Strategic Research Centres in the Life Sciences

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SCIENCE • MEDICINE • TECHNOLOGY •
Swedish Foundation for Strategic Research

The interviews in this publication were made by

Emilia Hagberg, partly within the framework of the project work for

her course in Scientific Communication at Stockholm University.

The aim of this course is to give people with a scientific

education the knowledge and skills needed

to present in a comprehensible, objective and ethically

satisfactory manner scientific information for those

who are not experts.

With its strategic research centres in the life sciences, the Swedish Foundation for Strategic Research wishes to promote strong research environments with clear leadership. The goal has been geographically co-located centres where several research teams – preferably in multidisciplinary constellations – work together under one roof to address particularly important or challenging questions. These centres have a unique opportunity to recruit new staff internationally to add expertise to the research setting. The Foundation expects the centres to tackle strategically important problems which, if they are solved, will not only lead to top high-class publications, but can also serve as an impetus for various kinds of innovations that can contribute towards Sweden's economic prosperity, as well as new forms of treatment, diagnostics, or other ways to improve human health.

Staffan Normark

Research centre way of the future for stem cell research

Stem cells can be transplanted and replace dead or sick cells. This may provide a way to cure such diseases as diabetes and Parkinson's disease in the future. New knowledge of stem cells that could lead to new therapies is the goal of stem cell research in Lund. And cooperation across traditional boundaries will ensure success.

The scientists collaborating at the new Stem Cell Center, SCC, in Lund (full name: the Lund Strategic Research Center for Stem Cell Biology and Cell Therapy) have varying backgrounds, but all are focused on stem cells. Stem cells are immature cells with the capacity to develop into many different kinds of cells. If we understood better how stem cells normally function and develop into different cell types, they could be used in the treatment of intractable diseases. The stem cells can be transplanted, and after growing they can replace sick or damaged cells. Or a patient's own stem cells can be stimulated with drugs to produce the cell types that are needed.

Stem cells have long been used

"One form of stem cell therapy that has existed for a long time is bone marrow transplantation. It is mainly employed for treating blood diseases such as leukaemia," says Sten Eirik Jacobsen, head of the centre. But mortality in leukaemia is still very high. One of the most common complications is an immune reaction in the recipient to the transplanted tissue. Bone marrow transplants are therefore only used today when there are no alternatives. If the method could be improved so that mortality is reduced, many more diseases could be treated by bone marrow transplantation. Examples are diabetes and other autoimmune diseases, such as rheumatic diseases.

There is also a great future potential for therapies using stem cells to treat Parkinson's disease, where certain brain cells die. Researchers in Lund were the first to show that dead brain cells can be replaced by transplanting healthy cells, thereby improving the patient's condition. But no established therapy exists as yet.

"Up until now, experiments have used brain stem cells from aborted foetuses. This involves many problems, not least of an ethical nature, and has no prospect of becoming a large-scale therapy. The research is therefore being focused on trying to use other types of stem cells, for example from the brains of adults."

Unique collaboration

The Stem Cell Center involves around 130 persons divided into smaller research teams. Most of the teams have existed previously, but now they are collaborating in a new way. An important aspect is that the clinical researchers, who work close to the patients, are collaborating with the more experimentally oriented researchers.

"And it is unique for haematologists, blood specialists, and neurologists, who study the brain, to collaborate in this manner," says Jacobsen, who is himself studying stem cells in the blood system.

The advantage of working so close to each other is that the researchers can benefit from each other's advances and exchange knowledge. Jacobsen gives an example.

"A very small fraction of the bone marrow cells, around 1 in 20,000, are stem cells. In order to study them, the stem cells have to be isolated from other cells. It has been possible to do this very well for a long time in the case of blood cells. Thanks to our collaboration, we can use the technique that has been developed to isolate stem cells from the brain as well."

The idea for a research centre was hatched long before the Swedish Foundation for Strategic Research announced its plans to establish strategic research centres.

"We realised that there are common questions for stem cell research in the blood system and the central nervous system, and that we also have the same problems recruiting and keeping the best young scientists. It was in particular this business of recruitment that made us decide to cooperate and develop together."

Sten Eirik Jacobsen was chosen by his colleagues to head up the work at the new centre.

"But a prerequisite for my consenting was that I would be able to continue to head my own research team. Supervising young, promising researchers is one of the most rewarding parts

