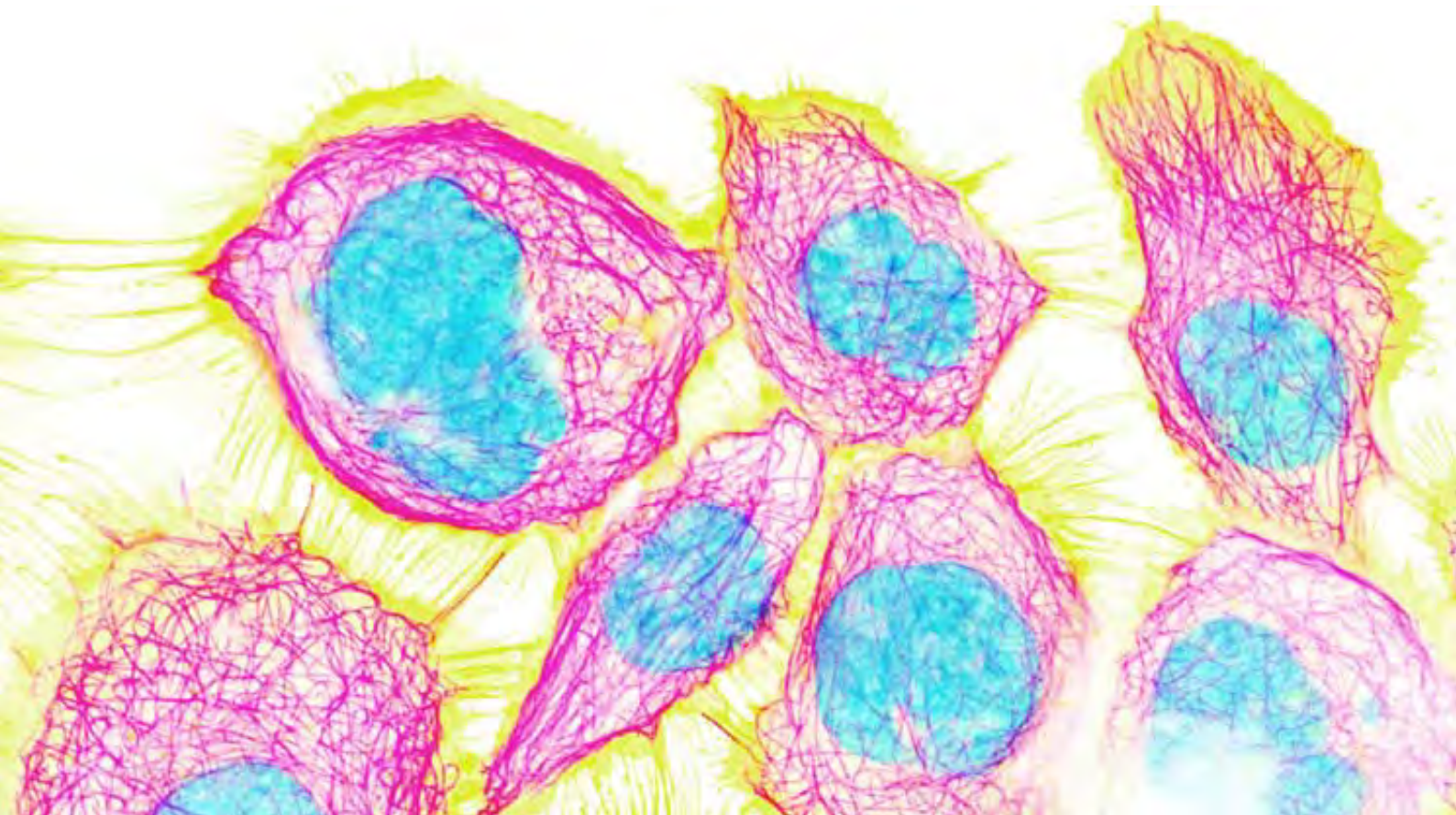


THE SWEDISH RESEARCH FUNDING AGENCIES  
VETENSKAPSRÅDET, VINNOVA, FORMAS AND FAS

# Passion

FOR RESEARCH AND INNOVATION



**Published by:**

Vetenskapsrådet (The Swedish Research Council), [www.vr.se](http://www.vr.se)

VINNOVA (The Swedish Governmental Agency for Innovation Systems), [www.vinnova.se](http://www.vinnova.se)

Formas (The Swedish Research Council Formas), [www.formas.se](http://www.formas.se)

FAS (Swedish Research Council for Working Life and Social Research), [www.fas.se](http://www.fas.se)

ISBN 91-7307-154-4

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**Graphic design:** Typoform AB

**Translation:** Jon van Leuven

**Cover picture:** Non figurative version of a confocal microscope image showing protein expression in human cells.

The cell nuclei is shown in blue and two different proteins are highlighted in pink and yellow, respectively.

Source: Human Protein Atlas, [www.proteinatlas.org](http://www.proteinatlas.org)

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**Print:** CM Digitaltryck, Bromma, Sweden 2009

# Free Research



**Research improves** the citizens' possibilities of living a good life. It strengthens growth and thereby also welfare. The cultural encounters and technological progress that take place in today's globalized world have given rise to new questions that research seeks to answer. How are the ever greater numbers of elderly people to obtain a better quality of life? How can we come to grips with influence on the climate? How will our computers be built in the future to make rapid calculations with constantly growing amounts of data?

The world is changing fast, and crises occur that cannot be planned for on a central level. There are issues waiting around the corner which we do not yet know that we will need to resolve. This is why the researchers themselves must choose which questions they want to study and how they should proceed. Many of the great breakthroughs have come to light because of researchers who were driven primarily by curiosity. Research has to be given abundant freedom. Universities should have more autonomy than until now in relation to the state powers.

Last autumn the Swedish government presented the research policy for the next four years. Its investment was the largest ever – the funding was increased by five billion Swedish Kronor. In times of crisis it is important to dare to invest in the future. We raised the grants substantially that the seats of learning themselves have at their disposal, and the government also introduced what we call “strategic investments” in areas of special importance where Sweden has great competence. If we gather our forces and maintain

a focus, even a small country like Sweden can contribute to world-leading research. The strategic investments lie particularly in the fields of medicine, technology and climate.

Some of the necessary investments in the research infrastructure are so extensive that no country can cover them by itself. Sweden is offering, together with Denmark, to host a large neutron cannon, the European Spallation Source, ESS. With the help of ESS, European scientists in a modern facility would be able to study how materials are constituted, which is important in many areas of research. Asia and America already have facilities of this kind, and now it is high time for Europe's material researchers to be able to keep up with the competition.

I look forward to working intensively with the European issues during the Swedish Presidency of the European Union the second half of 2009. Sweden will advocate

- stronger ties between higher education, research and innovation,
- better correspondence between the EU framework programme for research and the challenges facing Europe today, and
- stronger responsibility and commitment for European research from the member states in the creation of the European Research Area.

*Tobias Krantz*

Minister for Higher Education and Research

▼ The Nobel Prize is awarded every year for innovations and discoveries that have conferred “the greatest benefit on mankind” in physics, chemistry, medicine, literature and peace.



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# Sweden at a glance

In Sweden we have a high level of educated people, we are advanced in regard to equality and democracy, and we are well-known for being early adopters of new trends. When it comes to research and innovation we collaborate in creating strong innovative environments – some of which you will meet in the following pages.

**Capital:** Stockholm

**Population:** 9.3 million

**Area:** 450,000 km<sup>2</sup> {third largest in Western Europe}

**Life expectancy:** 79 years {men} and 83 years {women}

**Language:** Swedish, English widely spoken

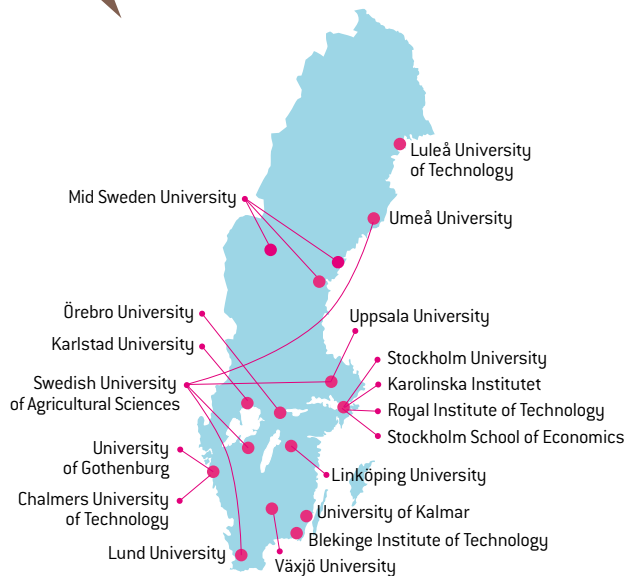
**Form of government:** Constitutional monarchy, parliamentary democracy

**Presidency of the European Union:** 1 July 2009–31 December 2009



## Universities in Sweden

SOURCE: SWEDISH NATIONAL AGENCY FOR HIGHER EDUCATION



▲ The highest ranked university in Sweden is Karolinska Institutet followed by the universities of Uppsala, Stockholm and Lund (according to Academic Ranking of World Universities 2008).

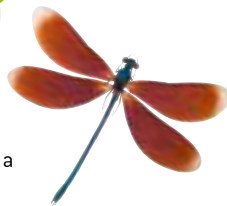
◀ Around 75 per cent of Swedish dads take some form of parental leave.

## The green country

The first UN conference on environmental issues was held in Stockholm in 1972. Since then Sweden has been a pro-active country in recognizing the rapid loss of natural resources and other environmental problems that have to be confronted, for instance concerning the Baltic Sea.

The Riksdag (the Swedish parliament) has adopted 16 environmental quality objectives that are to be reached by 2020 at the latest. The overall goal is to pass on to the next generation a society in which the major environmental problems have been solved. Considerable progress has been made in a number of fields, but much remains to be done.

