Between 2007 and 2011, the Estonian Science Foundation organised a research cooperation programme called the European Economic Area (EEA) Financial Mechanism and the Norwegian Financial Mechanism in cooperation with the Ministry of Finance and the Ministry of Education and Research. Foreign aid allocated to the support scheme of the research cooperation accounted for 1.5% of the total amount of financial mechanisms allocated to Estonia of the period. The support scheme of the research cooperation totalled EUR 534 461, of which 85% came from foreign aid and 15% was co-financed by Estonia.

The support scheme of the research cooperation aimed at promoting co-operation of Estonian researchers with their colleagues from Norway, Island and Liechtenstein. The co-operation with the researchers in Island, Liechtenstein and Norway within the framework of the project was also one of the criteria for applying. The competition which was organised in 2007 saw 31 eligible proposals, the total requested amount of which was 1.6 million euros. On a proposal of an international evaluation panel, it was decided that ten projects would be financed, of which there is a brief overview in this book.

The Estonian Research Foundation thanks the donor countries for their support and the partners for their help in implementing the support scheme of the research cooperation.

Research Cooperation Programme

PROGRAMME MANAGER	The Estonian Science Foundation (ETF)
AIM	To support the co-operation of Estonian researchers with their colleagues from Norway, Iceland and Lichtenstein
TOTAL FINANCING	EUR 534 461 85% - EEA Financial Mechanism and Norwegian Financial Mechanism 15% - Estonian Ministry of Education and Research
RESULTS OF THE CALL	31 eligible proposals (requesting a total of 1.6 million euros) Ten projects were selected for financing

The Cultural Heritage of Environmental Spaces: A Comparative Analysis between Estonia and Norway

Sabine Brauckmann, Liisi Jääts, Renata Sõukand, Morten Toennessen, Peder Anker, Finn Arne Joergensen

Title of the project “The Cultural Heritage of Environmental Spaces: A Comparative Analysis between Estonia and Norway”

The project researched how humans perceive environmental spaces, either pointing to a specific Estonian landscape populated by a humble plant (peat moss), spanning herbal landscapes, socializing agro-cultural landscapes, or zooming in the Norwegian *Umwelten* of humans, wolves and sheep.

Besides capturing folk medicine and the socio-cultural representation of arable land of the 20th century, the Estonian theme broadened to "civic botany", considering also the culture of (popular) science among the Baltic-German *Bürgertum* and best capturing the growing influence of academic societies on university positions. Over the past two years the Estonian sub-project slowly, but persistently enlarged, encompassing besides mapping the moving spaces of a sphagnologist (Brauckmann), the transitions of the (agri)cultural landscape (Jääts), and the notion of the 'herbal landscape' (Sõukand). The choice for a (geo)botanical case study was intentional, because botany enjoyed huge popularity as recreation and as the basis of a lucrative business in plant breeding and horticulture. Moreover, it became the 'big science' around 1850s in Europe.

The Norwegian sub-project directed the attention to social and cultural factors, which have propelled *Umwelt* transition in the contemporary Norwegian situation. To analyze the conflict between wolves and sheep, it mapped the *Umwelten* of three species, with a particular emphasis on wolf-sheep, wolf-human and sheep-human relations. For developing Uexküll's *Umwelt* theory towards ecophenomenology, the notion of *Umwelt transition* was introduced. The study showed that the extinction of wolves in Norway is attributable to the *general and universal* claim to the land by farmers and hunters who became accustomed to a wolfless environment over generations. This will not come as a surprise, for, in cultural terms, hardly any animal is as loaded with symbolic value as the wolf accused of being the predator of sheep.

What united these projects was the subject of 'environment at risk' as an implicit feature of cultural heritage, and the focus on a modern view towards Nature, which is not merely a depository for classifying species, hunting predators, cultivating the soil, or embracing Nature as idyllic garden of *Eden* that is not yet destroyed by (agri)culture, but foremost a projection space of the lifeworld that is ever more depending on our careful handling of the resources.

When recalling the beginning in spring 2008 and the end in winter 2010, there is an idiom perfectly summarizing the work – it was sometimes an out-of-body experience. For we were stuck for days and nights at airports due to the so-called snow blizzards

(which turned out to be some tens of snowflakes above 0° C) and with nothing else for consumption than the fatty version of fast food, were caught in heated discussions with Russian border guards, because a passport number did not match the visa number (but we crossed the border), stacked up in sticky hotel rooms where only the night desk's bible opened the window (the smell we will probably have in our noses for the rest of our life), had to make intelligible *ad nauseam* why a non-Estonian is conducting an Estonian project, or had to waste months for editing again and again the same manuscripts, thanks to dealing with not-too-smart reviews. Would we do it again?

Of course, the rewards were not too bad. Besides the scientific results delineating the different usages of environmental spaces, either for (geo)botany, (agri)culture, folk medicine, or ecophenomenology, there were also practical ones: the project resulted in an accepted MA thesis, a successfully completed PhD, and a PhD in progress (to be finished in Sept. 2011). Furthermore, the research on the Estonian plant-space and the Norwegian wolf-sheep-human case study led to several publications: three special volumes (one scientific journal, two humanities journals), a lecture series co-organized with AHHAA, four international workshops, a mini-conference and two exhibitions. Besides several invited lectures at universities abroad and a presentation at international meetings.

