

## The Nordic EMBL Partnership – a paragon of collaboration

Daniela Ruffell

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Scientific progress moves on a high-speed train, creating an exponential growth in knowledge. Scientists unavoidably focus and specialize in their topic, digging into the depths of microscopic detail. While this is an essential approach towards discovery, the process of specializing will take the scientists' vision further away from a comprehensive understanding, which takes us to the importance of collaboration. Funding agencies today encourage collaborations to obtain a broader vision and foster creativity through the bridging of disciplines.

With this in mind, a partnership was initiated in 2007 between the University of Oslo, Umeå University, the University of Helsinki and the European Molecular Biology Laboratory (EMBL), with the aim of creating a highly competitive network of institutes and facilities dedicated to Molecular Medicine. The partnership was renewed in 2013 with the addition of a Danish node to the Network, upon the opening of

the Danish Research Institute of Translational Neuroscience at Aarhus University.

In addition to the partnership between the nodes, each of the Nordic research centres engages in collaborations with other national partners, including research and public health institutes, hospitals and research councils, to establish an extensive Nordic network for Molecular Medicine.

We interviewed Jaakko Kaprio, who was interim Director of the Institute for Molecular Medicine Finland (FIMM) until January 2018; Bernt Eric Uhlin, Director of Molecular Infection Medicine Sweden (MIMS); Kjetil Taskén, Director of the Centre for Molecular Medicine Norway (NCMM); and Poul Nissen, Director of the Danish Research Institute of Translational Neuroscience (DANDRITE) as well as Silke Schumacher, Director of International Relations at EMBL, to bring an exemplary model of collaboration into the limelight.



Professor Jaakko Kaprio, former Director of FIMM. Photo: Veikko Somerpuro

### FIMM

FIMM was founded in 2006 as an initiative to establish an international Molecular Medicine Research Centre in Finland. Besides the University of Helsinki, the Hospital District of Helsinki and Uusimaa and the National Institute for Health and Welfare were involved in the establishment of the Institute. The Ministry of Education as well as The City of Helsinki and several national foundations, provided financial support for the establishment phase. In the beginning of 2017, FIMM joined the University of Helsinki's new life science research centre, Helsinki Institute of Life Science (HiLIFE), as a scientifically and financially independent operational unit.

The mission of the institute is to improve the precise diagnosis and treatment of disease, and benefit public health, by promoting translational research and the adoption of personalised medicine in health care. To reach these goals, a new type of research institute was created, where molecular medicine research is integrated with cutting-edge technology platforms and a biobanking infrastructure under one roof, strongly

focusing on a few scientific 'grand challenges'. These Grand Challenge programmes provide an opportunity to align the research projects on large and complex issues and draw researchers, technology experts and clinical collaborators together to achieve a common goal through collaboration.



Professor Bernt Eric Uhlin, Director of MIMS. Photo: Mattias Pettersson, Umeå University

### MIMS

The establishment of The Laboratory for Molecular Infection Medicine Sweden (MIMS) was initiated in 2007 at Umeå University. While it is embedded in the Swedish academic setting involving regular faculty members of Umeå University, MIMS has an institute-like organization. The newly recruited MIMS Group Leaders are employed by the university, where the research groups are working in laboratories dedicated to MIMS, and are primarily affiliated with the Department of Molecular Biology, funded by both the Faculty of Medicine and the Faculty of Science and Technology.

MIMS contributes with expertise in molecular infection medicine. This includes mechanisms of infection and host defense strategies as well as connected research fields in immunology and cancer research. MIMS researchers study bacterial, viral, and fungal infections, as well as infections by parasites. One of the strategic goals of MIMS is to strengthen the translational infection research locally and nationally. The recruitment of young clinicians, designated MIMS Clinical Research Fellows, with strong research backgrounds has also been strategically important as a means for implementation. These researchers carry out their work in close collaboration with scientists in different research areas, while dedicating 50% of their time to their clinical duties. The MIMS Clinical Research Fellow initiative has been expanded as a national program and it is present at all major Swedish Universities.