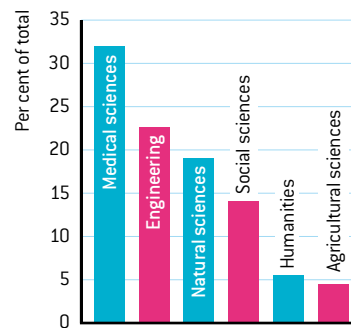
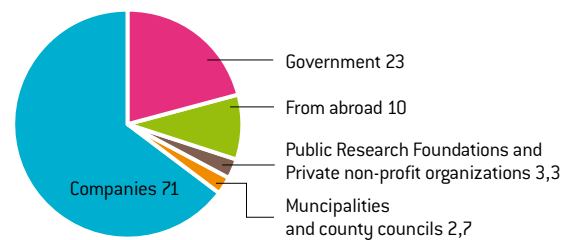
SOURCE: WWW.MILJODIEN.NU



## The Swedish research system

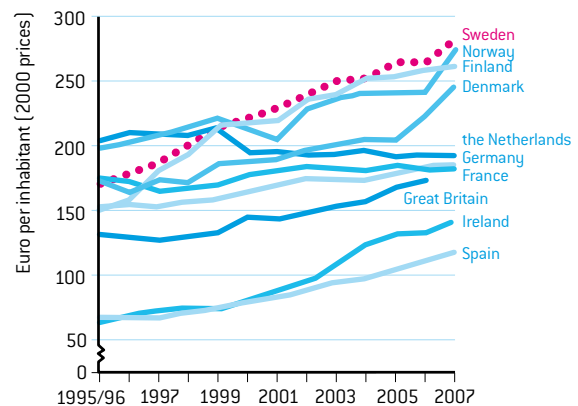
Sweden is recognized as one of the world's most knowledge-based and innovative economies. Around 4 per cent of GDP is spent on R&D, of which the government accounts for 1 per cent and industry the remaining 3 per cent.

▼ Financiers of R&D 2007. Total SEK 110 billion (approx. 10 billion euro).



◀ R&D expenditures at higher education institutions 2007 by area of research (per cent of total).

▼ R&D expenditures in the "extended academic sector" (sum of higher education institutions, government agencies and private non-profit organizations) in Sweden compared to selected European countries.



# Abduktus

**What was the most common cause of death in Stockholm in 1821? Does a divorce of parents influence their children's health later in life? By combining different databases, researchers can now seek answers to questions that they once were unable even to dream of asking...**

Sweden has well-preserved population statistics ever since 1750, and we introduced personal numbers already in 1947. These assets, together with a positive national attitude toward research and a high level of IT competence, have allowed Sweden to build up databases on population history which have no international equal. Register research, micro-

data research, biobanks, e-science – there are many names for it. But how do we make sure of benefiting from these registers? And how is people's integrity dealt with?

**Juni Palmgren**, professor of biostatistics, is designing strategies to develop e-science for the Swedish Research Council.

“The idea is that the research should ultimately contribute to improving public health by increasing the knowledge of how different factors interact. For example, living conditions in childhood raise the risk of obesity, cancer and other ailments, as well as of other social problems like addiction and criminality.”

In regard to ethical issues, the use of databases is strictly regulated in legislation. It is naturally of extreme importance to be able to guarantee people's anonymity. Securing the routines for de-identification is therefore an important task for Juni Palmgren.

“You can compare it with bank secrecy, which is perhaps not always complete. But there it is really only a matter of money. If the protection of individuals in research databases is not watertight, this new venture collapses.”

The largest single grant from the Swedish Initiative for

◀ *Parish registers are a source of information about the Swedish population that goes back to the 17th century.*



Research on Microdata in the Social and Medical Sciences, SIMSAM, goes to Umeå University – whose vice-chancellor, **Göran Sandberg**, explains the intention.

“Umeå University has several high-quality research registers and population databases. The new funding gives us even greater possibilities.”

Göran Sandberg takes a concrete example.

“We live ever longer. But we also want to have a good quality of life when we get older. The complex connections between aging, social structure, and living conditions provide important knowledge of what characterizes ‘successful’ aging.”

Research in Umeå is not only about the elderly, though. **Anneli Ivarsson** is an associate professor in the section for epidemiology and public health science at Umeå University, to which the strategic programme Umeå Centre for Global Health Research is also linked. Her focus is children.

“What happens during childhood affects our future health and welfare. But how? What can be done to improve health and well-being, both in childhood and later in life?”

The Umeå SIMSAM node is directed by scholars from epidemiology and public health sciences, statistics, sociology, human geography, and occupational and environmental medicine. Thanks to this broad competence, they will be able to study many different factors that might influence health.

Large registers, however, do not by themselves guarantee interesting research results. It is the formulation of questions that calls for both experience and innovative thinking.

## Twice as good

The Swedish Twin Registry was established during the 1960s to study how our health is affected by smoking. Today the registry contains information on about 85,000 identical and fraternal twins, and is not only the largest but also the most complete on Earth. Researchers around the world, in fields ranging from genetics to epidemiology and behavioural science, have realized that the twin registry provides invaluable information.

Among the perhaps best known examples of twin studies are those conducted on twins who were separated as children. One such important study showed that the susceptibility to the bacterium *Helicobacter pylori* is higher in a twin who grows up in a crowded home. The study also demonstrated that genetic factors contribute to causing sensitivity to these bacteria, which are connected with illnesses such as gastritis, peptic ulcers and inflammatory intestinal diseases, as well as to chronic fatigue syndrome.

Professor **Nancy Pedersen**, vice dean of research at the Karolinska Institutet, emphasizes another aspect of the registry – that it can be operated simultaneously with information from the Swedish population register.

“We have permission to link patient registers and death-cause registers, but everything we do is based on our having permission from ethical committees and naturally from the twins themselves.”

The Swedish Twin Registry has drawn interest from foreign countries. In the United States, the National Institutes of Health used the Swedish Twin Registry when carrying out a study of *interstitial cystitis* (chronic inflammation of the bladder).

“What attracted them was that it was so easy to contact the twins,” says Nancy Pedersen.

◀ The Swedish Twin Registry is unique – it contains information about 85,000 twins!



# Miracles of Life

**It can seem indeed miraculous that every human being has developed from a single cell at the moment of fertilization – and that we share this miracle with all other multicellular organisms on Earth: carrots and cockroaches, shrimps and chimpanzees. All life is one.**

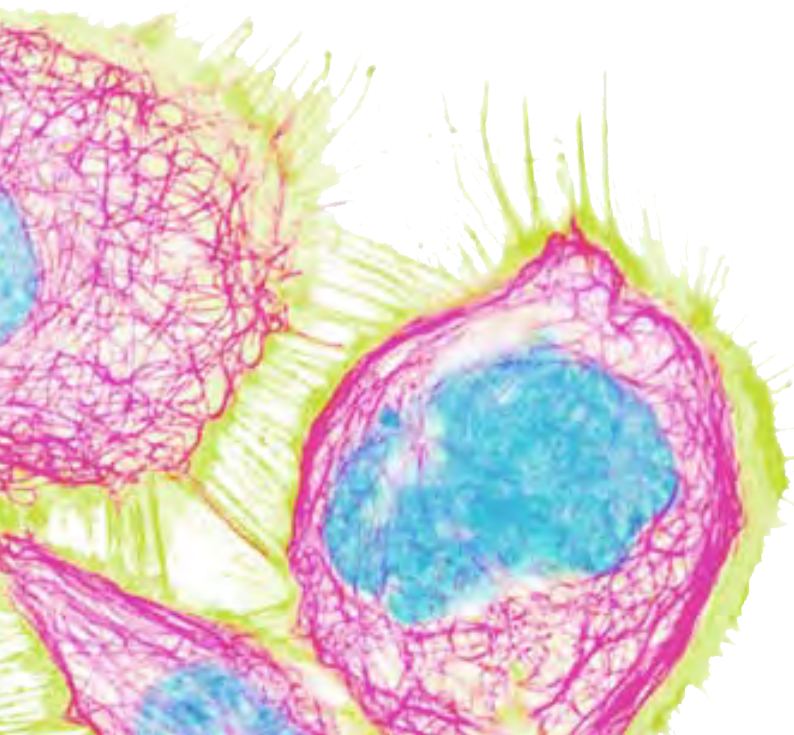
Medical sciences are without doubt among Sweden's strongest research fields. Pioneers like the Nobel laureates Arne Tiselius and The Svedberg have meant much to it, as has the growth of a large pharmaceutical industry during the late 20th century. Sweden has also long been in the front line of technological progress, which has been of great significance. Today's research and development in the biotechnological area are substantially concerned with handling huge amounts of data.

But it is also a matter of having the trust of politicians, so that the legislation does not become a limiting factor. Stem cell research is an example where Sweden, unlike many other countries, allows new stem cell lines to be developed with state funds.

A stem cell line is a group of identical cells that derives from one and the same stem cell. The argument for establishing many different stem cell lines is that a patient must be given cells which agree as nearly as possible with his or her own tissue, in order to minimize the risk of rejection.

**Outi Hovatta** is a professor and chief physician at Karolinska University Hospital in Huddinge. She is satisfied with the Swedish legislation in the field.

◀ *By generating new antibodies the Swedish Human Proteome Resource programme can visualize where in a cell or tissue a certain protein is present. The Human Protein Atlas contains over seven million microscope pictures such as this one (here showing a detail).*



## Food instead of drugs

Innovative new foods can be used to combat prevalent diseases like obesity, age-related diabetes and cardiovascular disorders. This is the aim of the research being run at the Antidiabetic Food Center, at Lund University.

Many of the drugs in current use can reduce our risk of contracting a range of different diseases, but we don't always know how and why. Accordingly, the researchers are trying to understand what mechanisms influence various events and then enhance desirable effects. Their aim is to identify the components in food which have a protective effect. This may also involve altering the structure of food to influence the way it is absorbed in the gastrointestinal tract.



“There are clear laws and ethical principles that govern. This allows us to conduct research that is scientifically important. We have a good situation compared with many other countries.”

Sweden is one of the countries in the world that has come farthest, in regard to both research on all types of stem cells and treatment of certain patient groups with cell therapy. For example, we have long treated leukaemia patients with blood stem cells and, since the early 1990s, repaired cartilage injuries with cells cultivated from the patient's own cartilage – a method that is now established around the world.

Outi Hovatta is developing new treatment methods for involuntarily childless people.

“We cultivate stem cell lines from embryos that are left over from test-tube fertilization.”

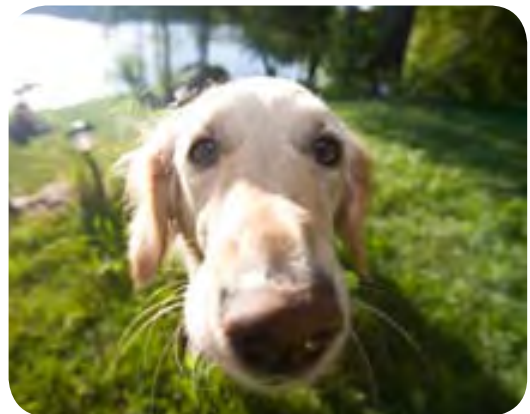
She is also optimistic about other areas. Her greatest hopes are of treating ailments in the nervous system with stem cells. Today research is conducted on stroke, spinal injuries, Parkinson's, Alzheimer's and Huntington's diseases.

