



Foto: Bjarne Resjip

The great challenge

■ Scientific progress has provided us with a vast amount of information about synapses, nerve paths and mechanisms in the human brain, but the mind and consciousness are still blank spaces on the map. The philosophers Bjørn Ramberg and Olav Gjelsvik are taking up the great challenge: Can progress in the natural sciences contribute to a new understanding of the relationship between body and mind? ● Pages 6-7

■ At the same time the psychologists Svein Magnussen and Tore Helstrup will be developing a new model of the human memory – a capacity that surpasses any film director when it comes to creative interpretation and colouring of the past. ● Pages 4-5

The thread of life

is woven with carbon, nitrogen and phosphorus. The proportion of these elements determines how rapidly cells can grow, how prolific ecosystems can be – and even has consequences for the climate. Biologist Dag. O. Hessen will be unravelling some of the major tangles.

● Side 2-3

The Centre seeks proposals for group leaders for 2006/2007

The Centre for Advanced Study organises basic research on an international level. In December this year the Board is to evaluate candidates to head research groups that are to spend one year at the Centre in the academic year 2006/2007. The group leaders are chosen from among leading Norwegian researchers within the fields of the humanities, natural science/mathematics/medicine and social science/law. The groups are to have an international composition and will be fully funded by the CAS in co-operation with the Norwegian universities.

The Centre is now asking for proposals for candidates to serve as leaders. Proposals should include:

- The name(s) of the candidate(s), their place of work and CV
- A brief description of the research group's theme and central issues for the project

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**The closing date for the submission of proposals is
Monday 24 November 2003**

Elite research à la norvégienne

In 2002 the Norwegian Research Council established 13 Centres of Excellence (CoE) for research within the humanities, social sciences, natural sciences and the formal sciences. The aim was to bring about conditions in which Norwegian basic research would flourish of quality and make its mark at the highest international level. According to the Norwegian minister of research, Kristin Clemet, the long-term ambition of the Government is that these centres shall "conduct research of Nobel Prize calibre".

With this measure the Government declare that uninhibited and uncensored curiosity coupled with talent is the best and surest generator of knowledge. The basic research elite are no longer living on "artists' state stipends", but on utility pay. The star student is enjoying a renaissance, and the "boy at the top of the class" has become politically legitimate and sought after. The CAS welcomes this change of attitude.

The CAS, established in 1989, has made contributions to this development by inter alia formulating the vision that lies at the basis of today's CoEs: To put Norwegian basic research on the world map through advantageous funding, the selection of researchers, shielded research, the reduction of bureaucracy and the building of networks across national borders and disciplines in co-operation with the universities. The founders of the CAS did not get the political recognition they deserved from their contemporaries, because at the beginning of the 1990s the notion of equality still had a solid grip on the organisation of research in Norway. The change in society's attitudes to elite research came around the turn of the century, and more obviously lies in store for Norwegian basic research.

The Government has announced that more CoEs will be established from the year 2007, and the Research Council of Norway is planning 30 new centres. The Government is standing by its aim of giving support to improving the quality of basic research in Norway. This is to be welcomed, and will undoubtedly contribute to raising the quality of Norwegian basic research in general. However, whether the spreading of the funding to 30 new centres will provide research results of "Nobel Prize calibre" is another story.



Willy Østreng
Scientific Director, CAS

In search of the thread of life

A connecting thread runs through life on earth, and it is woven with carbon, nitrogen and phosphorus. If there is too little phosphorus or nitrogen, the thread becomes feeble and ineffective. Professor Dag O. Hessen is heading a research group that is intent on unravelling as many as possible of the mechanisms around this thread – right from the level of the cell, straight through ecosystems and up to the global climate.

The farmers have known this for a long time: You do not get better growth in your fields by heaping nitrogen fertilisers into them if there is too little phosphorus, iron or other important substances in the soil. "And that's how it is with all organisms in all ecosystems: Growth depends on the factor that is the limiting one, whether we are talking about the sea, the forest or freshwater. Both animals and plants are dependent on a certain ratio between carbon, nitrogen and phosphorus in order to be able to grow, but out in the wilds there's often a great discrepancy between the need for these elements and the supply of them. In the natural environment the supply of these nutrients is often – quite simply – very poor in relation to the needs plants and animals have," says Professor Hessen.

