitions. Traditional beliefs and the opposition of nature and culture (new reality, theoretical approaches and interpretations)*  
Dr Mare Kõiva, Department of Folkloristics of the Estonian Literary Museum  
Dr Ekaterina Anastasova, Institute of Ethnology and Folklore Studies with Ethnographic Museum of the Bulgarian Academy of Sciences
- *Impact of mineralogical compositions on the crystal-chemical and thermal properties of environmentally friendly effective composites*  
Dr Tiit Kaljuvee, Laboratory of Inorganic Materials at the Department of Materials and Environmental technology of the TalTech School of Engineering  
Professor Vilma Petkova Stoyanova, Institute of Mineralogy and Crystallography “Acad. Ivan Kostov” of the Bulgarian Academy of Sciences
- *Thin new film made of multi-component metal oxide for a new generation of solar energy technology*  
Dr Olga Volobujeva, Laboratory of Photovoltaic Materials at the Department of Materials and Environmental technology of the TalTech School of Engineering  
Dr Maxim Ganchev, Central Laboratory of Solar Energy and New Energy Sources of the Bulgarian Academy of Sciences

Of the seven applications submitted in the application round of Estonian–Hungarian research cooperation projects, the following projects will be supported in 2022–2024:

- *Major and Minor Uralic Languages: Intersections and Mutual Impulses*  
Professor Gerson Klumpp, Tartu ülikooli eesti ja üldkeeleteaduse instituut  
Dr Éva Katalin Dékány, Hungarian Research Centre for Linguistics
- *Our Psychological Folkways: Approaches from Semantics, Pragmatics and Metaphysics*  
Professor Bruno Mölder, Institute of Philosophy and Semiotics of the University of Tartu  
Professor Demeter Tamás, MTA-BTK Lendület Morals and Science Research Group
- *Barospectroscopic study of the structural dynamics of photosystem II*  
Professor Arvi Freiberg, Institute of Physics of the University of Tartu  
Professor Garab Győző, Szegedi Biológiai Kutatóközpont Növénybiológiai Intézet
- *High magnetic field THz spectroscopy of magnetoelectric materials, spin-spiral magnets and spin liquids*  
Professor Toomas Rõõm, National Institute of Chemical Physics and Biophysics  
Dr Karlo Penc, Wigner Research Centre for Physics, Institute for Solid State Physics and Optics  
Globality and Locality in the modern-day folklore of Estonia and Hungary  
Dr Piret Voolaid, Estonian Literary Museum  
Dr Katalin Vargha, Research Centre for the Humanities, Institute of Ethnology

# ESTONIAN ACADEMY PUBLISHERS

Founded in 1994

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In cooperation with Estonian universities, the Estonian Academy Publishers continued publishing seven internationally peer-reviewed gold open-access scientific journals that are included in leading international databases. The journals have international peer-review teams and are placed in category 1.1 in the Estonian research information system ETIS.

All of the published scientific articles can be found in the Scopus database (an abstract and citation database of Elsevier Publishers). Clarivate Analytics' database Web of Science covers articles from six scientific journals:

- Acta Historica Tallinnensia
- Estonian Journal of Archaeology
- Estonian Journal of Earth Sciences
- Oil Shale
- Proceedings of the Estonian Academy of Sciences
- Trames. A Journal of the Humanities and Social Sciences

Information about the publications of the Academy Publishers is provided by international electronic portals, such as EBSCO, CEEOL, The Gale Group Inc., ProQuest LLC, Airiti Inc. and CNKI Scholar Oversea Journals.

The DOAJ (Directory of Open Access Journals) database covers the journals Proceedings of the Estonian Academy of Sciences, Estonian Journal of Earth Sciences and Estonian Journal of Archaeology. The aim is to also register the rest of the Academy Publishers' journals in the DOAJ database.

The ERIH Plus database covers the journals Estonian Journal of Archaeology and Linguistica Uralica.

2021 was a jubilee year for the Estonian Academy Publishers: the journals Proceedings of the Estonian Academy of Sciences and Estonian Journal of Earth Sciences celebrated their 70th year of publication. Both of these

journals are considered the successors of the Proceedings of the Academy of Sciences of the Estonian SSR (*Известия Академии наук Эстонской ССР*), which was first published in 1952.

The first jubilee issue of the Proceedings of the Estonian Academy of Sciences contained three review articles:

- Engelbrecht, J., Tamm, K., Peets, T. 2021. Continuum mechanics and signals in nerves. doi.org/10.3176/proc.2021.1.02
- Rassõlkin, A., Orosz, T., Demidova, G. L., Kuts, V., Rjabtšikov, V., Vaimann, T., Kallaste, A. 2021. Implementation of Digital Twins for electrical energy conversion systems in selected case studies. doi.org/10.3176/proc.2021.1.03
- Hussain, A., Kamboj, N., Podgurski, V., Antonov, M., Goliandin, D. 2021. Circular economy approach to recycling technologies of post-consumer textile waste in Estonia: a review. doi.org/10.3176/proc.2021.1.07

In 2021, a total of 25 issues of the seven journals were published, containing a total of 171 articles: 146 scientific articles, 17 review articles, four reviews and four forewords. The electronic versions of the articles were published before the publication of the paper journals. The electronic versions of the Proceedings of the Estonian Academy of Sciences, the Estonian Journal of Earth Sciences and the Estonian Journal of Archaeology were published immediately after the final layouts of the articles were complete.

The published works were from 517 authors, of whom 233 were Estonian authors and 284 were foreign authors. The majority of the articles were published in English, except in *Linguistica Uralica* and *Acta Historica Tallinnensia*. The journal *Linguistica Uralica* included 26 Russian articles (59% of the articles), seven English articles (39%) and one German article. As a large number of the authors of this journal are Russian linguists of Finno-Ugric peoples, we consider the publication of Russian contributions very necessary.

The articles of *Acta Historica Tallinnensia* were mostly in Estonian, accompanied by English summaries; only two articles were in English.

The volumes of the journals in 2021:

Title (the first year of publication)	Number of issues per year	Total volume in pages	Format, mm
<i>Acta Historica Tallinnensia</i> (1997)	2	377	168×240
Estonian Journal of Archaeology (1952)	2	213	168×240
Estonian Journal of Earth Sciences (1952)	4	254	210×285
<i>Linguistica Uralica</i> (1965)	4	320	168×260
<i>Oil Shale</i> (1984)	4	359	168×255
Proceedings of the Estonian Academy of Sciences (1952)	5	548	210×285
<i>Trames</i> (1997)	4	483	168×240
<b>Total</b>	<b>25</b>	<b>2,554</b>	

Three thematic issues were published:

- Proceedings of the Estonian Academy of Sciences Vol. 70, Issue 4S, 2021: “Selected papers of the 3rd International Visual Physiology, Environment and Perception conference”; guest editors: Aiga Svede from the University of Latvia and Kristjan Kask from Tallinn University
- Proceedings of the Estonian Academy of Sciences Vol. 70, Issue 4: “Selected papers of the international conference Modern Materials & Manufacturing 2021”; the presiding professor of the conference was Kristo Karjust
- *Acta Historica Tallinnensia* Vol. 27, Issue 1, 2021: “On Saints, Migrants and Communists: Transnational Explorations in Estonian History”; guest editor Professor of Estonian and General History Karsten Brüggemann from Tallinn University

The homepage of the Academy Publishers was updated in 2021, visually and in terms of content and structure. The most important updates included a digital archive of journals and the option to order e-mail notifications of the publication of new issues of journals from the homepage.

The digital archive on the homepage of the Academy Publishers makes it possible to find old articles that have previously only been published in the paper versions of the journals. The full texts of the digitised articles can be

read online in the digital archive and downloaded as PDF files. All of the digitised articles have been assigned digital object identifiers (DOIs), which makes the articles easily linkable directly to the original source. Work is ongoing to make the summaries and links of the digitised articles available in the HTML format. This offers the opportunity to conveniently and quickly obtain an idea of the content of articles and to reach the original source via DOI addresses (if such exist) and to use them in creating new articles.

The digital archive is constantly being expanded, adding new articles. Over time, a search system will be developed which will make it possible to find articles by the name of the author or the title.