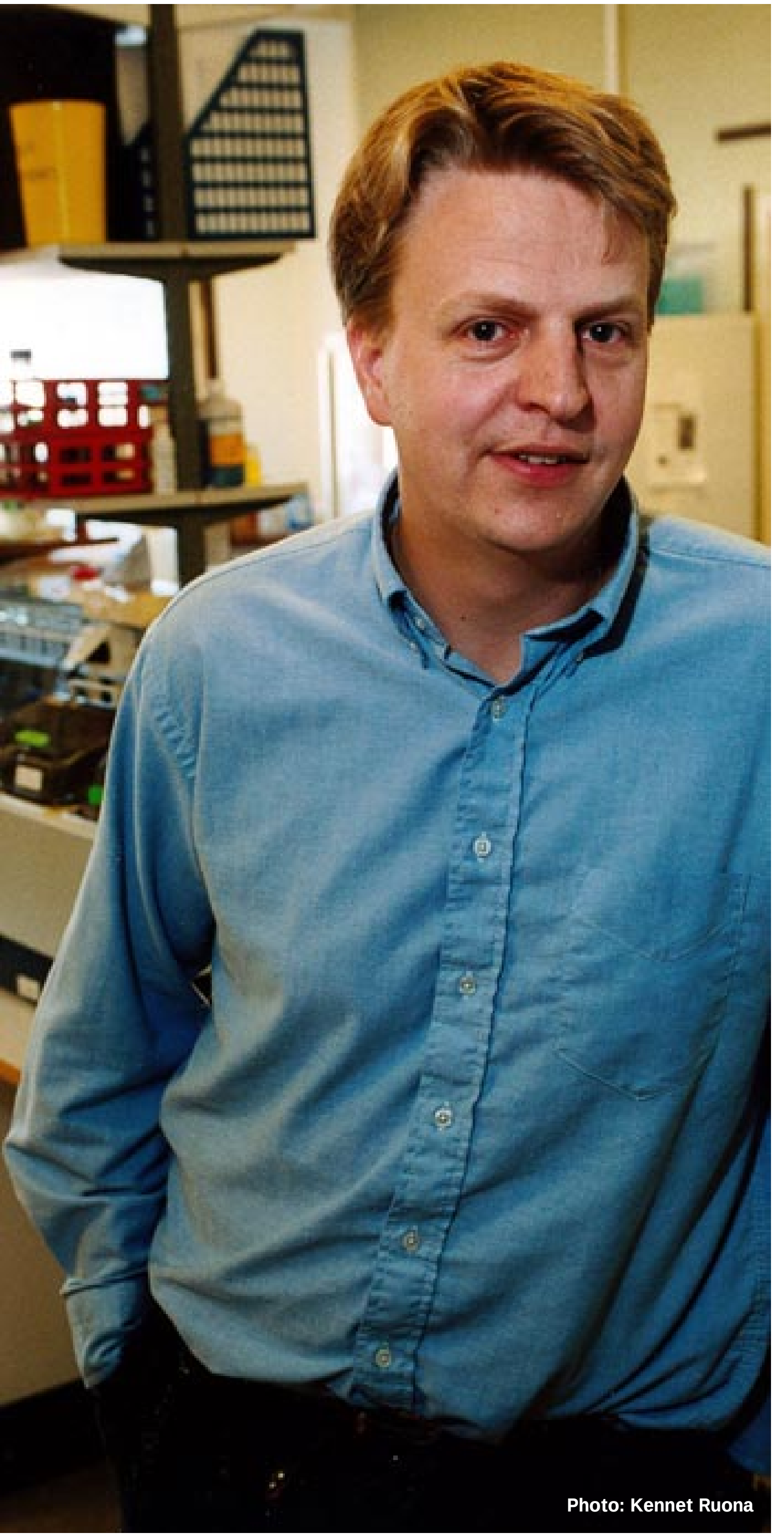


Photo: Kennet Ruona

of this work. It is important that I be able to combine my work as head of the centre with my role as an active researcher."

Jacobsen had no plans to become a research scientist when he started his medical education in Bergen, Norway. But when he was finished with his internship, his father, also a professor, encouraged him to take up research.

"Then I quickly discovered that research was something for me. So I guess I have my father to thank for my career as a researcher."

Inspiration from America

Sten Eirik Jacobsen has had several sojourns working in the USA and has been inspired by the research climate there. The creation of special centres is an international trend in research and has been for some time. And it has been carried farthest in the United States.

"I believe it is the wave of the future. We have to gather our resources and cooperate across the traditional institutional boundaries. We are quite simply dependent on other groups for exchanging knowledge, complementing each other and making effective use of strategic resources, such as in recruitment."

An important purpose of the centre is to attract and support young researchers. They often leave Sweden for the USA, where they are offered good research conditions. Young top researchers want to have an attractive environment with qualified colleagues. Furthermore, it's impossible to attract biomedical scientists without a technological platform of the highest quality.

"We are working to improve in these areas. And there is no doubt we have already become more attractive to researchers thanks to the centre. But we can get even better."

Besides getting lots of ideas on what creates a good research climate, Jacobsen also brought back a passion for golf from the USA.

"I learned to play while working at a lab that was closed for a half a day a week, when everyone took off for the golf course. I also like the outdoor life and cross-country skiing. I am, after all, Norwegian," he laughs. He also mentions the family's summer place as a way to relax.

"But actually I work a bit too much."

For the past six years, Jacobsen has lived in Lund together with his wife and two children.

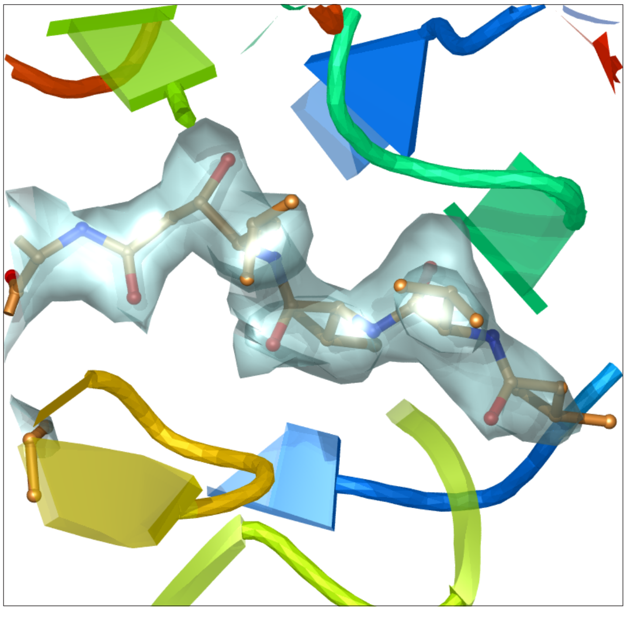
"I'll probably still be here in Lund in 10 years time, but by then some younger able researcher will naturally have taken over as head of the centre. I think the welfare of the centre is more important than my own personal welfare," he concludes.

Appearance of enzymes gives clues for new medicines

Detailed knowledge of the structure of enzymes makes it possible to design better drugs against malaria and tuberculosis. But it takes a long time. "At best we will have a useful medicine in five years," says Alwyn Jones, head of research.

Proteases are a group of enzymes that play a crucial role in many diseases, such as infections and inflammations. Many drugs, such as those used to treat malaria and tuberculosis, act by blocking the activity of the proteases.

"The proteases work by cleaving certain proteins. A protease inhibitor is a molecule that fits precisely into the protease and binds to the receptor site, blocking the action of the protease," explains Jones. In order to design protease inhibitors that will fit well and be effective, you need to have good knowledge of the structure of the proteases."



Active site of plasmepsin II from *P. falciparium* in complex with the inhibitor pepstatin A. The atomic coordinates are from Silva *et al.* (1996), while the electron density is determined from our own diffraction data, collected at the ESRF synchrotron (Jimmy Lindberg & Torsten Unge).

Centre has three parts

Scientists at the Uppsala Biomedical Centre (BMC) study the structure of molecules in order to be able to develop new drugs. With support from the Swedish Foundation for Strategic Research, they have been able to bring together researchers with various specialities in a strategic research centre. The RAPID centre (Rational Approach to Pathogen Inhibitor Discovery), which is headed by Alwyn Jones, is divided into three parts: structural biology, medical chemistry and theoretical chemistry. All are needed. The structural biologists study the structure of the proteins by first making crystals of them.

"The crystals are not just highly useful, they are also very beautiful," says Alwyn Jones, pointing to the colour pictures on the wall.

