

Myths legitimise the power of rulers

In the Viking Era, the power of the rulers was to a great extent legitimised by ‘sacred marriages’ between gods and giant women, for example. In the Middle Ages, however, Christianity introduced a stronger power of rulership by holding that the King was God’s representative and, as such, had almighty power over life and death. “Religion is an important key to understanding the motive forces that prevailed in pre-modern society”, states Professor Gro Steinsland. Pages 6–7

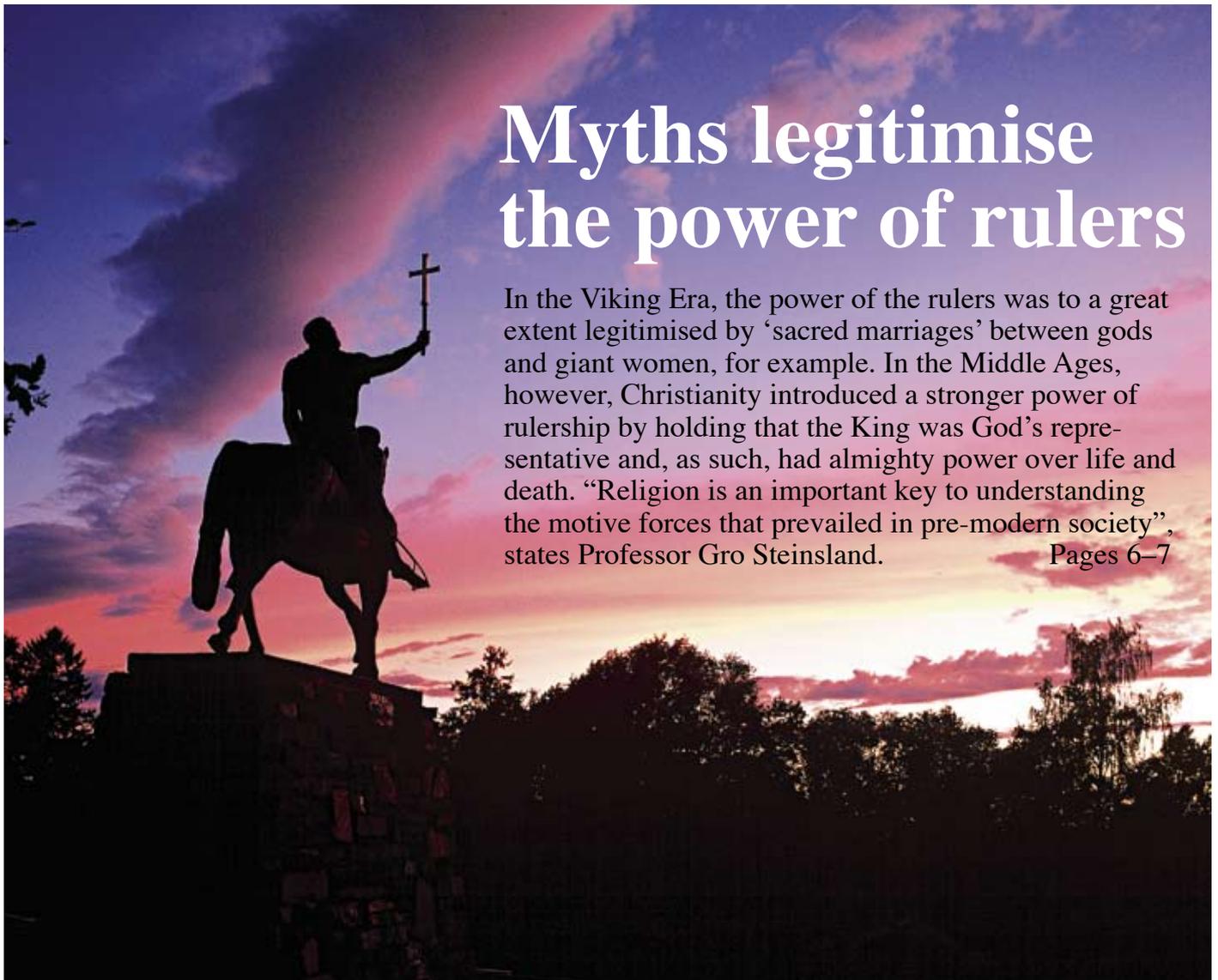


Photo: Aune Publishing House/Ole P. Rørvik

The Centre calls for proposals for group leaders for 2010/2011

■ The Centre for Advanced Study organises basic research, both disciplinary and interdisciplinary alike, of a high international calibre. In December 2007, the Board of Directors will assess nominees to chair research groups that will be granted a one-year stay at the Centre during the 2010/2011 research year.

Group leaders will be selected from among leading Norwegian researchers in the humanities/theology, natural sciences/mathematics/medicine and social sciences/law. The groups are to have an international composition, and they will be fully funded by the Centre in collaboration with all Norwegian universities.

The Centre invites nominations for candidates to chair groups. Proposals should include:

- Name of the candidate(s), place of work, and a brief CV detailing relevant publications, involvement in the relevant field of research and project management experience (1 – 2 pages in A4 format).