On 11 September, the Academy Publishers took part in the Literature Street Festival in Kadriorg, where it sold recent issues of scientific journals and books published in previous years.

On 14 October 2021, the Estonian Patent Office made a decision on the registration of the *Eesti Teaduste Akadeemia Kirjastus* trademark. In order to also ensure protection for the English trademark Estonian Academy Publishers, an application for the registration of the English name and logo was submitted to the Patent Office on 5 November 2021.

The Academy Publishers also published the Yearbook of the Society of Estonian Areal Studies in 2021.

# UNDER AND TUGLAS LITERATURE CENTRE

Founded in 1993 (the Affiliate Museum, formerly called the Friedebert Tuglas House Museum, founded in 1971)

Personnel: 14, including nine researchers

Address: Kohtu 6, 10130 Tallinn

Museum Department: Väikese Illimari 12, 11623 Tallinn

www.utkk.ee

Director: Jaan Undusk, 644 3147, jaan@utkk.ee

Academic Secretary: Marin Jänes, 644 3147, marin@utkk.ee

The Under and Tuglas Literature Centre of the Estonian Academy of Sciences (henceforth referred to as the Literature Centre) is an institution for research on literature and culture. Its main task is the complex investigation and theoretical modelling of the Estonian-language written culture in its entirety and the multilingual Baltic-German culture from earlier eras, thereby making the historical Baltic and the later Estonian realm of written culture visible, interesting and available for comparison with similar realms in international scholarship.

The main research areas of the Literature Centre are:

- Estonian literature and culture in the 20th and 21st centuries,
- Earlier Estonian and Baltic German written culture in the 13th–19th centuries and the role of the Baltic states' German- and Latin-speaking cultures in the development of modern Estonian culture,
- Mechanisms of identity formation of Estonian literary culture (spontaneous emergence, cultural transmission and entanglement),
- Rhetorical and discursive basic research on European and Estonian cultures,
- Environmental history research.

The Literature Centre publishes the results of its research, as well as cultural history source materials, and organises conferences, exhibitions and other events. The Literature Centre's Museum Department (henceforth referred to as the Museum) is the holder of the heritage of the writer and Academy member Friedebert Tuglas and of other collections, including the library and art collection of the Tuglas family, Artur Adson's and Marie Under's library and art collection, the art collection of the Estonian

Cultural Foundation in the USA, and the Paul Reets library and art collection. In total, these bequests form a collection that bridges literature, cultural history, the history of thought, art history and art criticism, which thanks to their enduring scientific value have earned a place in the Estonian national collection in the field of the humanities.

In 2021, the Literature Centre published four books. Two of these were published in the *Baltische Literarische Kultur (Baltic Literary Culture)* book series, which focuses on academic treatises and source publications of the German and Latin literature of the Estonian and Latvian regions, and which the Literature Centre publishes in cooperation with LIT-Verlag academic publishers. The founder and editor-in-chief of the series, Martin Klöker, who has worked at the Literature Centre since 2013, published the source publication *Caspar und Catharina. Eine Revaler Liebe in Briefen des 17. Jahrhunderts (Caspar and Catharina. Love in letters in 17th-century Tallinn)*. The book is the second volume in the series and contains 102 love letters from the period 1636–1652, sent to each other by the lawyer and secretary of the Estonian Knighthood Caspar Meyer and the Tallinn citizen Catharina von der Hoye. The original copies of the letters are preserved in the Tallinn City Archives, and the established chronology and the publication of the letters in a book is the result of meticulous detailed research by the compiler. The letters are published in the early modern style of writing and each letter is preceded by a thorough commentary with source references and an explanation of the contents in modern German.

As the third volume in the series, the Literature Centre published *Sub velis poeticis. Lateinische Gedichte (Under the sail of poetry. Poems in Latin)*, an edition with commentary of the collected poems of the Livonian humanitarian,

politician and lawyer David Hilchen, with a German translation. The edition was prepared, translated and edited by Kristi Viiding and Martin Klöker. David Hilchen's more than 40 Latin poems, which make up the earliest layer of Livonian political occasional poetry, have been gathered from his manuscripts and 16th–17th century prints, most of which have only one or two copies surviving. The poems are scattered across the whole of Eastern and Central Europe, mainly in the archives and libraries of Estonia, Latvia, Poland and Germany. The edition and the German translation, with commentary from the viewpoint of book, personal and literary history, are accompanied by a source-critical discussion of David Hilchen's biography and the role of poetry in his life, as well as a thorough analysis of the metres and verse forms of Hilchen's poems, with which Maria-Kristiina Lotman helped the compilers of the book.

As the seventh volume in the Oxy Mora series, which focuses on literary, art and cultural theoretical monographs, the Literature Centre published Rein Undusk's monograph in English, *The Rhetoric of Culture. The Case of Infinity*. The book discusses the dynamics of definitions in culture. Making a provisional claim that culture can largely be divided into three genres – aesthetics, rationality and theology – the book strives to describe the process of definition development and change based on the historical reception of the definition of infinity (from antiquity to classicism).

As a single publication, the Literature Centre published *Omnibusega ümber Põhja- ja Kesk-Euroopa. Väike Skandinaavia reisisaatja (A Little Travel Guide on Scandinavia)*, a book which describes the journey of the writers Karl Ast Rumor and Friedebert Tuglas to Scandinavia and Central Europe in 1931. The travel recollections previously published in different sources are now collected in one book, which is abundantly illustrated with materials from the research collection of the Literature Centre, particularly Tuglas's photos, postcards, travel booklets and media coverage, plus artworks and photo materials from the collections of several Estonian memory institutions. The book was compiled by Elle-Mari Talivee and Kri Marie Vaik, the afterword was written by Mart Kuldkepp and the book was designed by Tiiu Pirsko.

In close cooperation with the Literature Centre, the University of Tartu Press published *Keskused ja kandjad (Centres and Carriers)*, the first part of the multi-volume and multi-authored tome *Balti kirjakultuuri ajalugu (The History of the Baltic Literary Culture)*. The book provides an overview of the emergence and development of the institutional framework necessary for the functioning of literary culture in the Baltic area in the 13th–16th centuries, as well as of the development of the literary public and the forms and channels of communication between writers and readers. Liina Lukas is the editor-in-chief of the book, with

four employees of the Literature Centre included among the authors: Martin Klöker, Ulrike Plath, Jaan Undusk and Kristi Viiding.

2021 was not only substantive in terms of books; other weighty publications were also released. The Literature Centre's researchers presented the results of their research in 12 Estonian and eight foreign language academic articles, published 16 book reviews, translations of works of fiction, popular science articles and other writings. Elle-Mari Talivee earned the Annual Literature Award of the Cultural Endowment of Estonia for her article *Ühis-transport Eesti kirjanduses* ("Public Transport in Estonian Literature"), published in the previous year.

In connection with the Literature Centre participating in the Horizon 2020 scientific research innovation programme project "Envirocitizen – Citizen Science for Environmental Citizenship" (leading partner: the University of Stavanger in Norway; Estonian project manager: Elle-Mari Talivee), environmental history was one of the focal topics for the Centre in 2021. For instance, on 21 May the Literature Centre in cooperation with the Institute of Philosophy and Semiotics of the University of Tartu organised the web seminar "About the world-view of writers. A seminar about weather in literature" which was dedicated to the tenth year of operation of Tallinn University's Centre for Environmental History KAJAK. The sub-topic of the seminar series "Children in literature", organised with the Estonian Children's Literature Centre on 26 October, was "Children and the environment". In order to celebrate the 100th anniversary of the Estonian Ornithological Society, the virtual exhibition "Birds in the archives and in the museum" was opened on the homepage of the Literature Centre (curated by Elle-Mari Talivee and Marin Jänes from the Literature Centre). The exhibition offers fragments gathered from memory institutions on how birds have moved from the natural environment into folklore and folk art, books and commodities and from there to museums, archives and libraries. The Literature Centre's employees also took part in organising the second international Conference on the Environmental Humanities and Social Sciences (Baltehum II), held on 1 and 2 November. Approximately 150 scientists from Estonia and abroad attended the presentations of environmental humanities, sociology, anthropology, philosophy, semiotics, archaeology and ecocriticism on both conference days.