The crystals are analysed by means of X-ray crystallography in order to obtain a three-dimensional picture of what the molecules look like. When the structural biologists have identified functioning protease inhibitors, the medical chemists take over.

"Once you have found protease inhibitors that work in the lab, you have to make sure they will work in the patient's body as well. That is what the medical chemists do. Their job is to enable the protease inhibitors to find their way from the drug ingested into the body to the right location in the body. This is difficult, and in many cases proves to be impossible."

The medical chemists and the structural biologists get theoretical support in their work from theoretical chemists, who carry out calculations and construct computer models of the different structures.

In order for the ultimate objective to be achieved, bridges must be built to the pharmaceutical industry. Right now, close collaboration is being established with Astra Zeneca, which Alwyn Jones hopes will be fruitful.

"At the university we can do research on drugs, but we can't make them. In order for new drugs to be produced and find their way to market, we have to have good contacts with the pharmaceutical industry."

Children important influence

Alwyn Jones started out as a physicist, but became more and more interested in biology, especially the structure and function of molecules. He has succeeded in designing computer programs to model the structures.

"Unfortunately I don't have much time for programming anymore. But I treasure the hours at night after the children are in bed or when we're on holiday and I can sit down in the shade with a computer on my lap."

Jones grew up in a Welch mining town. His father worked in the mines, and many of his relatives suffered from lung diseases. He decided at a young age not to become a miner. He experienced culture chock when at the age of nineteen he moved from the Welch countryside to London to study, alone and penniless. But he endured.

"I loved physics and quickly discovered that research was fun," he says.

It was his children, now eight and twelve, who got him interested in medicine.

"Nowadays it feels important to do something meaningful in life, something that benefits people. I have my children to thank for that insight. They have got me to shift focus. But maybe I should really slow down and spend more time with my children," he says wistfully.

Jones's wife is on the staff of RAPID:

"She does research and also supervises doctoral students. I have to spend a lot of time on administration," says Jones with a note of frustration in his voice.

The beginning of the beginning

Some ten or so doctoral students have been recruited to the new centre, but other scientists were already in the house.

"We have many of the best scientists here already, so we haven't had to recruit from the outside. But now we can work together in a new way thanks to the support from the Swedish Foundation for Strategic Research."

The work on protease inhibitors as malaria medicines began some time ago. The next step is to target tuberculosis, making use of the knowledge already acquired. Right now, they are in the midst of the first step in the long process of developing a new drug.

"Winston Churchill once said: "This isn't the end. This isn't even the beginning of the end. It is perhaps, the end of the beginning," Jones quotes from memory. "I would say that we aren't even there yet. We are only at the beginning of the beginning. I will be very happy if we have an effective drug in five years."

New clues to the unsolved mysteries of immunology

Despite the fact that the immune system plays an important role in many diseases, there are still great gaps in our knowledge of how it works. The new immunological research centre will help to close these gaps. With better knowledge, the immune system can be stimulated to improve the treatment of tumours, infections and inflammatory diseases.

The immune system plays a central role in many diseases, but we don't yet know exactly how it works.

"Our research is concerned with how the body's immune system responds to various substances. Why it is activated in some situations and not in others," explains Klas Kärre, head of the new centre for research on the regulation of the immune system at Karolinska Institutet in Solna.

The cells of the immune system have receptors which sense foreign substances in their environment. The latest research has shown that many of the cells have several types of receptors, so that they can recognize many substances and signals from other cells simultaneously.

"Some receptors sense foreign substances and issue a signal that the cell should be activated. Other receptors instead sense whether the substances around them are those that should normally be present, in which case it sends a stop signal to the cell."

Kärre scribbles enthusiastically on the white board in his office while explaining.

"All the time there are different signals that say either 'stop' or 'activate'. When the activating signal predominates, the immune system responds. We want to understand how the decision processes in the cell work. Since numerous signals have to be compared, it gets rather complicated. Researchers from different disciplines have to collaborate to analyse this. We are studying the structure of the different receptors, where in the cell they gather during the decision process, and how the cell counts the signals."

Controlling the immune system

The centre focuses on basic research, where specialists in immunology, inflammation, structural biology, image analysis and mathematics work together. But the centre does not focus on any special area such as infections, transplants or autoimmune disorders.

"We are focused on basic research, but our findings can be used in treating a number of diseases in which the immune system is involved. If you know how the immune system responds, you can also control it."

In the case of diseases such as cancer or infections, the immune system is stimulated to act more strongly. In the case of inflammation, for example in autoimmune disorders when the immune system reacts to the body's own tissues, an attempt is instead made to suppress the immune response. This is easier with better knowledge.

Klas Kärre also mentions bone marrow transplantation as an example. Transplants of bone marrow or blood stem cells are done above all in leukaemia. The recipient's bone marrow cells are destroyed and healthy cells are transplanted. This entails a great risk of complications. Firstly, the recipient's bone marrow can react strongly to the new cells, and secondly, the new bone marrow's immune system can react to the recipient's body.

"If the new cells react strongly to all the recipient's cells, the recipient gets very sick. But if the immune system reacts in a more precise fashion, this can be good, since the reaction can then be targeted at any remaining cancer cells. We believe that some of the fundamental decision processes we are studying can be used to control the immune system to respond optimally."

Popular science aroused interest

It was somewhat by chance that Klas Kärre came to be interested in research on the immune system. After a couple of terms at medical school he happened to see an ad where Georg Klein, Professor of Tumour Biology, was looking for assistants. He started working for one of the doctoral candidates who was then occupied with cells in the immune system. The rest is history.

While in school, Kärre had always planned on studying engineering at KTH (the Royal Institute of Technology in Stockholm), but then he became interested in biochemistry.

"I sat leafing through course catalogues, and medicine caught my fancy. Not because I wanted to become a doctor, but because the subjects seemed so exciting."

His interest in science had been awakened early by popular science books.

"I was fascinated by James Watson's *The Double Helix* about the discovery of DNA. It described research as a combination of hard work and technical skills, but also creativity and an open mind."

If Kärre ever quits doing research, he may switch to a career in popular science writing.

"It would be fun to write essays, for example. I've already tried it a bit as a trainee at the science magazine *Forskning och Framsteg*. And I still read a great deal of popular science literature."

Kärre is married and has three children between the ages of eleven and twenty-two. He and his wife went to school together, but have chosen different careers entirely – she is a school teacher.

"I think it's good that we have different professions. But it's also fun that we have been able to exchange experience more in recent years, since we both ended up in supervisory positions."

