Strategic research centres
for industry and society

In December 2005, seventeen internationally prominent researchers received large five-year grants totalling around SEK 800 million from the Swedish Foundation for Strategic Research (SSF) to conduct top-level scientific research of national strategic relevance.

"This represents a huge investment in strong research environments based on the premise that the research results should be of strategic benefit to Sweden," says Foundation Chairperson Lena Hjelm-Wallén.

An announcement in 2004 resulted in 230 applications. A selection committee is responsible for judging the applications, and in this they have been assisted by three panels working side-by-side in the evaluation process. A research panel judged scientific quality, a university panel judged the applications from a research-structural perspective, and an industry/society panel judged the relevance of the research for the development of industry and society. Seventy-three foreign experts participated in the review process. Each application was judged by more than thirty persons.

The magazine Teknik&Vetenskap was contracted to provide a brief presentation of all seventeen research centres in issue 1/2006 - as well as in this reprint - and then follow the progress of the research in the magazine and report the results.

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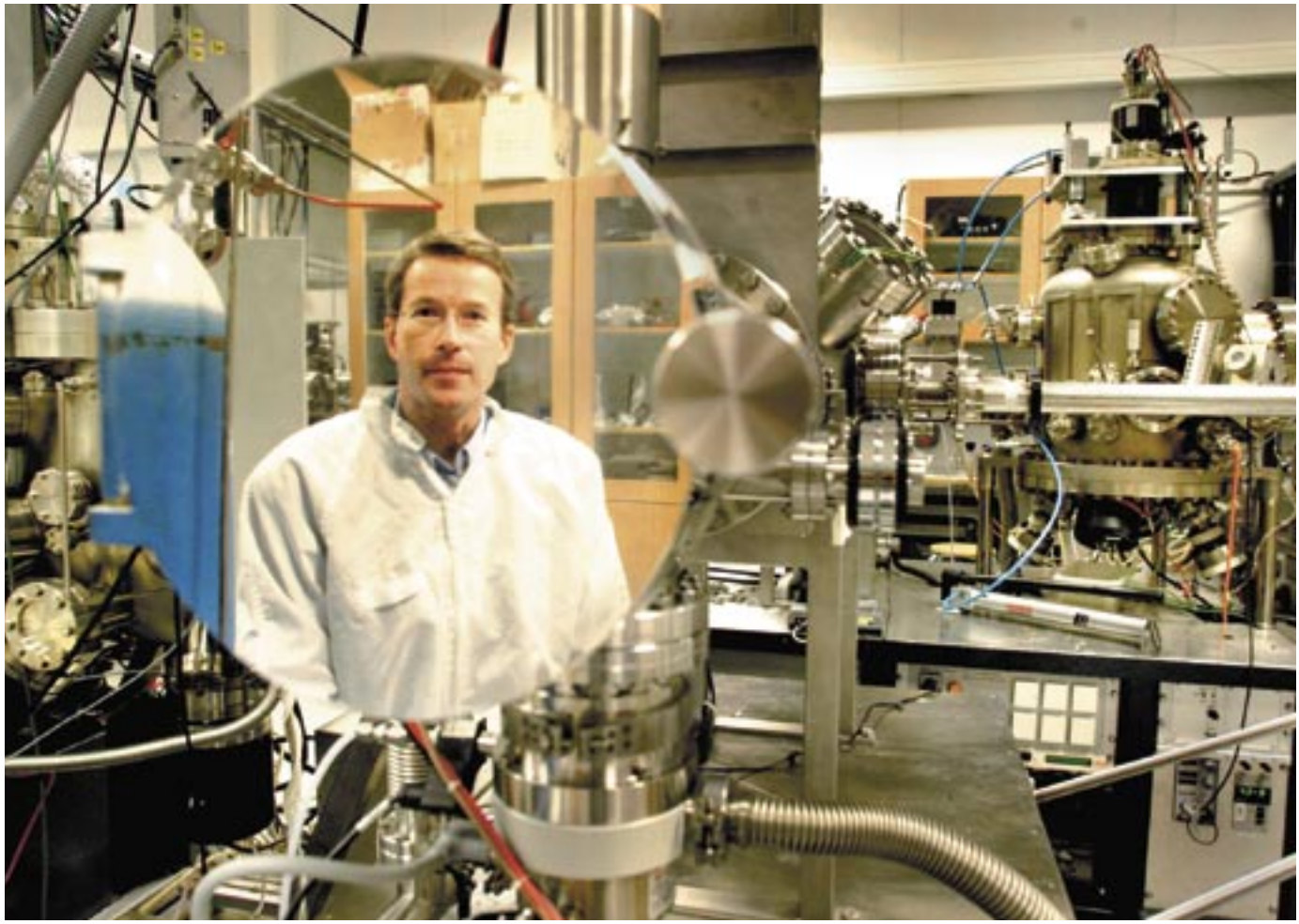