Space technology provides possibilities for monitoring water quality in lakes

Anu Reinart, Senior research fellow at Tartu Observatory

Title of the project “Improving Satellite Remote Sensing Products for Large Lakes”

Lakes offer a wide range of ecosystem services to society, the multiple use of which creates multiple pressures on these water bodies, such as nutrient load and toxic pollution, modification of hydrology and shore line structure, and a potential increase in the global emission of greenhouse gases. Eutrophication affects significant numbers of lakes and reservoirs across the whole Europe. Monitoring of inland waters is of utmost importance for the protection of the environment and for ensuring good water quality in general. Physically large lakes exhibit several similarities to seas and oceans in their thermal structure and circulation dynamics, but their optical properties differ remarkably. Small lakes on the other hand are of great value to the local environment; however, they may be difficult to even reach, as they are located in remote areas or complicated landscapes. Here, space technology will provide a unique possibility to gather data over large areas and long time periods.

Critical issues in the remote sensing of lakes in Nordic areas are: (i) the adjacency effect that may strongly interfere with the near-infrared channels used in the atmospheric correction methods for turbid waters; (ii) the relatively high amount of dissolved organic matter which diminishes the water-leaving radiance over the whole spectrum; (iii) the large variation among the inherent optical properties and their (unknown)

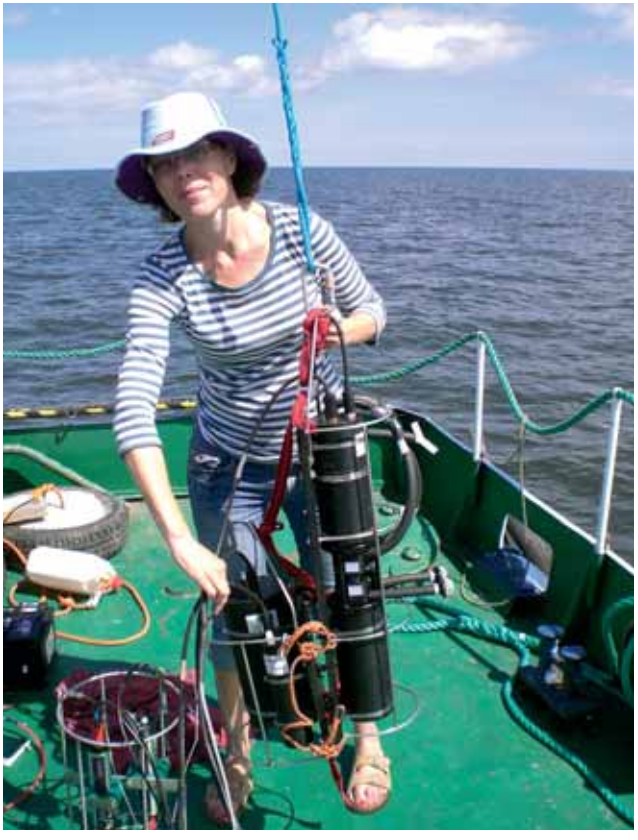
relationships to the water quality parameters in different lakes.

The development of comprehensive methods for deriving environmentally and ecologically relevant quantities from optical remote sensing measurements for lakes can be achieved by close cooperation with the international remote sensing community. To this end, data with consistent quality is necessary. Therefore, three institutions in Estonia experienced in water remote sensing and monitoring – Tartu Observatory, Estonian Marine Institute and Võrtsjärv Centre for Limnology – collaborated with the Norwegian Institute for Water Research (NIVA) and the University of Oslo. The main goals of the joint activities were:

- Improvement of scientific research in the field of satellite remote sensing of inland waters on the basis of optically different lakes;
- Development of comprehensive methods for deriving environmentally and ecologically relevant data by the harmonization of measurement methods and protocols;
- Exchange of results and information between different research groups and environmental monitoring and protecting authorities;
- Improvement of academic education possibilities for researchers and PhD students;
- Reduction in duplicate work and creation of new ideas by joint measurement campaigns and seminars.

It can be concluded from the work that variations of water colour between lakes and seasons are clearly visible in the satellite data, by inspection of both images and reflectance spectra. Good agreement between satellite and in situ data for Secchi depth, Chlorophyll and suspended matter was observed.

The project promotes the use of new and modern monitoring methods in getting a comprehensive overview of the state of eutrophication of lakes as required by the Water Framework Directive. To fully implement this method by water monitoring authorities, a better understanding of the needs of end users is necessary. This can be achieved only with further bilateral discussions when possible solutions from research outcome are presented.



Preparations for measurements of the vertical profile of absorption and scattering coefficients during field camping on Lake Peipsi on 18 June 2008. *Photo by I. Ansko*

Epiphytic lichens - valuable indicators for evaluating various forest qualities

Tiina Randlane, Associate professor at the Institute of Ecology and Earth Sciences of the University of Tartu; **Liis Marmor**, PhD student at the Institute of Ecology and Earth Sciences of the University of Tartu

Title of the project "Potentional indicational value of epiphytic macrolichens in evaluation of forest age and protection requirements"

The main aim of this project was to research the indicational value of epiphytic lichens concerning the various qualities of forest ecosystems. Lichens form a specific part of the biodiversity and are sensitive to different environmental factors, like air pollution, forest management and habitat history. They have been used to assess air quality and to identify valuable sites and habitats of high biodiversity. We studied the effects of forest continuity and tree age on epiphytic lichen biota in coniferous forests in Estonia and Fennoscandia.

Identification of species is an important step in such ecological and bioindicational studies, but so far user-friendly and richly illustrated keys for Nordic lichens were lacking. As one of the results of the project, we prepared a practical identification key for 32 European *Usnea* species, the so-called beard lichens (Fig. 1). It is presented in the traditional form as a published dichotomous key (Randlane et al. 2009), but also in the interactive form on the Internet (http://www.ut.ee/ial5/k2n/key/usnea_eu/). Another key - a tool for the identification of epiphytic macrolichens of Estonia - was also compiled; it is freely available on the Internet in Estonian, English and Russian, while the publishing of this key as a separate book in three languages is in progress (Fig. 2). Both identification tools are addressed to a wide circle of users - foresters, nature conservationists, biologists, students, etc.