Kärre has been a department head for several years, but now with the establishment of the centre he will be devoting more of his time to his own research.

"It's been a long time since I stood at a lab bench myself, but I can't wait. It won't be so long now before that happens," he says with enthusiasm.

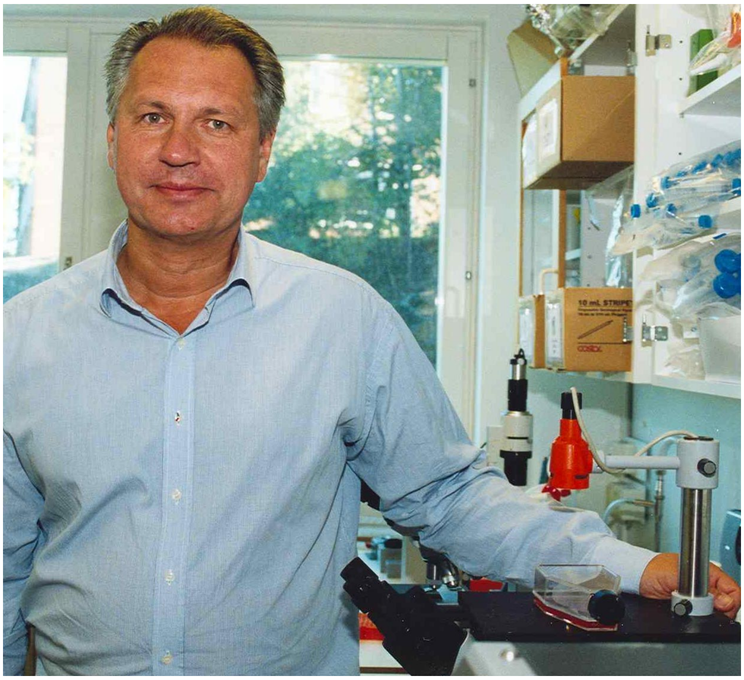
Animal experiments necessary

Cells from both humans and mice are used in the research.

"We sometimes use mice, since we can then perform experiments that aren't possible on humans. We can, for example, disable genes or cells in an organ, inject tumour cells and see how the immune system reacts."

Kärre makes no bones about the fact that animal experiments are an important part of the research. The first thing he points out is the building where the animals are housed.

"I believe that animal experiments are necessary sometimes, and then I think we should do them. They are an important part of medical research. But we scientists have to get better debating the issue and explaining why certain animal experiments are necessary."



Around 45 researchers are involved in the centre, and soon all the groups will move into common premises. Kärre thinks this will be of great importance for the work.

"We will create an intellectual environment where scientists from different fields rub shoulders in both the laboratory and the lounge and can exchange ideas freely.

The grant from the Swedish Foundation for Strategic Research makes it possible to work in a new way. Instead of a couple of researchers specialising in certain methods or molecules, the centre makes it possible to concentrate considerable resources from different disciplines on specific questions to arrive at solutions together.

"When I applied for the grant, I decided to try something new, something I would never have been able to do otherwise. We built further on a collaboration that had already begun on a small scale and has now been broadened to encompass more competencies. Now we're learning brand new things together.

Love of nature leads to interest in stem cells

Some of the world's leading stem cell scientists are working together in a new research centre to unravel the secrets of stem cell function. With better knowledge of how stem cells in the nervous system mature, we can guide their development towards different cell types. This can help in the treatment of such neurological diseases as ALS and Parkinson's.

"We are trying to understand how cells become specialised," summarises Urban Lendahl, head of the new Center of Excellence in Developmental Biology at Karolinska Institute in Solna. Developmental biology is a broad field of research, from fertilisation to the development of an adult individual. The centre has chosen to focus on the nervous system and its stem cells.

"Stem cells are immature cells which later develop into mature cells of various kinds. They are formable and open to the possibility of becoming different types of cells."

Basic research in hot new field

Lendahl explains that they have focused on two questions in particular. The first is: how does a stem cell become specialised as a neuron (nerve cell)? The second is: how are different types of neurons generated? Examples of different interesting types of neurons are dopamine-producing cells and motor neurons, cells which control our motor function.

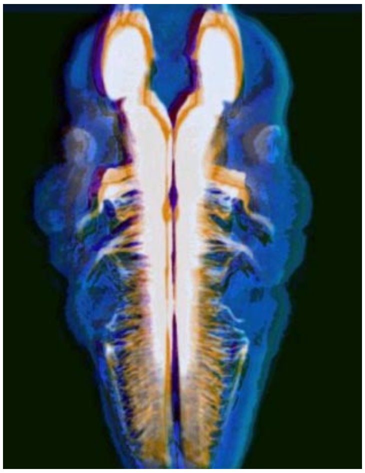
"We want to understand what internal properties control the stem cell's fate in becoming a specific type of cell, and how the external environment influences this. If we understand why a stem cell chooses a given fate, we can also influence this choice to promote or block the development of certain cell types."

This may be an important step towards finding a cure for such neurological diseases as Parkinson's and ALS. In Parkinson's disease, the dopamine-producing cells degenerate, affecting brain function. In ALS, it is the motor neurons that degenerate, impairing motor function.

"It may be possible to culture a certain kind of cell for transplantation, or to administer a drug that promotes the tendency for certain cells to choose a given fate.

Even though the field has many possible applications, Lendahl points out that the centre focuses on basic research.

"Looking back, we find that basic research has given rise to many of the big discoveries. But certainly we believe that our findings will have a wide range of potential uses. Stem cells are a very hot field of research to which great future hopes are attached, and even though we are working with neurons, we believe that many of the discoveries are also applicable to other cell types."



The picture shows the developing nervous system in the hindbrain of a 10-day old mouse embryo. The immature nerve cells in the rudimentary cranial nerves are visible in white in the picture and can be identified and studied by means of genetic (transgenic) techniques.

Mice or chicken embryos, in other words fertilised chicken eggs, are often used in this research.

"We at Karolinska Institutet are very adept at producing transgenic mice. These are mouse strains that are genetically modified so that their different traits can be studied. Certain genes can be activated and the effects noted."

From birds to stem cells

Curiosity and a desire to understand are important driving forces for Lendahl's own research.

"I knew at an early age that I wanted to do research. There is something enticing about the unknown and finding the answers to mysteries. And I have always been the kind of person who turns over stones and takes things apart."