- A project description that contains the main questions for investigation and hypotheses, and an assessment of the project’s scientific merit relative to ongoing national and international research in the field. The description must contain an assessment of the professional added value the applicant expects to result from a stay at the Centre, and the project’s status relative to the project manager’s current research (1 – 2 pages in A4 format).

For more information, please visit www.cas.uio.no or contact

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Deadline: Monday, 19 November 2007

Creativity and innovation

This year's research groups at the Centre for Advanced Study all have a multidisciplinary composition and interdisciplinary objectives. The groups are very well aware of the fact that issues know no disciplinary borders. The issues are the focal point and serve as the criterion for the selection of disciplines, not vice versa. This avenue of approach is demanding.

The Innovation group describes the challenge as follows: "Researchers in this field can be compared with a fragmented community consisting of different 'tribes' that lack a common 'language' and which therefore have problems communicating with each other." This barrier can be broken down through *interdisciplinary curiosity*, where a 'rainbow community' of specialists develops a common professional position by breaking new ground and learning foreign tongues.

If this 'Babel-like' confusion in the research community persists, it will prevent the potential inherent in the creative tension that arises in the interface and interaction between different disciplines.

This creativity is also an important input factor in research-based innovation processes that aim at creating new products, services and processes for the community.

Modern innovation studies indicate that there is not a linear, straightforward correlation between increased investments in R&D and what comes out at the other end in the form of results. Huge investments can give modest payoffs, and vice versa. Innovation draws inspiration from many sources. Among other things, there is complex interaction between investments, different social players, and conflicts between different schools of thought. In isolation, innovation lacks dynamics, efficiency and creativity.

There are strong indications that research can improve innovative capacity and ability further by moving across disciplines, and by inducing productive tension between different disciplines and approaches, i.e. by promoting what Daniel Kahneman calls 'adversarial collaboration'.

This avenue of approach is being used by this year's research groups at the Centre. It may result in surprising academic and innovative extra dividends. The central government authorities can improve their innovative power in future by paving the way for transboundary research.



Willy Østreng
Scientific Director

Tidying up the concept of innovation

Everyone talks about innovation, but is it more than a buzzword? Professor Jan Fagerberg has initiated a project to generate new knowledge about what innovation is, what factors influence innovation capacity, and what impact innovation has on society.

Professor Jan Fagerberg of the Centre for Technology, Innovation and Culture at the University of Oslo is a highly respected researcher on innovation and he has an international reputation. He served as the lead editor of *The Oxford Handbook of Innovation*, published in 2004, which summarised current knowledge about innovation, based on the results of the EU-supported Teari Project (Towards a European Area for Research and Innovation), headed by Fagerberg.

Fagerberg has previously organised an international innovation network with support from the Research Council of Norway. The list of his publications and research projects is long and covers a wide range of topics.

Fagerberg's intellectual curiosity has resulted in him heading the research project on *Understanding Innovation* at the Centre for Advanced Study in 2007–2008. "The concept of innovation is used in many different ways. There is no generally accepted theory or consensus of the kind that is common in many disciplines or fields of research. Granted, a great deal of research has been done on innovation, but the researchers have often come to the field carrying their own individual baggage from disciplines such as economy, sociology, business administration, history, psychology, organisational theory and so on. Consequently, I believe it is important to try to help create more common understanding in the international research community with a view to concepts, terminology usage and analyses, since that would facilitate a better platform for sensible discussions about innovation. It will be difficult to make scientific headway without such a platform", maintains Fagerberg.

A young field of research

Innovation Studies, as the field is called, is a

relatively young field of research. "If we go back to 1950, there were hardly any social science publications on innovation. Since 1960, the number of publications has increased at a steady pace, and in the past few years in particular, innovation research has picked up tremendous momentum", says Fagerberg.

The great pioneer in the field of innovation was the Austrian-American economist Joseph Schumpeter (1883–1950), who explained that innovations and the entrepreneurs who implement them are the real forces behind economic development. This was controversial in Schumpeter's time, when traditional economists described capitalism as a system that is in principle stable and where economic development is driven by the market's efforts to strike a balance between supply and demand.

The subject of Innovation Studies has generally had a weak position in Norway relative to its position in Sweden and other countries. "This is not least because there has been little interest in innovation research on the part of the ministries and the Research Council. There were actually several programmes of relevance to innovation research back when Norway had sectoralised research councils, but a few years after the unification into a single Research Council, just one programme remained and funding opportunities had been reduced correspondingly. Not long afterwards, the last remaining programme, KUNI (Knowledge Base for Innovation and Technology Policy), was discontinued with a stroke of the pen by the Ministry of Trade and Industry", recalls Fagerberg.