To gather material for indicational studies, extensive fieldwork was carried out in the boreal forests in Estonia, Finland, Norway and Sweden. Analyses of the lichen specimens recorded on 330 trees from 66 sample plots in spruce and pine forests in Estonia indicated that the richness of lichen species per plot was significantly higher in old forests compared to first-generation forests; several species, including all red-listed and protected species, were restricted to old forests. Three lichen taxa *(Arthonia leucopellaea, Chrysothrix* spp. and *Lecanactis abietina)* can be recommended as good indicators of old coniferous forests with long continuity in Estonia. The materials collected in Fennoscandia indicate that the richness of lichen species in old boreal forests in this region is much higher than in similar forests in Estonia. This might be related to the fact that old unmanaged forest stands in our country are often fragmented in the surrounding managed forest landscape which may have affected the distribution of lichen species with low dispersal ability.

This project was carried out by the lichenological team of the University of Tartu; besides, authors T. Tõrra, E. Leppik, I. Jüriado, L. Saag and A. Saag were actively involved in the work. We thank Prof. P. L. Nimis from the University of Trieste and Prof. E. Timdal from the University of Oslo, who contributed to the preparation of the identification keys, and Dr. O. Hilmo from the

Norwegian University of Science and Technology for consultations. Financial support was received from the Norwegian Financial Mechanisms and the EEA Financial Mechanisms (grant EMP9).

11(10) Older parts form clearly inflated sausage-like segments (terminal branches less inflated) .....*U. articulata*

Branches do not form sausage-like segments 12

Fig. 1. Excerpt from the identification key for European *Usnea* species.

Tiiu Tõrra and Ede Leppik, the PhD students at the University of Tartu, in fieldwork in an old boreal forest of Norway - collecting lichens (June 2009). *Photo by Liis Marmor*

Thallus foliose or fruticose

Thallus squamulose

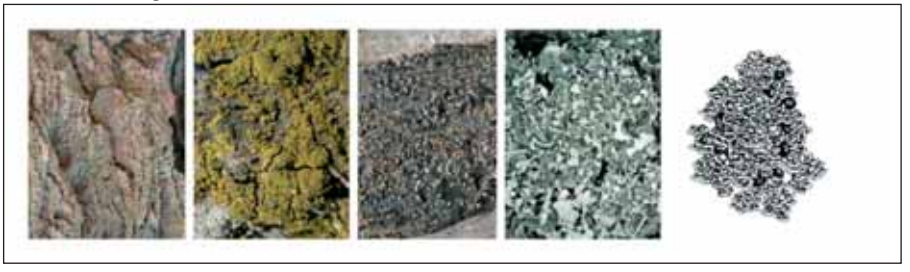


Fig. 2. Excerpt from the three-language identification key for epiphytic macrolichens of Estonia.

Battle in our intestine: Good *vs.* Bad bacteria

Epp Sepp, Senior research fellow at the Institute of Microbiology of the University of Tartu;
Paul Naaber, Senior research fellow at the Institute of Microbiology of the University of Tartu

Title of the project "*Clostridium difficile* infection in Estonia and Norway: molecular epidemiology (incl prevalence of hypervirulent strain 027), phenotypic characteristics of strains and interaction with intestinal lactobacilli"

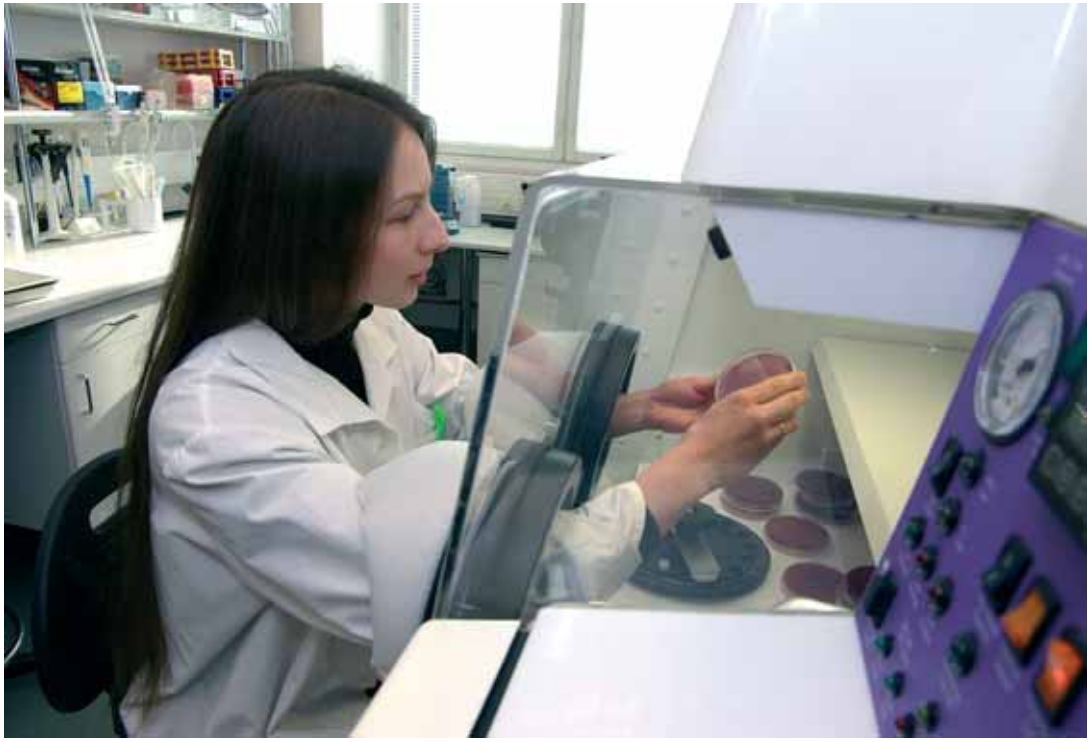
Antibiotics have been used for more than half a century to kill bad bacteria and save lives. Unfortunately, they cannot distinguish between good and bad bacteria and thus attack also our normal microbiota. This can sometimes result in mild diarrhea, but in some cases, when good intestinal bacteria are significantly suppressed, one evil microbe - *Clostridium difficile* - can multiply and cause severe diseases or even death.