2021 was a year of important anniversaries at the Literature Centre. On 2 March, we celebrated 135 years since the birth of the Academy member and writer Friedebert Tuglas with several events. Due to the pandemic, the celebration was electronic for the first time and attracted a record number of participants on the Literature Centre's homepage and social media channels. The events included a

literary walk along the revolutionary trail of young Tuglas, from the Volta factory to Toompea, with Mart Juur, Andrus Kivirähk and the dog Robin symbolically making the journey which Tuglas made in December 1905, when he was arrested in the basement of the Volta factory and was then imprisoned on Toompea. To celebrate the anniversary of Tuglas's birth, the Literature Centre released its photo and postcard collection on the Estonian photo heritage crowdsourcing platform [ajapaik.ee](http://ajapaik.ee), where the day was celebrated with a crowdsourcing event that included amateur research activities and the launch of jointly adding data to the postcards and photos collected by Tuglas. The anniversary also included the presentation of the book of Tuglas's and Karl Ast Rumor's travels, *Omnibusega ümber Põhja- ja Kesk-Euroopa (Round Central and Northern Europe on an Omnibus)* (Literature Centre, 2021). An exhibition of the same name was opened at the museum and a part of the exhibition was also displayed in the Tuglas museum corner of the Ahja library. Together with the Estonian Writers' Union, the authors of the best short stories were, as is traditional, awarded on the anniversary of Tuglas. The Friedebert Tuglas Short Story Award is the oldest continuously awarded Estonian literary award and was awarded for the 51st time. The jury, on which the Literature Centre was represented by Kristi Viiding, chose to bestow the award on Lilli Luuk for the short story *Kolhoosi miss* ("The Miss of the Collective Farm") and Tauno Vahter for *Taevas Tartu kohal* ("The Sky above Tartu"). Although the laureates were announced on 2 March, the festive bestowal of diplomas and medals was postponed until restrictions were lifted and took place on 18 June in the garden of the Museum of the Literature Centre.

The Museum of the Literature Centre celebrated its 50th year of operation in autumn. When he bequeathed his cultural collections to the Estonian Academy of Sciences, Tuglas hoped that a house museum/research centre would be founded at his post-war home in Nõmme. On 28 September 1971, the Academy of Sciences did, indeed, found the Friedebert Tuglas House Museum, which in 1993 became a part of the Literature Centre. The event was celebrated together with the Estonian Literature Centre, a good cooperation partner that celebrated its 20th year of operation in autumn.

The Literature Centre's largest international event was the conference "Poetry Is a Noble Fright", organised with the Estonian Literary Museum in the annual conference series of the Centre of Excellence in Estonian Studies, "Dialogues with Estonia" (Mirjam Hinrikus and Aare Pilv were the organisers from the Literature Centre). The conference was held on 9 and 10 December and included scientific presentations, as well as sound poetry performances, happenings and a stage programme by theatre

students, and was dedicated to the 100th anniversary of the birth of Ilmar Laaban, one of the most avant-garde authors in the history of Estonian literature. As a part of the conference, the Literature Centre opened a virtual exhibition on its homepage (Marin Jänes was the curator from the Literature Centre), which explores the activities of Ilmar Laaban as a translator of Estonian poetry on the basis of his manuscripts.

Throughout the year, employees of the Literature Centre presented the results of their research at various Estonian and international conferences and seminars. We would like to highlight Mirjam Hinrikus' presentations "Nietzschean decadence in Estonia and in the works of Tammsaare" at the 16th autumn conference of the Museum of A. H. Tammsaare, "A Modern Myth", and "Mimetic Relationships between Life and Art" at the Estonian Literature Museum's seminar "Curriculum vitae – the meeting place of life, history and literature. Rutt Hinrikus 75"; Marin Jänes's and Elle-Mari Talivee's presentation "The travel and weather map of a political refugee from the Baltics from the early 20th century" at the Baltic Conference on the Environmental Humanities and Social Sciences; Hegely Klaus's presentation "Proletarian children and their environment in the proletarian literature of the early 20th Century" and Elle-Mari Talivee's presentation "The (pre) echoes of major environmental disasters in the children's literature of Soviet Estonia" at the conference "Children in Literature" at the Estonian Children's Literature Centre; Martin Klöker's presentations "Verdichtung in der verbotenen Liebeskorrespondenz des 17. Jahrhunderts. Produktive Aneignung, Bearbeitung und Plagiat im Schreibprozess" at the conference "Formen, Praktiken, Dynamiken literarischen Schreibens vom Mittelalter bis zur klassischen Moderne" in Osnabrück, and "How we can make use of any verse in common life. Seat and function of early modern poetry in literary culture" at the 14th conference of the Estonian Association of Comparative Literature, "The factor of lyrical poetry in the formation of literary cultures", at the University of Tartu; Jaan Undusk's presentations "Über das schicksal der Herder-bibliothek. Eine wortmeldung" at the August von Kotzebue conference at the Academic Library of the Tallinn University, and "On the boundaries of morals and reasonability" at the conference of the Estonian Chamber of Culture, "Humans on the boundaries from the viewpoint of different areas of science" at the Estonian Academy of Sciences; Kristi Viiding's presentations "Key genres and texts of Estonian and Livonian renaissance humanism" and "David Hilchen – a key figure in the transmission of Knowledge to Livonia at the turn of the 16th and 17th Centuries" and the workshop "Taking Notes in Law Studies: David Hilchen's Guidelines in Dikaiomatheia. Genres of academic note-taking:

The many-facets of knowledge production in medieval and renaissance Europe” at the Institute of Philosophy and Sociology of the Polish Academy of Sciences.

In addition to academic events, the Literature Centre also took part in several events aimed at the general public. The Estonian Embassy in Berlin hosted a discussion between Jaan Undusk and Cornelius Hasselblatt on the topic “History and histories – Estonia and Germany reflected in their literature”, which focused on the coverage of Estonian cultural history and history in German-language literature. The Centre also participated in the presentation of various publications whose authors included the employees of the Literature Centre. For instance, the presentations of “The history of Baltic literary culture” (University of Tartu, 2021) were held in German and Estonian, with Martin Klöker participating in the former and Jaan Undusk and Kristi Viiding in the latter. The Literature Centre also attended the presentation of the compilation *A Rose on the Heath. Goethe’s Poetry in Estonian* (University of Tartu, 2021), one of the translators of which was Jaan Undusk. Jaan Undusk also participated in the presentation and discussion evening to celebrate the publication of the article compilation “Carl Gustav Jochmann, ein Kosmopolit aus Pärnu” (“Carl Gustav Jochmann, a Cosmopolitan from Pärnu”, Jochmann-Gesellschaft and the Literature Centre, 2020) in Heidelberg, where he gave the presentation “Geheime Mission Öffentlichkeit”. From the autumn of 2020 until the summer of 2021, Kristi Viiding from the Literature Centre and Maria-Kristiina Lotman conducted a translation course with weekly workshops called “Children and Childhood in Greek and Roman Sources” at Academia Artium Liberalium in Tartu, which ended with the publication of a selection of translations from authors of diverse backgrounds and in different genres, “The Most Beautiful Adornments. Children in Antique Literature” (Academia Artium Liberalium, 2021). The Literature Centre also took part in debates on social issues, mainly on topics related to research and higher education; for instance, Kristi Viiding took part in the discussion group organised by the Estonian National Library, “About the Inevitability of the Humanities” and Mirjam Hinrikus took part in the round-table “Literature Studies at Universities” at the summer school for literary scientists.