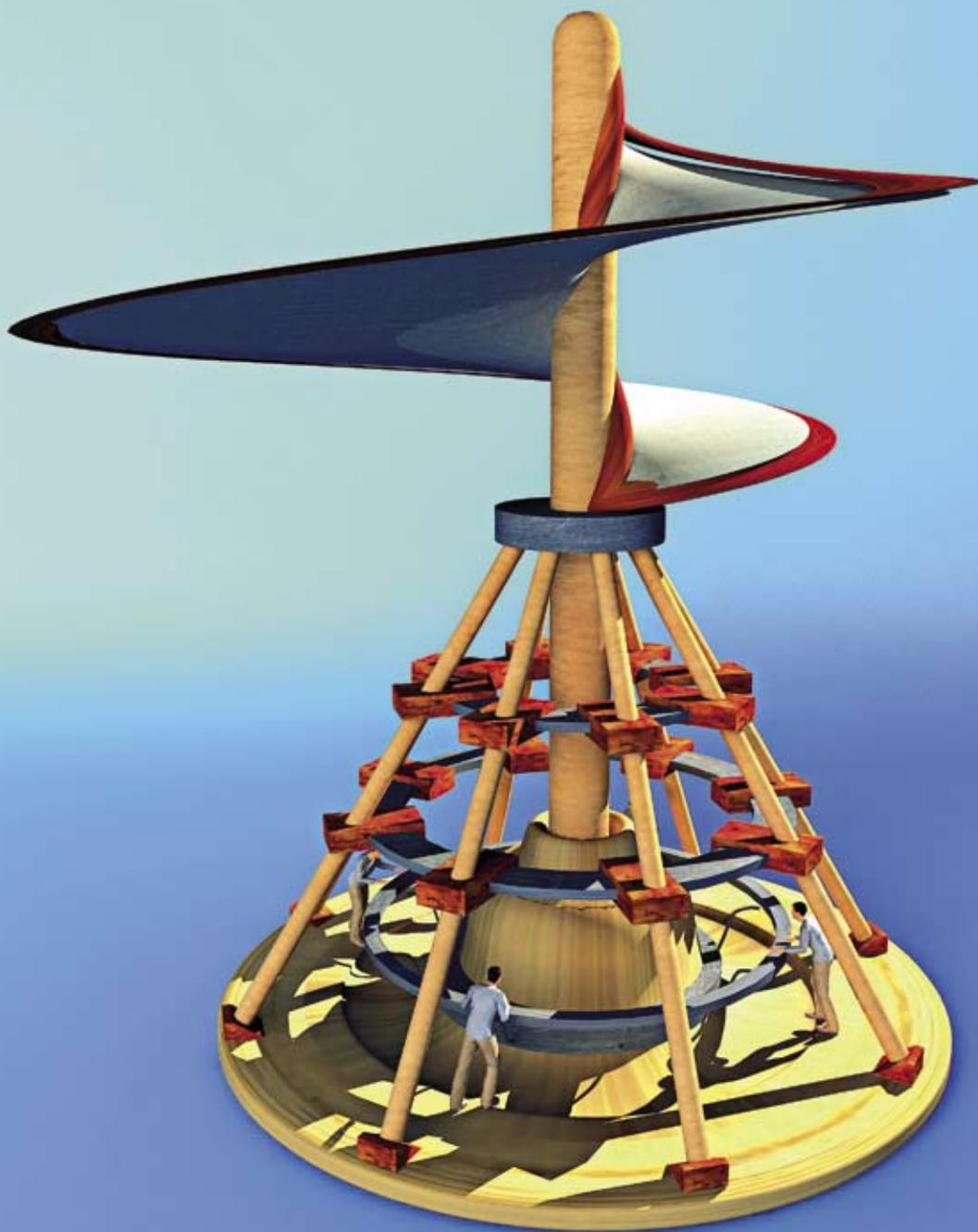
Not really knowledge-based

According to Fagerberg, Norway lacks a good knowledge base for framing policy in the area of innovation. "In Norway's public administra-



"There is no organised research community in the field of innovation nor any organised academic 'public' of the kind that is common in many other disciplines and fields of research," according to Jan Fagerberg.

(Photo: Maria Sætre).



“Many people believe that inventions and innovations are the same, but that is completely wrong. For example, Leonardo da Vinci sketched a helicopter, a flying machine and a parachute in 1488, but it took more than 400 years for Leonardo’s inventions to reach the innovation stage. He lacked a power source, since the internal-combustion engine was not invented until the late 1800s”, Fagerberg points out. (Illustration: Science Photo Library)

tion, there have been many cases of deterioration over time in the role of in-house research/analysis, affecting employees who should have up-to-date, cutting edge knowledge. This also holds true in the field of innovation. Instead, much of this work has been ‘outsourced’ to applied research institutes and consultancies, without a similar strengthening of the competence in the university system. That being said, there is little merit in spending money on reports if there is not enough capacity in the public administration and academia to assess, absorb and make good use of the knowledge. Norway is lacking in these respects today, meaning that we are not well equipped to develop a knowledge-based policy in this field”, continues Fagerberg.

What is innovation?

“What is innovation really?”

“Innovation is what happens when new

ideas are put into practice. In other words, we are talking about a type of practice that involves the production of goods and services. Innovation can also take place in the public sector, in public hospitals, for example, or in government administration”, replies Fagerberg.

Schumpeter defined innovations as new combinations of skills and resources from different contexts, and that observation is important. If a small population were isolated for 100 years, it is unlikely that they would invent much new. However, if they interact with people around them, it is more likely that they will find new solutions.

“It is generally accepted that innovation is a prerequisite for wealth creation, and that is no doubt one reason that many politicians use the term ‘innovation’ to spice up their speeches as often as they can. Economic growth invariably comes from innovation, and there are two possibilities here. One is to copy solutions that

have been developed other places, and the other is to develop new things ourselves. A country with a high standard of living should invest a great deal in developing its own innovations, while less developed countries can to a greater extent use innovations already developed other places”, explains Fagerberg.