Professor Kjetil Taskén, Director of NCMM.  
Photo: John Hughes

### NCMM

NCMM (Norwegian Centre for Molecular Medicine) was established in 2008 as a joint venture between the University of Oslo as host, the Research Council of Norway and The South-Eastern Norway Regional Health Authority. In January 2017, NCMM successfully completed a merger with the Biotechnology Centre of Oslo (BiO). The new NCMM now consists of two departments: NCMM Translational Research (former NCMM) and NCMM Biotechnology (former BiO).

Today, the institute is home to an exciting cohort of young and talented group leaders, researchers and staff, working across a wide range of topics within regulatory biology and cell signaling in health and disease. 70% of the staff is international, which helps to bring fresh ideas and perspectives to research at NCMM. The institute has also built strong collaborative links with other

scientists and research groups working across Norway, thanks to its wide network of Associate and Young Associate Investigators.

At NCMM specifically, scientists work to improve our molecular understanding of health and disease to facilitate improved medical practice and patient outcomes. The research groups focus on cancers, neurodegenerative, and inflammatory diseases. They are also increasingly working with precision medicine and cancer drug sensitivity screening.



Professor Poul Nissen, Director of DANDRITE. Photo: Lars Kruse, AU University

### DANDRITE

DANDRITE was created following an initiative by the Lundbeck Foundation to establish a Danish node of the Nordic EMBL Partnership, with a focus on neuroscience. The Centre was formally inaugurated in 2013. DANDRITE is hosted by two faculties at Aarhus University: the Faculty of Science and Technology (Department of Molecular Biology), and the Faculty of Health (Department of Biomedicine).

The institute is home to a dynamic community of over 120 researchers, representing more than 20 different nationalities. This means DANDRITE is connected to leading neuroscience centres all over the world. The appointment of five Group Leaders, who have introduced new research topics and models of behavioral and circuit neuroscience in Denmark, alongside three core Group Leaders that represent broad foundations of molecular and translational neuroscience, mean that DANDRITE is very well equipped to conduct cutting-edge neuroscience and to generate fruitful research synergies.

DANDRITE brings novel expertise, techniques and instruments of relevance for neuroscience, cell biology, disease modeling and behavioral studies to the Nordic EMBL Partnership.

### Dr. Schumacher, how did the idea of the Nordic EMBL Partnership come up? What is the advantage of creating a geographical partnership, apart from a thematic one?



Dr. Silke Schumacher, Director of International Relations at EMBL

For EMBL, partnerships are a sustainable mechanism by which the interaction between EMBL and the

member states is enhanced. The idea to create a [Nordic Partnership for Molecular Medicine](#) came up in 2003 and was endorsed by the Nordic Research Council that represents Finland, Sweden, Norway and Denmark. They were inspired by the desire to bring biomedical research to a higher, more international level by raising the international profile of the institutes, creating state-of-the-art infrastructures and recruiting excellent scientists mainly from abroad. It took some time for this idea to mature and the establishment of the partnership happened in 2007, when three nodes were established in Norway, Sweden and Finland. The partnership was extended in 2013 with the Danish node at Aarhus University joining. Each

partner brings in a broad and unique set of expertise, spanning from molecular mechanisms of disease, microbial pathogenicity and molecular infection to genetic epidemiology and neuroscience. They each complement the research expertise of the other partners and the network has emerged as a strategic player in Europe, for understanding some of the most challenging problems of biomedicine.

Geographical partnerships are important as they allow exchanging expertise, best practices and pooling resources across countries or regions that often face very similar challenges.