The Museum of the Literature Centre continued to focus on development activities in 2021 (Digitisation Specialist: Kri Marie Vaik). In the framework of the Ministry of Culture’s Action Plan for the Digitisation of Cultural Heritage 2018–2023, Friedebert Tuglas’s photo negatives mainly created in 1900–1940 were digitised. The description and entering of photo negatives in the Museums Public Portal information system MuIS continued in 2021 and everyone can now access information on 2,200 negative images, of

which 1,500 have been entered together with digital images. The foreign Estonian archiving grant from the Estonian National Archives was used to digitise 400 pieces of art from the collection of the art and literature critic Paul Reets, of which there were not yet permanent archived digital images. The applied art collection of Paul Reets was also entered in the database, together with digital images. From the art collection of Friedebert Tuglas, we digitised and conserved Aleksander Tassa’s “Temple of Amor in Versailles” and Voldemar Kangro-Pool’s “Portrait of Friedebert Tuglas”. A reproduction was made of the portrait of the yet unidentified member of the Siuru literary group on the back of the latter painting. In total, 750 permanent archive files were added to the art collection in the database. The digitisation of editors’ notes and dedications from the library of Marie Under and Artur Adson also continued in 2021. More than 2,000 image files were added to the database. By the end of 2021, information about more than 35,000 archival documents from the science collections of the Literature Centre was entered in MuIS. More than half of these include digital images and the information contained in these is reflected on the homepage of the Literature Centre. Development activities have opened up new opportunities to explore the collections, and Museum employees also gave general presentations of the collections at various conferences: for instance, Elle-Mari Talivee and Kri Marie Vaik gave the presentation “Karl Ast Rumor and the digitized collections of Friedebert Tuglas” at the 14th Conference on Baltic Studies in Europe (CBSE) in Uppsala, and Hegely Klaus, Elle-Mari Talivee and Kri Marie Vaik gave the presentation “Secrets of the Friedebert Tuglas house museum: founding a memory institution during the era of stagnation” at the 13th conference of Baltic literary scholars, “Shifting Literary Culture since Stagnation in the Brezhnev Era”, in Riga.

Due to the recent development work performed at the Museum, the remote use of science collections became more frequent in 2021: the files of the collections of the Literature Centre were accessed on information systems 240,904 times. Offering digital solutions for reviewing museum exhibits and using the collections proved particularly important during the pandemic, when the Museum could accept significantly fewer guests than in previous years: only 200 over the whole year. Due to the pandemic, most museum events were held online and the Museum carried out various cooperation projects to find ways to offer museum education under those difficult conditions. The video clips introducing the works of Estonian writers created in the framework of the project “Tähtse kiirkursus” (“A Crash Course on Star Objects”), carried out in cooperation with the Association of Estonian Writers’ Museums, won the Estonian museum annual award,

the Museum Rat, in the museum education promoter category. Animated clips of the works of Estonian classics and as yet undiscovered pearls, together with study materials, are accessible in the Opiq.ee environment, and teachers can integrate these into their literature lessons. In order to increase cooperation between memory institutions and present the contents of the collections of memory institutions to the public, the Literature Centre initiated the virtual exhibition “Birds in the Archive and Museum”, in which environmental topics are mainly approached through humanities and arts collections.

There was very close cooperation with higher education establishments, and a great emphasis was placed on research organisation activities. The Literature Centre continues to be a practical training base for Tallinn University and the University of Tartu, with the employees of the Literature Centre providing instruction to undergraduate and doctoral students. The employees conducted lecture courses and seminars at Tallinn University, the University of Tartu, the Estonian Academy of Music and Theatre, Academia Artium Liberalium, and the Institute of Philosophy and Sociology of the Polish Academy of Sciences (with participation by Hegely Klaus, Piret Kruuspere, Ulrike Plath, Elle-Mari Talivee, Jaan Undusk and Kristi Viiding). The Literature Centre participates in the work of the Tallinn University Academic Library, the Research Council of the Estonian National Library and the Doctoral Council of the Estonian Academy of Music and Theatre (Jaan Undusk), the Tallinn University Centre for Environmental History KAJAK and the Council of the Estonian Ornithological Society Birdlife Estonia (Elle-Mari Talivee), the Tallinn University Senate (Ulrike Plath) and the Board of the Estonian Writers’ Union (Aare Pilv), and is linked to many other organisations. Jaan Undusk is a member of the Jaan Kross Literary Award jury and Elle-Mari Talivee is a member of the Estonian-Latvian Language Award jury and the Article and Essay Award jury of the Estonian Cultural Endowment

Annual Awards, and is a member of the Estonian Bird Names Committee and the Ichthyological Terminology Committee. Kristi Viiding continues to lead the work of the International Association for Neo-Latin Studies as its secretary. In addition to the above, the employees of the Literature Centre take part in the work of several other organisations and juries, belong to the panels of various scientific publications and participate in peer reviews of contributions to scientific journals. At the end of 2021, the Estonian Research Council decided to finance the research project “The Emergence of a Civilised Nation: Decadence as a Transition in 1905–1940”, led by Mirjam Hinrikus. The Literature Centre thereby gained a new international research group that will, in the coming five years, focus on the decadent literature, visual art, history of thought and music produced in the small Baltic and Nordic cultures at the beginning of the 20th century in comparison with that produced in Western Europe.

The Literature Centre moved to Kohtu Street, on the slopes of Toompea Hill, in 2021. Since its foundation in 1993, the Literature Centre had been located on Roosikrantsi Street in the heart of Tallinn, where premises had been allocated to the Centre’s predecessor, the Institute of Language and Literature of the Estonian Academy of Sciences, in 1981. The new location is in the building of the Estonian Academy of Sciences, which now houses the Academy of Sciences Publishers, which was there before, and the Literature Centre. In addition to the synergy created from cooperation between the three institutions, the building itself is important, as is its courtyard, with a gravestone inscription from the 14th century, which is one of the earliest gravestone inscriptions preserved in Estonia. After all, multilingual Baltic-German literary culture is one of the areas of research of the Literature Centre and a site closely connected with science and Baltic-German culture is therefore a fitting location for fulfilling the tasks of the Literature Centre.

# INSTITUTIONS AND ORGANISATIONS ASSOCIATED WITH ACADEMY

As specified in the Estonian Academy of Sciences Act, passed in 1997, research and development institutions and cultural establishments which are not part of the structure of the Academy, and academic societies or other organisations whose activities and objectives comply with the activities and objectives of the Academy may associate with the Academy. The association is effected under bilateral

agreements that state the aims of association and the tasks and commitments of the parties. Short information on the activities of associates institutions and organisations see pages 108–115.

Institutions associated with the Academy (in alphabetical order):

	<b>Institution</b>	<b>Information and contacts</b>
1.	Academic Library of Tallinn University Associated with EAS since 17.06.1998	Founded in 1946 Personnel: 95, including 2 researchers Registered users: 37,140 Items in the circulating collection: 2,666,348 More information: <a href="mailto:tlulib@tlulib.ee">tlulib@tlulib.ee</a> <a href="http://www.tlu.ee/en/repositories/academic-library">www.tlu.ee/en/repositories/academic-library</a>
2.	Art Museum of Estonia Associated with EAS since 9.06.2015	Founded in 1919 Personnel: 154 More information: <a href="mailto:muuseum@ekm.ee">muuseum@ekm.ee</a> <a href="http://kunstimuuseum.ekm.ee/en/">kunstimuuseum.ekm.ee/en/</a>
3.	Estonian Crop Research Institute Associated with EAS since 23.09.2008	Founded in 1920 Personnel: 145, including 45 researchers More information: <a href="mailto:info@etki.ee">info@etki.ee</a> <a href="http://etki.ee/en/">etki.ee/en/</a>
4.	Estonian Literary Museum Associated with EAS since 11.05.1999	Founded in 1909 as the Archival Library of the Estonian National Museum Personnel: 94, including 32 academic staff More information: <a href="mailto:kirmus@kirmus.ee">kirmus@kirmus.ee</a> <a href="http://www.kirmus.ee/en">www.kirmus.ee/en</a>
5.	Estonian National Museum Associated with EAS since 21.12.2006	Founded in 1909 Personnel: 140, including 18 researchers More information: <a href="mailto:erm@erm.ee">erm@erm.ee</a> <a href="http://www.erm.ee/en">www.erm.ee/en</a>

	<b>Institution</b>	<b>Information and contacts</b>
6.	Institute of the Estonian Language Associated with EAS since 11.05.1999	Founded in 1947 Personnel: 93, including 60 academic staff More information: eki@eki.ee www.eki.ee/EN/
7.	University of Tartu Tartu Observatory Associated with EAS since 8.05.1998	Founded in 1808, an institute of the University of Tartu since 1 January 2018 Personnel: 95, including 44 academic staff More information: kosmos@ut.ee kosmos.ut.ee/en