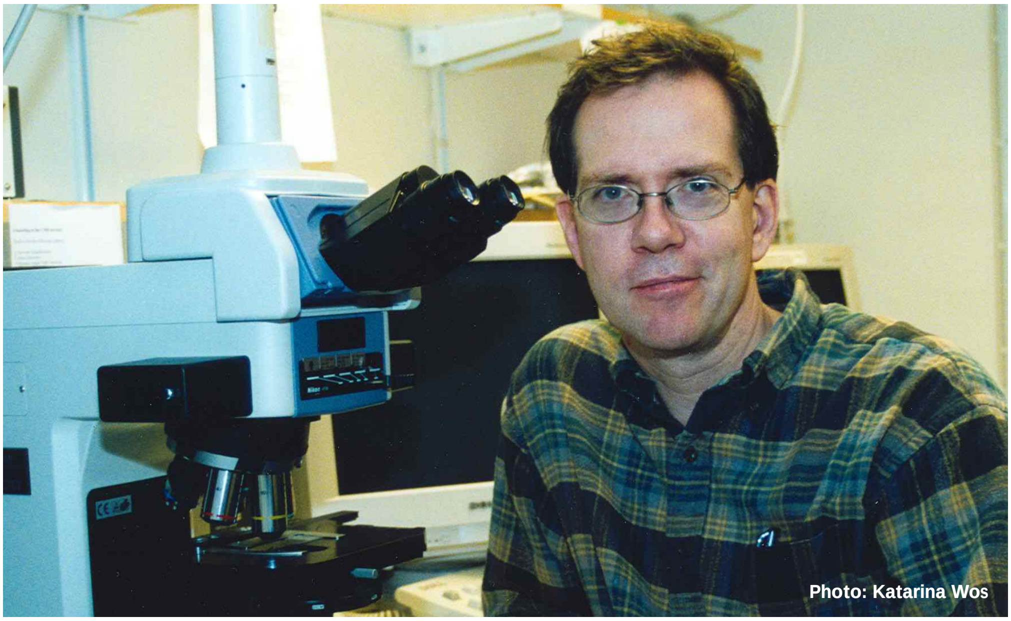


Photo: Katarina Wos

A passion for ornithology eventually led to studies in biology and chemistry at Stockholm University. Then Lendahl got his PhD with a dissertation in molecular biology and genetics at Karolinska Institutet. He came into contact with stem cells during postdoctoral studies at MIT in Boston.

"I had the privilege of working with a researcher who had the idea, controversial in the 1980s, that there were stem cells in the nervous system. This is generally accepted today."

His interests in cells and birds are two sides of the same coin.

"I'm a bit of a Renaissance man who is interested in everything. The world of biology with all its life forms is exciting, and I am fascinated with the beauty of nature's solutions."

Even though Lendahl grew up in Stockholm's inner city, he is not a city person. His idea of relaxation is wandering the Baltic island of Öland with its rich bird life, or the pristine forests of Jämtland up north. But with a three-year-old in the family, he doesn't have as much time for such pursuits anymore.

"Between my family and my work, there's little time left over. Of course, being with small children also involves outdoor activities, although usually restricted to the back yard."

Attractive research environment

Besides heading his own research group, Lendahl is in charge of keeping the centre together and making sure everything runs smoothly.

"Success is mainly dependent on our having good researchers and research groups and getting them to pull in the same direction, and we have that here."

Bringing together scientists with different competencies in one place also creates, as Lendahl puts it, a big toolbox of scientific methods. Having access to such a toolbox is important even for groups that do not strictly belong to the centre.

"Research is advancing so quickly today that you can't afford sitting around for a year developing a new method. You'll fall behind if you do. The centre gives us in-house access to broad expertise."

The centre started with nine research groups collaborating and will soon number fifteen groups. The final recruitments are now being made. There is no doubt that the centre offers an attractive research environment.

"We get a lot of enquiries from people who want to come here and work, both from Sweden and from the rest of the world," says Lendahl.

The researchers occupy joint premises at Karolinska Institutet.

"It's a little crowded," he says, pointing at a lab bench cluttered with jars, bottles and microscopes in a room shared by several researchers. "But that's the idea, then you meet the others at the centre in a natural way."

Having been put in charge of a strategic research centre, Lendahl feels a responsibility to defend Sweden's position as one of the leading nations in developmental biology. The scientists at the centre are in the very forefront of research already today.

"Just during the months since we started, the centre has published papers in some of the world's top scientific journals, such as Nature and Cell. Our objective is to be on a par with the best in the field, and we won't settle for less. The backing of the Swedish Foundation for Strategic Research enables us to be competitive."

Patient-based research to yield new therapies

The Center for Infectious Medicine will be one of the leading centres of its kind in the world. This is Hans-Gustaf Ljunggren's ambition. Forty full-time researchers work directly with the patients at Huddinge University Hospital. In this way, the new research findings can quickly be put to use in healthcare.

"Research on infectious diseases is important because it affects so many people. More people die of infections than of other diseases. Particularly children in developing countries," says Ljunggren. The HIV/AIDS epidemic is a telling example of the need for research on infectious diseases.

Infections are strongly suspected of being behind many other diseases as well.

"In certain types of cancers, for example liver cancer and cervical cancer, we already know that there is a cause-and-effect relationship. There is reason to believe that infections may also lie behind diseases that are not normally regarded as infectious diseases, such as autoimmune disorders. These include diabetes and multiple sclerosis (MS).

Research close to patients

Hans-Gustaf Ljunggren is the head of the Center for Infectious Medicine (CIM), which was recently established at Huddinge University Hospital outside Stockholm with the support of the Swedish Foundation for Strategic Research.

"Working close to the patients can be of great importance for the research here in a way that would not have been possible if the centre had been located at an ordinary university," he says. "Our ambition is that the laboratory work should take place very close to the patients. In this way, we hope that the clinical questions will drive the research directly. Moreover, findings will be able to be tested immediately on patients."

Immunotherapy against leukaemia (blood cancer) is a concrete example where a basic discovery has led to a new form of treatment which is now being tested for the first time at Huddinge University Hospital. In immunotherapy, the immune system's own cells are used, in this case a special type of cells called NK cells, *Natural Killer cells*. They have a unique capacity for killing tumour cells.

"In the laboratory, we have learned to culture these cells in large numbers in test tubes, and now a large programme is being conducted where the cells are reintroduced into patients with tumour diseases. The first patients have now undergone treatment and the effects are now being observed in detail."

Wanted to be an engineer

Hans-Gustaf Ljunggren's own research started as an interest in the body's immune system.