Professor Lars Hultman, Linköping University, reflected in a surface coating system with vacuum chamber. Photo: Tord Olsson

Nanoscience for industry

Designing new materials with nanostructuring, which provides new, exciting properties – that is the goal of the research centre within materials science for advanced surface technology in Linköping and Uppsala that has received a grant from the Swedish Foundation for Strategic Research. Professor Lars Hultman in Linköping emphasises that the centre is concerned with materials science for industry.

The researchers devote their energies to application-inspired basic research.

"This makes the research both exciting and strategic," Professor Hultman says.

Today Swedish industry is so knowledge-oriented that it can assimilate the discoveries made in university research and apply this knowledge in production. And things move fast in the marketplace - companies such as Sandvik and IKEA turn over a product in five years nowadays.

"It's really a dream situation," notes Professor Hultman. "We're curious to invent new materials."

Sweden's material-based industry is strong, thanks to earlier strategic investments in materials research, he explains. That is why such research is even more important now, to ensure that Swedish industry remains strong in the future as well. Lars Hultman and his colleagues at the University of Linköping and in Uppsala - spearheaded by Karin Larsson - will mainly devote themselves to research on metals and ceramics, and particularly surface coating processes where different substances are allowed to condense in a controlled sequence on devices for the engineering and electronics industries. This requires in-depth knowledge of what new properties nanostructuring can endow a material with.

Knowledge-based design of materials is vital for being able to develop functional materials for the future. The aim is therefore to integrate theory, calculation and experimentation and adopt a broader approach, resulting in true interdisciplinary research and a better overall understanding.

"We have just begun to exploit the existing structures," concludes Lars Hultman.

Viewing whole systems

Wireless communications is a rapidly advancing technology, where mobile phones are just the beginning. If we are to be able to handle the constantly growing volume of airwave traffic in the future, targeted research is needed. That is why Mats Viberg and his research group at Chalmers are being given a large research grant of SEK 43 million by the Swedish Foundation for Strategic Research.

Photo: Jan-Olof Yxell

Mats Viberg and his researchgroup at Chalmers want to spread signal processing knowledge to many different fields. "Many of them should update their signal processing," Viberg says.

When everything from WLAN to wireless broadband to mobile communications, navigation and surveillance systems have to have their own antennas, this can cause problems. If a mobile phone needs ten antenna functions and a car fifteen, there is clearly a great risk that they will interfere with each other.

"A whole antenna system has to be able to be simulated in a realistic fashion," says Viberg, "but it isn't enough to describe it, it must also be possible to improve the design."

To tackle this problem, the research at the centre will focus on new ways of optimising the systems – including microwave components, antenna radiation and algorithms for signal processing. This research requires the development of simulation tools and measurement technology, which are in great demand in the industry. A number of adjunct professors from the industry will also be involved in order to forge strong links in that direction.

"We also have two research institutes involved," says Mats Viberg. "SP (the Swedish National Testing and Research Institute) and FOI (the Swedish Defence Research Agency) are key partners, since they have a great deal of expertise in this area of a more applied nature than ours."

Mathematics with dirty nails

A new generation of mathematicians is being educated at KTH's (the Royal Institute of Technology) Centre for Industrial and Applied Mathematics. The support received by the centre from the Swedish Foundation for Strategic Research is intended to lead to new applications for mathematics that will strengthen Swedish industry in the future.

Mathematicians do not like splitting their discipline into pure and applied, they just see it as mathematics that has found its application and mathematics that has not yet done so.

"Pure mathematics today will be applied mathematics tomorrow," says Professor Anders Björner at the Department of Mathematics at KTH.

As far back as 600 BC, Pythagoras was fascinated by mathematics and wanted to use it to describe the world. Today mathematics is also the common language of all science and technology, and it plays an increasingly important role for industrial development. Close contacts with industry are also of vital importance for the Centre for Industrial and Applied Mathematics.

"We are determined to create a centre with good industrial contacts and to educate a new generation of researchers specialising in applied and industrial mathematics," Professor Björner explains.