Hessen is now in charge of a research group that aims to develop new knowledge of the connection between the relative proportions of elements and the productivity of ecosystems by combining large sets of data from lakes and ocean areas, experimental data and mathematical models. "If

we ignore water, most organisms consist of roughly 50 per cent carbon, 10 per cent nitrogen and about 1 per cent phosphorus. Algae and other plants normally contain significantly less phosphorus, and this means among other things that grazing animals must eat "too much" carbon and nitrogen in order to get enough phosphorus. The excess carbon and nitrogen must be excreted again, so we see that ecosystems may be inefficient. Quite simply a lot of energy is lost," explains Professor Hessen. "Models and experiments too can show how the relationship between the elements influences the dynamics of ecosystems."

Phosphorus in cells and ecosystems

Professor Hessen points out that the disproportion between carbon and nitrogen/phosphorus is of significance for cell growth, the regeneration of ecosystems – and even the global climate. "The relationship between the three important elements is of importance both for how rapidly individual cells can grow, and how fertile different ecosystems can be. But in addition this research

Food-webs, Stoichiometry and Population Dynamics

The research group Food-webs, Stoichiometry and Population Dynamics is focusing on the elements carbon, nitrogen and phosphorus because they limit production in most ecosystems. Analysis of quantitative proportions between elements (stoichiometry) in food webs can provide fundamental information about the uptake, use and excretion of carbon both in individual cells and in the networks. The relative mass ratios of important nutritious minerals are crucial not only for plant growth (primary production) but also for what is called the grazers' secondary production.

The researchers are going to analyse data from both a Norwegian database with approx. 500 Norwegian lakes, and corresponding databases from the USA and the

Netherlands. In addition a number of marine data sets will be used. The results will be compared with data from experiments with what are called chemostats, i.e. laboratory experiments in which algae and animal plankton can grow under controlled conditions, as well as more theoretical analyses and models that describe carbon flux and ecosystem dynamics under different conditions.

Norway is well suited to the research in Professor Hessen's group, because this country has a large number of varied lakes. Bessvatn in Jotunheimen is an example of an extremely clean lake with a visible depth of more than 30 metres, while Østensjøvannet in Oslo is extremely nutritious and lies at the other end of the scale.



Professors James Elser (left) and Dag O. Hessen taking a closer look at the lake at Bogstad in Oslo – one of approx. 500 Norwegian lakes from which great quantities of data have originated.

can help us to get a better understanding of the climate. There's quite simply a connecting thread of carbon, nitrogen and phosphorus running right from the individual cells via the food webs and up to the carbon dioxide in the atmosphere," Dag Hessen claims. At the level of the cell phosphorus is particularly important for cells that are to grow rapidly. "One of the characteristic features of cancer cells is that they are extremely phosphorus-intensive, because they grow faster than normal cells. The same principle applies to individual cells in organisms: If they get too little phosphorus, then they can't manage to make use of the carbon and nitrogen to be found in the surroundings," says Professor Hessen.

In the summer of 2003 Dag Hessen and the American Professor James Elser were on Svalbard to study organisms that are dependent on rapid growth to complete their life cycle in the short Arctic summer. "Here we're

studying the evolutionary connection between rapid growth and high phosphorus content, as well as how the phosphorus content (the RNA content) is genetically governed," Dag Hessen continues.

Consequences for the climate

Professor Hessen places great weight on the fact that grazing organisms, i.e. animals that eat algae in seas/lakes or plants on land, must consume an excess of carbon and perhaps nitrogen in order to get sufficient amounts of phosphorus. Much of the "excess carbon" is converted into carbon dioxide (CO₂) and naturally enough this leads to the excretion of CO₂ into both seawater and the atmosphere. In this way the imbalance between the elements may also be of significance for the greenhouse effect and the climate.

"There have in fact been suggestions to reduce the greenhouse effect by "fertilising"

the sea in order to reduce the CO₂ emissions into the atmosphere. In the Sargasso Sea it's iron that sets limits to growth, and one proposal was to add iron in order to increase the uptake of CO₂ in the ocean area. Suggestions have also been put forward to use doses of phosphorus along the Norwegian coast. Personally I simply don't believe we can "fertilise" ourselves away from the greenhouse effect, but on the other hand this research can contribute to giving us a better understanding of the climate models. You see, today's models are not good enough, among other things because they can't manage to account for what happens to all the carbon in the cycle," says Professor Hessen, adding that the ratio between carbon, nitrogen and phosphorus in the sea and on land is an important factor in the climate models.

Agriculture and combustion: A global experiment

Agriculture and the consumption of fossil fuels together constitute a global fertilising experiment on a large scale. "Both are leading to a dramatic increase in nitrogen fertilising all over the world, but we know little about what all this may lead to in the long term," says Dag Hessen.