"The most important function of the immune system is to protect us against infections. The same immune system that can protect us against cancer can also, if it responds inappropriately, cause autoimmune diseases such as MS, diabetes, asthma and allergies," he says.

He started doing research on tumour immunology during his first terms as a medical student. This led to a doctoral thesis on NK cells. But from the beginning he had planned to enter KTH (the Royal Institute of Technology).

"I finished my military service in December. KTH didn't have admissions then, so I applied to medical school."

Now Ljunggren is married with three children. This afternoon his eldest son is playing football, and his mobile phone rings repeatedly.

"We're all coming to watch, even the little kids," he says on the phone. "Where is the match being played?"

He thinks it's fine to combine doing research with a family.

"One possible difference is that I don't have a hobby. My work and my leisure time blend together, and I get to do what I like best."

He compares himself to an athlete or a musician in that his hobby is also his profession.

"How do I relax? I go watch my kids in their different activities. Or I take them to a hockey game," he says after a moment's reflection.

HIV vaccine

One field of research at CIM is developing a vaccine against HIV.

"It is very difficult to make a HIV vaccine, since the virus mutates constantly. A vaccine that works today will be ineffective tomorrow. There are many ideas today on how to solve this problem, but we know that most of them won't work."

CIM is working on a method where the HIV-infected cells are induced to die by programmed cell death, also known as apoptosis, which entails that the cells commit suicide. It has been found in laboratory experiments that infected cells that die in this way can be absorbed by other cells that are good at stimulating the immune system.

"Infected blood is taken from the patients and vaccine is prepared from it. Then the patients are vaccinated with their own blood to activate the immune system."

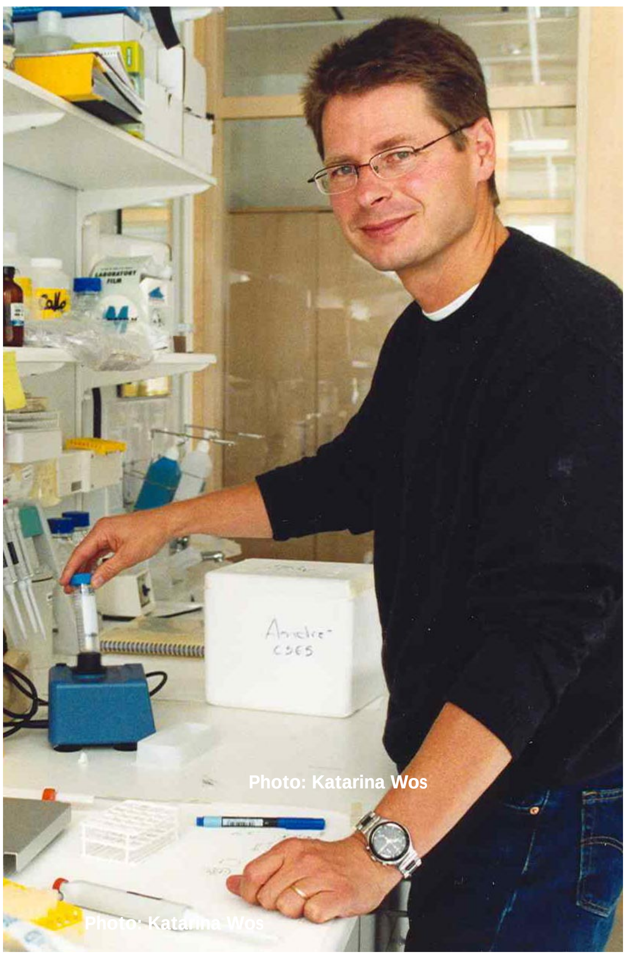


Photo: Katarina Wos

Photo: Katarina Wos

CIM is also participating in a research project, together with a biotech company, to develop a better drug against tuberculosis.

"Tuberculosis is a very urgent field of research, not least from an HIV perspective. Very many HIV patients in developing countries also have tuberculosis. It is a disease that was under control a few years ago, but which is now spreading rapidly again. This is due to the fact that the drugs we have are not sufficiently effective, and no new ones have come along in 30 years."

People in developing countries are particularly afflicted with both HIV and tuberculosis, along with many other infectious diseases.

"One problem is that these are diseases that hold out no commercial interest for the pharmaceutical companies. For example, many big international companies that were at first interested in finding an HIV vaccine discontinued their research because they can't count on making money from such a vaccine. To be cynical, you could say that the drugs that are of the greatest commercial interest are those used to treat chronic diseases that afflict people in the wealthy part of the world, such as diabetes or MS, or cardiovascular diseases.

"That's the way it is, but my intention isn't to malign or criticise the pharmaceutical industry. Pharmaceutical companies operate on a commercial basis in a capitalistic economy. The universities bear great responsibility for going research that is of great import, but is not commercially viable."

Rotation a good idea

Hans-Gustaf Ljunggren speaks very enthusiastically of his ambitions with the centre. He wants to create an attractive workplace that draws the very best scientists in the field. So far he has not had any problems finding people who want to work there.

"Many have contacted me of their own accord," he says, holding up a thick bundle of letters.

CIM moved into renovated premises in January 2003, and by May of the same year all forty positions were filled.

"But I hope we can continue to recruit one or two people every year. It's good if people who work here get so accomplished that they become attractive to others. Furthermore it's good if we have more rotation of researchers in Sweden.

"What will I myself be doing in 10 years? I live my life in seven-year periods, so it's difficult to say. But I have no other plans than to continue doing what I'm doing today," says Ljunggren. "And I hope this place will by then have developed into an internationally leading centre for infectious medicine."

Genetic engineering improves Swedish forest production

In the future, the world's leading research in forest biotechnology will be conducted in Umeå. Of this Göran Sandberg is convinced. Forest production can be improved dramatically in the future by means of genetic engineering. But the impetus for the research is to understand how tree cells work.

Forest research is conducted at the Umeå Plant Science Center (UPSC), a project launched jointly by Umeå University and the Swedish University of Agricultural Sciences. With the support of the Swedish Foundation for Strategic Research, a centre has now been created for studies of the developmental biology of plants.

"The research is aimed at understanding, for example, how trees form wood," explains Göran Sandberg, head of the centre. "Trees are the basis of the forest industry. It is therefore vital to have a basic understanding of the mechanisms that control the growth of trees. But the ultimate goal is to improve forest production."

Just inside the bark, cells form and divide in what is known as the zone of cell division. There it is determined how much wood will be formed and how long its fibres will be, properties which determine wood quality.