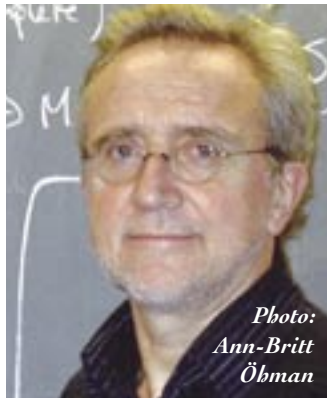


Photo: Ann-Britt Öhman

Much of applied mathematics is concerned with data processing, and the mathematicians at KTH are building further on the work that was previously funded by VINNOVA for ten years. Large computer-based projects are being conducted there for Swedish industry. In addition, datalogy is a discipline that uses mathematics for everything from cryptographic protocols to digital money.

"But the most important thing is perhaps that we can teach advanced, applied mathematics in a new way to a new generation," says Anders Björner. "It is our ambition to do research that strengthens Sweden strategically for the future."

Understanding how genes work together

Professor Leif Andersson is the third person from the right in the bottom row. Photo: Vladimir Jankovsky

Today the human genome has been completely mapped, but we still don't understand how all genes work. That is what Professor Leif Andersson in Uppsala and his co-workers are trying to do, especially to understand how genes cause diseases. The Swedish Foundation for Strategic Research has allocated SEK 35 million for this purpose.

Professor Andersson says that there is a heavy focus on domestic animals in their research.

"We have assembled a unique collection of animal material from which we can now reap the benefits."

By using domestic animals and model organisms whose genome is well-known and enables their relationship to each other to be determined, it is believed that great discoveries can be made for human medicine. Especially when the researchers focus on complex genetic diseases.

"Great progress has been made in understanding monogenetic diseases such as cystic fibrosis," explains Professor Andersson, "but complex diseases are more difficult to untangle."

Monogenetic diseases are caused by a single gene, while in the case of complex genetic diseases a number of genes interact with the environment to determine how the disease is expressed. The environmental aspect is difficult to control in the case of people. Each family has a different environment, while in the case of mice, for example, we can ensure that all individuals have the same environment.

"In this programme we will identify a number of genes whose function has previously been partially or completely unknown," says Professor Andersson, "and we will also try to link gene function with specific diseases."

Thanks to the SSF grant, Professor Andersson and his colleagues will now have adequate resources to tackle the problem. Powerful methods are available today for scanning an entire genome, but they are expensive. Thanks to the grant they will now be able to utilise the full potential offered by these unique approaches.

"The timing of this grant is perfect," says Leif Andersson. "Right now we can derive maximum benefit from it and achieve something meaningful."

Building the future – of wood

Sustainable development requires that society switch to more environmentally friendly materials made from bio-based raw materials. But these new materials must perform just as well as existing plastics and composites. Professor Tuula Teeri at KTH and her interdisciplinary research group want to enhance the performance of fibre-based materials. By imitating natural materials – biomimetics – the new materials will have better properties.

In order to create an interdisciplinary environment, the researchers will use a model reminiscent of the way things work in industry: they will hire in the expertise they need during the time they need it to achieve their goals. "To start with we will combine biotechnology with, for example, polymer chemistry and materials science," says Professor Teeri.

"But it won't be a lifetime project, she notes. "In ten years they may need to use physics instead, in which case physicists will be engaged."

The opportunity is also being utilised to train young researchers in a new, cross-border setting. This creates an interdisciplinary infrastructure for the future, something she thinks will be increasingly needed.

The researchers are using biotechnological methods to synthesise new natural materials. The researchers want to simulate wood to develop new, more environmentally-friendly composite materials. They are looking at how cellulose is synthesised, and when they understand the mechanisms they can make changes, for example create transgenic trees with optimised fibre structures. Then the surface chemists and materials engineers can take over to create the new materials.

This is basic research that will

Paperless mathematical solutions

Using mathematics to achieve better results without increasing costs or using more raw materials or energy sounds too good to be true, but this is what the researchers at the Centre for Mathematical Modelling in Göteborg are trying to do. Together with research institutes, the centre is working on industrial applications.

Professor Holger Rootzén at the Department of Mathematical Sciences at Chalmers is the director of the research centre, which has received a grant from the Swedish Foundation for Strategic Research. The researchers aim to solve problems in society in new ways and are working with everything from risk calculations for insurance companies to car design and analysis of microscopic images.

Photo: Jan-Olof Yxell

"These are general tools," says Professor Rootzén. "New mathematics is developed for one area of application, but can then be used in many others."