Learned societies and other organisations associated with Estonian Academy of Sciences (listed in alphabetical order)

	<b>Organisation</b>	<b>Information and contacts</b>
1.	Estonian Academic Agricultural Society Associated with EAS since 6.03.2018	Founded in 1920 Membership: 209 active members, 31 honorary members, (incl. 3 honorary presidents) More information: aps.emu.ee/en/
2.	Estonian Academic Oriental Society Associated with EAS since 12.06.2018	Founded in 1935, re-established in 1988 Membership: 75 active members, 7 honorary members, 27 correspondent members More information: eao@eao.ee www.eao.ee
3.	Estonian Academic Theological Society Associated with EAS since 15.10.2019	Founded in 1921 Membership: 65 members, 2 honorary members More information: usuteadus.ee/
4.	Estonian Association of Engineers Associated with EAS since 23.09.2008	Founded in 1921 as the Estonian Society of Engineers Re-established on 10 December 1988 as the Estonian Association of Engineers Membership: 18 legal entities More information: inseneronlooja@hot.ee www.insener.ee/
5.	Estonian Association of Sociologists Associated with EAS since 18.06.2019	Founded in 1990 as the Academic Association of Estonian Sociologists, restructured in 1999 Membership: 105 More information: sotsioloogideliit@gmail.com sotsioloogia.ee/in-english-2/
6.	Estonian Biochemical Society Associated with EAS since 13.11.2009	Founded in 1959 Membership: 106 members, incl. 80 active and 26 student members More information: katrina.laks@ttu.ee biokeemiaselts.ee/en/
7.	Estonian Chemical Society Associated with EAS since 5.04.2011	Founded in 1919 Membership: 75 active members More information: info@keemiaselts.ee www.keemiaselts.ee/english

	Organisation	Information and contacts
8.	Estonian Economic Association Associated with EAS since 16.06.2011	Founded in 1930, re-established in 2002 Membership: 121 private persons and 4 legal entities More information: <a href="http://emsconference.org/">emsconference.org/</a>
9.	Estonian Geographical Society Associated with EAS since 27.01.1998	Founded 1955 Membership: 180, 17 honorary members, 5 foreign members More information: <a href="mailto:egs@egs.ee">egs@egs.ee</a> , <a href="mailto:geograafiaselts@gmail.com">geograafiaselts@gmail.com</a> <a href="http://egs.ee/">egs.ee/</a>
10.	Estonian Learned Society in Sweden Associated with EAS since 19.03.1999	Founded 1945 Membership: 87 members, incl. 3 honorary members More information: <a href="mailto:teadusselts@gmail.com">teadusselts@gmail.com</a> <a href="http://www.etsr.se">www.etsr.se</a>
11.	Estonian Literary Society Associated with EAS since 23.01.2001	Founded 1907 Membership: 262 members (incl. 43 life-time members, 3 honorary members and 18 trusted members) More information: <a href="mailto:eks@kirjandus.ee">eks@kirjandus.ee</a> <a href="http://tartu.kirjandus.ee/en">tartu.kirjandus.ee/en</a>
12.	Estonian Mathematical Society Associated with EAS since 26.02.2019	Founded 1926 as the Academic Mathematical Society, re-established on 17 September 1987 as the Estonian Mathematical Society Membership: 351 members More information: <a href="http://matemaatika.eu">matemaatika.eu</a>
13.	Estonian Mother Tongue Society Associated with EAS since 4.02.1998	Founded 1920 Membership: 375 active members and 17 honorary members More information: <a href="mailto:es@eki.ee">es@eki.ee</a> <a href="http://www.emakeeleselts.ee">www.emakeeleselts.ee</a>
14.	Estonian Musicological Society Associated with EAS since 21.06.2004	Founded 1992 Membership: 93 active members (4 from abroad), 1 honorary member More information: <a href="mailto:emts@hot.ee">emts@hot.ee</a> <a href="http://www.muusikateadus.ee">www.muusikateadus.ee</a>
15.	Estonian Naturalists' Society Associated with EAS since 23.01.1998	Founded 1853 Membership: 9 honorary members, 668 active members, 57 trustees Divisions: 23 More information: <a href="mailto:elus@elus.ee">elus@elus.ee</a> <a href="http://www.elus.ee/index.php/en/">www.elus.ee/index.php/en/</a>
16.	Estonian Physical Society Associated with EAS since 14.06.2005	Founded 1989 Membership: 163 active members More information: <a href="mailto:efs@fyysika.ee">efs@fyysika.ee</a> <a href="http://www.fyysika.ee/efs">www.fyysika.ee/efs</a>
17.	Estonian Semiotics Association Associated with EAS since 15.12.2009	Founded 1998 Membership: 71 More information: <a href="mailto:info@semiootika.ee">info@semiootika.ee</a> <a href="http://www.semiootika.ee">www.semiootika.ee</a>

	<b>Organisation</b>	<b>Information and contacts</b>
18.	Estonian Society for the Study of Religions Associated with EAS since 16.06.2011	Founded 2006 Membership: 57 active members, 1 honorary member More information: <a href="http://eaus.ee/en/welcome/">eaus.ee/en/welcome/</a>
19.	Estonian Society of Human Genetics Associated with EAS since 5.04.2011	Founded 2000 Membership: 123 active members, 1 legal entity (Asper Biogene) More information: <a href="mailto:estshg@ebc.ee">estshg@ebc.ee</a> <a href="http://estshg.ut.ee/">estshg.ut.ee/</a>
20.	Estonian Society of Toxicology Associated with EAS since 31.05.2017	Founded 1997 Membership: 66 active members More information: <a href="mailto:ets@kbfi.ee">ets@kbfi.ee</a> <a href="http://ets.kbfi.ee/">ets.kbfi.ee/</a>
21.	Estonian Union of the History and Philosophy of Science Associated with EAS since 4.02.1998	Founded 1967 Membership: 57 active members, 12 honorary members, 6 collective members More information: <a href="mailto:kaija.koovit@gmail.com">kaija.koovit@gmail.com</a> <a href="http://et.wikipedia.org/wiki/Teadusajaloo_ja_Teadusfilosoofia_Eesti_%C3%9Chendus">et.wikipedia.org/wiki/Teadusajaloo_ja_Teadusfilosoofia_Eesti_%C3%9Chendus</a>
22.	Estonian Young Academy of Sciences Associated with EAS since 14.12.2021	Founded 2017 Membership: 33 active members More information: <a href="mailto:enta@akadeemia.ee">enta@akadeemia.ee</a> <a href="http://www.akadeemia.ee/en/eyas/">www.akadeemia.ee/en/eyas/</a>
23.	Learned Estonian Society Associated with EAS since 23.01.2001	Founded 1838 Membership: 111 active members and 17 honorary members More information: <a href="http://oes.ut.ee/english/">oes.ut.ee/english/</a>
24.	Society of Estonian Areal Studies Associated with EAS since 27.01.1998	Founded 1939 Membership: 176 More information: <a href="mailto:ekus@ekus.ee">ekus@ekus.ee</a> <a href="http://www.ekus.ee/en/">www.ekus.ee/en/</a>

# IN MEMORIAM



Anto Raukas

17 February 1935 – 19 April 2021

In the beginning was the Word, according to Genesis, and some people deserve very many of them. A selection of them, and all justified. A diligent student. Gold medallist. Geologist. Aspirant (i.e. almost a doctoral student). Specialist in Quaternary. Candidate of Sciences (equivalent to a PhD). Junior research fellow. Senior research fellow. Avid sportsman. Junior national champion. A founder of orienteering in Estonia. Umpire in the All-Soviet category. Master of hiking. Honorary member of the Kalev sport society. Sector director. Department head. Doting spouse, father and grandfather. USSR Doctor of Sciences. Founder of a school of thought. Teacher. Supervisor of junior researchers. Professor. Academy of Sciences member. Member of the presidium of the Academy of Sciences and academic secretary of a department. Author or editor of hundreds of articles and dozens of books. Meritorious scientist. Organiser of student science activity. Editor-in-chief of a key international journal in his field. Organiser of conferences. Leader of scientific societies. Populariser of science. Developer of Estonian-language terminology. Scientific encyclopaedia editor. Tireless advocate for style in his mother tongue. Adviser to national leaders. Four-time recipient of the Estonian National Award for Science (1993, 1996, 2003 and 2015). Recipient of many medals.