“What do you hope to achieve in one year, that is, what will it take for you to be satisfied with the work done by this research group?”

“The year will be used to launch several activities that may leave their mark on the field. We aspire to organise several major international workshops on innovation in enterprises, on the interaction between universities and industry, and on innovation policy. We will also cooperate with the Research Council of Norway to communicate with relevant users outside the universities. Hopefully, this initiative will also help improve innovation research in Norway”, concludes Fagerberg.

Chemists inspired by nature

Professor Signe Kjelstrup is on a quest to find inspiration for new, more energy-efficient chemical processes by studying nature. She need not look far, e.g. the human body is an impressive chemicals factory which performs in processes from which we can learn a great deal.

Professor Signe Kjelstrup has studied energy conversion in natural and industrial systems for more than 20 years, and she has collected an imposing list of merits. She has, for example, headed the theoretical computation of a design for a distillation column that is 40 per cent more energy efficient than those currently used in the petroleum industry. No less than 10 per cent of the USA's energy consumption goes to separating crude oil to produce fuel for cars in the US. Obviously, then, a more efficient distillation column could save huge amounts of energy and have an impact on the global climate.

For the moment, the new distillation column exists on paper only, but several foreign research groups have indicated their interest in the technology. The University of Delft in the Netherlands has appointed Kjelstrup to a professorship at the Centre for Sustainable Development. Moreover, the French industrial enterprise Air Liquide is interested in her technology and was recently granted funding through an EU project which aims to use the technology to develop a better process for air separation.

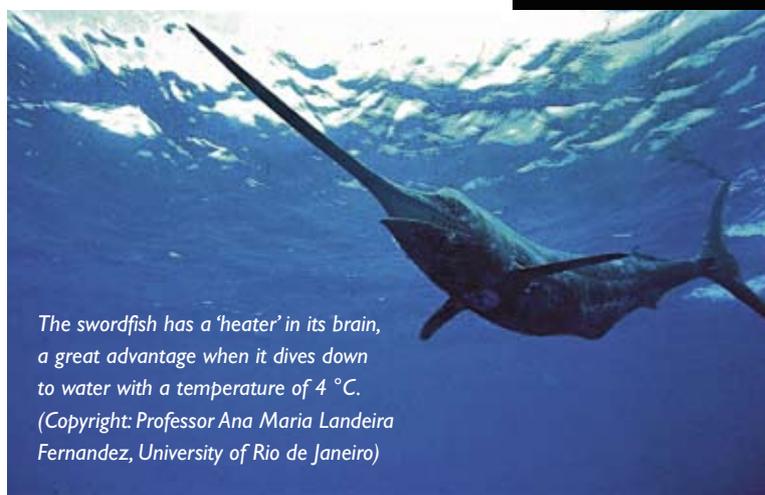
Basic research and innovation

While Jan Fagerberg's research group at the Centre for Advanced Study will be studying the social prerequisites for innovation in 2007–2008, Kjelstrup's group will be working with innovation from a platform based on the natural sciences. "We want to understand natural chemical processes better, and we intend to use physics and mathematics to improve our descriptions of these processes. This may later lead to better models for energy-optimal technical design. Otherwise, innovation is something that must take place in continuous interaction between scientists and users", points out Kjelstrup.

Professor Kjelstrup is especially interested in making theoretical descriptions of chemical processes, and the new distillation column is the result of a prolonged study of the processes at play when molecules in a liquid change and become a gas. The work was supported by the Research Council of Norway's Storforsk programme (Large-scale researcher-initiated projects), which was established to fund large-scale independent

basic research projects entailing high risk and scientific boldness.

The development of the distillation columns has now progressed past the stage of basic research, and Kjelstrup is looking for new challenges. She



*The swordfish has a 'heater' in its brain, a great advantage when it dives down to water with a temperature of 4 °C.
(Copyright: Professor Ana Maria Landeira Fernandez, University of Rio de Janeiro)*

has found one such challenge in the human body, which converts several kilos of chemical reagents to keep us going every single day.

