PREFACE

"If you look back, you turn your back towards the future." I have heard this presented as an argument against celebrating anniversaries. Physically and literally it may be true that one cannot look in opposite directions at the same time, but for the life of an institution like the Centre for Advanced Study it is both possible and necessary to keep an eye on the past while preparing for the future.

The academic year 1992 - 93 marked the start-up of the activities at the Centre, so we can mark our tenth anniversary in September, 2002. This is the occasion for distributing this booklet.

Ten years is not an impressive age, but it is an occasion to pause and consider what has been achieved so far. In particular, what were the aspirations of those who founded the institution, and have they been met?

The tenth anniversary might be a good time to answer these questions. Our founders are no longer in leadership positions at the Centre and are hence not responsible for what happens today, but they are still alive and active. We have asked some of them to tell about the background and the pre-history of the Centre and to express some views on its development.

The activity at the Centre is organised in research groups. In order to give a sense of what we are doing, we have asked some of the past group leaders to tell about their research. (A complete list of the groups in the past ten and the coming years is given at the end of this booklet.)

International contacts and cooperation are essential aspects of advanced research. Through our research groups we seek to promote this, by bringing to Oslo leading experts within the various fields and promoting their cooperation with Norwegian colleagues.

The concept "centre for advanced study" is an international one. We have a number of sister institutions, and hope to benefit from contact with them. It is a striking fact, however, that many of those have a lot more resources and can offer their fellows much better material conditions than we can. Talent is the most important input for advanced research, but economic and physical resources are also needed. Therefore, we shall continuously strive to improve the financing of the Centre, both from public and private sources.

The Centre's present mode of operation is described elsewhere in this booklet (“How the Norwegian Centre for Advanced Study operates”). At the moment, the Board has no plans for making fundamental changes to this, but we always have a responsibility for evaluating our activities and considering possible changes. This will be done with an eye on the past experience and with the aim of best promoting basic research in Norway in the future.

I thank the contributors to the booklet and wish ourselves all the best for the next ten years and the time thereafter.

Aanund Hylland
Chairman of the Board

On the internationalisation of Norwegian research.

Kristin Clemet, Cabinet Minister.

The development of new knowledge has at all times taken place across national borders. The individual craftsman, artist and researcher has moved, learnt from colleagues in other countries and shared his knowledge with others. In this way ideas have been exchanged, skills have been strengthened and knowledge has been built up. Today international contact is more important than ever for research and it is a necessary condition for the further development of the common store of knowledge on which all researchers and nations are dependent. At the same time international research co-operation contributes to increased communication and understanding between countries.

One of this Government's objectives is to put more Norwegian researchers at the forefront of research. As a small country with limited research resources in an increasingly internationalised knowledge market, Norway is totally dependent on international research co-operation. Furthermore with our resources we have a duty to participate in the global development of knowledge.

Norwegian researchers must travel abroad, become visible and create international networks for themselves. At the same time we must make it easier for foreign researchers to come to Norway. We must exploit the coming end of a generation in Norwegian research to create a new generation of researchers with international networks. Norwegian students go abroad as never before. It is therefore important that those who go on to a research career should be encouraged to continue their contacts with communities abroad.

International R&D co-operation proves to advance the quality of our own research. Contact with the international research front is both a stimulus and a corrective. Creating meeting places where Norwegian and foreign researchers can co-operate is therefore of fundamental significance. The Centre for Advanced Study has been, and is, one of the most important instruments of quality in Norwegian basic research. The Centre has become a meeting place for outstanding researchers from many countries, and it has shown results on a high international level. The Centre possesses many qualities that we covet in Norwegian research. Therefore it is important for the Centre to show itself. This jubilee publication is an excellent contribution.

Congratulations on your 10th jubilee!