This is of particular interest to industry, which makes the collaboration with the Fraunhofer-Chalmers Research Centre for Industrial Mathematics, FCC, especially important. Thanks to FCC's close contacts with industry, the basic research being done at the centre can be applied in a much shorter time that would otherwise have been possible. Furthermore, the researchers at the centre work across the disciplinary boundaries, enabling them to combine mathematical tools that no one would otherwise have thought of combining to tackle a given problem.

"The subject is so big no one can master everything," says Professor Rootzén. "This gives us access to much more knowledge all at once."

An attempt is made to use computers for calculations wherever possible instead of conducting experiments. This is cheaper and faster and makes it possible to test many more possibilities. This is particularly useful in the case of non-standard problems, such as how human tissues or cells behave, or the properties of new materials. The goal is to come up with equations for these phenomena.

"No matter what kind of work you do you sit there at the computer," says Holger Rootzén, "and behind what lies in the computer is a large quantity of mathematical thinking that makes it work."

directly benefit the forest industry. Professor Teeri and her colleagues do not regard it as their mission to create finished products, but rather new principles the lay the foundation for new products.

"We lay the scientific foundation for the applications," Tuula Teeri says.

Photo: Jens Lasthein

Organic electronics

Devices made of organic materials offer new possibilities for bridging the gap between biology and electronics. The centre being built up by researchers at Linköping University and Karolinska Institutet is interested in translation between electrons and the chemistry of the human body. With the grant they have received from the Swedish Foundation for Strategic Research, the researchers will now have the resources to tackle the big questions.

Photo: Mikael Svensson

What determines when stem cells differentiate? How does calcium ion signalling really take place in the cell?

"These are the kinds of things we will now be able to study," explains Magnus Berggren at Linköping University, the director of the new centre together with Agneta Richter-Dahlfors of Karolinska Institutet.

The phenomenon is linked to several diseases, which shows that even such general questions are closely connected with applications. Since cells signal in a different way than electronics, it has been difficult to unite the two. But the research group for organic electronics in Linköping has developed an electrochemical transistor that can translate from and to the body's systems. Organic electronics entails building devices with organic materials, which means they work together with biological systems. This makes it possible to get cells to grow, which is very difficult on silicon-based devices.

"When we use organic electronics we can create signals identical to those in biological systems," says Berggren.

A total of twelve researchers at Linköping University and Karolinska Institutet are collaborating at this centre to work on neurons, stem cells and cell signalling. They were already collaborating, but now they can broaden their approach and tackle the more fundamental questions. "This will lead to new analysis tools and new forms of analysis, and in the longer term perhaps even to electronic drugs," speculates Berggren.

"We are very proud to have received this grant," he concludes. "It will enable us to do many new things."

Diabetes research of great breadth

There is a strong tradition of cardiovascular research in Göteborg, a tradition that is now receiving a five-year research grant from the Swedish Foundation for Strategic Research. The money will be used to build a research centre for eleven research groups who, with their complementary expertise, will be world leaders in metabolic cardiovascular disease, in particular type 2 diabetes or adult-onset diabetes.

Jan Borén coordinates the interaction between the eleven groups.

"More than seventy percent of myocardial infarction patients have type 2 diabetes or preliminary stages of it," he says.

Understanding why patients with type 2 diabetes have such an elevated risk of contracting cardiovascular disease is central in their research. The purpose is to be able to detect and treat high-risk patients. With the increase of obesity in the western world, this type of metabolic cardiovascular disease is a growing problem for society and a source of great suffering for the afflicted individuals.

In Göteborg in particular – with the broad spectrum of complementary expertise that exists among the centre's member groups – the chances of getting far with this research are particularly great. Everything has been gathered together here, from patient-based research with unique biobanks to experimental research combined with bioinformatics and applied mathematics.

"We see the support from SSF as seed capital," says Jan Borén, "so it's not a five-year plan that will then be abandoned. This is just the beginning!"

Even though Jan Borén is the official recipient of the grant, he is very careful to point out that it is not a "one-man show", but rather research groups collaborating on equal terms. He is equally careful to point out that it isn't a question of research just for the sake of it, but rather research with a very specific purpose.

"The goal is to obtain results that can be used in healthcare and industry," he says.