A molecular pump

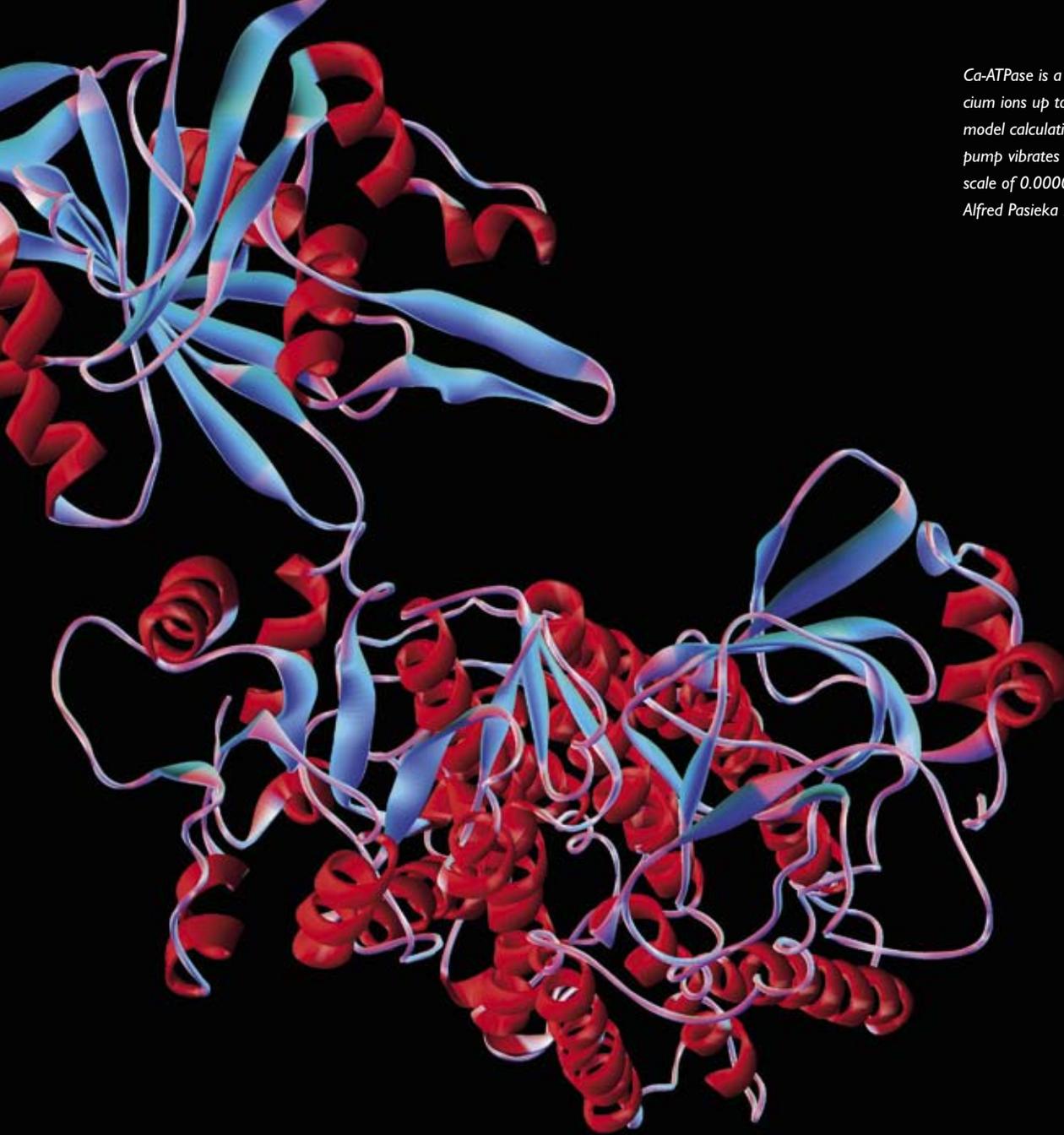
"Cellular respiration in the human body and other organisms is a chemical reaction that takes place inside the cells. It involves converting glucose and oxygen to carbon dioxide, water and energy. The energy from this reaction is initially stored in a molecule called ATP (adenosine triphosphate). Synthesis takes place in the body's power plant, the mitochondria. The ATP molecule can, in fact, be part of a new chemical reaction that releases a high-energy phosphate ion, and this energy can then be used to run the different processes in the body's machinery. Just look, I'm lifting my arm, meaning I used a lot of ATP", continues Kjelstrup.

Kjelstrup and her colleagues have constructed a mathematical model of a large enzyme that uses the ATP molecule for an energy-conversion process. The enzyme is complex and weighs roughly the equivalent of 110 000 hydrogen atoms. "Ca-ATPase, as the enzyme is called, is quite simply a sort of molecular pump, in the sense that it pumps calcium ions up to higher



Signe Kjelstrup is heading the research group 'Nature-inspired Chemical Process Design' at CAS in 2007–2008. She is a professor at the Chemistry Department at Norwegian University of Science and Technology. (Photo: Bjarne Røsjø)

energy levels. We are trying to understand this pump, which consists of a single molecule and is capable of transforming chemical energy for the transportation of ions. This is a highly efficient chemical process. If we can understand it better,



Ca-ATPase is a molecular pump that pushes calcium ions up to higher energy levels. Kjelstrup's model calculations show, for example, how the pump vibrates under various conditions on a scale of 0.000000000001 second. (Copyright: Alfred Pasiëka / Science Photo Library)

we may possibly be able to use the knowledge to develop other effective chemical processes at the nano level", postulates Kjelstrup.

A better understanding of the Ca-ATPase molecule could give us new insight into obesity, a growing problem in many affluent countries. "Obesity and overweight are associated with the body's ability to regulate heat and work, and there is a good chance that it is calcium pumps that regulate those functions. We believe that Ca-ATPase is a heat pump in addition to being an ion pump", suggests Kjelstrup.

A brain heater

Ca-ATPase is found not only in the human body, but also in the vast majority of living organisms, including animals and bacteria. Professor Kjelstrup's co-workers have found an especially interesting application of Ca-ATPase in the brain of swordfish, which often dive down to great depths in waters down to temperatures of 4 °C to hunt for prey. The swordfish brain would have func-

tioned poorly at such low temperatures, had it not contained a sort of heater that turns on automatically when the fish dives down into the briny deep. Humans and many other animals can stay warm by increasing muscular activity, for example, by flailing their arms or shivering. Swordfish, on the other hand, gear up their brain metabolism.