In our collaborative study, researchers from Stavanger University Hospital and the University of Tartu aimed to investigate *Clostridium difficile* and good bacteria in the intestinal tract of Norwegian and Estonian patients. The key issues of the research were as follows: firstly, which *C. difficile* types are dominant in patients from these countries? During the recent years, even more dangerous "hyper-virulent" *C. difficile* strains circulating all over the world have caused outbreaks in hospitals and are associated with high mortality. Secondly, we wanted to explore the relationship between *C. difficile* and some good bacteria such as lactobacilli. Lactobacilli are of many different species and strains and several of them belong to our normal intestinal microflora. Since Mechnikov-times (Ilya Ilyich Mechnikov, biologist, Nobel prize in Physiology and Medicine 1908), lactobacilli have been believed to protect us and prolong life, and they are traditionally used in milk products as good bacteria. However, a few lactobacilli strains used in commercial products have shown contradictory effects against *C. difficile* infection.

Fortunately, we did not find the new hyper-virulent *C. difficile* strain in Estonia nor in Norway. High variation of different strains and the absence of dominating *C. difficile* types indicate the absence of infection outbreaks in our hospitals. So, we should thank the high-level hygiene and good work of our infection control teams.

Although in our study, the high total amount of lactobacilli had no association with *C. difficile*, we found that some particular lactobacilli species may have a role in the protection against this bad microbe. Namely, *Lactobacillus plantarum* and *Lactobacillus gasseri* were frequently absent in patients infected with *C. Difficile*, but more commonly present in the intestine of non-infected patients. Interestingly, *L. gasseri* was more frequent in Estonian and *L. plantarum* in Norwegian patients. This may indicate that the importance of good bacteria in the protection against some particular diseases differ between nations and countries.

As usual, our study raises questions and ideas for future studies rather than gives definite answers. Do these lactobacilli have a causative role in the protection against *C. difficile* or are they just indicators of better



condition of intestinal microbiota? If they really are good bacteria that protect us against the bad ones, are some good bacteria more specific to Estonians and others to Norwegians? If yes, should we use different strains or species of lactobacilli in Norwegian and Estonian milk products? Etc., etc...

Project: *Clostridium difficile* infection in Estonia and Norway: molecular epidemiology (incl prevalence of hypervirulent strain 027), phenotypic characteristics of strains and interaction with intestinal lactobacilli.

Team: Epp Sepp, Paul Naaber (coordinators); Jelena Štšepetova, Imbi Smidt, Merle Rätsep, Siiri Kõljalg, Liis Jaanimäe, Elena Shkut, Iren H. Löhr, Olav B. Natås.

Special thanks to the personnel of Stavanger University Hospital, Tartu University Hospital, North Estonian Regional Hospital, East Tallinn Central Hospital, West Tallinn Central Hospital and the Department of Microbiology of the University of Tartu.

Deciphering the cell division code

Mart Loog, senior research fellow at the Institute of Technology of the University of Tartu

Title of the project "Mass spectrometry-aided phosphoproteomics - the key for mapping the signalling networks in cells"

Protein phosphorylation is a process of covalent addition of phosphate groups to proteins by enzymes called protein kinases. It is the most important mechanism of molecular switches in cells. The human kinome includes more than 500 protein kinases and more than one-third of all human proteins are phosphorylated. Phosphorylation and dephosphorylation can switch on and off many crucial cellular processes via a variety of mechanisms, including alteration of protein stability, cellular location, substrate affinity, complex formation and activity.

Protein phosphorylation is also a mechanism regulating cell proliferation. Cells multiply by division into two after having duplicated their contents. This process is known as cell division or the cell cycle. The switches that control transition points of the cycle must be tightly regulated, since in case of their failure, the cells undergo uncontrolled proliferation which ultimately leads to cancer. The master regulators controlling these switch points are cyclin-dependent kinases (Cdks). These enzymes phosphorylate hundreds of different protein targets triggering a complex sequence of well-orchestrated events, including DNA replication and chromosome separation. Intriguingly, for Cdk to trigger a switch, it must add multiple phosphates to the target protein. This phenomenon of multisite phosphorylation has largely remained a mystery for cell cycle researchers. Our hypothesis is that the unique positioning of sites and the defined order of addition of phosphates form certain logical networks which are able to differentially process kinase signals. Such 'barcodes' assigned to a protein can define the timing and ensure the irreversibility or abruptness of the switch. Also, the network of phosphorylation sites on the surface of a protein can act as a single-molecule-based signal processor which is able to filter out unwanted signals or amplify selected signals. To prove this, we aimed to study the dynamics of target multiphosphorylation by Cdk1. Unfortunately, there are nearly no reliable methods allowing to quantitatively study the multisite phosphorylation dynamics. We aimed to develop several such techniques using mass spectrometry (MS)-based phosphoproteomics. To quantitatively detect the multiple phosphates in proteins, we used different isotope-coded mass tags combined with a number of separation and enrichment methods for differentially phosphorylated forms of peptides and proteins. However, in order to excel in these elaborate new methods, we needed trained and skilled personnel.