Receiver of state decorations. Honorary citizen of Tallinn. One of Estonia's great people of the 20<sup>th</sup> century. Honorary scientist of Europe. Leading research fellow. For about ten days now, an onward journeyer.

The name Anto Raukas has been synonymous with “scientist” in Estonian society for decades. The kind of scientist who looks at things deeply, in the long term (which for a geologist means at least thousands and typically millions of years), and does not allow himself to be swayed by interpretations that merely change details. Someone who dared to be sure that Estonia would one day have a nuclear power plant, in his own backyard, if need be. Someone who understood that the results articulated in top science journals have to have applications in the economy. Someone who knew that without a robust processing industry and natural resource extraction, a country could not become wealthy, that they could both stimulate the economy and slow emigration. He was also a staunch advocate for a national geology service, for launching granite quarrying and, in the near future, begin phosphate rock quarrying in north-eastern Estonia.

His confidence was based on an immense amount of knowledge and practical experience. They were derived not so much from textbooks as from talking to the wisest

colleagues of his era, and naturally those who were in decision-making positions at the time. He was able to steer those decisions through his wisdom and by providing supporting evidence. It wasn't sufficient simply to communicate a message from a top scientist or to make controversial statements. More was needed. It took broad-based knowledge and a sense of the local and cultural contexts. He saw a professor above all as an elite scientist responsible for finding resources for himself and for his task forces. An academician also had to be a universal cultural phenomenon who understood the concerns of other fields and also helped solve the concerns of other scientists. And the greatest task of the Academy of Sciences was to stave off major foolishness.

Anto Raukas believed in expressing himself clearly and forthrightly, in a way that many people could understand. In this way, he was someone who pointed out ways to integrate science into society. One thing he certainly had no love for and probably avoided for that reason was flowery language and empty consolations, whether that involved championing the rights of owners, debates over climate change or selections of articles for "his" journal, or in a dozen other fields in which he made abundant contributions.

In his opinion, metrics were far from the only factor in an argument. It was no doubt because of this that he became the kind of scientific spokesperson for scientists who was always on the scene and ready to make a contribution. Not only on the front lines of science in his own

discipline but also via TV, radio, newspapers and books. He communicated through the spoken and written word and through images, invariably with his characteristic passion and marvellously articulate manner. It didn't matter whether he was talking about urgent problems of science, nature conservation or how to ensure Estonia's energy security. He knew precisely that to talk to the public and write a popular science article he had to know the subject particularly well and present it so that people understood it.

A particular notion often recurred in interviews with him: a scientist who stuck to his principles should inevitably have many enemies. However, he also believed that whoever had many enemies also had many friends! He certainly had a countless number of friends. They all now mourn their departed colleague, teacher, brother-in-arms and a congenial and wise man, someone who only comes along once in a long while.

Estonian Academy of Sciences  
Estonian Geographical Society  
Geological Society of Estonia  
Tallinn University  
Tallinn University of Technology  
University of Tartu  
Estonian University of Life Sciences  
*Sirp*, 30.04.2021, 17(3839), 11



Richard R. Ernst (foreign member of Academy)

14 August 1933 – 4 June 2021

The Academy has lost a Nobel Prize winner who was one of its foreign members.

Richard R. Ernst was born on 14 August 1933 in Winterthur, Switzerland, the son of an architect. In 1956, he graduated from the Zürich University of Technology (ETH Zürich) with a degree in chemical engineering and defended his doctorate in technology – specifically apparatus construction – in 1962. He was then hired as a researcher in a university physical chemistry laboratory and a year later moved to Palo Alto in Silicon Valley, where he worked for an early high-tech company, Varian Associates, and specialised in automating spectroscopic experiments. In 1968, Richard Ernst returned to Zürich University of Technology, where he worked his way up the academic ladder from associate professor to full professor (1976). He was a visiting professor at Harvard and delivered guest lectures in universities in the US, Canada and Germany. He was a professor emeritus from 1998 on.

Professor Ernst's scientific achievements in physics, especially in stochastic resonance methods, Fourier and multidimensional spectrometry and Fourier tomography, were groundbreaking. He was prolific in developing new physical theories and methods, combining them with all of the opportunities offered by state-of-the-art experimentation and computing technology. His physics-centred theoretical and applied research was complemented in recent decades with numerous applications in molecular biology and in the study of solid bodies. He has more than 350 scientific publications to his name and was the author of a number of inventions and a co-holder of patents.

The main core of his research was covered in the 1987 monograph "Principles of Nuclear Magnetic Resonance in One and Two Dimensions" (co-authors G. Bodenhausen and A. Wokaun), giving a thorough overview of the physical principles of multidimensional spectrometry. Ernst's research has had a significant influence on the development of chemistry and has been applied in other disciplines as well.

Besides his work as a researcher and teacher, Ernst was also involved for many years with the National Swiss Science Foundation and Swiss Research Council. He was the president of the ETH Zürich Research Commission (1990–1995), a member of the university board (1998–2006) and served on the editorial boards of numerous journals, including the Journal of Magnetic Resonance, Magnetic Resonance Imaging and Molecular Physics. He was a member of the London Royal Society, the (US) National Academy of Arts and Sciences, the Swiss Academy of Technical Sciences, the German Leopoldina, the Russian Academy of Sciences, the Indian Academy of Sciences, the American Physical Society and many other scientific associations, and held an honorary doctorate from a number of universities. He was elected a foreign member of the Estonian Academy of Sciences in 2003 in the field of physical chemistry.

In 1991, Richard R. Ernst was awarded a Nobel Prize in chemistry for outstanding achievements in the development of nuclear magnetic resonance spectroscopy methods. He was also the recipient of prestigious scientific prizes, including the Benoist Prize (1986), the Ampere Prize (1990) and the Louisa Gross Horwitz Prize (1991). Since 2012, the ETH Zürich magnetic resonance research and experimental laboratory has been known as the Richard R. Ernst Magnetic Resonance Facility.

Richard R. Ernst was greatly interested in questions related to the study and restoration of Central Asian paintings. To analyse and determine the pigments used in the ancient paintings, he made extensive use of Raman spectroscopy. He also invested a large portion of his Nobel prize money in Tibetan art. He was fond of enthusiastically relating his contacts with Tibetan monks and initiated courses and science education for Tibetan monks. Contacts between Occidental and Oriental world-views were of great interest to him. Ernst often gave public lectures on a topic dear to him: the social responsibility of scientists and teachers.

Estonian Academy of Sciences



## Arved-Ervin Sapar

7 February 1933 – 1 December 2021

A bright star in the firmament has gone out. A long-time denizen of the observatory town Tõravere and one of the bulwarks of Estonian astronomy, Arved-Ervin Sapar has concluded his worldly journey. We now need to get used to not seeing the light shining from the window of his office late at night.

This country boy from the village of Paatna, near Rakvere, managed to gather and disseminate a great deal of intellectual enlightenment. Having graduated from the University of Tartu in 1957 as a theoretical physicist, he became one of Estonia's most acclaimed astronomers. He was not so much enthralled with gazing up at the starry sky with a telescope as with the elegance and power of mathematics in describing that sky. In other words, what attracted Sapar was mainly theoretical astrophysics.

The scales of the phenomena we deal with often dictate a large part of the fundamentals of our thinking and logic. In the case of thinkers like Arved Sapar, who could be called a deep theoretical scientist, these scales determine how we perceive boundaries in time and space, and where we happen to find ourselves in the universe.

As befitting the times, Sapar's first scientific works examined the movements of Earth's man-made satellites. He soon turned to cosmology, trying to describe the origins and formation of the entire universe. Stars and the light emanating from them, models of sidereal atmospheres and the spread of electromagnetic radiation became his life's work.

A line from a traditional funeral song goes, "the sky behind the stars becomes bright". Astronomers, astrophysicists and cosmologists probably hear the words differently

from others, as they have devoted their lives to studying what is behind the stars. For them, solving the secrets of the universe is just as much an everyday occurrence as teaching, forestry or farming for others. For them, the stars in the sky are more like letters in the alphabet [the word for star and letter is the same in Estonian – ed], letters/stars that can be used to construct poems, essays, stories and novels.