There has been a lot of talk about the greenhouse effect and man-created emissions of CO₂ in recent years, but according to Hessen human beings have influenced the nitrogen cycle and the phosphorus cycle to a much greater extent than the carbon cycle. "We now have a dramatically higher fall-out of reactive nitrogen than ever before," he says.

There are first and foremost two causes of the increased fall-out of reactive nitrogen and increased circulation of phosphorus. One of the causes lies in the use of nitrogen fertilisers in agriculture. The producers of fertilisers take huge amounts of non-reactive nitrogen from the atmosphere and convert it into reactive nitrogen in artificial fertilisers. The second cause is the combustion of oil and gas, which also leads to the formation of reactive nitrogen. While atmospheric nitrogen does not react with other substances, reactive nitrogen can be absorbed by plants and transported around in the ecosystems.

"The increased fall-out of nitrogen

probably has some positive effects, like increased growth in the forest and in the oceans, for example. But there are also some clearly negative effects, such as the fact that the fall-out contributes to acid rain. We also have problems with over-fertilising (eutrophication) and enormous growth of algae in many coastal areas, which nitrogen fertilising contributes to reinforcing," he points out. "The basic interest for our group is to assess how this increased availability of nitrogen affects carbon fluxes and nutrient ratios in aquatic ecosystems".



Some of the members of the research group: From left Tore Helstrup, Annika Melinder (University of Oslo), Lars Göran Nilsson (University of Stockholm), Asher Koriat (University of Haifa) and Svein Magnussen (University of Oslo).

The memory is its own editor

This article is a strictly edited version of a conversation that took place at the Centre for Advanced Study. If you had read a verbatim transcript instead, the text would have been disjointed, incomprehensible and terribly long. "That's roughly what it's like with the memory too: It is a strictly edited version of what happened," say Svein Magnussen and Tore Helstrup.

So Svein Magnussen and Tore Helstrup, who are both professors of psychology at the University of Oslo, have killed off one of the myths about human memory: The belief that we really remember everything that has happened, but that it can sometimes be difficult to recall the memories.

"It's not the case that we go around like living video cameras with unlimited storage capacity. Quite the reverse; the memory is extremely selective. And it's simply not possible to call up 'unsaved' memories by means of hypnosis and such things", says Magnussen.

"The memory is not only choosy and *selective*, it is also *constructive*. This means in the first place that the memory chooses what's to be stored, but in addition it may add things that didn't happen at all," adds Helstrup. "I see that you're recording this interview – so you know well that there's an enormous difference between what is said and the finished article. The difference between 'what happened' and the memory is at least just as great!"

"We know of course that many situations in life can be pretty ambiguous, and in a conversation people don't

react first and foremost to what you say. They react instead to what they perceive as the meaning behind what you're saying. Great differences in interpretations arise even before the memory sets in," comments Magnussen.

Cognitive laziness

"But is it true that women remember better than men?"

"No! It may well be that women remember

individual things better than men, but men also remember individual things better than women. Those differences are to do with interest, because it's much easier to remember things one's interested in," Svein Magnussen replies.

"Women and men live in slightly different worlds, in our day and age too, so we don't remember the same things. What's more, cognitively speaking we are lazy people who

Strengthening legal safeguards

■ "Neither the police nor other actors in the Norwegian judicial system know enough about the standards it's reasonable to demand that a witness's memory should satisfy. But this is changing, and the interest in witness psychology has grown sharply over the last few years," says Svein Magnussen.

Human memory functions perfectly in many everyday situations, but in court cases a witness's memory can be faced with demands that it's quite unreasonable to make. "So it's very important that both police officers and other actors in the judicial system know what it's reasonable to expect of a witness," Magnussen goes on. He refers to a number of investigations from the USA, where for example it was proved by means of DNA technology that people who had been convicted of murder

could not possibly have committed the crime. "It seems as if at least half of the miscarriages of justice in the USA are due to the fact that central witnesses have remembered wrongly. There is no reason to believe that Norwegian witnesses remember better than American ones!"

In 2003 Norway became the second country in the world to establish an independent criminal cases review commission. People soon called this body the "Miscarriage of Justice Commission", and Magnussen was elected as one of the two lay members.

Helstrup and Magnussen emphasise that there is something worrying about raising destructive criticism of witnesses, because on the whole we remember amazingly well. "But the memory isn't

The relation between body and mind

Every nook and cranny of the human brain has been mapped in three dimensions and four colours, but nobody has found the mind or consciousness. "But man is still more than matter. The progress made in the natural sciences has led to a need for a new understanding of the relationship between body and mind," say the philosophers Bjørn Ramberg and Olav Gjelsvik.