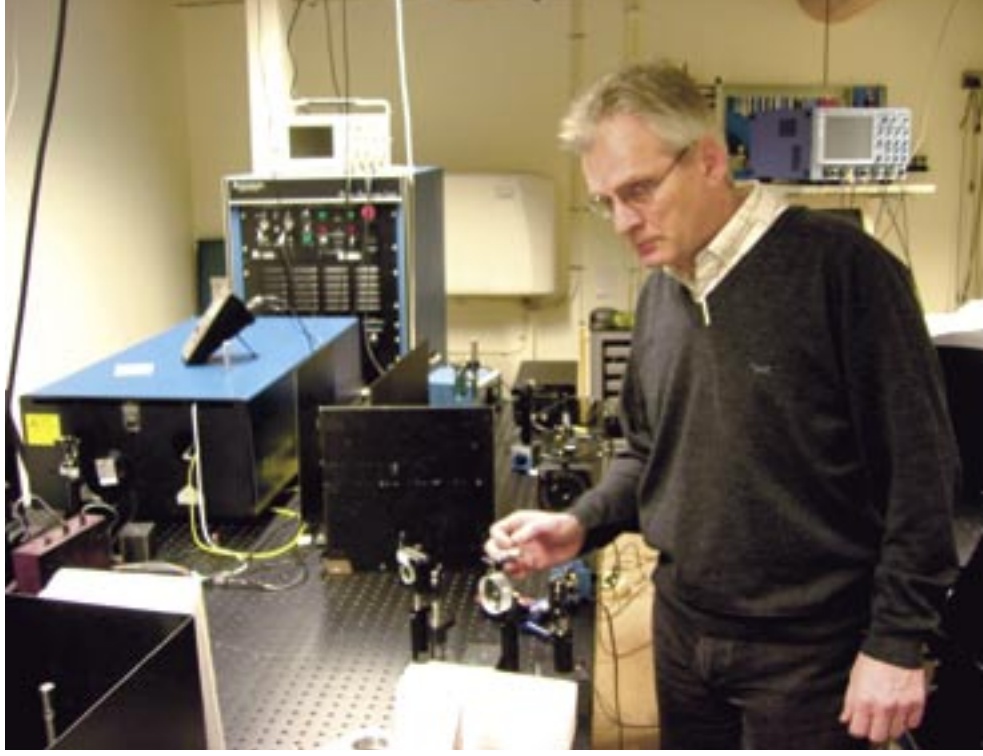
Photo: Göran Olofsson

Here the researchers can portion out small volumes of 350 pL of antibodies for the production of microarrays.

From theory to practice

Development in the field of biomedicine is proceeding at a breakneck pace. New methods for highly complex analysis are becoming available almost daily. However, the time it takes for the new methods to be applied in clinical research is increasing. That's why technological development and clinical research have been brought together in Lund in a centre that is unique in Scandinavia. The goal is to come up with ways of tailoring cancer treatment to the individual patient.

The proteome is the entire complement of proteins that exist in the human body, and in special combinations it indicates, for example, a given disease. In traditional biomedicine investigators usually look at one protein at a time, but this doesn't have much predictive power for a given disease. The meaning of an elevated value is not known for certain. If a combination of many proteins is



Professor Marcus Aldén in the combustion laboratory at the Lund Institute of Technology. Photo: Per-Erik Bengtsson

The breadth of the research is hard to beat, from laser diagnostics of the combustion process to fire prevention technology - the Lund University Combustion Centre at the Lund Institute of Technology is one of the leading centres of its kind in the world, in large measure thanks to its broad perspective. I wouldn't want to trade my job with anyone in the world," says Professor Marcus Aldén.

Combustion – of burning interest

The project for which a grant has been received from the Swedish Foundation for Strategic Research will mainly be focused on turbulent combustion, spray combustion and biofuels. "All applied combustion takes place under the influence of turbulent flow, and understanding the combination of turbulence and the complex chemistry of combustion is a huge challenge, which also requires advanced measurement technology," explains Professor Aldén.

"This knowledge is applicable to biofuels as well," he says, "and if we want to shed our dependence on fossil fuels we will have to turn to alternative fuels."

Spray combustion entails atomising a liquid fuel so that combustion will be as efficient as possible and produce as little soot and nitrogen oxides as possible. "This research is being driven by the fact that Sweden has such a strong motor vehicle industry," notes Professor Aldén.

"In order to be credible you have to aim towards applications while at the same time having an opportunity to do more basic research," he says. "It's a challenge to collaborate with industry."

If industry has a problem they want to solve it today or tomorrow, not wait for three years. That's why parallel knowledge-building research is needed now, so that the tools will be available when it come time to solve tomorrow's problems.