## Man's best friend

Dogs, too, can acquire the nerve disease ALS (Amyotrophic Lateral Sclerosis).

Researchers at Uppsala University have identified a mutation in a gene, SOD1, which gives rise to these symptoms in several dog breeds. This is the same gene that causes ALS in humans.

“We are now going to look for other genes that can influence the debut age in dogs. Then we hope to be able to investigate whether these genes are also important for the disease's progress in humans with ALS”, says **Kerstin Lindblad-Toh**, guest professor at Uppsala University, who has previously done research at MIT and Harvard University. She is one of the year's recipients of the EU research grant for promising young researchers, the European Young Investigator Award (EURYI).



When mankind's genetic make-up was presented some years ago, there were already many who saw the next important actor in the cells. Genes to be sure, but actually life's whole mystery has to do with proteins! The discussions were vigorous, and the expectations grew about what a charting of all human proteins would mean. But there is also a need to go from words into action. This was done by **Mathias Uhlén**, professor of microbiology and one of Sweden's most prominent researchers.

He now leads the Human Proteome Resource Project (HPR), which began in 2003 with the goal of systematically charting the entire corpus of human proteins. Around 21,000 proteins are to be described by the year 2014 – and

## *“The study of nature guards against prejudice.”*

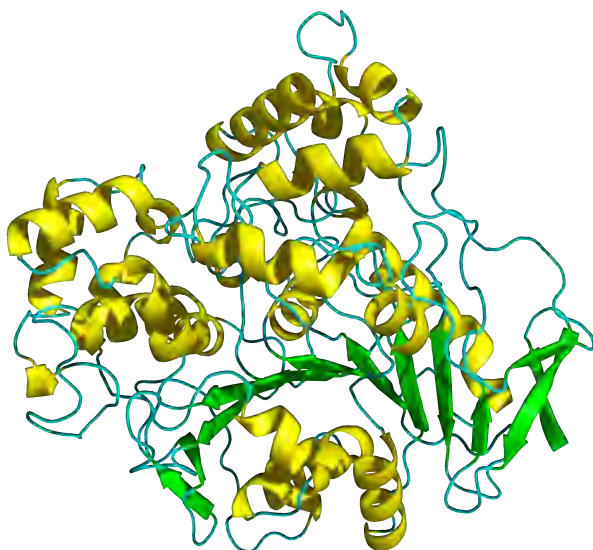
CARL LINNAEUS, BOTANIST, PHYSICIAN, EXPLORER (1707–1778)

so far, a third of them have been dealt with. Mathias Uhlén emphasizes that there has been a continual improvement in effectiveness.

“During these five years we have succeeded in doubling our productivity each year with the same budget. The hardest thing in such a gigantic project is to make the right priorities. We must keep in mind that this is probably one of the most complex research projects in the world, and it places enormous demands on processes, techniques and quality assurance.

“Every week we send 2,000 gigabytes of data to our supercomputer. This corresponds to information about the approximately 50 new proteins that we reveal here each week. The challenge is to identify what is interesting within this vast amount of information!”

A way of doing so is to show high-resolution pictures of where the proteins are located in the cells and tissue. This is the basis of the great Human Protein Atlas which is now emerging. And the researchers have already made controversial discoveries.



### **Biomaterial**

A lost finger grows out again – what was regarded as pure science fiction

a few years ago will soon become a reality. At least in the view of researchers at BIOMATCELL, a research programme at Göteborg University. They are combining knowledge of new materials with the latest stem-cell research in order to develop new product ideas and clinical therapies. These include new implants, tissue regeneration, and other innovations within what is called regenerative medicine.



“It turns out that things are not as we believed, with the kidneys containing kidney proteins and the brain cells producing those proteins which are needed for the brain’s function. Instead we see all the proteins everywhere, regardless of where in the body we look.”

This must mean that the proteins differ widely in quantity and that they create different combinations for different functions. Mathias Uhlén draws a parallel with music.

“When one looks at each individual part in an orchestra, it doesn’t seem very advanced, but when all the instruments play together it becomes both complex and beautiful. And an assemblage of instruments can play infinitely many musical works!”

The Swedish Human Proteome Resource programme is not only a basic research project for understanding life’s magic at the protein level. Mathias Uhlén sees many applications, especially in new medicines.

“99 per cent of all medicines have a direct connection with proteins. We are now focusing particularly on cancer’s ‘Big Four’ – breast, colon, lung and prostate cancer – in order to find new markers.”

◀ *The genes in our cells are coding for proteins – in Sweden all 21,000 of them are being mapped and available for other scientists at [www.proteinatlas.org](http://www.proteinatlas.org).*

# ORGANIZING A CREATIVE PROCESS

## Swedish Profiles

### In Mathias Uhlén's

bright office stand a number of cardboard boxes leaning against

the wall. Is he moving? No, this is a scientist who has come close to it many times, but has always been attracted to staying in Sweden. Most recently in 2003, when he received the largest research grant that has ever been awarded in our country - from the Wallenberg Foundation. With this support, Mathias Uhlén began the strenuous work of charting all human proteins. He reveals that it started as a thriller.

"For the first six months we got no results! It was a crisis. Then suddenly one day, one of our doctoral candidates stumbled upon something that turned out to be the solution to the problem. She discovered something that quite simply made us change our strategy. Since then, it has rolled along!"

### Ten new proteins every day, 2000 gigabytes of data per week, a new patent each month...how does one manage to lead this enormous work?

"One has to be a good organizer, no doubt about it. As a research director you must also be an active part of the creative process, asking the right questions. With as much data as we have, one must see patterns, prioritize, and make quick decisions. We have to deliver constantly!"

### What different competences do you have at the department?

"Well, we are a little unusual. In this work we need knowledge from many different areas – of course we have experts on proteins, but also on IT and robotization, pathology and gene cloning. We are truly multidisciplinary."

### You seem happy with everything you do – from basic research to starting and running companies. What do you have that others don't?

"Primarily, luck! And I have been nudged in the right directions, just when I needed it most. Sometimes by older colleagues who served as informal mentors, sometimes in the form of awards, prizes and research grants."

**Name:** Mathias Uhlén

**Research field:** Proteins!

**Age:** 54

**Family:** Fiancée and three teenage daughters

**Secret talent:** Electric guitar

### And now you have the power to nudge others forward...

"Yes, and I really try to do that. It is fun that we have so many extremely competent scientists here, not least the young women."

### You have three teenage daughters – what have you learned from them?

"That there is more to life than cancer cells, gene sequences and conferences! Every winter we make a long trip to some new exciting place in the world. Then I can relax completely!"

### But you aren't moving?

"No, I'm staying in Sweden! Stockholm is a wonderful city. The cardboard boxes are there because I want to get rid of some rubbish on the bookshelves. Plenty of information is flowing!"

▼ *Mathias Uhlén, professor of microbiology at the Royal Institute of Technology (KTH).*



**More than half of Sweden's area is covered by forests. They are both ecologically and economically important. They take care of nearly half the carbon dioxide we emit from fossil fuels, and economically they provide over 12 per cent of our total exports.**

It is not only at Christmas time that the Swedish spruce deserves attention. Such is the view, at any rate, of scientists in Umeå who have now begun the arduous work of charting the spruce tree's genetic make-up. **Ove Nilsson** at the Umeå Plant Science Center (UPSC) has played an important role of developing UPSC into one of the most prominent plant research environments in Europe. Today, 180 scientists of 35 different nationalities are working at UPSC. Ove Nilsson explains why they want to understand more about the spruce.

"Coniferous trees have been on Earth for 400 million years and are therefore extremely interesting in terms of evolutionary biology. We will learn a great deal by comparing them with deciduous trees and other flowering plants." But Ove Nilsson – who also led the research group that, some years ago, identified the gene which controls tree flowering

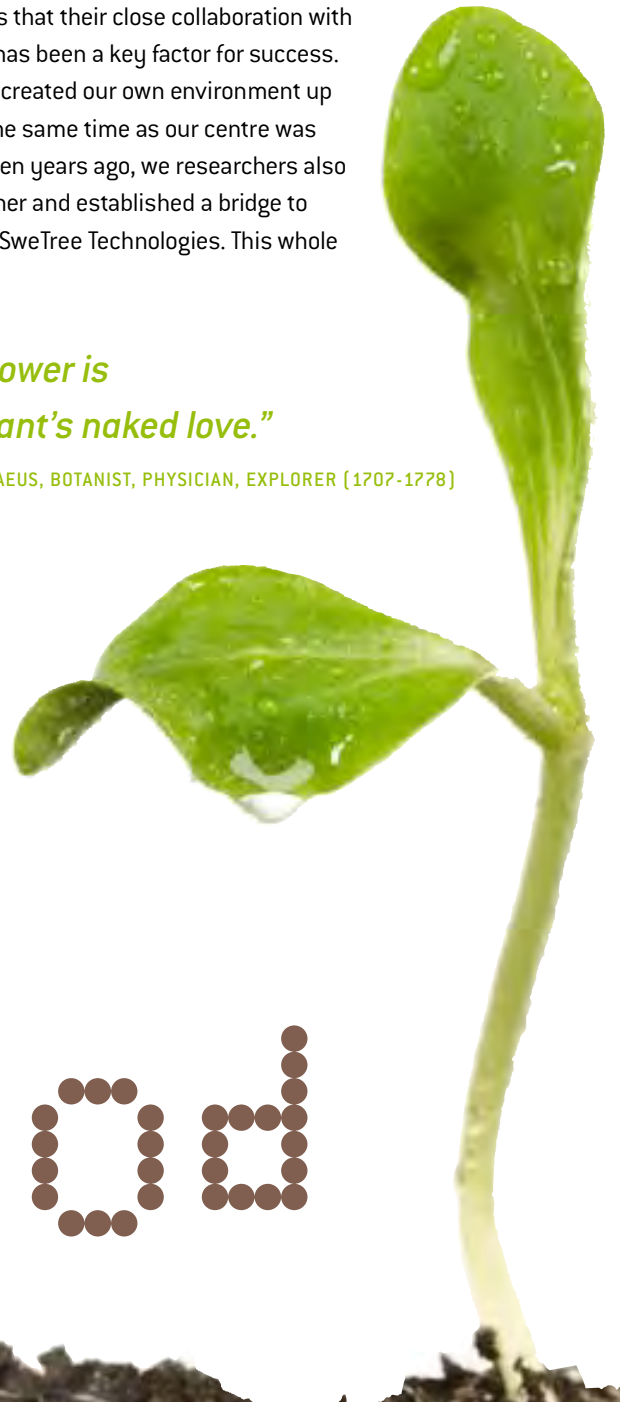
– also sees important commercial applications. "The spruce is Sweden's leading plant! New knowledge of how the spruce functions, for example in taking up nutrients and forming wood, will have valuable consequences in the forest industry, for production of both bioenergy and new materials. The forest industry will become much more high-tech in the future!"