Philosophers have been striving to understand the relationship between body and mind, or between the physical and the mental, ever since Descartes presented his mechanistic world picture in the seventeenth century. In the mechanistic picture man is first and foremost a physical or physiological system, but at the same time we think of ourselves as acting, thinking and moral/normative beings. One of philosophy's greatest challenges has been to explain how the same person can be described in two so widely different ways.

"This challenge has become greater, or at least different, after the great progress made in the natural sciences in the previous century," Bjørn Ramberg and Olav Gjelsvik believe. "It's true that the natural sciences have given us vast amounts of knowledge of structures and synapses and nerve paths in the brain, and we can for example use imaging techniques to reveal which different parts of the brain are active when we're cycling, talking, eating or dreaming. In other words, we're in the process of developing a detailed description of the brain as a physiological and mechanical system. Nevertheless, in purely general terms these descriptions don't shake the validity of our experiences of ourselves and other people as morally committed individuals. So the relationship between the new knowledge of the brain and these valid descriptions of ourselves needs to be thought through."

Taking the natural sciences seriously

"The progress made in the natural sciences has created a danger that we may lose sight of the spiritual or mental part of man. We want to take our point of departure in the new know-

ledge of the brain, to the extent that it seems to have implications for, or to be in possible contradiction to, other knowledge we already have," Olav Gjelsvik explains.

The two philosophers emphatically stress that they most certainly do not intend to criticise the progress made in the natural sciences. "All the participants in this research project take natural-scientific descriptions absolutely seriously. So we do not share the post-modern view of natural science as 'one truth among many that are possible' – we're convinced that we're subject to one form or another of naturalistic determination. At the same time we take it for granted that human reality can't be exhaustively described by science. But instead of rejecting natural science, we want to use the increasing degree of concrete knowledge to develop a new understanding of human consciousness," says Bjørn Ramberg.

Two plus two does make four

If the brain is something more than physical and chemical processes, man must be something more than a natural-scientific product of evolution. Olav Gjelsvik resorts to mathematics to illustrate this point. "Human beings have a highly developed ability to cognise mathematical truths, from the simple 'two plus two is four' to extremely complicated mathematical equations. But I don't suppose anybody will claim that evolution has led to the fact that two plus two makes four! Our ability to cognise mathematical truths has its source in natural selection, but these truths in themselves have another origin. Indeed, we can in fact imagine that any other creature



Bjørn Ramberg (left) and Olav Gjelsvik want to apply the modern natural sciences' detailed mapping of the brain to develop a new understanding of man's mental world.

whatsoever that developed a capacity for mathematical cognition, would arrive at the same results, even if the creature were biologically and physiologically different. To the extent that the creature was concerned with the same mathematical structures, of course.

"Today there's a certain tendency among biologists to say that the source of the moral and ethical truths must lie in evolution. But I think we must regard the moral/ethical truths in the same way as the mathematical truths: We've developed an ability to cognise them, but the content of them doesn't come from evolution," Olav Gjelsvik goes on.

"But there's a far greater consensus when it comes to the mathematical principles than where the moral ones are concerned?"

"Well, there're no doubt quite a few who sin against the mathematical truths too. But they're true of course, anyway," Bjørn Ramberg interjects. "What's more, I think that there is in fact a great deal of agreement about general moral norms ... the problem crops up in the application of the interpretation."

"That's something that has a lot to do with the formulation! If you formulate the commandment more precisely as 'Thou shalt not kill others who have not done thee or any others the least harm', there'll be a very high degree of agreement on the principle," Olav Gjelsvik concludes.

Towards a New Understanding of the Mental

The researchers on the CAS project *Towards a new understanding of the mental* are working on a new approach to man's double role as a physical/physiological and spiritual/moral being. The group is particularly concerned with research into how a physical system like man can only exist with free will and the possibility for autonomous actions.

The project is headed by Professor Bjørn Ramberg and Professor Olav Gjelsvik from the University of Oslo. The international participants come from among other places Stanford University, the University of Oxford, the University of London and the University of Paris.



The century of the brain

The research project *Towards a New Understanding of the Mental* has come at just the right time, Bjørn Ramberg and Olav Gjelsvik believe. "In the previous century the natural sciences focused on the development of new knowledge of the fundamental relationships in the physical world. I'm convinced that the century we've just started on is going to be 'the century of the brain'. We've already learnt a great deal about the brain, but it's still the case that important aspects of human consciousness can't be reduced to knowledge of the brain," Olav Gjelsvik stresses.