"The technologies we developed in the 1980s, which were considered very academic then, are in general use today," says Marcus Aldén. "The basic research being supported by SSF will therefore yield dividends in the future – both environmentally and economically."

used instead it is possible to identify protein patterns associated with various pathological conditions.

"The idea is that we should be able to take a blood sample from a patient, determine the protein pattern and say that a given type of therapy will have the best prognosis," says Professor Carl Borrebaeck at Lund University.

This is what the Centre for Translational Cancer Research is trying to accomplish. "Translational refers to a combination of clinicians and basic researchers," Professor Borrebaeck explains. The advanced analysis methods available at the basic research level are combined with clinical experience to find the ten or twenty proteins that are markers for a given disease.

"We don't work with model systems, but with the real thing," notes Professor Borrebaeck. "It is this combination of competencies that is the most important aspect," he maintains. It is a new approach, and not just more of the same thing, that is being made possible by the grant from the Swedish Foundation for Strategic Research. Introducing advanced technology into clinical research is what I think makes it all so exciting.

"It's going to be fantastic," says Carl Borrebaeck. "We are at the among the world leaders in this field."

Invisible computers

For every ordinary, standalone computer there are already hundreds of computers embedded in everyday objects. These computers also need software to work, and it is such software Professor Hans Hansson and his colleagues at Mälardalen University work with. They want to solve tomorrow's problems today.


Photo: Katinka Öberg

Already today, a new car may have as many as a hundred small embedded computers. Washing machines, dishwashers - in fact, everything from advanced switches to big industrial automation systems contain embedded computers.

"Embedded computers can provide competitive advantages in more and more products. The extra functionality they can provide is important for the manufacturers - especially since it's cheaper to provide this functionality with software than with hardware," says Professor Hansson. Another advantage is greater flexibility. These are the factors that are driving the trend.

"Research and development in this area is particularly important for Swedish industry," says Professor Hansson. "If we don't keep up with this trend, there's a risk we'll fall behind and be out-competed. The international pace of technological development is furious. If devices that are operated mechanically today can be developed so that they can be operated by software, production costs can be greatly reduced. Because of this fast pace of development, it isn't enough for research to solve today's problems – we also have to solve tomorrow's problems today," he explains.

With a lead time of perhaps fifteen years, which is not possible in industry, the research centre headed by Hans Hansson, which recently received a grant from the Swedish Foundation for Strategic Research, will develop methods for programming embedded computers for the products of the future.

The demands on the software will continue to increase. The programming as such has already changed from the first, primitive form that was based on shifting cables around to today's situation with different development tools that generate the code.

"But we want to take everything one step further by combining model-based development with device-based programming," explains Hans Hansson.

Vaccine emerges from creative environment

Almost all infections enter the body via the mucous membranes, so if a strong defence perimeter could be set up there it would prevent all of our most common diseases. That is why the Swedish Foundation for Strategic Research is giving SEK 40 million to Professor Nils Lycke and his colleagues, who are experts in this area.

If vaccines were produced in the form of aerosols or liquids, the vaccine could be applied directly to the mucous membrane, which would protect against most common diseases. "The problem is that they do not normally provide enough immunity," explains Professor Lycke.

"Knowledge is needed on how the vaccines can be strengthened so that they provide full immunity when they are absorbed by the body," he continues. "That would provide the same effect as injecting the vaccine."

Solid expertise in this area exists within the centre.

The researchers also have good international contacts and collaborate with a number of countries in the Third World in particular. There are a number of diseases that are less common in developed countries, but are particularly well suited for prevention with mucous membrane vaccines, such as cholera, tuberculosis and HIV. The centre is taking part in two EU projects and cooperating with Sida/SAREC (Swedish International Development Cooperation Agency/Department for Research Cooperation) in this particular area.

With the grant from the Foundation, the nineteen research groups will now be able to gather geographically around Göteborg University and Sahlgrenska Akademin. They are being housed together in two buildings so that they can work closely, permitting an easier and more convenient exchange of knowledge and ideas.


Photo: Göran Olofsson

"This will lead to an even more creative environment," says Professor Lycke, "and that may be the biggest advantage of all. The environment will last longer than five years and will drive internationally competitive research for a long time."

The centre will also create forums that will communicate with industry. They already have several partners in this arena.

Unique expertise regarding difficult proteins

Photo: Oravia foto

Membrane proteins constitute a third of all proteins in a cell. Above all, they are a means of communication between the cells and the outside world. Approximately half of all drugs target the membrane proteins, but they are so difficult to study that they are often neglected by research. The Center for Biomembrane Research will change this with the aid of a grant from the Swedish Foundation for Strategic Research.