Arved Sapar was the only astronomer in the Soviet Union who had a chance, in 1978, to look into the stars using NASA's International Ultraviolet Explorer. The processing of the magnetic tapes he took with him from the Goddard Space Flight Centre and writing about them would last for many years.

There are an immense number of stars, many more than letters in the alphabet or ideograms in Chinese or Japanese. There are immeasurably more atoms and particles in the microscopic world. But there are very few equations, constants and variables that govern the behaviour of all of them. Even merely finding, measuring and calculating the factors in an equation – without necessarily solving the equation – makes life easier for others, because each time something has become clearer about the universe's structure, the darkness on the other side of the horizon recedes and the world becomes more visible.

There is often confusion in society. Stars can behave in what appears to us a chaotic way. Turbulence is sometimes dominant in air and water: one of the biggest unsolved secrets of the world. The movements of particles within and around the stars may be even more complex. The stars radiate a whole spectrum of signals. Radiation on different wavelengths reaches us at different intensities.

And then there are the radiation signatures that tell of the origins of the universe. All of this is controlled by definite laws. Sapar's life's work, to put it briefly, was to analyse the equations describing these laws: to generalise and simplify them, finding individual solutions and imbuing them with meaning.

It isn't necessary to go into space yourself to study the stars. As to who becomes a star in the scientific world, one's colleagues decide. In 1990, Sapar became a member of the Estonian Academy of Sciences. On the occasion of his 80th birthday, in 2013, the name Sapar was bestowed on asteroid 28107. He had many students who defended their candidate's degrees, as they were known back then; in today's parlance, they are called doctorates. There are even more who got instruction from him on how to express their scientific ideas and thoughts in articles or presentations.

Sapar applied his investigative spirit to complicated language problems, the properties of the sensitivity of the human eye, semiconductor physics, photon statistics and a number of other topics. Many will remember him as a diligent lover of singing, a skilful wordsmith and a master

of doggerel. We are grateful that we had the chance to work with such a great man of Estonian science.

The stars will continue to shine even after those whose names are written in them depart this world. A thinker who tries to grasp the development of the world from its origins all the way to its possible end is always a great mind and, to a degree, a prophet, because by trying to solve the mysteries of the past he has insight into the future.

As Estonian President Lennart Meri said: "A country that has free access to the sea cannot be called a small country." A country and a people that is able to build and maintain at a global level such a specific branch of theoretical physics as the study of the universe's beginning and end, which the late Academy member Arved-Ervin Sapar pursued, cannot be considered small.

University of Tartu, Tartu Observatory  
Estonian Academy of Sciences  
*Sirp*, 10.12.2021, 49(3871), 38



Arvo Ots

26 June 1931 – 9 January 2022

An apostle of pyrolysis

Temperature close to 1500 degrees. Flames flickering through the bars of an iron grate, or from a burner. Like the entrance to hell. A terrestrial inferno. Actually, more of a furnace where oil shale is burned – a natural resource that largely gave birth to modern science in Estonia and which has served us well for more than a century.

Whoever has gazed into such a burner will not soon forget it. Fiery hot ash in huge quantities that flies everywhere and slowly wears down the walls of the chamber. Water being heated in those walls. The steam formed driving turbines that bring quiet and bright light into all of our homes. Or powering some appliance that has made our lives incomparably easier.

Someone has to know how that heat is created, how the rushing energy streams have to be fed, how much oil shale in what grades of coarseness have to be fed into the furnace, or how to clear away the ash and slag. How to build the shale-firing chamber and configuring the firing process so that it is least wasteful and most efficient, at the lowest cost.

Estonia has for many years been a world pioneer in the science. A key component in that discipline has now left our ranks. The Academy member Arvo Ots was the developer and guardian of this knowledge for decades. He was a scientist with a thankless mission, as Margus Maidla wrote 12 years ago.

Today, when the measure of people's modernity has become how savagely they can disparage oil shale energy, the loss is even more poignant. Luckily, Professor Ots was able to pass on his knowledge of how to turn this burning

rock into energy to hundreds of students. Without this knowledge, the existence of an information society based on a high-quality supply of energy would not even be possible. He preserved and developed further the fundamental knowledge in this field. He understood that the listener must be educated as well in order to debunk emotional reactions in regard to the energy sector. Like good government, he not only wanted to but also succeeded in making life better for all of us, through the simple knowledge that voltage (electrical pressure) has to be strong in a power socket. But social and political pressure is another matter: it has to be weaker. Now that he is gone, the pendulum of pressure will hopefully not swing to the other extreme.

His road to the front lines of technology began with his family background. His father was a role model who, as the headmaster of a small school, had to master many skills to function, from baptising children, making music and organising celebrations, to technical knowledge and fixing equipment, to giving the deceased a proper send-off. His grandfather, a blacksmith, was able to fix the technological wonders of his time. He learned from his parents that an engineer is a person who knows absolutely everything there is to know about technology and has studied it at university, so his career path was completely clear to him. He felt his calling was to become just that sort of engineer. And he did.

What led the future young scientist Arvo Ots to combustion processes isn't important any more. What is important is that whatever he did, he did with the utmost devotion: graduating cum laude from a technical university, completing his candidate's thesis (the equivalent of today's PhD)

in three years, and taking 10 years to write and defend his doctoral thesis at the highest level of the Soviet system. This was a work that created a new scientific discipline: how to use a poor-quality fuel in the best way possible. In principle, the solution is simple: you grind it to a fine powder and blow it into a burner along with ambient air so that the flames reach every burning particle. Nothing goes to waste.

In this way, Arvo Ots became a pioneer in the theoretical science of burning oil shale in his own country and around the world. He was the kind of thinker and engineer who knew how to observe, understand and optimise the complex processes taking place in huge, ultra-hot devices, as well as their effects on furnace walls. It is largely thanks to his research and engineering skills that the oil energy systems in Estonian power plants were developed, and that we have been able to enjoy a country that has energy independence, and can even share the wealth with others.

In his youth, old-fashioned iron-grate furnaces were replaced with circulating fluidised-bed boilers that made better sense and that made his abilities and intelligence even more important. The environmental impact was decreased dramatically, in some cases more than thousandfold. However, this knowledge was senselessly cast aside in the construction of the large new Auvere plant.

A year after defending his Soviet-era doctorate, Arvo Ots received what was very high recognition at the time: professorship. Back then this recognition was lifelong. Another dozen or so years went by, and Professor Ots was elected an Academy member. There his remit was energy. He managed to contribute to the Academy for close to four decades. His influence can be seen in the

work of the Academy's Committee on Energy, where he always, sometimes even inflexibly, relied on facts and figures and debunked pleasant emotional but often dead-end arguments. His contribution can still be clearly discerned in the Republic of Estonia's first Energy Act, in the first state energy strategy's vision, and in later energy sector development plans.

For more than 60 years, he contributed to the development of and teaching at the University of Technology, for close to 35 years of that time as a professor and then a professor emeritus and senior research fellow. Such people are noticed by every kind of government, under every political regime. On two occasions (in 1970 and 1980), Arvo Ots's work was awarded the Soviet Estonia science award, and in 1981 he was named a meritorious scientist of the Estonian SSR. After the restoration of independence, he was recognised even more widely. In 1996, Academy Member Arvo Ots was elected a foreign member of the Finnish Academy of Technology, in 2001 he was awarded the Estonian Academy of Sciences medal, in 2003 the Estonian Order of the White Star, Fourth Class, in 2006 the title of engineer of the year, and in 2010 the national lifetime achievement award.

To friends and family, he will undoubtedly be remembered as an avid skier and orienteer, as well as a serious music aficionado. We join his widow, son and daughter and their families in mourning his loss.

Estonian Academy of Sciences  
Tallinn University of Technology  
*Sirp*, 21.01.2022, 3(3875), 36



Ülo Lepik

11.07.1921–12.02.2022

Ülo Lepik was born on 11 July 1921 in Tartu. In 2021, when he turned 100, he became the oldest member of the Estonian Academy of Sciences ever. He was a 1940 graduate of the Treffner Secondary School and in the same year entered the University of Tartu, where he studied mathematics. Due to the war, his studies were interrupted twice and he received his degree, in physics, only in 1948.