How the Norwegian Centre for Advanced Study operates

Ole-Jørgen Skog, Scientific Director, Centre for Advanced Study

Elite research institutions are new constructions in Norway, which is a country with strong egalitarian traditions. In fact, the Centre for Advanced Study at the Norwegian Academy of Science and Letters was the first of its kind in Norway, having been founded only ten years ago.

As several of the articles in this publication bear out, the establishment of the Centre was by no means a quick and easy job. At that time, many supporters suspected that the initiative could never succeed. Fortunately these sceptics were proven wrong. At present the climate is rapidly changing, and today the idea that the best researchers deserve special treatment is receiving increasing support. Several new elite research institutions are in the process of being established. Hopefully, this is just the beginning of a new trend that will continue to develop in the years to come.

The Centre is organized as an independent foundation. The Board of Directors is appointed by the Norwegian Academy of Science and Letters and the Norwegian Council for Higher Education. In addition, the Research Council of Norway appoints one member of the Board, representing the State. The Centre has a small, but un-bureaucratic and efficient administration and is located in the Academy's magnificent villa in central Oslo.

The Centre occupies modern and beautifully converted premises with individually designed offices in the Academy's mansion. (Amdahl Strøm & Cappelen Arkitekter AS)

Although the Centre's budget is still limited, both compared to the budgets of similar institutions in other countries, and in relation to the original plans, the situation has gradually improved in recent years. In 2002 the total budget is close to 11 million Norwegian kroner, and most of the funds come from direct governmental appropriations. Another 4 or 5 million will be needed to fulfil the Board's ambitious goals in the future.

As opposed to many other Centres, the CAS in Oslo does not invite individual scholars. All fellows are members of project groups, and the Centre hosts three groups simultaneously each year – one in mathematics and natural sciences, one in social science and law, and one in the humanities and theology. Each group can consist of up to 8 fellows at the same time. The groups stay for one whole academic year, but the duration of the individual fellow's stay varies considerably. The core members typically spend the whole year at the Centre, while others may participate for a few weeks or months. In addition to the senior scientists, the groups are expected to include one or two post-doctoral students.

The selection of scholars at the Norwegian Centre is organized as a three-step process. The process is initiated nearly three years before the groups will start their work at the Centre. In the autumn, all the universities are invited to nominate group leader candidates. Nominations are normally proposed by Deans or Heads of Department, or by individual university professors (often former fellows at the Centre). Furthermore, at each of the four universities, the Centre has a number of contact persons who ensure that the process runs smoothly. The initial proposal can be quite short, simply including the title of the project and CV for the potential project leader. Typically, the number of nominations each year varies between 20 and 30.

Among the proposals, the Board selects a number of candidates who are invited to submit a more detailed description of their project and the team they wish to invite. On the basis of this material the Board selects approximately three candidates from each of the three categories. They will then submit the final outline of their project, aimed at experts in their own field, plus an overview of the senior members of the team, including their CVs and letters of intent. After an international peer review, where each proposal is evaluated by at least 4 or 5 experts, the Board makes its final selection early in the summer the following year. The selection is made solely on the basis of scientific merit.

This process leaves the invited groups with two years for finalising the details of the plans for their work at the Centre. The Centre rents a number of small and some larger apartments for visiting scholars (and their families, whenever necessary) close to the Centre. The administration takes care of all kinds of practical arrangements, including helping scholars to find appropriate schools for their children.

Regarding the fellows, the Centre operates on a “no loss – no gain” principle. Accommodation and travel expenses (as well as expenses relating to school or kindergarten, whenever necessary) are paid by the Centre, and visiting scholars receive a stipend to cover extra expenses during their visit. The Centre may also reimburse expenses for replacements for foreign scholars who are unable to have an ordinary sabbatical from their own university. However, in the case of Norwegian scholars, cooperative agreements between the Centre and the Universities of Oslo, Bergen and Trondheim, ensure that they are entitled to an extraordinary sabbatical during their stay at the Centre. These agreements represent an important part of the Centre’s economy.