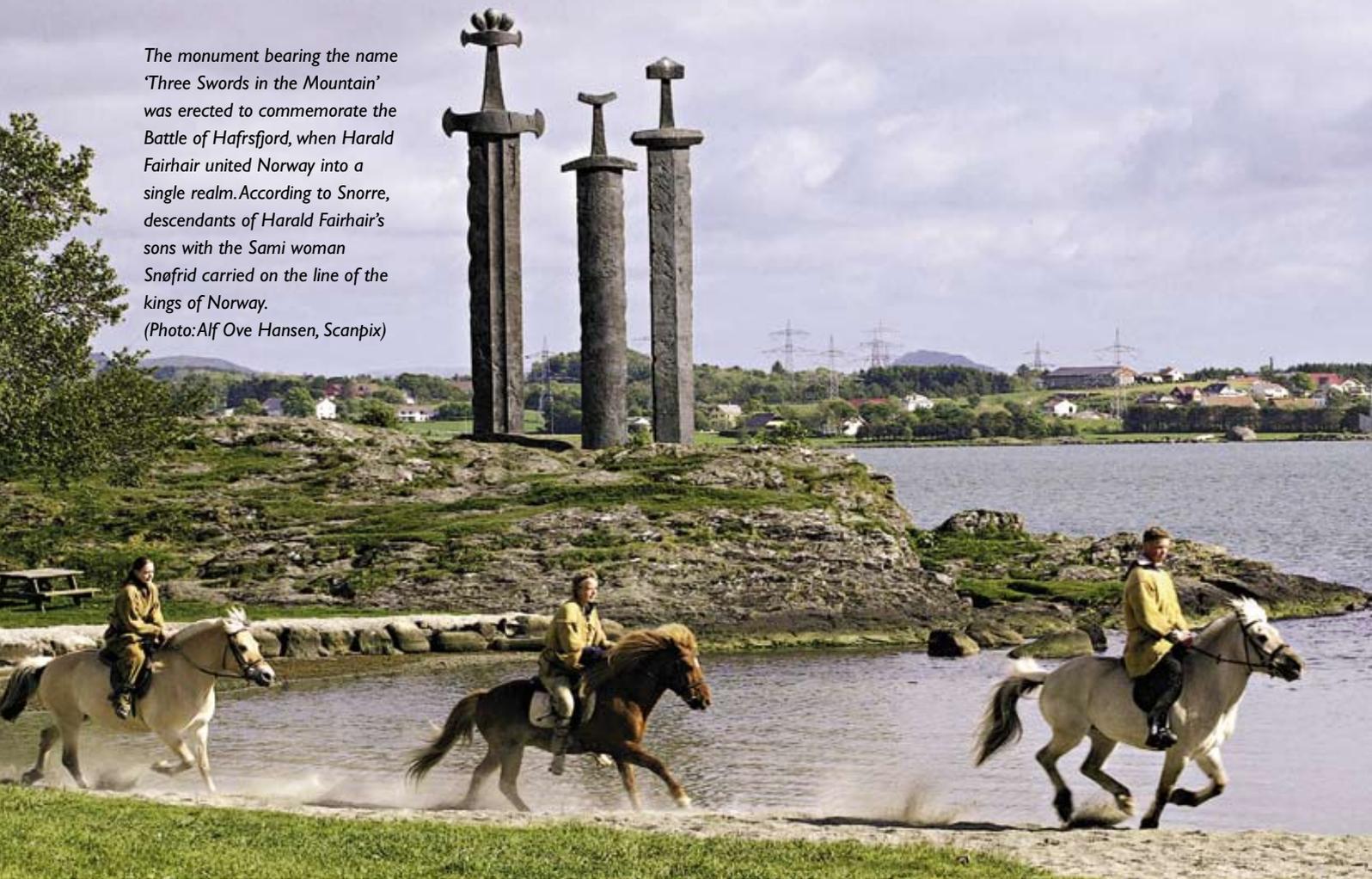
Professor Kjelstrup is heading the research group *Nature-inspired Chemical Process Design* at the Centre for Advanced Study in 2007–2008. The group will spend the autumn semester concentrating on gaining a better understanding of ion pumps, especially Ca-ATPase. "We believe we can use that knowledge to design better chemical processes in general. During the spring semester, we'll take a closer look at the reaction between hydrogen and oxygen in fuel cells. The common denominator between the ATP project and the fuel cell project is that we need to develop a better understanding of the molecular processes and a thermodynamic description at the nano level", adds Kjelstrup.

Mathematics is the language of nature, and Professor Kjelstrup uses mathematical modelling as an important tool. The mathematical computations for modelling are sometimes heavy-going. It helps that the CAS group has access to computing resources at Riken research institute in Japan, Imperial College in England and the Spanish supercomputer system Mare Nostrum in Barcelona.

The Kjelstrup group's computer contains a model of Ca-ATPase that shows how the 'pump' works before abruptly spitting out a high-energy calcium ion from the one end. The model shows, for example, that the pump vibrates at the pico-second level, i.e. vibrations take about 0.000000000001 second.