"We want to understand how the cells develop. The zone of cell division is therefore of interest from a research point of view."

Genetic engineering accelerates breeding

An important part of the work is understanding what functions different genes have. Some of the genes have been mapped, but many gene functions are still unknown. By switching off specific genes in a plant, it is possible to study their function.

"For example, if you want to study whether a certain gene controls flowering, you switch off the gene by inserting a copy of the gene in the plant in such a way that the original gene is blocked. If flowering then fails to occur, you know that this particular gene is involved."

Despite the fact that forest research is very much a strategic field, the forest industry has adopted a wait-and-see attitude.

"I think it's because they don't want to be associated with genetic engineering yet, since it may jeopardise their sales on certain markets," says Sandberg.

He says that genetic engineering may have further applications and gives some examples. One use is to accelerate plant breeding. Coniferous trees flower very late, when they are 10-15 years old. Since they cannot be crossed very often, breeding takes a long time. By genetically accelerating flowering, breeding can be simplified. The tree's fibres can also be altered so that the surface of a finished paper made from these trees has different properties. Genetically modified trees with improved growth characteristics are another possibility. Such trees could be used for plantation growing.

"Trees that are sterile and don't flower can be bred. I think this could increase public acceptance of genetically modified trees, since it reduces the risk that genetically modified seeds will spread.

"It's important to note that there are no absolute guarantees, but the risks can be minimised," he continues. "All technologies involve risks, and these must be weighed against the benefits."

Good research climate despite the cold

Even though the research is ultimately intended to be applied, Sandberg stresses that the centre focuses on basic research.

"Good research yields good applications," he asserts. "The big challenge is to create an attractive environment that will draw quality people."

The biggest drawback in recruiting researchers to Umeå is the climate.

"Madrid, or even Stockholm, is preferable in terms of climate. But instead, we can offer highly qualified colleagues and equipment of a high technical standard. It is extremely easy to do good research here."

Approximately 150 persons work at the Umeå Plant Science Center, and a third of them come from other countries. Sandberg thinks it's important to have outside influences. An environment where all the researchers sit in the same building, do

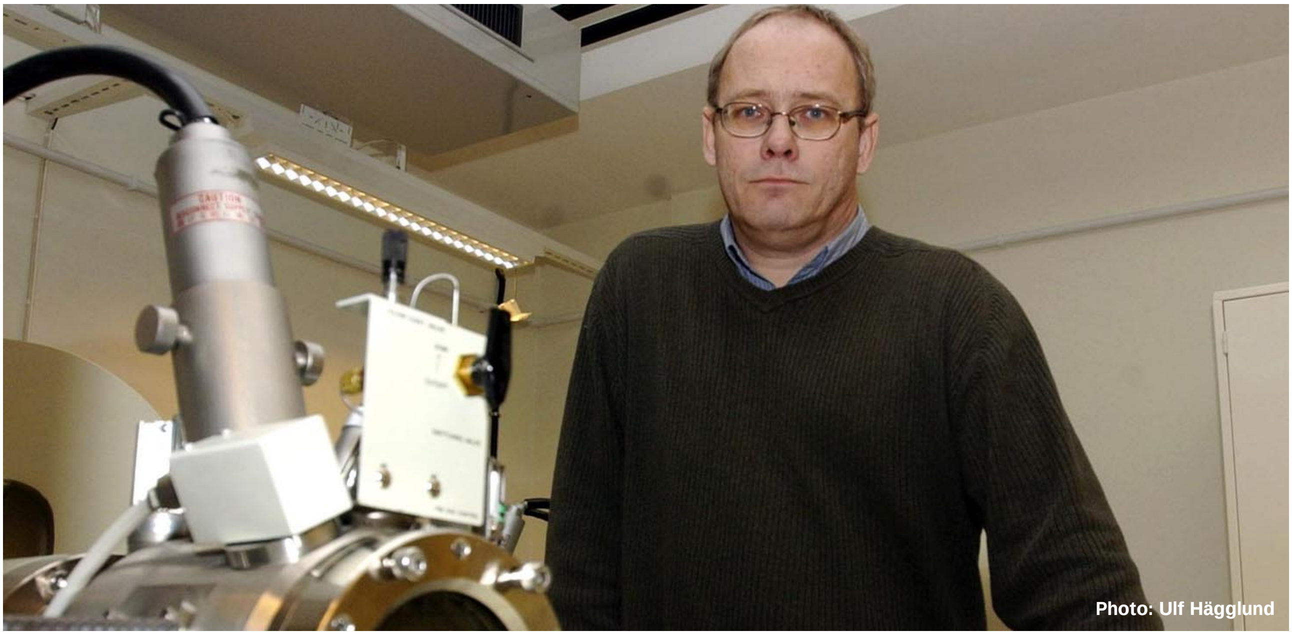


Photo: Ulf Hägglund

lab work together, take coffee breaks and have discussions is conducive to good research. The centre particularly attracts young scientists.

"It is the young researchers, doctoral students and those who have recently obtained a PhD, who drive the research forward. The more people who are thinking good thoughts, the better," he says with conviction. "I don't believe in the great leader theory, but more in collective solutions."

Sandberg himself devotes about half his working hours to his own research, even though as head of the centre he also has heavy administrative responsibilities that take a lot of time.

"To build up a scientific environment I need to be close to the research. I can't spend all my time on administration."

In the future he will be devoting even more time to his own research, since he has decided to resign from all duties and involvements on boards and councils.

"The big problem for scientists is making time to think. I have decided to give myself that time. I can't spend half my time in meetings in Stockholm," he states emphatically.

Environmental activist when young

Göran Sandberg was born just outside of Umeå, and research was not a part of the world he grew up in.

"Timber floating was important for Umeå at that time, and for my father the finest job you could get was in floating, or possibly with the railway. He couldn't understand how I could choose university studies when I had landed a steady job in the timber floating association."

Sandberg started studying biology due to his environmental commitment.