The general goal of the grant was to train qualified PhD level specialists in MS-based phosphoproteomics in collaboration with our Norwegian partners who are already excellent in this field. A collaboration was set up between the protein kinase group from the University of Tartu and the cell signalling group from the University of Bergen to train Estonian PhD students in theoretical and practical aspects of the field. With kind help from Prof. Kari Espolin Fladmark and Dr. Ralf Kellmann we acquired skills essential for MS-based phosphoproteomics, including sample preparation, phosphopeptide

enrichment methods and data analysis. Obtained experience is being applied by the protein kinase research group in Tartu to work out and optimize the novel MS-based protocols used for quantitative study of the kinetics of multisite phosphorylation processes.

Ervin Valk, a PhD student and a promoter of the project

From informed consent to no consent? In search of new bioethical frameworks

Margit Sutrop, Professor of Practical Philosophy, Head of the Centre for Ethics, University of Tartu

Title of the project "New ethical frameworks for genetic and electronic care record databases"

A decade has passed since the mapping of the human genome - an event that paved the way for many new developments in biomedicine and related fields. In ethics, this milestone was accompanied by calls for changes in the governing ethical frameworks. Since the WW II bioethics has been guided by values of liberal individualism, thus stressing every person's voluntary decision-making capacity and the inviolability of his/her informed consent. However, the developments in genetics and related disciplines during the last decades of the 20th century have increasingly questioned the applicability or rather the sufficiency of the individual-centred value discourse as the sole ethical framework of guidance in these areas. Genetics has uncovered the fundamental biological relatedness of humans; large biobanks and e-health databases (electronic health record collections) have created a new context where risks to individuals are lesser than in traditional medical research and clinical practice. These advancements promised important public benefits - knowledge and better health for everybody. One of the main targets of these discussions has been the concept of informed consent - many have argued

that the concept should either be modified (to open consent or broad consent in biobanking, etc.) or, in some areas of application (e.g. in electronic health record database projects), abandoned altogether. Traditional informed consent has been criticized as being too individual-centred (to the detriment of collective or community interests), too formal and unnecessarily cumbersome to obtain. It has been suggested that a communitarian turn, involving greater emphasis on the principles of solidarity, equity and public good, as opposed to the predominance of autonomy-based argument, would solve some of the dilemmas introduced by new technologies.

The current project application was motivated by our conviction that there are several important and unanswered questions about this change in ethical frameworks. Will the new ethics framework be conducive to encouraging civic participation for the public welfare? Will it still be able to respect individuals' liberty and autonomy and protect them against possible breaches of confidentiality and discrimination? How should the complex notion of public interest be construed and protected and what are the conditions under which the public interest may override individual interests?

We began by scrutinising the ethical debates of the past decade and offered an assessment of the so-called communitarian turn. In the long run our aim was to find proper ethical frameworks for biobanks and e-health databases in an interdisciplinary context. We investigated the new developments in science and technology from the perspectives of philosophical ethics, law, biomedical science, and sociology. Our team consisted of philosophers, lawyers, medical scientists, biologists, and sociologists. On the one hand we carried out a philosophical conceptual analysis on the notions of consent, autonomy, privacy, solidarity, justice and trust. On the other hand we analysed the recent scientific developments and noticed how ethics responds to scientific developments. In order to find out how changes in ethical frameworks will be received by the public, we conducted sociological research on how the direct users - doctors and patients - perceive the risks and benefits of the e-health databases.

At the same time we worked in close cooperation with our international partners from the Universities of Reykjavik and Bergen. We organised workshops and conferences for exchange of ideas and for preparation of joint publications. The main results of our research were presented at two high-level international conferences in 2008 and 2010 in Tartu. The selection of the conference papers "From informed consent to no consent? Challenges of new ethical frameworks" (November 2010) will be published in a special section (edited by Margit Sutrop and Kadri Simm) in a well-known journal, *Cambridge Quarterly of Health Care Ethics.*

One of the main outcomes of our project was a proposal to avoid a dichotomy between individual rights and public interest, as well as a dichotomy between individual and collective values. We argued that there is no need to set liberal and communitarian frameworks in opposition to each other. Firstly, this is simply unhelpful as it ultimately turns the debate into an argument about ideologies. Secondly, it is also a restricted view raising concerns that the replacement of one framework with another could, for example, leave individual rights unprotected, or allow for potential misuse of the public interest argument. This is not an either/or issue. Public interest is not by default in

conflict with private interests and these can often overlap - in fact, one might reasonably have a private interest in the common interest being respected. Thus, the choice is often not between two opposing values of individual and communal kinds, but between values that can be conceptualised in both ways.