He tells that their close collaboration with industry has been a key factor for success. "We have created our own environment up here. At the same time as our centre was founded ten years ago, we researchers also got together and established a bridge to industry, SweTree Technologies. This whole

*"The flower is  
the plant's naked love."*

CARL LINNAEUS, BOTANIST, PHYSICIAN, EXPLORER (1707-1778)

Knock  
on  
wood



process has functioned as a bottom-up process and it has worked very well.” If one believes Ove Nilsson, forestry will become more diversified in the future and some aspects will be more like today’s agriculture.

“We are going to cultivate different trees for different purposes, and be able to produce trees that are more resistant to disease and cold.”

But what about risks? Ove Nilsson explains.

“In principle there is no difference between this and what agriculture has been doing for thousands of years. The idea is that the trees we put out in the forests will not contain any foreign genes, but will be new and highly refined types, just like all our farming crops.”

The changes in climate have also reminded us that it can be risky not to invest in this research. “We need new knowledge about what happens in the forest when the climate becomes warmer. Not only do the trees grow faster. Other processes begin that are very unpredictable. For instance, trees need a period of cold during the winter before they start to grow in the spring – otherwise the growth may stop completely!”

**Anders Lindroth** is a professor of natural geography at Lund University. He has conducted research on forests’ carbon dioxide exchange with the atmosphere since the early 1990s. Recently he has published interesting results.

“Our new studies confirm that forests capture lots of carbon dioxide, but we can also see that the forests release great quantities of carbon dioxide when they are cut down and the photosynthesis is stopped.”

Anders Lindroth points out that there is potential for substantially increasing the uptake of carbon dioxide in forests by changing our way of exploiting them.

“An interesting observation we have made is that the carbon dioxide uptake is hardly affected at all by normal thinning of the forest. This can be explained, for example, by the fact that the remaining trees receive more light and nutrition due to less competition. This supports the hypothesis that a more continuous exploitation, which avoids clear-felling, could radically increase the net uptake of carbon dioxide.”

## Packed and ready

Sweden has successful industries in forestry, electronics

and biomedicine. But the knowledge in different industries has seldom been combined within one and the same research field. The research at industrial companies has been oriented toward their respective special areas, which has made it difficult to develop products requiring many different competences. Now this will change!

**iPack Centre** is a joint interdisciplinary research platform at KTH Royal Institute of Technology, a centre that will develop intelligent paper and packaging for biomedical applications. The centre’s research focuses on wireless communication, biomedical sensors, and energy supply for applications to fibre-based packaging.

▼ “There are disturbing studies which show that deciduous trees such as bird-cherry and lilac are flowering a month earlier nowadays than when I was a child. We need more knowledge of how the forest reacts to climate change”, says Ove Nilsson, professor of plant reproduction biology at the Swedish University of Agricultural Sciences (SLU).



# Green

# thinking

**Ecology and economics are closely interwoven. This calls for interdisciplinary research initiatives, and new knowledge about attitudes, behaviour and learning. Here, Sweden is in the front line.**

The climate issue has brought everything to a head. How we take care of our land, waterways and forests, as well as whatever crawls or peeps or rustles there – but also how we live, consume and travel. Moreover, we have all become more conscious of the socio-economic dimension of the threat to our planet. My choices in the small country of Sweden influence the living conditions of families on the other side of the Earth ...

At the Stockholm Resilience Centre, a knowledge base is now being built up in ecosystem management and climate change. **Johan Rockström** is the Centre's director.

“When we are most in need of robust ecosystems, to bind greenhouse gases and provide us with environment-friendly products and services, then they are weakest.”

“In our eagerness to optimize ecosystems for our own short-term benefit, we have impoverished the soil, drained important wetlands, and destroyed the living conditions for many species.”

Johan Rockström also sees a paradox in our relationship to nature and to what is natural. “We like to believe that everything in nature is linear and slow. Actually, abrupt changes are a universal part of ecosystems, which we need to learn more



## Climate economics

**Per Krusell** has just come from a meeting with a group of meteorologists. He himself is one of Sweden's leading economists, a professor at Stockholm University, and recently returned from the USA where he held a professorship at Princeton University.

"We economists awoke rather late to the climate issue. It was actually first when the Stern report appeared that we began to understand what influence the climate has on the economy, and also how the economy affects the climate."

He sees many intellectual challenges in the future.

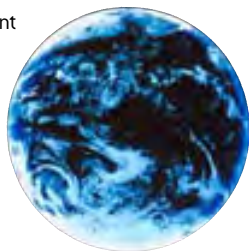
"In my own research I have previously focused on what drives technological progress and creates welfare. For me it is especially satisfying that the methods I used there can now be employed for understanding what happens in the interplay between economy and climate."

Per Krusell takes the area that he has just discussed with the meteorologists as an example: effects on the agricultural market.

"They have advanced climate models that show which regions are becoming, for instance, more dry. What effects will this have on the prices of agricultural products globally? And if the prices go up, who will be the winners and losers on different markets? How will the consumers react? It is questions of this type that we economists can answer."

He thinks it is exciting that ever more economists are beginning to take the climate issue seriously.

"We have methods that enable us to analyze and evaluate important trade-offs in economic policy, such as emission rights and carbon dioxide taxes. This gives us a feeling that we are really useful. Climate economics has become a truly hot area, and that's cool."



◀ *Are some species more valuable than others?*

## Sun and salt: a winning Swedish recipe

**One fourth** of the global emissions of carbon dioxide comes from heating and cooling of buildings. Thanks to a young Swedish company, ClimateWell, these emissions can be reduced. It is all based on the old dream of being able to capture and store the energy in solar radiation.

The heat pump that ClimateWell has developed makes use of chemical storage of energy in salt, and therefore it operates without any moving parts or carbon dioxide emission. This "magical" technique has received much attention and, among others, an award from the World Economic Forum. **Per Olofsson**, managing director of ClimateWell:

"The work during the year has really gone fast – we have been able to proceed from a prototype to a finished product that we have begun to sell."

The energy storage can also be used for other purposes than solar energy.

"An exciting application is also to scale up the technique for taking care of waste heat from industries. This would help Swedish basic industry to utilize its energy better, and thereby to increase the companies' competitiveness."



from. The basis of our research is the insight that threshold effects, so-called tipping points, exist and that because of this we have to find new ways of preventing undesirable surprises from happening."

An example that illustrates what he means is forest fires.

**Oonsie Biggs**, one of the scientists at the Centre, explains.

"Avoiding or suppressing small fires usually makes the forest vulnerable to a really big fire. If there are no small fires, lots of combustible material will build up so that when a fire inevitably occurs it tends to be very big. For this reason, people that have lived with fire for generations often allow small fires to burn in order to protect themselves from devastating big fires."

## Other strong research environments

**Göteborg's Centre for Environment and Sustainability/Chalmers:** "It is time to go from know-how to do-now", says **Christian Azar**, professor of physical resource theory at Chalmers.



The areas of strength at Chalmers are climate and energy issues on a general level, energy effectiveness, environmental systems analysis, material flows, risk assessments, logistics and transport systems, urban water systems, and sustainable construction.

*"It is time to go from know-how to do-now"*

CHRISTIAN AZAR

Oonsie Biggs' research is about ecological regime shifts and how they can be predicted – if they can. She has used a fisheries simulation model to investigate the ecological situation in the sea. Can we take action to avoid a situation where the system has "tipped over" to an undesirable state?

"We found that, for variables such as fishing pressure that can be rapidly reduced, it is possible to 'turn back' from a regime shift even once it has started. On the other hand, if the variable driving the regime shift can only be manipulated gradually, such as restoring shoreline habitat, action needs to be taken before a regime shift in order to avoid it."

Johan Rockström emphasizes the importance of attacking these crucial issues in an interdisciplinary way. The Centre has gotten off to a flying start and attracts many talented researchers from diverse fields. A key part of the activity, too,

**LUCID – Lund University Centre of Excellence for Integration of Social and Natural Dimensions of Sustainability:**

In the same way as sustainable development is a gigantic challenge for politics and economics, it is a great challenge for research. At Lund University, a centre has been established that integrates dimensions of the natural and human sciences in order to conduct research on climate change, water shortage, loss of biological diversity, and land usage.

"This is an unexplored area in the interface between social science and natural science, between knowledge and action. Therefore, we have researchers ranging from natural science to philosophy and economic history in our group," says

**Lennart Olsson**, coordinator for LUCID.

**Bert Bolin Centre:**

Why is the Arctic ice melting faster than expected? How is cloud formation affected by the emission of greenhouse gases and particles in the air? To probe deeper into these and related questions, the Bert Bolin Centre has recently been established at Stockholm University. Among other things it will be devoted to research on climatic variations, atmospheric and marine circulation, and circular flows. **Georgia Destouni**, professor of hydrology, hydrogeology and water resources explains:

"A significant challenge for us in the years to come is to improve the climate modelling regionally and over the next 10–50 years, in order to meet the need for information from society."

is that new knowledge becomes available to decision-makers.

"How governance and policy at different levels can be improved is a part of our work where we see a growing interest in both politics and industry. We must act locally, regionally and globally at the same time!"

*"Climate science needs to be discussed critically and in public. What is not needed is the kind of pseudoscientific reasoning that many so-called skeptics tend to fall back on."*

OLLE HÄGGSTRÖM, PROFESSOR OF MATHEMATICAL STATISTICS, UNIVERSITY OF GOTHENBURG

# THE IMPORTANCE OF READING

## Swedish Profiles

**We meet one** sunny afternoon at Södertörn University, just south of Stockholm. This is

a relatively new seat of learning, which suits Sara Danius very well. She is a professor of aesthetics, and enjoys being in a culture prone to change with plenty of tolerance and a young faculty. She came here three years ago from Uppsala University, with a successful international career in England and the USA behind her – something that is relatively unusual for a humanist in Sweden today. Sara Danius makes clear what she thinks of the lack of mobility among researchers in all the humanities.

“There is a painful tendency toward institutional reproduction! To avoid moss on the stones we need to keep them rolling.”