"We can't learn everything about ourselves

by understanding biology and physiology, but it's interesting to see what we can learn from these subjects. The important thing is to understand whether the natural-scientific approach to the brain will impose any new ways in which we view man. Our point of departure is that the abilities to choose, think, evaluate and judge are completely central to being a human being, but we can't describe these abilities with a neuro-physiological vocabulary. But at the same time it is, without any doubt, neuro-physiological processes that make it possible to be creatures with these abilities," adds Bjørn Ramberg.

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The Centre for Advanced Study

■ The Centre for Advanced Study at the Norwegian Academy of Science and Letters (NASL) is an independent foundation with a board appointed by the NASL and the Council for Universities and Colleges. The CAS shall be recognised as achieving the highest international standard and thereby contributing to raising the level of basic research in Norway. The academic activity is of a long-term nature and it is to be permanent and academically independent vis-à-vis political and economic influences and the influence of research policy. Outstanding researchers from Norway and abroad are invited for one-year stays to engage in research in the Centre's premises. Each year the activity is organised in three research groups, each with

from six to ten members. Each group is planned and organised within a common theme and headed by one or more outstanding researchers.

The groups are chosen from three areas:

- The Humanities
- Social Sciences/Law
- Natural Sciences/Medicine/Mathematics

The Centre is exclusively a basic research institution where the participants have no other obligations than their own research. The Centre is administered by a permanent staff of four and was officially opened on 1 September 1992.

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Research and the modern police

Researchers played an important part when the police developed into an open and modern service, and they've contributed to improving the working methods of the police in many areas," says the jurist Ann-Kristin Olsen.

The present County Governor of Vest-Agder and board member of CAS has inter alia 26 years of service in the police behind her, and she well remembers how the researchers influenced what the 1968 generation called "Klassepurken", a pejorative name for the police in Norwegian, used by the extreme left.

"When I started in the police, the service had an image of being pretty closed, with a culture that turned its back on the media and liked best to be left in peace. This was in the period just after the 'student's revolution of 1968', a time that was marked by sharp political confrontations," says Ann-Kristin Olsen.

There was little reason to expect miracles when a group of radical researchers began to take an interest in the service. "But then it turned out that researchers like Bjørg Aase Sørensen from the Institute of Occupational Research and the criminologist Liv Finstad were well received, and the police appreciated the fact that somebody was interested in their everyday lives. Gradually the police and the researchers found common ground, and this contributed significantly to the fact that the police became a more open and more modern service. The meeting with the researchers was in my opinion a watershed for the police and inspired a new dialogue with society," Olsen continues.

Research for increased legal safeguards

Ann-Kristin Olsen has also experienced at close quarters how researchers in different fields have broken new ground within forensic medicine and other technical areas. "It's of crucial importance that those who are to evaluate evidence should have great insight into how the evidence can be used. So I'm looking forward to the contributions researchers like Svein Magnussen can make in such areas as witness psychology and memory research," she says.

Olsen is furthermore very interested in the role of expert witnesses in court. "The expert witnesses must not only defend a report, but in practice they put the whole of their expertise on the line in the courtroom. I've experienced expert witnesses who have seemed pretty helpless and not won much response in court, but on the other hand we've – most often with the wisdom of hindsight – seen examples of the testimony of experts perhaps being stretched too far. My impression is that the Norwegian judicial system hasn't developed a good enough framework of conditions around the expert witnesses. This matter needs to be seen to, perhaps through co-operation between the experts' own professional bodies and the judicial system," concludes Ann-Kristin Olsen.



"The meeting with the researchers was a watershed for the police," says Ann-Kristin Olsen, board member at the CAS and County Governor of Vest-Agder.

Pioneer in several fields

Ann-Kristin Olsen, who is now the County Governor of Vest-Agder, has better qualifications than most to evaluate what research has meant for the development of the Norwegian judicial system. She started in the police in 1973, became the first female chief of police in Norway – in Halden – in 1983, and the first female Governor of Svalbard in 1995. Both in Halden and on Svalbard she had very difficult and harrowing cases to get to grips with, but her open and co-operative attitude was impressive to such a degree that she was awarded the prize of honour of the Norwegian Press Photographers' Club in 1998.

After the air disaster on the Opera

Mountain on Svalbard in 1996, in which 141 Russians lost their lives, DNA analysis was used for the first time as the main method for the identification of the dead in major accidents.

Ann-Kristin Olsen chaired the Board of an Interpol group that was to combat crime against children and young persons, and today she is heading a panel of experts in the Council of Europe. She has also been a member of the Board of the Police College and of the University of Tromsø. Today she is vice-chairman of the Norwegian Criminal Cases Review Commission and the representative of the Norwegian State on the Board of the CAS.

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