As people have personal interests as individuals and as members of a community, an appropriate balance between individual and public interests must be maintained. Often the so-called public-private conflicts of interest could be reconceptualised as simply conflicts between two personal interests (e.g. a personal interest in protection of confidentiality, on the one hand, and a personal interest in promotion of health and public safety, on the other, etc.). Secondly, the traditional liberal-communitarian watershed should be viewed in a pluralist setting. Instead of choosing between ethical theories, frameworks or ideologies, we have to notice that the problem is caused by the fact that there exist several important objective values (e.g. privacy, autonomy, solidarity, reciprocity, benevolence) that cannot be respected simultaneously. We believe that the values which we care about are plural and contextual. Value conflicts are frequent mostly because we want to realize incompatible goals and incommensurable values. Since there is no one highest value, we cannot solve value conflicts by authoritatively ranking all other values in relation to the overriding value. In a pluralist approach rankings of values are reasonable only in particular situations, because they depend on both facts of reality as well as on the traditions we stand in and individual conceptions of a good life. To conclude - there is no need to substitute one framework for another. We need individual rights even when we participate in large e-health projects geared by the common good rhetoric. While in the Estonian e-health case the informed consent requirement was waived, this does not mean that autonomy can be forsaken as well. Autonomy continues to be crucial, but we might have to find other, more appropriate

Margit Sutrop, the head of the Centre for Ethics of the University of Tartu and professor of practical philosophy; Toivo Maimets, the director of the Institute of Molecular and Cell Biology of the University of Tartu and professor of cell biology; and Kadri Simm, the senior research fellow of practical philosophy at the Institute of Philosophy and Semiotics of the University of Tartu

means to protect it. A move from liberal to communitarian ethics is not a solution. We need to balance different values and to pay attention to the context to avoid presenting corporate interests as public interest. It is crucial to understand that the common good or public interest is a shared interest, not someone's private interest. The way these concepts are debated is heavily dependent on how democratic a society is. Thus, new ethical frameworks should be developed taking into account that states have different levels of democracy. A communitarian turn in bioethics may be beneficial in old democracies where there is a lot of trust towards institutions undertaking research, but may bring along several risks for new democracies or leave patients without protection in totalitarian regimes.

Shoaling and runup of long waves generated by high-speed ferries

Ira Didenkulova, Senior research fellow at the Institute of Cybernetics of Tallinn University of Technology and research fellow at the Institute of Applied Physics of the Russian Academy of Sciences

Title of the project "Shoaling and runup of long waves generated by high-speed ferries"

The main goal of the project has been to describe the nonlinear long wave dynamics in the coastal zone, required to prevent and mitigate marine natural hazards in coastal waters (storm surges, anomalous waves from high-speed ferries, tsunami and freak waves) with the basic idea of using the wave generation by fast ferries in a shallow environment as a well-controlled input to model the shoaling and runup of extreme oceanic waves of big scales (tsunami, sneaker waves, swell, storm surges). Usually such big waves cannot be correctly reproduced in laboratory tanks due to "scale effects". As a result, the models developed so far have no reliable validity. This is the principal difference of our approach from past and existing projects in the same field.

Figure 1. Waves from high-speed ferries in Tallinn Bay, the Baltic Sea

To achieve the aim of the project we have combined analytical, numerical and experimental study of long waves in the coastal zone. I. Didenkulova (Institute of Cybernetics, Tallinn, Estonia) has been concentrating on the analytical study of wave runup and experimental measurements of waves induced by high-speed ferries in Tallinn Bay, the Baltic Sea. T. Torsvik (Bergen Centre for Computational Science (BCCS), Bergen, Norway) has been responsible for the development and implementation of numerical models for long wave generation in the Tallinn Bay conditions.

Ira Didenkulova, the principal investigator of the project

The analytical study has been based on the rigorous solutions of the nonlinear shallow-water theory. The key and novel results here are as follows:

i) parameterization of basic formulas for extreme runup characteristics for bell-shape waves, showing that they weakly depend on the initial wave shape, which is usually unknown in real sea conditions;

ii) runup study of periodic asymmetric waves with a steep front, as such waves are penetrating inland over large distances and with larger velocities than symmetric waves;

iii) statistical analysis of irregular wave runup demonstrating that wave nonlinearity near the shore influences the probability distribution of the displacement of the moving shoreline (runup) and its moments. The runup of waves was studied experimentally in 2008-2009 by using waves from the fast ferries in Tallinn Bay. The experimental data included the measurements of high-resolution profiling of the water surface 100 m from the coast and measurements of wave runup on a beach. Additionally, the damage potential of fast ferry wakes was demonstrated based on observations of a semi-sheltered beach on the Island of Aegna that receives substantial ship wave energy. The beach profiles demonstrated considerable variability over relatively short periods of time, with levels varying by over 0.5 m. It was also shown that the passage of 3-4 high-speed ferries was enough to reduce the beach volume by up to 1 m^3/m.

Environmental impact of oil shale combustion ashes on topsoils in Narva Thermal Power Plants region: combined geochemical and ecotoxicological approach

Liidia Bitjukova, Senior research fellow at the Institute of Geology of Tallinn University of Technology

The project was carried out in collaboration with Anne Kahru, a chief research fellow at the National Institute of Chemical Physics and Biophysics.

Title of the project "Environmental impact of oil shale combustion ashes on topsoils in Narva Powerplants region : combined geochemical and ecotoxicological approach"

Oil shale is the main source for energy production in Estonia, the share of which in the power generation is 94%. Up to 13 million tons of oil shale is burned annually at the world's two largest thermal power plants (Estonian and Baltic TPPs) that leads to the annual generation of up to 5 million tons of ash deposited as gigantic plateaus in the vicinities of these TPPs. However, about 1-2% of the finest ash particles (the so-called fly ash) is not captured by electric filters and is thus emitted to the atmosphere. Oil shale contains most of the naturally occurring chemical elements at least in trace amounts, which may be realised during combustion and can pose environmental and human risks. To get detailed information regarding an input of harmful substances in the soil as one of the main recipient of airborne emission, the current project has been initiated and fulfilled by two research groups: from the Institute of Geology; IG TUT (led by Dr. L. Bityukova) and from the National Institute of Chemical Physics and Biophysics; NICPB (Ecotoxicology and *in vitro* toxicology group led by Dr. A. Kahru).