### What is humanistic research to you?

“While natural scientists deal with explaining, we concentrate on understanding – a humanist wants to understand people and their presence in the world, society, and history. We study the arts of reading, writing and thinking, and convey them to young people who are to make contributions to society. A country that treats the humanities as an exception soon becomes a poor country. Humanities are an area where society scrutinizes itself and acquires awareness of itself. Democracy calls for strong humanistic research.”

### More books and audio books are consumed today than ever before – how do you view the fact that so many people flee from the real world into fiction?

“One doesn’t flee! Certainly we sometimes read in order to escape reality, and this isn’t wrong – but as a rule we read because we want to understand reality.”

### Then does one become a better human being by reading?

“No, unfortunately there are no such guarantees! But since human beings are capable of symbolic thinking, they can do many things that no other creatures on Earth can, and it is these representative worlds that we humanists study. Ideally, this gives people a greater understanding of themselves and

**Name:** Sara Danius

**Research field:** Literary history

**Current reading:** Irene Nemirovski, Seneca, Ernst Billgren, and the children’s books “Bu och bä”

**Secret talent:** Trained croupier and card dealer

their place in the world, so that they find it easier to identify and handle new situations and problems. Besides, we are not timeless, but immersed in history – and history creates us as much as we create it. One understands this, too, as a humanist.”

### So by understanding how we thought in the past, we can better relate to what happens today?

“Yes, in my own research I have studied, for instance, how people’s ways of representing and simulating reality have changed. New sensory technologies such as photography and cinematography allow one to narrate a new history of how realism and later modernism emerged during the 19th century. Didn’t X-ray pictures mean a great deal for medicine – and for art and literature? Suddenly it became possible to visualize what happens inside the body, and to recreate the perception as an object, a picture to hold in the hand. I am working just now with the history of visibility.”

▼ *Sara Danius, professor of aesthetics at Södertörn University.*



Being

Is it our creativity and curiosity  
that make us human beings?  
Or perhaps the ability to teach?  
If so, perhaps we should devote  
a little more attention to what  
actually goes on in our schools...

If one asks a biologist what a human being is, the answer is simply 99 per cent chimpanzee and 1 per cent unknown. With the latter percentage we have not only built pyramids and microchips – we have also created poetry and differential calculus, networks and blogs...

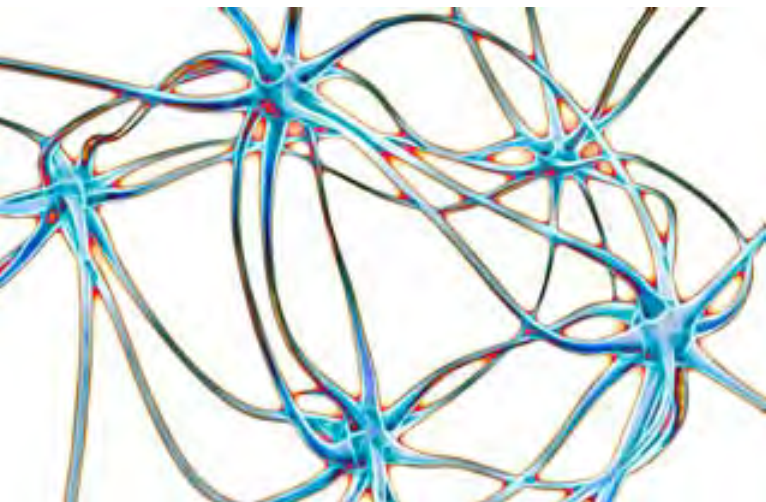
human

Humans are creatures whose biology gives them unique abilities to build up cultures. This insight is the basis of the Centre for Evolutionary Cultural Research, an interdisciplinary research environment at Stockholm University. **Kerstin Lidén**, professor of archaeology, is one of the research directors at the centre. What, then, is special about us humans, in her view?

“The unique thing about human cultures is the capacity for cultural accumulation, where both learning and creativity are important elements. This capacity has made people today the only large animals existing on all the Earth’s continents.”

▼ *A child can learn 8–10 new words every day.  
What can we learn from that?*

▼ *Connected nerve cells are one level of explaining what goes on when we learn new things. But there are more ...*



## *“All great things in the world first happened in someone’s fantasy”*

ASTRID LINDGREN, AUTHOR (1907–2002)

In order to study cultural evolution and construct models of it, knowledge is needed in mathematics as well as cultural history. What has been concluded is that it is not enough to have cultural transmission – in other words, learning – as an explanation for mankind’s cultural development. Neither is creativity alone enough. It is the very combination of these which becomes so powerful.

Another interdisciplinary effort is now occurring at Lund University under the heading of “Thinking in Time: Cognition, Communication and Language”. There, researchers are gathered in neurophysiology, logopedics, linguistics, psychology and cognitive science. Different levels of brain processes and behaviour are to be studied. **Peter Gärdenfors** is a professor of cognitive science and leads the centre. He believes that language can be seen as a tool for humans to satisfy their curiosity and their search for meaning in life.

“Look at children! Until their teens, they learn 8–10 new words every day – about one new word per hour! They obviously learn languages in an exceptionally effective way, but there is still no good theory of how this happens.”

To investigate it, the researchers want to find causal connections and link the different levels together, so as to get a broad understanding of the brain’s function when we learn concepts and comprehend words in a language.

“The fact that we study languages with such a wide perspective is unique in an international perspective,” says Peter Gärdenfors.

Studying people who have difficulty in learning is another means of acquiring more knowledge about how learning functions.

**Torkel Klingberg** is a professor of cognitive neuroscience at the Karolinska Institutet, and one of the driving forces behind the project “Learning and memory in children and young people”. He uses, for instance, brain scanning to study the activity in the brain when children carry out various work-tasks.

## How do we learn?

How do we learn new things in modern society? **Roger Säljö** is a professor of pedagogy at University of Gothenburg and leads the research in collaboration with the University of Borås. Its focus is on questions of how knowledge and skills are created and recreated. The overall aim is to obtain empirically grounded knowledge about learning in Swedish society. Primarily it deals with schools and education, but learning in working life will also be studied.



This project is aimed at connecting the biological research with psychology and pedagogy, so that one can better help children with dyslexia as well as learning more about how learning functions in general.

“It is a matter of integrating cognitive science with influences from genetics and developing a scientifically based education. We must create more research-oriented schools,” thinks Torkel Klingberg.

▼ *Kerstin Lidén during field work at Luspasjaure in northern Sweden, seeking clues to better understand early human cultures.*



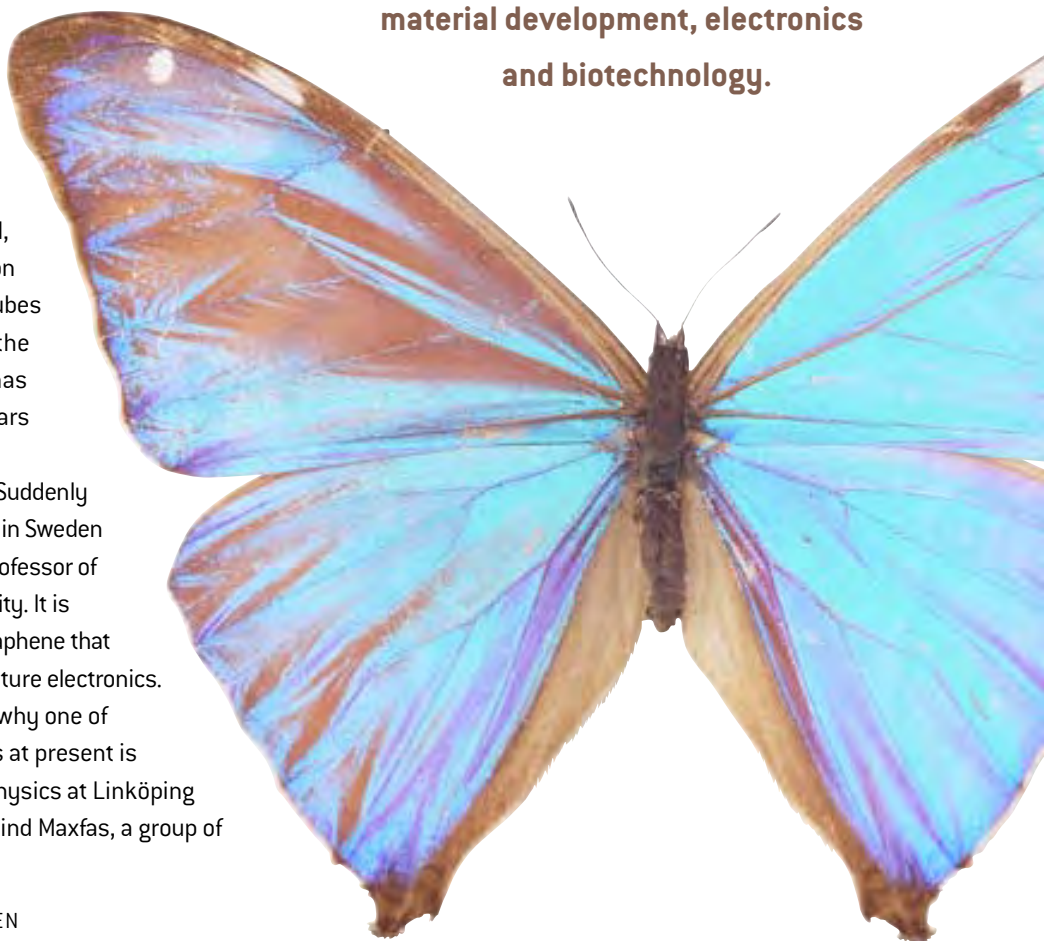
# the Creative scale

It is on the scale  
of nanometres that materials acquire  
their properties – everything decisive  
takes place there! Scientists are now  
opening up entirely new possibilities for  
material development, electronics  
and biotechnology.

In school we learned that carbon occurs in two forms: graphite and diamond. With the discovery of carbon footballs, or fullerenes, we had to add a sibling in the family. And now it is time for another addition. Graphene, as the new material is called, resembles chicken-wire made of carbon atoms, and can build up carbon nanotubes and other structures. It is definitely the thinnest material known today and has become a giant trend during recent years in Swedish research on materials.

“This is extremely prominent today. Suddenly there are several large research groups in Sweden within the field,” says **Karin Larsson**, professor of materials chemistry at Uppsala University. It is primarily the mobility of electrons in graphene that researchers believe will revolutionize future electronics.