Et in arcadia ego

Gudmund Hernes, Director, International Institute for Educational Planning, UNESCO, and Professor, University of Oslo

In 1966 I came to Johns Hopkins University on a Fulbright Scholarship to study mathematical sociology with Professor James S. Coleman. His seminal *Introduction to Mathematical Sociology* had been published in 1964. Reading the preface I could see that he had written most of it nearly a decade before, at the *Center for Advanced Study in the Behavioral Sciences* in Palo Alto, up on the hill behind Stanford University. He also told me about how that Center functioned: That each year a select group of scholars were given a year to pursue their research interests with no other obligations whatsoever. And how, for this highly distinguished and very influential scholar, this had been the best year of his academic life.

In 1974/75 I was invited to spend a year there, in the company of the likes of the sociologist Robert K. Merton and the political scientist Aaron Wildavsky – and Nobel laureates like Steven Weinberg or Kenneth Arrow coming by at lunchtime. Clearly that year ranks as the best and most productive in my life as a scholar – I have some work started then that can be completed now.

Not only was the personal gain obvious but also the public benefit as well. It is easily documented from the so-called Tyler-collection in the Center's library which holds the books written by former fellows while there. Many have been among the most influential in fields as diverse as linguistics and statistics or economics and literary criticism. *Introduction to Mathematical Sociology* was one of these.

While a graduate student at Hopkins, I also learned about other such institutions – the most notable of which was the *Institute for Advanced Study* established at Princeton in 1930 (Albert Einstein had been of its first fellows), or the much later established *Wissenschaftskolleg zu Berlin.*

In 1987 I was asked to chair a Royal Commission on reorganizing higher education and research in Norway. This provided the opportunity for launching a proposal for establishing a "Center for Advanced Study" in Norway. In writing the proposal (found in NOU 1988: 22, *"Med viten og vilje"*, pp. 183-185), I went back to and read carefully the original justification that the legendary Abraham Flexner had given when he first proposed the Princeton Institute.

In the report of the Royal Commission, a key concern was to improve the conditions for doing basic research. The key arguments for establishing a center for advanced study in Norway were:

- The fraction of total resources going to basic research was declining.
- Funding for applied research influences more than before how funds for basic research are being spent.
- The social organization of research is not only democratized – it is bureaucratized.
- Researchers themselves have more taxing administrative tasks.
- The organization of teaching at universities can interfere with the concentrated periods of work that basic research requires
- External demands for taking part in evaluation, funding activities and administration are increasing.

- Extra-university tasks and temptations – ranging from consultancies to business opportunities – may draw attention and effort away from basic research.

Hence basic research needs an organizational counterweight. It is a high-risk activity: it can fail, but also lead to breakthroughs. Hence basic research needed a defense out of the ordinary.

A brief presentation of different types of centers of advanced study abroad was given, which could inspire a similar construction in Norway. The recommendation made was that it should provide the best possible conditions for concentrated basic research for established researchers in a multidisciplinary environment – ordinarily for a year's time. The fellows should have no administrative or other duties and be sheltered from the chores of their home institutions. It was proposed to locate the Center in Oslo.

After the Royal Commission had delivered its report in 1988, the next phase was to try to implement it. Two lines of action were followed. First to convince the Norwegian Academy of Science and Letters to house the Center in its beautiful mansion in Oslo. The then Presidium was not hard to convince and the Secretary general, professor Leif Mæhle, became an enthusiast. I was invited to present the proposal at a Plenary meeting of the Academy on November 10, 1988 – and the audience for once broke the tradition never to applaud after an introduction.[1]

Institutional support had to be matched by funding. I was asked to chair an interim committee to drum up financial support. One colleague on it was Tora Houg, a prominent member of Parliament and of its Education and Research Committee as well. Another was the General Director of the Kvaerner Group, Mikal H. Grønner. The net result was that appropriations from the Norwegian Parliament came in place and some support from private sources as well. Hence the plans for redesigning the basement and loft of the mansion of the Academy to house a Center could begin.