Membrane proteins are lipophilic or "fat-loving", which binds them to the fat-rich cell membrane. This makes them difficult to study, since the standard methods of protein chemistry are designed for proteins in aqueous solution.

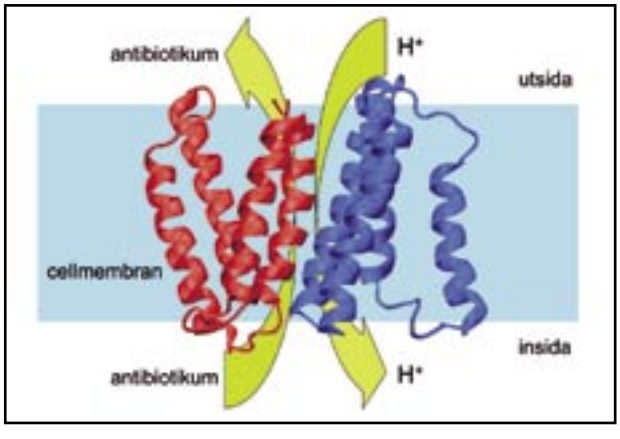
The centre will tackle this problem in a new way. Strong theoretical expertise will be combined with molecular biological and structural biochemical expertise to find new ways to understand membrane proteins.

"We won't limit ourselves to a specific protein," says Professor Gunnar von Heijne at Stockholm University, "but work with more general problems."

The money from SSF will strengthen the collaboration between the existing theoretical and experimental research groups and also be used to recruit additional structural biochemical expertise. This breadth will be unique for the new centre.

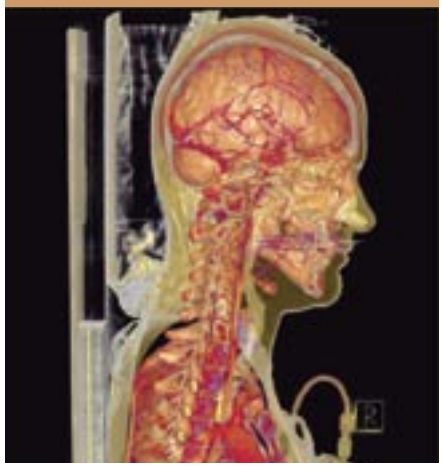
"I don't know of any other settings that span the entire range from fundamental molecular and cell biology to structural biochemistry and bioinformatics," says Professor von Heijne.

The centre will also improve and expand contacts with the biotechnology and pharmaceutical industries, which are doing a great deal of research on membrane proteins.



Membrane proteins in antibiotic-resistant bacteria pump out the antibiotic as soon as it enters the cell.

The researchers have been working on compiling signals from various sensors in the fighter plane Gripen's navigation and landing systems. Unmanned aircraft and easy-to-interpret medical images are some examples of what the research on integrated decision support and autonomous systems at Linköping University can lead to.



Decisions from large quantities of data

Five research groups with different areas of expertise in IT research are joining forces to tackle problems which none of them alone is capable of solving. The interdisciplinary collaboration will not only solve methodology problems, it will also lead to new perspectives for the future, explains Professor Lennart Ljung of Linköping University.

Professor Lennart Ljung was awarded an honorary doctorate in Leuven in 2004.

Integrated decision support and autonomous systems may not sound so exciting to the uninitiated. If we instead say unmanned helicopters or the possibility of converting terabytes of data to a picture that is easy to understand, it immediately becomes more tantalizing.

These are examples of applications that could result from this research, even they are not the ones the researchers are working on directly. They are working on the underlying methods instead. How do you compile information from radar, GPS and transponders to enable a decision to be made?

The methods can just as well be applied to medicine, where large quantities of information have to be compiled into easily accessible images that can be interpreted quickly.

"No one wants to see long lists of data," says Professor Ljung. Interdisciplinary collaboration is needed to tackle all the questions, which will now be made possible by the grant from the Swedish Foundation for Strategic Research. That is why Lennart Ljung, whose expertise lies in control engineering, is working with Fredrik Gustafsson (sensor informatics), Lars Nielsen (vehicle systems), Patrick Dogherty (artificial intelligence) and Anders Ynnerman (scientific visualisation).

"There is no other method-oriented project in the field with this breadth," Professor Ljung concludes.