Another new material is the reason why one of Sweden’s most successful researchers at present is **Lars Hultman**, professor of thin-film physics at Linköping University. He is among the brains behind Maxfas, a group of



*"Many physicists have thought that the fundamental laws of Nature should be beautiful and simple. But perhaps they are not. And perhaps that is much more interesting?"*

ULF DANIELSSON, PROFESSOR OF THEORETICAL PHYSICS,  
UPPSALA UNIVERSITY

completely new ceramic materials with such revolutionary properties that it is called the most important discovery since steel: it is strong, light and heat-resistant, as well as a good conductor of current. Its leading application until now has been as a substitute for gold in electrical components – which in just a few years has given the company Impact Coatings a global market worth billions. Lars Hultman thinks that the new materials are far superior to those formed in nature, although difficulties certainly exist.

"It is a challenge to get them to alloy. We vaporize the materials in a vacuum chamber and guide the atoms' movements there."

Nanomaterials can also be used to develop new appliances. Well, at least these are handy for nanoresearchers with itchy fingers! **Xiaodong Zou**, professor of structural chemistry at Stockholm University, builds porous materials with nanometre-sized holes in order to strain molecules. Her research group is the first in the world to have constructed porous crystals with holes about two nanometres wide. Besides sorting molecules, her crystal strainers can function as catalyzers for diverse chemical reactions.

Nanotechnology is becoming ever more relevant in the biomedical field. **Maria Strømme** is a professor of nanotechnology at Uppsala University. Her research lies partly in the area of nanodiagnosics and aims at creating tests for home use. Is your daughter's runny nose the victim of a virus or of bacteria? If you can find this out simply at home, you will not have to burden the medical service needlessly.

◀ *When light strikes the nanostructures in the butterfly's wings, different effects can appear. The colour can shift from blue to purple or gold.*

## Nano-ethics: no small question

What are we really after with nano-research? What do we know about the

risks? And where do we draw the line for our tinkering with new materials and medicines?

**Göran Hermerén** is professor emeritus of medical ethics at Lund University, and chairman of the Swedish Research Council's ethical committee. He thinks it is essential to recognize that ethics can contribute much more than risk analysis and risk management.

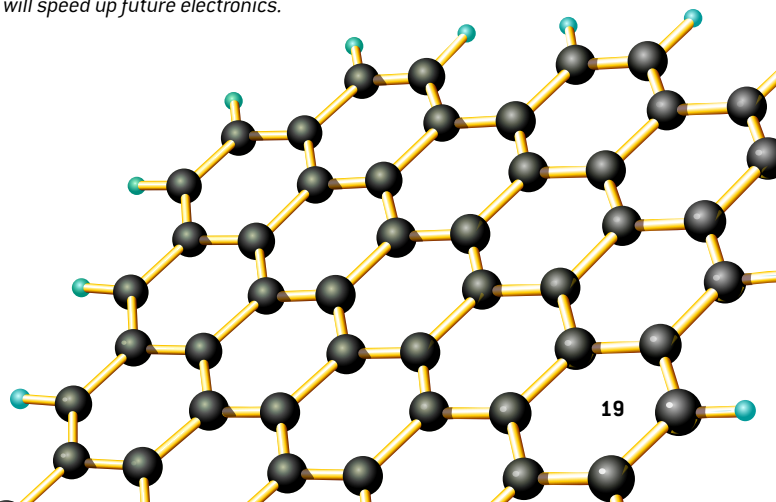
"It is necessary to emphasize the underlying values, clarify them and rank them in importance. This is especially difficult and important in such a rapidly growing and dynamic field as nano-research, where the knowledge gaps and uncertainty are great."

Göran Hermerén therefore believes that the crucial goal is to establish limits, in an ethically acceptable manner, for how fast and in what direction the developments should be pursued. Our hopes for revolutionary medical care, and the strong economic and other interests that exist in the area, do not make this any easier.

"The aspects of safety are important, but are not the only ethical issues raised by new growing technologies. Justice and influence are involved, as well as risks. It may even be unethical to refrain from exploiting opportunities to create a better way of life for many people, both here and in developing countries."

Maria Strømme makes no secret of seeing enormous opportunities for nanotechnology. "My gut feeling is that this will be a decisive step towards being able to use molecules that 'build themselves' in practical applications. This would open up completely new possibilities."

▼ *Graphene, the thinnest material in the world, will speed up future electronics.*

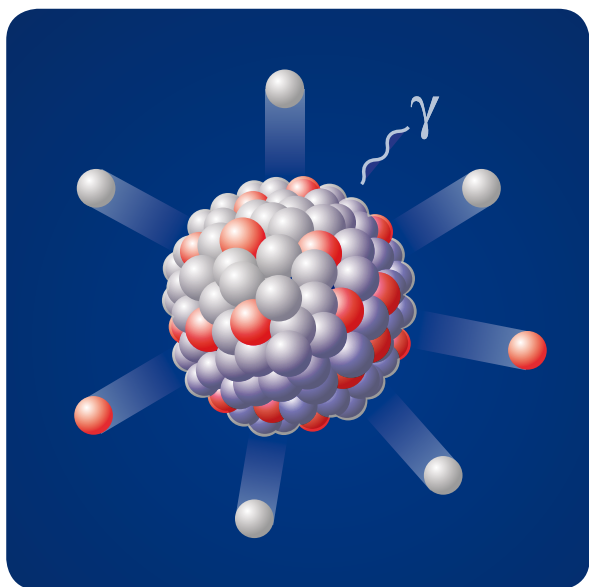


## ESS – revealing the secrets of Nature

European Spallation Source, ESS – it sounds like something from a science fiction novel. What does it mean, actually?

ESS will be the world's strongest neutron source when it is ready around the year 2018. Using rays of neutrons to study different materials' composition has to do with exploiting the fact that neutrons, unlike protons and electrons, are neutral. They can go straight through molecules and materials with almost no influence on these. Yet they themselves are affected by the material they penetrate. By analyzing this change, researchers can draw conclusions about how the atoms in the material are placed, how they move, and how they react with each other. As if a camera were filming in real time!

Neutrons are normally stuck hard inside atomic nuclei. To get them loose, an accelerator 600 metres long is built, in which protons are accelerated with the help of superconducting magnets. At the end of the accelerator tunnel, the protons hit a material of some heavy metal – such as lead, mercury or wolfram. In this collision neutrons are knocked out from the atomic nuclei in the



## "Nano science is the new platform for big science."

BÖRJE JOHANSSON, PROFESSOR OF PHYSICS, UPPSALA UNIVERSITY

heavy metal, a process called spallation. The neutrons are then guided toward the material that is to be investigated. It may be a fuel cell "in action", or human cancer cells.

What makes the use of neutrons so smart in this type of research is that they can "see" into the substances and compounds and provide detailed information on the atoms and positions, the atomic structure of the substance, and all kinds of motions of them. For example in biological materials the neutrons see position and motions of the carbon, oxygen, nitrogen and, not least, hydrogen. The dynamics of living systems will be possible to study in detail with the new technique, which understandably will have great effects on medical research, but also on materials research.

That the new European research facility will lie just outside Lund is, of course, an extra boon to Sweden and Denmark.

"This is a fantastic opportunity for researchers throughout Europe," says **Pär Omling**, director general of the Swedish Research Council. "ESS will be an extremely competitive international facility and we all have much to gain from neutron research being given a big boost."

Before the facility can begin to be built, however, it must be tested in terms of the Radiation Protection Law and the law on planning and building. Moreover, uneasy voices have been raised from researchers who think that ESS takes resources from other research. But this risk is small, thinks Pär Omling.

"On the other hand, I believe that research on neutrons and materials will be very high-quality in Sweden in the long run. And since the Research Council favours research of high quality, there is little doubt that this work will increase its share of the funds for research."

◀ *Spallation with release of neutrons occurs when the atom nucleus of a heavy metal is hit by a high energy proton. Energy in form of gamma rays ( $\gamma$ ) is also released in the reaction. The neutrons (white in the picture) can now be directed to whatever is to be investigated.*

# WAITING FOR THE MUSCLES OF ESS

## Swedish Profiles

**In Sweden he** is known nowadays as “the man behind ESS”. Naturally we have more people

than Lars Börjesson to thank for the new large European research facility ESS being located in Sweden, but undeniably this inquisitive physicist from Gothenburg has had great influence on the facility’s creation. His own research deals with understanding diverse types of materials that has vast importance, for example, in the development of fuel cell, batteries, materials for controlled drug release, magnetic memories, sensors, electronics, optical fibres, and thereby the whole of information technology.

### What is it that you most want to investigate when ESS becomes operational?

“Glass – I want to understand how glass is formed.”

### Don’t you know that?

“Not on the atomic level. There, nobody knows. I would like to follow the process in detail from the liquid to the solid phase, and this is something one has to study on different time scales. Close to the glass transition, a small temperature change leads to that molecular processes change time scale from thousands of a billionth of a second to thousands of seconds. To study these different phenomena simultaneously, one needs a facility such as ESS. They are extremely complex systems.”

### And still there must be much more complicated processes to study, for instance in the human body.

“Yes, biological systems are another area where ESS will be useful. Since neutrons are electrically neutral and do not react with other matter, one can also investigate living tissue. By contrast, radiation like X-rays is harmful to the cells.”

### Now that your ESS wish has been fulfilled, what do you dream of?

“I really hope that many exciting research environments are established in the surroundings of ESS – that universities both here in Sweden and internationally will open branches

**Name:** Lars Börjesson

**Research field:** Materials physics

**Age:** 51

**Family:** Agneta and two grown-up children

**Secret talent:** Yacht racing!

in the Lund-Copenhagen region, so that many fields of science can get the most out of this investment for many years to come.”

### Why did you become a physicist in the first place?

“I have always been interested in natural science. Most of all, probably, I am curious about physics a little more generally, to understand the big picture.”

▼ *Lars Börjesson, professor of condensed matter physics, Chalmers University of Technology.*





◀ Scientists are now one step closer to recreating the photosynthetic reactions that take place in all green leaves around us.

# Here comes the sun

**Society's great transformation from old to new energy requires not only new investments and initiatives. It also calls for making more efficient use of the energy we have – for becoming, quite simply, a little smarter.**

In Sweden about half of all the heat we use comes from district heating. This is an energy-efficient and environment-friendly form of heating, which mainly utilizes resources that would otherwise be wasted: energy from garbage and other rubbish, residues from timber-cutting, and waste heat from industry.

“Much more can be saved here when it comes to the need for both heating and cooling,” thinks **Louise Trygg**, a researcher in the Department of Energy Systems at Linköping University. “We must improve our ability to treat heating and cooling as convertible processes.”