### **What kind of investment on behalf of EMBL does the partnership entail?**

The partnerships are formal links between EMBL and a national institute in an EMBL member state. EMBL can provide resources in terms of scientific expertise and exchange of services and know-how, but transfer of funding to the partner institutes is not possible. Instead, the funding is raised nationally. The high quality of the scientific projects attracts significant national funding, which secures important support for the institute and the researchers and allows them to pursue ambitious and risky projects. EMBL provides the administrative model and assist in its implementation. Our leadership is involved in setting up the advisory system of the partner institute and sits on their steering committees and Scientific Advisory Boards. We help to set up the institute, institutional structure, the governance, the recruitment of faculty and the scientific evaluations that they undergo. We also encourage and give support in setting up training programmes that are similar to EMBL's PhD and Postdoctoral programmes.

### **How does EMBL benefit from this partnership?**

The EMBL Partnership Programme is designed to bring mutual benefits to the partners. EMBL strengthens its links with EMBL Member States and disseminates its operational and organizational model across Europe, ultimately aiming to raising the quality of science across borders. Partner institutes are leading at national level and often at international level in research areas they pursue. As a rule, they are engaged in activities that complement the research conducted at EMBL. Scientific complementarity can encompass entire research fields that are not covered by EMBL or areas in which EMBL is active, but in which synergy can be achieved

through a partnership. The Nordic Partnership focuses on research in molecular medicine, which builds on complementary strengths in all partner institutes. EMBL has recognized research strengths in areas such as molecular, cellular and developmental biology, bioinformatics and structural biology. Therefore, gaining access to more translational expertise through the Nordic partnership is of great importance to EMBL.

### **Turning to the Nordic Institute Directors: How have the Nordic institutes benefited from the partnership with EMBL in terms of scientific exchange, access to services, training or technology transfer?**

As part of the Nordic EMBL Partnership for Molecular Medicine, the Nordic nodes follow the EMBL operational model and principles. This means aiming at scientific excellence and knowledge exchange, support in developing operational models and programmes as well as establishing mechanisms for independent, regular scientific evaluation of research activities.

*“The affiliation with EMBL has increased the visibility and profile of the Nordic EMBL Partnership and promoted the international awareness of the quality of the research conducted here. The annual research conferences within the Partnership have resulted in new contacts leading to scientific exchanges and research collaborations”*, says Prof. Bernt Eric Uhlin, Director of MIMS and current Speaker of the Nordic EMBL Partnership.

### **What are the main criteria during the recruitment of young group leaders?**

The individual nodes of the partnership benefit from joint group leader recruitment processes with evaluators from the EMBL and Nordic partners participating. They are committed to international recruitment and significant levels of staff turnover, thus guaranteeing a regular renewal of expertise and a steady inflow of innovative ideas.

During recruitment, the scientific quality of the proposed research programme is evaluated, focusing on talent and original ideas, rather than top-down strategies. Successful candidates are expected to initiate a new independent research programme in synergy with the local research environment. They are also expected to actively take part in collaborative research opportunities and exchange programmes within the Nordic EMBL Partnership for Molecular Medicine.



Members of the four Nordic EMBL nodes at the annual Nordic EMBL Partnership Meeting 2017, hosted by FIMM in Helsinki. Photo: Jouko Siro.

### **What facilities and specialized expertise are your institute offering to the Nordic EMBL Partnership?**

Given the diverse expertise of the individual nodes of the Nordic EMBL Partnership, each institute offers free access to its facilities to all the members of the network.

FIMM Technology Centre offers genomics, high-throughput biomedicine, metabolomics, digital and high-content imaging, single-cell analytics and extracellular vesicle services as well as related bioinformatics analyses.

NCMM provides access to state-of-the-art drug screening instruments, including a high-throughput chemical biology screening platform, a zebra fish core facility and a peptide array core facility. The Norwegian node is also in the process of creating a structural biology hub. In addition, NCMM is a member of the European translational medicine infrastructure, [EATRIS](#).

MIMS offers state-of-the-art infrastructures for molecular microbiology and infection research, imaging, as well as chemical biology (high-throughput screening and a compound library) and metabolomics.