The main aims of this study were to evaluate spatial distribution and accumulation of trace elements in the soils of the TPPs region. Special attention was focused on the study of the mobility of trace elements in soils and evaluation of bioavailability of toxic heavy metals using recombinant luminescent sensor bacteria that work as an early-warning system and indicate the potential hazard of soils. Trace elements leaching from fly ash and toxicity of fly ash depending on the applied combustion technology were also important aspects of this study.

The geochemical mapping in combination with multivariate statistical analysis revealed the areas with elevated concentrations and allowed to evaluate the impact of natural and anthropogenic factors on the accumulation of elements in the soils of the studied area. It was shown that geological factors play the main role in the distribution of elements in the soils of Narva region, i.e. the input of chemical elements from airborne emissions does not lead to concentration of chemical elements in the amounts significantly higher than the average concentrations in the agricultural soils of North-Eastern Estonia. Estimated values for the elements studied were substantially lower than permitted limit values for the residential areas defined by the Estonian Regulations.

Olesja Bondarenko and Aleksandr Käkinen, the PhD students at the National Institute of Chemical Physics and Biophysics, evaluate the bioavailability of heavy metals in environmental samples using recombinant sensor bacteria.

The study of 26 soil samples that were specially selected from two profiles oriented in a dominant wind direction reveals no tendency of the accumulation of elements being dependent on the distance from pollution sources (TPPs). The chemical analysis of these soil extracts (1:10) showed a slight positive correlation between Ba, Ca, Cu, P, Pb and Ni total contents in the soils and their concentrations in water-soluble extracts. Bacterial biosensors showed the presence of bioavailable As and Pb/Zn/Cd/Hg in soils.

Extraction of the studied metals from the soils into the water-soluble (bioavailable) fractions exhibits the following sequence: Mo > Sb > Cu> Cd > As > Sr > Zn > Ag > Ni > Mn. The higher leaching of metals was revealed for the soils with slowly acidic pH.

The content of 30 ashes was studied in detail to reveal the difference between the ashes from old pulverized firing (PF) and new circulating fluidized-bed boiler combustion (CFB) systems at the Eesti and Balti Power Plants. The water extracts of fly ashes were analyzed to evaluate elements leaching from the finest fractions of ashes.

The study of the aqueous extracts of the CBF and PF fly ashes (1:10 and 1:10000) showed that the toxicity of CBF fly ash to aquatic organisms was significantly lower than the toxicity of PF fly ash. However, the results of the tests with higher plants did not reveal any relations between toxicity and the “origin” of fly ash samples (CBF or PF). The high alkalinity of all the analyzed extracts seems to be the key factor in determining the toxicity to all investigated aquatic species.

The results obtained once more demonstrate that chemical and biological approaches supplement each other to get more objective information concerning the environmental hazard of ashes.

Helpful and unhelpful tools from the biobank

Agu Tamm, Professor at the Department of Internal Medicine of the University of Tartu

Title of the project "Angiogenic, inflammatory and bone markers in Estonian and Icelandic patients with distinct forms of osteoarthritis"

The social burden of osteoarthritis (OA) is ever increasing. This may be illustrated by the fact that the number of people in Estonia who suffer from bone and joint diseases increases more rapidly than the number of people who suffer from heart diseases (Statistical Yearbook of Estonia, 2007). Furthermore, it is estimated that joint replacement surgeries in industrial countries should increase sevenfold in the next 20 years! Even today, by far the largest part of osteoarthritis-related expenses is incurred for this treatment method.

The pathogenesis of the disease is complicated. One of the factors contributing to the progression of the disease is believed to be inflammation of the joint lining. The latter should give rise to the growth of new blood vessels in joint tissues. This process has been little studied, since it difficult to figure out what is going on inside the joints. This is how the clarification of the possible role of some vascular biomarkers in patients with certain forms of OA became one of the goals of our study.

Both study groups aimed at re-examining the patients who had first been examined 9-12 years ago. This way we received the most accurate information on whether the patient's OA progresses fast (continuously) or slowly or does not progress at all. A prerequisite for such a study was the awareness of the existence of blood serum of the patient in a biobank. Blood serum can be used to investigate the relationship of the patient's condition back then with today's findings. We started to investigate the expression of a) two metalloproteinases (MMP-7 and ADAM12) and their inhibitor TIMP-1; b) angiogenic vascular endothelial growth factor (VEGF) and its receptor VEGF-R2.

In most cases, there is no (reliable) data available on new biomarkers, not even in the possession of the manufacturers of reagents. Since we were aware of the relatively short-term storage life of the biomarkers that were of interest to us (e.g. MMP-s), we decided to carry out a series on *in vitro* experiments before investigating the data on patients.

We used certain systematic techniques for the accelerated ageing of cells and a special method of calculating for predicting the stability. It was found that MMP-7 has excellent stability: at least five years at -20°C and even a hundred years at -75°C. The VEGF receptor maintains 90% of its initial concentration at -20°C over three months, and decades at -75°C. By contrast, the inhibitor of metalloproteinasesTIMP-1 and VEGF showed poor stability even at -75°C. VEGF lost 90% of its activity already during the first freeze/thaw cycle.

Since the blood serums of the patients with OA had been stored for up to 9 years in Estonia and up to 12-15 years in Iceland, there was no point in identifying two of the four planned biomarkers. These two included the very interesting, but especially unstable VEGF.

Therefore, we began to determine the concentrations of the VEGF receptor (VEGFR2) and MMP-7 in the blood serums of the patients and abandoned the two other markers that were of dubious value.