Louise Trygg has also investigated how electrical efficiency can become better in industry. “Just by reviewing costs for lighting, heating, ventilation, and pumps that consumed energy all day and night, many companies have cut their electricity consumption in half!”

In other words, a lot has to do with switching off, shutting down, and changing. Simple measures that make a big impact on the electricity meter. But what about the production

*“I get pictures in my head. It is like freezing frames, everything stands still, and there I find the solutions.”*

ZLATAN IBRAHIMOVIC, FOOTBALL PLAYER

of energy itself? Wind power, wave power, and bioenergy are very active areas – but solar energy is the kind that enjoys fastest growth today, at 40–50 per cent per year globally.

**Anders Hagfeldt** is a professor of physical chemistry at Uppsala University. He leads a consortium of researchers in Uppsala and at KTH in Stockholm which is ranked as one of the world’s best. They imitate photosynthesis in plants by constructing so-called Grätzel solar cells, or solar nanocells. Whereas nature uses chlorophyll to transfer electrons, the solar cells contain nanoparticles of titanium dioxide that have been dipped in a red dye.

The world record in efficiency for solar nanocells is 12 per cent. At Anders Hagfeldt’s department, intensive research is done to obtain understanding and new concepts for taking the next leap in development to reach over 15 per cent. This means a constant hunt for energy losses, but is also a creative challenge.

“One has to keep thinking in new ways and have one’s own ideas. For instance, we have succeeded in designing a ‘toolbox’ to track what happens on a detailed level in the solar cell, which has become standard among researchers around the world.”

Where is the biggest challenge right now? Anders Hagfeldt takes up two important points.

“The first is that we must have a holistic view at the same time as we oversee every process on the molecular level. The second is to experiment with applications so that we develop the most promising design of the solar panel itself. Here our technology is yielding progress in large test facilities at Toyota in Japan, among others.”

The competition is very tough, but Anders Hagfeldt thinks that Sweden has great possibilities of keeping up, not least by introducing new combinations of competence. The chemistry and physics of surfaces is a traditionally strong

## A sunshine story

While the research on solar nanocells is forging ahead, thin-film solar cells have already reached the next stage.

The company Solibro is now building a large production plant in Germany. **Marika Edoff** is one of the founders of Solibro, a spin-off company from Uppsala University, and has been involved from the start.

“We see before us a situation where the consumers of electricity can produce their own – and sell the excess to others. This requires, among other things, that the system contains an inverter to transform the solar cells’ direct current so that it can be fed to the mains grid. With a current meter that sometimes goes backward, we will thus be able to take great steps toward smarter electricity supply.”



area of research here. And with the new facility Max IV in Lund, he expects exciting collaborative work.

“Exactly as in the case of materials, we must use people’s competence in an effective way. We can’t afford to lose energy there either!”

## MAX IV – it's brilliant!

Now that MAX IV has received the green light for building to start in 2010, it is nothing like a little brother

of the other radiation facilities in Lund, Max I, II and III. MAX IV will be immensely more powerful than any other synchrotron light facility in the world.

Synchrotron light is light with a very precise and well-defined wavelength. **Nils Mårtensson**, director of MAX-lab explains.

"This is a very intense kind of light covering a broad spectrum, from infrared light to shortwave X-ray. By filtering different wavelengths, the scientists can achieve exactly the light or the radiation needed for a certain experiment."

MAX IV can be compared with an adjustable wrench – the old Swedish invention that can be used to loosen nuts of all sizes, with no need of a wrench for each purpose. Then, what will this new multi-tool MAX IV be used for?

"In addition to crystallography, which is a method of investigating structure as well as function of macromolecules and proteins, synchrotron radiation is used in many other areas. One example is different kinds of advanced spectroscopy that is used for studying materials like superconductors, new batteries and magnetic material. It is also possible to investigate chemical processes on catalytic surfaces and charge transfer in photocells."

MAX-lab is the only facility in Sweden that produces synchrotron radiation for scientific use. It is a national facility, and therefore available for scientist from all over the country. There are also many international users of MAX-lab, and experts from many different scientific fields. Physicists, astronomers, biologists, chemists and material scientists are just a few examples. Nils Mårtensson is convinced that MAX IV will enhance this interdisciplinary character even further.

"MAX-lab has become a melting pot for new ideas and a source of transboundary discoveries. Each year nearly 200 scientific papers and around 30 dissertations are published with origin in this laboratory".

► *Southern Sweden will become an extremely attractive meeting place for scientists from all around the world when both ESS (see page 20) and MAX IV are established. The picture shows what the synchrotron ring MAX IV will look like from above.*



## Success by accident

Silicates have always interested the chemist **Saeid Esmaeilzadeh** at Stockholm University.

Why do thousands of silicon oxides exist naturally in the Earth's crust, yet not a single one whose oxygen atoms are replaced by nitrogen atoms, so-called nitridosilicates? In order to understand this, Saeid Esmaeilzadeh cultivated crystals to obtain new compounds – new materials.

He melted the materials at high temperatures and then let them cool slowly, so that the atoms had time to build up fine crystals with regular structure. But one night five years ago, something unexpected happened. A short-circuit stopped the cooling apparatus, and the melt did not cool at all as slowly as intended, but very quickly. Saeid Esmaeilzadeh laughs.

"A total failure – no crystals formed!"

Instead, he retrieved a little yellowish piece of glass. This would turn out to have remarkable properties of hardness as well as refractive index. And the explanation? A much greater proportion of nitrogen atoms than in other materials!

This became the starting-point for the spin-off company Diamorph, which holds a number of patents and collaborates with established companies, among other things for manufacturing ceramic rolls for wind power plants and knee-joint implants.

# TRYING NEW IDEAS ALL THE TIME

## Swedish Profiles

**While his classmates** in Uppsala were studying, partying and living the happy days of youth –

that was when Anders Hagfeldt became a father. It did not hinder his study ambitions, but suddenly his leisure time also had to include diaper changing and parent meetings. His contemporaries at the Department of Physical Chemistry in Uppsala were fully occupied with phase diagrams and molecular orbitals... Now his children are in this age themselves, and Anders can focus even more on his promising solarcells research.

### But how did you manage at the beginning of your career?

“Yes, I remember that I worked extra as a laboratory assistant in both the departments of physics and chemistry to get along financially. And then I was a table tennis trainer on weekends!”

### Do you still play table tennis?

“Well, it happens sometimes. In fact, I had an opportunity to play against some Chinese at a lab I visited there last autumn. That was cool!”

### Great efforts are being made with solar nanocells in China and Japan. Do we really have any chance of competing in a little country like Sweden?

“It’s true that they are very clever and advanced in Asia, especially when it comes to applications. They are highly committed. But one should not be defeated by the sight of all their resources. It was actually the same with table tennis. Sweden was a world leader for ten years, even though this ought to be impossible in view of how the Chinese went at it.”

### So you are the solar nanocells’ answer to JO Waldner or Jörgen Persson?

“Certainly the individuals themselves are important, but what made the Swedish table tennis miracle was rather that we were so creative. The guys played and had fun, developed new strokes and serves that surprised the Chinese and enabled us to beat them anyway.”

**Name:** Anders Hagfeldt

**Research field:** Solar nanocells

**Age:** 45

**Family:** Mikael, 22 and Rebecka, 18

**Secret talent:** Terrific on drums!

### Do you play and have fun in your lab?

“Yes, no doubt we do! We have an open and permissive atmosphere. In Sweden, of course, we are much less hierarchical than in most other countries, and this is an enormous advantage. It releases creativity and a progressive spirit so that we dare to have novel ideas!”

### And this yields results?

“Absolutely. Things are going very well for us now. And to see the younger researchers pursuing their own ideas with success is one of the biggest kicks for me. We are world leaders in this field and will continue to be. The dream is to see our solar panels on all the buildings around here while they supply us with energy!”

▼ **Anders Hagfeldt**, professor of physical chemistry at Uppsala University.





# Our mobile life

**Constantly connected, always present... Sweden is a world leader in research and development of new mobile products and services. We also ensure that the infrastructure does not lag behind. With the new powerful broadband networks, we lay the rails while we drive the train.**

When Lars Magnus Ericsson founded his company in 1876, he naturally had great hopes about telephones and networks, but he would probably have been rather proud to learn about the investigation that the International Telecommunication Union recently made. It compared 154 countries with regard to Information and Communication Technologies (ICT). Sweden tops the list, followed by the Republic of Korea and by Denmark. Thus, it is no accident that we find creative Swedes behind the latest innovations such as Skype and Spotify.

Sweden is also a rewarding market for testing new ideas. We are known for being both technology-interested and trend-sensitive, and statistics indicate that virtually the entire population is wired up. Nine out of ten Swedes have access to a computer and broadband at home, every fourth young woman has her own blog, and computer usage among the elderly has tripled since 2001.

At the Mobile Life Centre, techniques and services are developed for a future in which the limits between work, leisure and entertainment are dissolved – a future that, in many respects, is already here. Everything happens with human needs and desires in the centre, tells the director, **Kristina Höök**, professor of human-machine interaction at Stockholm University.

“The new technology changes how we live our lives. We do almost everything on the Internet: shop, declare taxes, find out about things... In the future we will connect the digital world with the physical.”

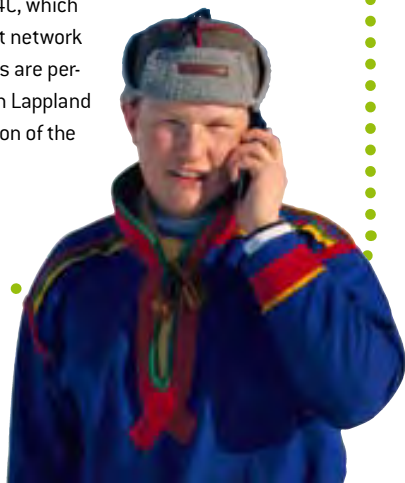
The researchers at the Mobile Life Center collaborate with world-leading technology companies in order to predict how future mobile technology will look – one has to stay a step ahead.

The mobile trends place ever higher demands on rapid and reliable Internet traffic. To meet the growing needs, great efforts are now being made in Europe to increase the bandwidth and security on the Internet. The projects 100GET and SIAM aim at high-quality data transmission of 100 billion bits per second.

Both of these projects belong to EUREKA, a European collaborative network that promotes cooperation between researchers and companies in Europe when it comes to market-near research and technological development.