"It is fantastic to get to be at CAS for a whole year. We will have a unique opportunity to delve deeply into details. During the course of this year, I hope that we will manage to develop some methods that we can use for research in the decades ahead", reports Kjelstrup.

The monument bearing the name 'Three Swords in the Mountain' was erected to commemorate the Battle of Hafsfjord, when Harald Fairhair united Norway into a single realm. According to Snorre, descendants of Harald Fairhair's sons with the Sami woman Snøfrid carried on the line of the kings of Norway.
(Photo: Alf Ove Hansen, Scanpix)



Exploring myths of power and ideology

Nordic societies underwent major changes in the transition from the Viking Age to the Middle Ages. The most obvious changes were that Christianity was introduced and the Crown was strengthened, but Gro Steinsland intends to delve more deeply into another issue that has not previously received quite as much attention: The ideological basis for the power of the ruler also changed.

The Nordic nations as we know them today came into existence at the end of the Viking Age, at the same time as the countries became Christian and the Crown became a centralised power factor. "With Christianity came a totally new philosophy for the Crown, under which the king was portrayed as God's image on Earth. The Christian king of the Middle Ages is a figure who governs by the grace of God and, in so doing, was in many ways a divinity on Earth. This very strong ideology of rulership helped make the king into a ruler who was

virtually almighty and had the power of life and death", expounds Professor Gro Steinsland. She is heading the research project *The Power of the Ruler and the Ideology of Rulership in Nordic Culture 800–1200* at the Centre for Advanced Study in 2007–2008.

Myths of origin that legitimise power

What was the rulership and power ideology really like *before* Christianity came to Norway? While this is a key question for the research group, little attention has been paid to it previously. "We see clear signs that the ruling classes' origins are linked to old genealogical myths about sacred marriages (*hieros gamos*) between gods and giant women, for example. We plan to take a closer look at the meaning of such dramatic myths and to investigate striking parallels in Irish culture. Our research will examine the ideas and ideology behind the power of the ruler in the Viking Age and the Middle Ages from a broader perspective, and try to determine how they differed", continues Steinsland.

Professor Steinsland and her colleagues are fortunate in the sense that they can rely on source material that is unique by international standards, since Norse mythology is exception-

ally well documented. This is quite simply because Christianity came late to Europe's northerly outpost, meaning that the memories of pre-Christian times were still relatively fresh when they were put down on paper. It should be noted that the source material came from the early Middle Ages, and must therefore be read with 'a mental filter' to compensate for the texts being written down by a Christian versed in the Scriptures writing about a pre-Christian era. "For that reason, we cannot read the texts as they stand. For example, Snorre Sturlason (1197–1241) was a learned Icelander who wanted to write the history of the Nordic people in a Christian, European tradition. His famous sagas of the Norwegian kings are a fascinating melange of domestic storytelling traditions and European erudition", underlines Steinsland.

Ynglings and the Earls of Lade

Steinsland reports, among other things, that both the two ancient ruling dynasties in Norway during the Viking Age, i.e. the Ynglings and the Earls of Lade, legitimised their status through myths about sacred marriages. In the Poetic Edda *Skirnismal*, Frey, the god of fertility, married Gerd, a giant

woman from Utgaard, the place in the cosmos where the giants and other forces of chaos make their homes. The marriage resulted in a son who was neither god nor giant, but something completely new. That son became the first in a long line of rulers in the Yngling Dynasty.

“Haakon Jarl, a mighty ruler in Norway from roughly 970 to 995, could boast of a poem that told of how he had descended from a marriage between a god and a giant woman through 27 generations. In other words, we can see that the Viking rulers had a religious platform for their power, but it was a very different type of platform from that in Medieval times”, recounts Steinsland.

“The history of Harald Fairhair’s marriage to the Sami woman Snøfrid bears a number of similarities to the myths of origin of the Ynglings and the Earls of Lade. “Harald Fairhair has been given the credit for uniting Norway into a single realm at Hafsfjord in 872. Both before and after that battle, he married the daughters of powerful men to build alliances. In Snorre’s saga, Harald’s marriage to Snøfrid is the last step in gathering all the fiefdoms of Norway into a single realm. Behind the story, we see the contours of the myth of the sacred wedding between the god and the giant woman. In Medieval history, the Sami were ascribed several similarities with the giants in Utgaard: They live on the world’s fringes in the cold regions far to the North, and they have knowledge and skills that were unknown among the Norse people”, explains Steinsland.

United and true until Dovre falls

Meanwhile, the name Snøfrid evokes connotations of the mountain Snøhetta (2286 metres above sea level) at Dovre Mountain, considered Norway’s highest and mightiest mountain before Jotunheimen was fully explored. Steinsland finds it intriguing that contemporary archaeologists have discovered pitfalls and other traces of an ancient Sami settlement at Dovre.