DANDRITE offers collaborative workshops in *in vivo* viral transgenesis, advanced electrophysiology, optogenetics and multielectrode arrays, and cryo-electron microscopy. The Danish institute also provides expertise in induced pluripotent stem cell-derived neurons, drosophila genetics and behaviour for gene function studies, along with models of advanced behaviour, such as sensory processing, neuromuscular control, memory and decision-making.

*“Our students come from a very diverse pool of relevant educational tracks, their backgrounds include everything from engineering to molecular medicine. We feel this diversity helps us to continuously generate new ideas and approaches to how we operate and conduct research”,* adds Prof. Poul Nissen, Director of DANDRITE.

### **What have been the landmark research achievements of your institute within the Nordic EMBL Partnership?**

#### **FIMM**

The Individualised Systems Medicine ([ISM](#)) Grand Challenge programme is a collaborative research effort between FIMM and several hospitals. The programme investigates living patient-derived

tumour cells to predict efficacy of emerging and established cancer drugs for individual patients and molecular subgroups of cancer [1,2]. The programme includes development of computational machine learning models to predict treatment responses.

The Human Genomics Programme and the 'Finnish Genomes Empowering Personalised and Predictive Health' Grand Challenge build on a long Finnish tradition of high impact genetic research [3]. We work to integrate genomic and health outcome data from Finnish national population registries and biobanks into a unique 'big data' repository. This data repository can be utilised for basic research building tools for healthcare, implementation and public-private partnerships. A recently launched [FinnGen](#) project aiming to collect and analyse data from 500 000 Finns is a great example of this.

The Digital Diagnostics for Precision Medicine Grand Challenge focuses on developing devices and applications that enable artificial intelligence-supported automated diagnostics. The paradigm shift from human expert-based interpretations to computerized readouts has vast implications in research [4]. In the future, pathology will become a more quantitative science, with an expert's decisions supported by an array of readouts performed by computer vision. FIMM researchers have already developed algorithms and remote diagnostics devices, such as the MoMic mobile microscope [5].

## MIMS

Over the last decade, the MIMS group leaders have made many important contributions to the understanding of molecular infection mechanisms through studies of different microbial pathogens.

One particularly striking example can be highlighted since it well illustrates how the recruitment emphasis on excellent young scientists who are supported by the research infrastructure established in accordance with the EMBL model, can promote basic science research that leads to truly novel breakthrough findings. Dr. Emmanuelle Charpentier, now Director at the Max-Planck Unit for the Science of Pathogens in Berlin, was, in 2008, the first recruited new group leader at MIMS. Her laboratory focused on the regulatory mechanisms of gene expression in the human pathogen *Streptococcus pyogenes*. In analyses of RNA regulation, the bacterial CRISPR-Cas9 system of these bacteria became of particular interest to the group. Charpentier and her collaborators thereby discovered the mechanism of the dual RNA programmable enzyme Cas9, and proposed that it could offer considerable potential for gene-targeting and genome-editing applications, and that the system could be developed into a novel broad, versatile and efficient tool for genome engineering in all kinds of cells and organisms. Key publications of the work were published in the journals *Nature* (2011) [6] and *Science* (2012) [7]. Since then Emmanuelle Charpentier received more than 60 scientific prizes and other distinctions for her landmark research achievements during her time at MIMS.

## NCMM

On the organizational side, a particular landmark was the merger of the Biotechnology Centre of Oslo (BiO) with NCMM. This has created a more complete centre, with a stronger technology base.

NCMM/BiO has, over the past 15 years, forged the establishment of infrastructures that actively enable research.

With regards to research, the past decade has seen major progress at NCMM/BiO in building a better understanding of the blood-brain barrier, in DNA repair and ageing, in immune regulation in infection and cancer, in biomarker discovery in cancer and in the structure-based understanding of molecular mechanisms of normal physiology and disease.