The results of the tests have been published and they should send a clear message to the world's biobank owners and the users of their resources.

The deadline of the final report is approaching. Some of the members of the working group: Kalle Kisand, Ann Tamm, Agu Tamm and Anne Krips.

All the Estonian electricity from the wind - is it possible?

Ants Erm, Senior research fellow at the Marine Systems Institute of Tallinn University of Technology

Title of the project "Probable locations of windfarms in the open sea in relation to most favourable meteorological, hydrographical, ice and environmental conditions"

The resources of wind energy in Estonia (both onshore and offshore) are comparable to those of Denmark; however, there is ~54 kW/km^2 installed in Denmark compared to only 3.3 kW/km^2 in Estonia. Taking into consideration the fact that the population density in Denmark is around five times higher than in Estonia, the relative potential of Estonia's wind energy is several times higher. To catch stronger wind and to avoid the worsening of the living conditions of countryside inhabitants, it is rational to move the wind energetics to the sea - to develop offshore wind farms preferably. In this study - Probable locations of wind farms in the open sea in relation to most favourable meteorological, hydrographical, ice and environmental conditions - three potential locations of wind farms were picked out in the coastal sea of North and North-West Estonia.

The physical measurements (detecting of waves, currents, turbidity, suspended matter concentration and optical density) showed that (1) the dependence of near-bottom currents on the mean winds is very complicated, (2) at a depth of at least up to 7 meters wave-generated sediment transport dominates over that induced by the near-bottom currents, (3) but following from the directional character of the current, the wearing of the bottom takes place by the influence of the latter, (4) at a depth of 20 m and more a wind of more than 20 m/s is needed to induce any detectable processes at the sea bed, (5) an underwater cloud of suspended matter could be moved more than 5 km per day.

The wind farms would be located near the area where a half of the Estonian population is living: nearby the South-West coast of Suur-Pakri Island, about 50 km to the west of Tallinn, the capital of Estonia; in Tallinn Bay, about 13 km to the north of Tallinn; and about 100 km to the east of Tallinn, in the Gulf of Finland and in the vicinity of Kunda town. Altogether it is possible to establish about two hundred turbines (10 MW of rated power each) only in these three wind farms that responded to 2100 MW installed power. It should be mentioned here that the total power of the Estonian thermal power stations is ~3000 MW.

Of course, wind electricity needs alternatives (if there is a calm period, for example). The most favourable alternatives are (1) gas turbine station(s) using (a) imported gas, (b) hydrogen produced by hydrolysis, (c) gas or oil produced from oil shale; (2) pumped storage hydroelectric power plant(s) (one such station is in a developing phase in Estonia - they are planning to construct a 300 m deep granite mine that will be used for the storage of sea water after the granite is worked out; (3) sea hydroelectric power plant (in principle also a storage station, but a dam and natural relief of the coastline will be used).

The answer to the question above is: not all, but a favourable part of electricity could be produced using the wind resource of Estonia. At first, the technology of oil shale stations must be totally renewed or stopped, and dynamic power stations must be introduced together with windmills.

“Eureka - the Doppler probe!”

Projects funded under the EEA/Norwegian financial mechanisms transfer of knowledge block grant

Grant No	Grant holder	Project title	Partner institutions in donor countries
EMP 1	Anu Reinart Tartu Observatory	Improving Satellite Remote Sensing Products for Large Lakes	University of Oslo, Section for Meteorology and Oceanography; Norwegian Institute for Water Research, NIVA
EMP 9	Tiina Randlane University of Tartu	Potentional indicational value of epiphytic macrolichens in evaluation of forest age and protection requirements	Norwegian University of Science and Technology, Dept. of Biology; Nord-Trøndelag University College (Steinkjer)
EMP 13	Epp Sepp University of Tartu	*Clostridium difficile* infection in Estonia and Norway: molecular epidemiology (incl prevalence of hypervirulent strain 027), phenotypic characteristics of strains and interaction with intestinal lactobacilli	Stavanger University Hospital
EMP 24	Mart Loog University of Tartu	Mass spectrometry-aided phosphoproteomics - the key for mapping the signalling networks in cells	University of Bergen, Department of Molecular Biology
EMP 31	Margit Sutrop University of Tartu	New ethical frameworks for genetic and electronic care record databases	Centre for Ethics, Dept. of Philosophy, University of Iceland; Centre for the Study of the Sciences and the Humanities, University of Bergen

Grant No	Grant holder	Project title	Partner institutions in donor countries
EMP 41	Irina Didenkulova Tallinn University of Technology	Shoaling and runup of long waves generated by high-speed ferries	Dept. of Mathematics, University of Oslo; Bergen Centre for Computational Science
EMP 45	Lidia Bitjukova Tallinn University of Technology	Environmental impact of oil shale combustion ashes on topsoils in Narva Powerplants region : combined geochemical and ecotoxicological approach	Geological Survey of Norway, NGU Norwegian Geotechnical Institute (NGI);Norwegian Institute for Agricultural and Environmental Research (Bioforsk)
EMP 48	Agu Tamm University of Tartu	Angiogenic, inflammatory and bone markers in Estonian and Icelandic patients with distinct forms of osteoarthritis	Landspitalinn University Hospital, Department of Rheumatology
EMP 53	Ants Erm Tallinn University of Technology	Probable locations of windfarms in the open sea in relation to most favourable meteorological, hydrographical, ice and environmental conditions	Institute of Marine Research, Bergen
EMP 54	Sabine Brauckmann University of Tartu	The Cultural Heritage of Environmental Spaces: A Comparative Analysis between Estonia and Norway	University of Oslo, Forum for University History; University of Oslo, Centre for Development and the Environment

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