Dovre is an interesting topic *per se*, since this mountainous area has occupied a central position in myths throughout Norwegian history. We find Dovre mentioned in the Færeyinga Saga, which tells the story of the establishment of a Norse community on the Faeroe Islands. The saga is about the hero Sigmund Brestesson who was first sent to Norway as an orphaned slave at the age of 11, but during his journey



Gro Steinsland is a professor of the History of Religion at the University of Oslo. She works at the interdisciplinary Centre for Viking and Medieval Studies. (Photo: Maria Sætre)

across the Dovre Mountains to Lade in Trøndelag County, he got lost and almost perished. Fortunately, he was rescued by a family of outlaws with a patriarch very reminiscent of the old heathen god Odin. Many years later, Sigmund brought Christianity to the Faeroe Islands, where he set himself up as a ruler along with the Odin-like figure’s daughter Turid.

Parenthetically speaking, the Dovre Mountains have occupied a central position in Norway’s national mythology almost up to the present day. The national assembly at Eidsvoll which drew up the Norwegian Constitution in 1814 swore that they would

be “united and true until Dovre falls”, and the Norwegian author Henrik Ibsen let his anti-hero Peer Gynt marry the green-clad daughter of Dovregubben, the Mountain King.

Religion and politics

“One important reason for this project is that we have seen the need for joint efforts in an area that was previously divided up among scientists from different disciplines, e.g. experts in the history of religion, philologists and historians. Yet traditional disciplinary divides have placed constraints on the research debate. By working across disciplinary divides, we are open to new approaches and new interpretations. We will revisit the sources and hope to bring out new aspects of the formidable cultural transition from the Viking Age to the Middle Ages. Religion is an important key to understanding the motive forces that prevailed in pre-modern society, where religion and politics were closely linked. Religion and politics were also closely linked 1000 years ago, and even today we see how religious issues are integral parts of the social and cultural debate”, Steinsland points out.

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The Centre for Advanced Study

The Centre for Advanced Study at the Norwegian Academy of Science and Letters is an independent foundation with a Board appointed by the Academy, the Norwegian Association of Higher Education Institutions and the Research Council of Norway. The academic activities of the Centre are distinguished by the highest international standards and thus help raise the calibre of basic and interdisciplinary research in Norway. The

Centre’s academic activities are long-term in nature, and intended to have a lasting impact and to be independent of research policy-related, political and economic influences.

Activities are organised in three research groups. One group is selected from each of the three following fields of research:

- The humanities/theology
- Social sciences/law
- Natural sciences/medicine/mathematics

Inspiration, innovation and power

This year's research groups at the Centre for Advanced Study have at least one thing in common, despite the fact that they are addressing themes as diverse as inspiration, innovation and power: All three groups are in fact totally interdisciplinary.

It has been nearly 10 years since the British astronomer and science journalist John Gribbin warned the world against increasing specialisation in science, as researchers focused on ever more narrow fields, "learning more and more about less and less", as he put it. No matter how one looks at it, those words of caution do not apply to the three research groups at the Centre for Advanced Study this year, as each and every one of them shatters disciplinary barriers in its efforts to develop new knowledge.

"Pooling our intellectual resources across subject areas opens the way for new approaches and new interpretations", points out Professor Gro Steinsland. The religion researcher is heading the project *The Power of the Ruler and the Ideology of Rulership in Nordic Culture 800–1200*, a study of the various ideological reasons for the power of the ruler in the Viking Era and the Middle Ages.

"There is a growing understanding of how religion and power were inextricably linked in pre-modern society. In fact, it is not possible to understand culture or social development in the Viking Era or the Middle Ages without taking religion into account. Age-old disciplinary divides have caused people to study religion and policy separately, impeding our understanding of important social processes. By working across disciplinary divides, we are open to new approaches and new interpreta-



Professors Gro Steinsland, Jan Fagerberg and Signe Kjelstrup are heading the three interdisciplinary research groups at the Centre for Advanced Study in 2007–2008. (Photo: Maria Sætre)

tions of our sources", continues Steinsland. Accordingly, her group of researchers consists of religious historians, historians and philologists, all of whom cooperate with experts in other disciplines.

Cause and effect

Professor Jan Fagerberg is heading the research group *Understanding Innovation*, which takes its point of departure in the fact that the topic of innovation has thus far been addressed from a variety of disciplinary angles. "My own background is in socio-economics, where emphasis is attached to studying economic growth, employment and other consequences of innovation. Economists, on the other hand, have rarely studied the *reasons* for innovation, which are at least equally interesting, and which have been explored to a greater extent by

researchers from fields such as sociology, psychology, management and organisational studies. However, a holistic perspective requires that we bring the various disciplines together. Accordingly, the Norwegian core group in this project consists of researchers with backgrounds from sociology, psychology and economics. The range will be even broader with the addition of international visiting researchers", adds Fagerberg.

Feedback to the disciplines

Chemistry professor Signe Kjelstrup is heading the research group *Nature-inspired Chemical Process Design*, which is made up of mathematicians, physicists, molecular biologists, chemists and chemical engineers. The group attaches a great deal of importance to computational chemistry, which involves using mathematical equations to build models of natural phenomena.

"Many contend that the next century will be the century of biology, but thus far the biological approach has largely focused on qualitative descriptions. Now it is time for us to take the laws of physics and mathematical techniques developed in other contexts and apply them to complex biological issues. The interdisciplinary approach will also provide feedback to the various disciplines about what is needed, and how they can improve and enhance their methods", observes Kjelstrup.

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