NCMM's strategies to target supramolecular signalling complexes may also have application in heart diseases, cancer and infection. The understanding of molecular mechanisms of immune regulation have also led to a series of clinical intervention trials with re-purposed drugs. [8,9]. A retrospective study [10] found that aspirin use in patients diagnosed with colorectal cancer appeared to improve their survival rates. This has now evolved into a Nordic, multi-centre, double-blinded, randomised, placebo-controlled study, where the first patients of 800 are currently being recruited at sites in Norway, Sweden and Denmark. NCMM's work with cancer drug sensitivity screening may also fit into future precision medicine approaches that can provide benefits to patients [11–13].

## DANDRITE

A particular landmark achievement for DANDRITE was receiving a five-year prolongation grant from the Lundbeck Foundation, to continue its ambitious research in the second funding period, up until 2023.

Another highlight was the launch of a new Danish National Research Foundation Centre of Excellence called [PROMEMO](#), which is led by DANDRITE Group Leader Professor Anders Nykjær. The centre will work towards identifying and understanding the function of memory-associated proteins that determines the persistence of a memory, with a view to improving the treatment of psychiatric disorders in the future.

An important achievement is also the development of a 'DANDRITE spirit'. This has meant building collaborative initiatives big and small, that facilitate our curiosity-driven research across disciplines, nurturing a 'can do' attitude that pulls down barriers and empowers scientists.

For example, DANDRITE has been involved in setting up a collaborative cryo-electron microscopy network called [CryoNet](#). This brings together experts in cryo-EM based at universities in Aarhus, Copenhagen, Stockholm and Umeå. This alliance, funded by the Knut and Alice Wallenberg Foundation and the Novo Nordisk Foundation, will share resources and expertise. It will also offer training opportunities in cryo-EM, as well as open courses and seminars that will benefit the research community in the Nordic region and beyond.

Another example of collaborative achievement within the Nordic EMBL Partnership is the creation of a joint PhD project between NCMM and DANDRITE. The project is funded by The Lundbeck Foundation, with the PhD student appointed jointly between the Nissen Group at DANDRITE, and a group at NCMM.

## What do you view as the future challenges in the local and European research scenery, and how do they apply to collaborative projects?

On answering this question, Jaakko Kaprio, former Director of FIMM, depicts a clear-cut scenario: “*There is increasing need for solutions to societal challenges – novel solutions can only come from science, which is a process for systematic generation and analysis of new knowledge. However, in many areas, scientific research is not considered in the political decision process. On a societal level we observe signs that science and innovation is not valued as highly as it perhaps once was. This translates to less funding for ‘blue skies -investigator-initiated’ research, and more pressure for immediate results. In Finland, we have experienced severe cuts to research funding. This also cuts into opportunities for collaborations, as extra funding is needed to establish and maintain the more complex nature of collaborations. There can be practical issues in harmonizing data and using standard protocols in exactly the same way. There are also more political and cultural aspects as the attitudes and approaches to tackling problems differ when multiple sites are involved.*”

## What core values are, in your opinion, essential for the successful establishment of long-standing collaborations?

The formula that makes the foundation for long-standing, bottom-up research collaborations is shared interests and focus and some complementarity with respect to competencies or research tools. This requires trust and altruism and a commitment to long-term goals, with a willingness to share ideas, resources and a vision for the project. The local leadership, such as institute directors and research directors, needs to provide support to encourage collaborations.

“*The core values that have guided my leadership are joy, courage and generosity. I cherish the joy of working together to do great science, the courage to strive to reach ambitious goals and the generosity to share. I feel that I have encouraged an open, conductive, interactive, interdisciplinary and international environment that brings with it a stream of new ideas and approaches, and where the atmosphere is welcoming, friendly and collaborative. The common aim is to use groundbreaking research to understand and appreciate the beauty of biology – simple really*”, remarks Prof. Kjetil Taskén, Director of NCMM.

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**Correspondence**

D. Ruffell

E-mail: daniela.ruffell@bzh.uni-heidelberg.de