## Hello!

Broadband there may be – but in sparsely populated areas, developing countries, and other parts of the world that lack coverage, where neither ADSL nor satellites nor 3G reach, one has to think in entirely new ways. At all events, this is done by **Maria Udén**. She leads the research project N4C, which develops delay-tolerant network technology (DTN). Tests are performed both in Swedish Lapland and in the Kocevje region of the Slovenian mountains.



## Next-generation health care

About a year ago, Lucas Alfredsson, nine years old, learned that he has diabetes. Now he is one of some

40 children who get to test a new system where, via his mobile telephone, he can find out his blood-sugar values.

The system, called Diasend, connects the patient's glucose gauge with a transmitter device, which sends the information to a database via the GSM network. The values are converted to easily interpreted graphics that can be read daily by hospital staff, but also by the user himself.

For Lucas, this means he does not avoid pricking his finger several times a day – but instead of his parents reading the gauge, writing the values in a log book, and reporting to the hospital every sixth week, this now occurs directly either via the computer at home or with the mobile phone. There are many advantages. The hospital continuously receives reliable data, which makes it possible to take the right steps faster. Lucas' parents feel much more secure, at the same time as both they and Lucas learn a great deal by obtaining direct feedback.

**Alexander Nilsson**, programme director for “Everyday IT” at VINNOVA, thinks that this shows an example of the ultimate form of needs-motivated research.

“Having an industrial partner does not always imply that its market is met. Here, a buyer and seller co-operate at an early stage with the users of the product or service that is to be developed. The real experts are often among the actual users!”

This mobile solution is a result of a project between Aidera, The Queen Silvia Children's Hospital and Chalmers University of Technology in Gothenburg.



*“Equality – it is everyone’s  
right to be different!”*

HELGA HENSCHEN, ARTIST, POET, AUTHOR (1917–2002)

T o g e t h e r

**Giving women and men the same chances on the labour market, and not discriminating against immigrants – these are politically hot issues that are also being studied in new research efforts.**

Unemployment is greater among immigrants than natives, and this is attributed to the fact that those who come to a new country find their education and experience neglected. This sounds plausible. But why the differences persist – and in certain cases even grow with time – cannot be explained by the present theory of migration. **Lena Nekby** is a researcher who wants to investigate the situation for second-generation immigrants is. She belongs to a research group at Stockholm University led by Eskil Wadensjö, Professor of Labour Economics at the Swedish Institute for Social Research at Stockholm University, also including competence in economics, sociology and criminology.

If the systematic differences in employment between immigrants and natives do not decrease, she sees a clear risk that large groups born in the country will become totally marginalized.

“Hopefully the integration research can help to prevent such a trend. As always, the first step toward change is to find out how things actually are. For example, is it really harder to be invited to an employment interview if one’s name is Mohammadi rather than Mårtensson?”

▼ *Penguins form monogamous pairs for the breeding season and share the incubation duties.*



## Swedish students

- It is free of charge to study at universities and colleges in Sweden.
- Women account for around 60 per cent of students in undergraduate university studies and about 44 per cent of doctoral degrees.
- The numbers of students are growing, both Swedish and those from abroad, who now constitute a fourth of the total. The largest group that comes to Sweden for doctoral studies is from China and other Asiatic countries.



To learn about this, the researchers have taken a somewhat unusual approach. They have gone out into the job market by writing applications by fictitious persons with Swedish or foreign names, respectively, and with otherwise identical CVs. Lena Nekby tells what happened.

“We found that persons with Arabic-sounding names must apply for almost twice as many jobs as persons with Swedish names in order to get a positive response from employers.”

Next, they decided to investigate whether those with Arabic names could compensate in some way for the discrimination against them.

And now the results became extremely interesting.

## Gender and power

When it comes to women with power in Sweden, one fourth of the highest positions of power are

held by women. This is a higher proportion than in most other countries, but the distribution is very uneven across different areas of the society. Women constitute only five percent of the industrial elite, yet 45 per cent of the political elite. In administration, organizational life, mass media, culture and science, the female top chiefs are between a fourth and barely a third. What hinders women in their careers is a subject that interests **Anita Göransson**, one of the research directors at GEXcel, an international research centre for excellent gender research in Linköping and Örebro.

“The fact that recruitment often occurs through informal networks is ranked by women as the main obstacle to their careers. Men think the greatest obstacle is instead that women do not apply for leading positions often enough. But one does not apply for the top positions – one is asked.”



“We repeated the first experiment, but added extra working-life experience to the CVs with Arabic-sounding names. The results show that women with such names quickly catch up to women with Swedish names – while for men, more work experience did *not* lead to any improvement in interest from employers.”

The research group thus revealed that discrimination seems to be much stronger against men with an Arabic background than against women with it. What lies behind this remains to be discovered – the research continues.

# How are you?

**How do we actually feel? We sit ever more, eat too much junk food, and are too stressed at work. Intensive research is done on life-styles, health and well-being. And not only in regard to people...**

Inequality in health becomes especially clear when one studies the quality and length of life in modern welfare states with high education level, compared with certain developing countries. But even in a rich country such as Sweden, there is great variation.

“We are interested in what determines public health in a country, and why the health of different groups in society has different trends.”

So says Professor **Denny Vågerö** at CHESS, Centre for Health Equity Studies at Stockholm University and the Karolinska Institutet.

There, a life perspective is taken on a human being's health. The state of health in adult years, according to this outlook, is an effect of how a person has lived previously in relation to environmental factors, social and economic circumstances, as well as genetic preconditions. But at

CHESS, more contextual influences are also studied – that is, how a person's health is affected by social contexts, as in school or in a residential area.



## Animal welfare

The interest in animals' situation and welfare is ever-increasing in international terms, and here Sweden stands in the front line. **Linda Keeling** works at the Department of Domestic Animal Environment and Health at SLU (Swedish University of Agricultural Sciences), and for many years has studied behavioural disorders in fowl and pigs.

She thinks that a great deal of the research on people and human care can also be applied to animals. Depression and anxiety are an example.

"In animal husbandry there are many hidden costs that can jeopardize profitability. Animals that do not feel well mentally, and therefore develop various forms of behavioural disorders, create an extra cost for the farmer."



Nearly every second middle-aged Swede is overweight, a situation that worries **Maj-Lis Hellénus**, associate professor of cardiovascular prevention at the Karolinska Institutet – in fact the only holder of this title in Sweden.

"Nothing's wrong with medicines, but small changes in life-style have a positive effect on the whole risk profile, including blood pressure, blood fats, and blood sugar imbalance. Tell me what pills can do that!"

During Maj-Lis Hellénus' years of out-patient medical care, she realized that as a doctor she came far too late into the patients' lives.

"I met one after the other who should have been given help much earlier with thinking about life-style in terms of smoking, alcohol, food and exercise."

But changing life-style is surely the hardest thing in the world – otherwise, wouldn't more people do it? Maj-Lis Hellénus thinks that one should not underestimate people's ability to change. Her research also shows that, with increased awareness and knowledge, the patient takes more personal responsibility for how she or he feels.

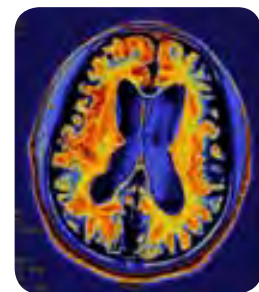
"One has to listen to each individual and not start 'telling' the patient what is best for her or him. If one finds the strategically important changes in each patient's life, small changes can be enough. But it is the patient who must do the job."

◀ *Sweden's entire population has equal access to health care by a government-funded and heavily decentralized health care system.*

## Swedish Brain Power

Dementia, Alzheimer's and other brain diseases are increasing rapidly in society. To meet the need

for new drugs and treatments, the programme Swedish Brain Power was initiated in 2005. It is one of the most extensive Swedish enterprises in medical research – and has already become a success. The aim is to develop a new holistic concept for integration and co-operation within a number of research areas that are important to the diagnosis and treatment of neurodegenerative diseases. There are not only universities and medical clinics that have come together in this network – industry plays also an important role. The programme is headed by **Bengt Winblad**, professor of geriatrics at Karolinska Institutet. "Thanks to this co-operation, we are shortening the process from basic research to new drugs."



## Attitudes toward animal experiments

Obligatory ethical evaluation of experiments on animals was introduced in Sweden already in 1979. According to a current proposal for an EU directive, it should now become obligatory throughout the EU.

A recently conducted survey by the Swedish Research Council of public opinion about animal experiments shows that 70 per cent of the Swedes accept animal experiments in medical research if the aim is to acquire more knowledge about diseases and how they can be prevented and cured. Young people are the group which is most negative toward animal experiments.



## Memory and aging

Five per cent of Swedes are aged 80 or older – the largest proportion in the European countries. At Stockholm University, cognitive aging has been designated as a profile area. The research is based on the successful Betula project, conducted with great success at Umeå University and led by Professor **Lars-Göran Nilsson** since 1988.

Betula is an interdisciplinary project with psychologists, neurophysiologists, geneticists and gerontologists, among others. It is a longitudinal study of aging that has proceeded in Umeå for twenty years in order to study how memory functions change during adulthood, and to determine risk factors for dementia so that early signs of the disease can also be seen.



## Swedish inventions

Swedish medical inventions include improvements in local anaesthesia, improvements in intravenous nutrition, the pacemaker, ultrasound, the gamma knife, beta blockers and Losec, the anti-ulcer drug. In recent years Losec has been the world's best-selling pharmaceutical product.





# Passion for research and innovation

This brochure gives a taste of some selected delicacies, what we in Sweden proudly call a "smörgåsbord", of exciting Swedish research and innovation environments. They are all chosen with the Swedish Presidency of the European Union 2009 in mind. We hope you enjoy the reading!



Vetenskapsrådet

**Vetenskapsrådet** – Swedish Research Council – is a government agency funding basic research of the highest scientific quality in all disciplines. The council has a national responsibility to support and develop basic research and promote research innovation and research communication.

[www.vr.se](http://www.vr.se)



The Swedish Research Council for Environment  
Agricultural Sciences and Spatial Planning

**Formas** – Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning – is a government agency promoting excellence in basic and applied research related to sustainable development.

[www.formas.se](http://www.formas.se)



**VINNOVA** – Swedish Governmental Agency for Innovation Systems – is a government agency funding the needs-driven research that a competitive industry and a flourishing society require, as well as strengthening the networks that are a necessary element of this work.

[www.vinnova.se](http://www.vinnova.se)



SWEDISH COUNCIL FOR WORKING LIFE  
AND SOCIAL RESEARCH

**Fas** – Swedish Council for Working Life and Social Research – is a government agency initiating and supporting basic and applied research about working life, public health, welfare, caring services and social relations.

[www.fas.se](http://www.fas.se)