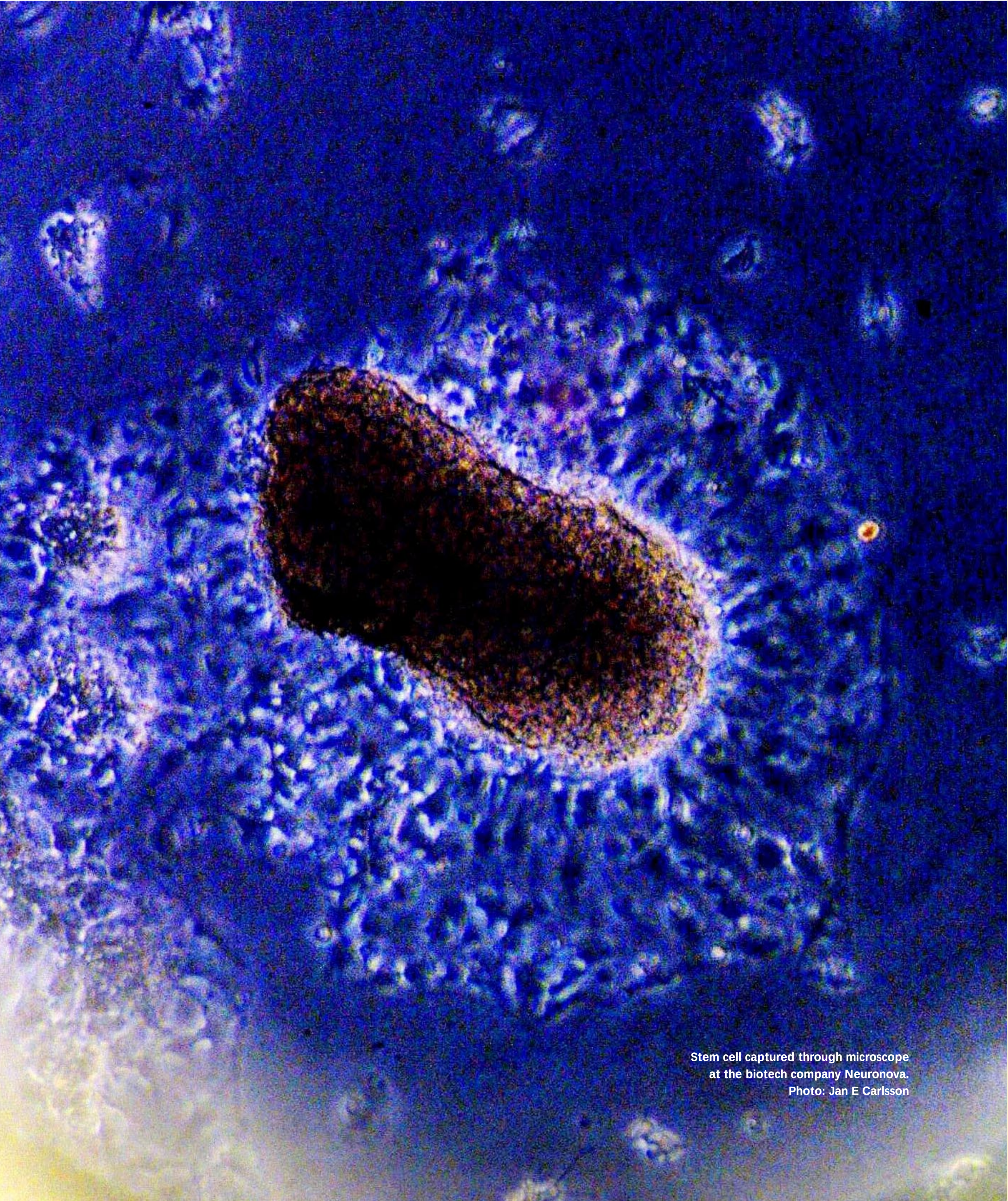
"I was a member of Fältbiologerna (a conservationist youth group) just when they evolved from being a birdwatching club to becoming environmental activists, and I took part in some actions."

He started his research career by writing his dissertation on plant growth hormones. After that, Sandberg held research positions in the USA, England and Canada before becoming a professor in Umeå. And he has decided that he will eventually move again.

"I will devote my time to this centre during the six years of the strategic research centre programme. Then the centre will have to stand on its own legs. I myself will then be somewhere else devoting all my time to research," he says "The centre is not dependent on a single person, it must be able to stand on its own. In a few years a new generation will dominate the research."

Göran Sandberg is convinced the centre is competitive.

"Our goal is to be no. 1 in the world in forest biotechnology, and one of the best in general plant biotechnology," he states categorically. "Even today, we are the ones driving plant biotechnology research forward in Scandinavia, and we will continue to do so in the future."



Stem cell captured through microscope
at the biotech company Neuronova.
Photo: Jan E Carlsson

Background

With the goal that Sweden should retain and strengthen its position in the life sciences, the Foundation allocated SEK 400 million in December 2000 for the establishment of strategic research centres in this field.

The centres should comprise time-limited, scientifically focused and geographically co-located research environments. They should be world-leading in their particular field, with a sufficient intellectual and technical mass and long-term relevance to industry and society.

Within a centre there should be collaboration between groups with different scientific expertise for the purpose of tackling interdisciplinary issues or research areas.

New research environments with a new content and great strategic interest will preferably be established. It is also important that a centre is headed by a researcher who can, by virtue of his scientific excellence, his visions and his leadership, attract other leading researchers to the centre.

A number of broad fields in the life sciences are being prioritized in the announcement:

- Mechanisms in biological systems
- Structural biology
- Computational biology
- Applications in diagnostics, prophylaxis and therapy
- Biotechnologically oriented applications
- Technology development for / based on biological systems

The research activities at each centre were intended to include components from one or more of these areas, but the exact scientific content and the goals were left to the researchers to define.

Announcement of the openings was done in a two-step process. In the first step, potential research leaders were invited by means of an international announcement to submit pre-proposals. At the end of the application period, 112 pre-proposals had been received. A national research committee consisting of 12 scientific experts from industry and academia identified 17 applicants who were invited in the second step to submit complete proposals. An internationally composed panel of seven scientific experts from academia and industry conducted individual hearings with the applicants and ranked them. In June 2002, the Governing Board decided to allocate funds for six strategic research centres, and it is these that are presented in this publication.

The Swedish Foundation for Strategic Research

- supports research and graduate training in the natural sciences, engineering and medicine for the purpose of strengthening Sweden's future competitiveness
- finances at present over 100 large research programmes at Swedish universities – many of them in collaboration with industry
- awards individual grants to particularly prominent researchers
- supports important areas such as biotechnology, materials research, IT and product realisation
- invests heavily in graduate training – almost 1 000 doctoral students are currently employed in the Foundation's various programmes
- has a total annual allocations volume of SEK 500 million (2004)
- has a capital of about SEK 8 700 million (November 2004) as the basis for its operations
- has former Deputy Prime Minister Lena Hjelm-Wallén as Chairperson as of 2004

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