In 1947, Lepik started work at the University of Tartu Chair of Theoretical Mechanics. He would serve there as a laboratory technician, teacher, senior teacher, head of chair and professor. In 1952, he defended his candidate's thesis (considered the equivalent of the modern PhD) on the topic of how the compressibility of material affects the stability of elastic-plastic panels, and in 1956 he was granted an associate professorship. Lepik enrolled in the doctoral programme at Moscow University and in 1959 he defended his dissertation in the Soviet research system on the balance of elastic-plastic panels and rods. He was elected an Academy of Sciences member in 1993 in the field of mechanics. He was named a University of Tartu professor emeritus in 1996.

Lepik was a mechanics scholar of international renown. He was considered a pioneer of plasticity theory and the optimisation of construction elements. At quite an advanced age, past 70, Lepik developed a keen interest in chaos theory and later in Haar wavelets and their possible applications for solving differential and integral equations. He was a co-author of a monograph on Springer as late as 2014.

Lepik also taught mathematics courses, such as variance theory and probability theory. He was the supervisor

of 13 defended doctorates and candidate dissertations. He published over 200 journal articles and three monographs, and was the author and co-author of many university textbooks. As an Academy member, Lepik was a member of a number of international scientific organisations and a member of the editorial board of several journals.

Lepik's works have been recognised many times. On three occasions (1982, 1989 and 1996), he was awarded a University of Tartu medal, in 1998 an Order of the National Coat of Arms of Estonia, Fourth Class, in 2001 an Estonian Academy of Sciences medal, in 2012 a Tartu Star, in 2014 the Harald Keres medal, and in 2016 a lifetime achievement award: the State Research Award.

### *A bridge from the interwar Republic of Estonia, across the war and Soviet occupation, to the Republic of Estonia*

Many feel the world is held up by only a few pillars. They are not of timber, stone or iron, but flesh and blood. We may not notice them when we look closely but their greatness becomes visible from a distance.

The number of years lived doesn't matter. It is much more important what these pillars have given us and how they have supported us, how the wisdom they have accumulated over long years has been gained, and how the combination of excellence and gravitas has crystallised. What matters is how such people have been able to surmount

all of the barriers that life has strewn in their path, while retaining the best human qualities despite all the difficulties. Maybe they have an uncommon talent for understanding that not all storms destroy your life. Some also clear dead-wood from your life's path.

Our valued colleague Ülo Lepik was such a pillar of the world for many decades: half a century of working as a university professor and a total of 70 years of brilliant science. The first award for his research came in 1948 when he was still a student. His last popular science article, on wavelets, appeared in *Postimees* in spring 2017.

He was the youngest professor at the university 65 years ago. He met new challenges in construction mechanics connected with the application of plasticity theory, in trying to create a better life for all of us. His masterful lectures, which were academic in the best sense of the word, supplemented by calligraphy-like notations and superb drawings, succeeded in making exceedingly complicated aspects simple and appealing.

For close to 30 years, we felt his support as an Academy member, the feeling that someone was beside you, an always forward-looking, benevolent spirit. For over a quarter century he was a professor emeritus. In his own words, he was a *Freiherr* who was able to dedicate himself completely to science. He was quite serious about that. Late in life, he was willing to delve into completely new fields: chaos theory and using Haar wavelets to solve differential and integral equations.

We marvel at his ability to apprehend what the future would be like and we should emulate that ability. Chaos has become a part of our lives. It was ten years ago that Lepik saw that there were many fields, from the sciences to economics, and in life generally, where chaos theory principles at least partially applied. Haar wavelets are the basic building blocks of complex curves, and are particularly well suited to the analysis of sudden jolts. In our lives, there are more and more such jolts and fewer and fewer smooth changes. So he understood that we can never know what might become salient and necessary, and he put that knowledge to use.

Of course, his excellence was expressed in both numbers and recognition. The Scopus database lists Ülo Lepik as the most often cited Estonian mathematician in 2010–2015. This type of honour is generally short-lived. But even now, Ülo Lepik is in the top 2% of scholars in terms of number of lifetime citations. He is in rarefied ranks, with barely 50 Estonian colleagues. Thanks largely to Ülo Lepik, Estonian mechanics has been as strongly on the map on both sides of the one-time Iron Curtain. Estonia has paid tribute to him with the Order of the National Coat of Arms, Fourth Class, and the Research Award for his lifetime achievement.

Awards come and go and decorations become tarnished. What is left behind of a person is measured in different ways, and not in how many foreign languages they speak or how many books are on their shelves. Lepik had a perfect command of the language of kindness: in Mark Twain's words, the language that the deaf can hear and the blind can see. He followed the wisdom of Confucius all his life: wherever you go, go there with all your heart. Whether it was family, colleagues or his attitude to life, to himself or to others, he was always connecting, never dividing or demolishing.

His student Andrus Salupere said Ülo Lepik's life in science was like a bridge linking the interwar Republic of Estonia with today's Republic of Estonia across the Soviet era. Ülo Lepik was able to embody scientific excellence in all of these eras, while remaining human. He was a Scientist with a capital S. He emanated a rare quality and was always a gentleman. In some strange way that transcended time, he was able to infect his colleagues and students with dignity, forthrightness and honesty. This type of influence makes the world a better place to live in, for all of us who remain behind in this world. We are eternally grateful to him.

Tarmo Soomere's eulogy to Ülo Lepik in the White Hall of the University of Tartu Museum, 19 February 2022  
*Sirp*, 25.02.2022, 08(3880), 37

# FINANCIAL ACTIVITIES

TYPE	BUDGET 2021	FUNDS SPENT 2021
<b>FOR THE ACADEMY FROM THE STATE BUDGET</b>	<b>1,734,000</b>	<b>1,734,000</b>
For the basic activities of the Academy	1,291,810	1,291,810
For remuneration to Academy members	293,090	293,090
For grants to Academy research professors	121,800	121,800
For granting research awards	27,300	27,300
<b>OTHER REVENUE</b>	<b>644,730</b>	<b>652,197</b>
Targeted allocations from the Ministry of Education and Research	594,400	594,400
<i>For the membership fees of international organisations</i>	44,400	44,400
<i>For repairs and renovations</i>	550,000	550,000
Received from the lease of premises and the sales of services	10,000	16,589
From the sales of journals and commissioned works (Academy Publishers)	40,330	41,208
<b>Allocations to the Under and Tuglas Literature Centre</b>	<b>421,898</b>	<b>382,795</b>
<b>TOTAL INCOME</b>	<b>2,800,628</b>	<b>2,768,992</b>
Basic activities of the Academy (via the Office)	1,031,810	1,219,685
Academy Publishers	310,330	296,135
Remuneration to Academy members	293,090	293,090
Remuneration to Academy research professors	121,800	121,800
Membership fees of international research organisations	44,400	42,502
Activities of the National Research Awards Committee	27,300	27,313
The Under and Tuglas Literature Centre	421,898	309,855
Repairs and renovations of the Academy's buildings	550,000	488,351
<b>TOTAL EXPENSES</b>	<b>2,800,628</b>	<b>2,798,731</b>

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The war in Ukraine is a nightmare in the heart of Europe, a crime without any rational justification and a flagrant violation of international law and the core principles on which the international rules-based order is built.

We need much more knowledge to identify, monitor and predict processes and decision-making chains in different cultures, and we need to learn how to react preventively to avoid such dreadful occurrences

The Academies cannot fight on the front line but they have a duty to provide the very best advice to their nations and governments. In recognition of this mission, we call on all Academies across Europe to consider in their advice to their nations and governments the need to join forces to help Ukrainians in their fight for their own future, to use every possible action to weaken the positions of the aggressor, and to further develop an understanding of processes that may lead to escalations of this type.

*Excerpt from the Estonian Academy of Sciences statement to European Academies of Sciences (26 February 2022). Full text of the statement together with declarations of other Academies and academic organisations see: [www.akadeemia.ee/en/news/academies-of-sciences-in-support-of-ukraine](http://www.akadeemia.ee/en/news/academies-of-sciences-in-support-of-ukraine).*