From gene to behaviour

Disturbances in the cognitive functions of the brain account for a large portion of society's healthcare costs. An overall perspective is needed for an understanding of how cognition works, which means beginning from the beginning. It also requires a unique breadth of expertise, which is provided by collaboration between three different universities in the Stockholm Brain Institute, SBI.

Cognition consists of the higher functions of the brain - thinking, reasoning, perception and decision-making. Disturbances in these functions lie at the root of many diseases, ranging from ADHD and schizophrenia to Alzheimer's.

"These diseases account for a large portion of society's disease burden," notes Professor Hans Forssberg at Karolinska Institutet.

Besides the disease aspect, learning is one of the cognitive processes that will be studied.

"In order to get an overall perspective we study the whole chain from gene to abnormal behaviour," says Professor Forssberg. Genes code for proteins and other molecules, which affect nerves, which in turn interact in neural networks, which control different cognitive functions, which then work in systems. Based on the biology of the brain, an

The last ten metres

In a brief span of time, data communications has fundamentally changed society and penetrated into even the most mundane activities. This has led to new and unexpected problems, such as "the last ten metres problem". Professor John B Anderson and his colleagues at the Centre for Wireless High-Speed Communications in Lund will tackle this and other problems.

One of the big problems in data communications today is the last ten metres or so of the cable. When a cable links different cities, thousands of users share the cost, but at the end of each cable is a single human being, and connecting that individual user is costly. The last bit between the main cable and the individual is the bottleneck in terms of cost.

"That little bit can cause companies to go bankrupt," says Professor Anderson. The only solution is wireless communications.

The problem is that the air around us is already full of radio waves, so how do we crowd in more waves without interference? Professor Anderson wants to open new bands between 24 and 60 GHz (today's only go up to 10 GHz).

These new wavelengths would allow the development of high-speed wireless data communications for private and business users alike. Speeds of up to several gigabits per second are conceivable.

"We couldn't do this work without doctoral students," says Professor Anderson, "and with the big research grant from the Swedish Foundation for Strategic Research we can now fund more doctoral students."

At the same time it is important to know why you develop technology. What is the goal of the new technology and who is going to use it? There is another big problem today, which John B Anderson considers important.

"We don't know what the consumers want, and the consumers themselves don't know what they want," he says. That makes it difficult to develop new products.

attempt is then made to understand human behaviour.

"It's a study of mind and soul," explains Professor Forssberg.

But no one human mind can grasp the entire chain of causality from the polymorphous gene up to behavioural disturbances. That's why researchers from many disciplines are needed: behavioural scientists, psychologists, biologists of various kinds, chemists, mathematicians and many others. To achieve this broad expertise, the three universities KI, KTH and Stockholm University collaborate. This will also

Photo: Ulf Sjborn

make SBI one of the leading centres for brain research in the world, made possible by the grant from the Swedish Foundation for Strategic Research.

"This is a hot field of research today," says Hans Forssberg.

Photo: Valentin Ogneov

Big steps on a tiny scale

Nanodevices that build themselves without the defects left on the surface by traditional manufacturing is the goal of Professor Lars Samuelson and his research group at Lund University. Their research findings will lead to advances in materials science as well as nanoelectronics and biomedicine.

Nanowires are extremely small crystalline semiconductor devices that the researchers have learned to build by a technique called self-organisation. The wires, or rather rods, are a few millionths of a millimetre thick and a few thousand millimetres long.

"When you say wires, many people think of something like cooked spaghetti," says Lars Samuelson, "but uncooked spaghetti is a more accurate description."

By placing a gold particle on a semiconductor wafer and then adding the molecules of which the semiconductor is to be built up, the researchers can get a finely designed nanowire to grow up from the surface.

So-called "controlled self-organisation" is highly advantageous, since it eliminates the defects resulting from traditional manufacturing. Since the nanodevices are so small, process-related defects on the surface have a great effect. With self-organisation, however, these manufacturing flaws can be eliminated.

Nanowires have many applications, not just in nanoelectronics but also in biomedicine. Highly accurate biosensors are one possibility, and further down the line perhaps connections between neurons and electronic circuitry.

"Even now, however, nanowires is a hot field where research is being conducted with great intensity all over the world," says Professor Samuelson. For this reason, long-term grants of the kind awarded by the Swedish Foundation for Strategic Research are vital to keep the leading Swedish researchers here and attract foreign ones as well.

"Without strong centres of this kind, it would be difficult for us in Sweden to compete internationally in strategic research fields," says Lars Samuelson.

The subject areas and directors of the seventeen research centres that have received grants from the Swedish Foundation for Strategic Research totalling SEK 800 million:

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