In the fall of 1990 I became Minister of Education, Research and Church Affairs. I could then pursue the policy of establishing a Center for Advanced Study from that vantage point, little by little expanding its financial support. Some of it came at the end of the year when funds for other purposes had not been spent. I had, however, to move slowly, not to come under the double attack of favoring my own baby, so to speak, and not funneling too much in the way of research funds towards the capital in a political environment where decentralization was very much on the agenda.

In the fall of 1992 the first three groups got started at the new Center: One on Henrik Ibsen's writings, one on Human rights in the Baltic states and one on Fractal Growth processes. The rest – as the saying goes – is history.

But it is a history with three footnotes. One is that it is a history in every way in the making – most of the groups have worked very well, have left important contributions and maintained scholarly exchanges since. Second: the Center bridges the two cultures – it has made students of lemmings interact with students of the Scriptures or students of quantum phenomena regularly meet students of ethics.

Third: The ideal Abraham Flexner sought to realize by his Institute at Princeton in no insignificant way has also been made real in Norway. He wanted to make the best possible

environment for free, basic research, "untrammeled facilities for easy-going and informal work between men who had passed the Ph.D. stage, had given promise of unusual ability, and who needed now the informal contact with masters which had characterized the German universities in their golden days." He believed that they should be exempt from all other burdens for a full-time engagement in absorbing basic research and hence needed an institutional defense for the use of useless knowledge.

My guess is that those who have been at the CAS in Oslo have appreciated this place of simplicity and contentment – being a Norwegian academic equivalent to the Arcadia which I found in Palo Alto: An almost imaginary and almost paradisal place.

Note:

[1] The speech at that meeting, ”Et norsk 'Senter for høyere studier' knyttet til Det Norske Videnskaps-Akademi” is printed in the Annals of the Academy 1988, pp. 170-181

The phase of construction

Torstein Jøssang and Vigdis Ystad, Professors, University of Oslo

In the course of the past 30 to 40 years the quality standards that research must satisfy have increased considerably, both in our neighbouring countries and in the rest of the world. This applies to such different nations as Denmark, Sweden, Finland, Switzerland and Israel. In Norway developments have in many ways gone in the opposite direction. The sharp increase in the numbers of students from the 1960s onwards, and the almost explosive building of regional colleges in the 1970s, were not followed up with corresponding investment in basic research. Political and geographical arguments for the distribution of funding to higher education and research were instead ascribed increasingly greater weight in the argumentation, both from research council and ministry, and the weight placed on free, academic basic research was correspondingly weakened. At the same time as this development was going on, the universities were "democratised" in the course of the 1960s and 1970s. This process was accompanied by a bureaucratisation the effect of which was more paralysing than stimulating on all those who were genuinely concerned about basic research. Instead of helping research, this bureaucratisation led almost incessantly to extra work for the researchers themselves. Not seldom did our best researchers find themselves directly up against irrelevant considerations and demands. Therefore many talented, established researchers gave up, in a competitive situation in which the arguments in the struggle for research funding were concerned with relevance to the business world, geographical situation and other non-essential matters.

There were therefore many people who felt a sense of liberation when in 1986 Gudmund Hernes published a leading article in the Norwegian national daily newspaper Dagbladet, in which he put both to the powers that be and to the researchers themselves an open question about what they really *meant* by the development of Norwegian research. Gudmund Hernes was himself at that time famous as a researcher with an international reputation, and he was a man with a great deal of political influence. Just home from Johns Hopkins University in the United States, he confronted the Norwegian research world with a number of unpleasant questions. Hernes' unpleasant challenge can be most simply summarised in two questions: Was it considered to be appropriate to stimulate elite research in Norway? If so, what measures would this demand?

Typically enough there were many who allowed themselves to be angered and irritated by Hernes' challenge; he had clearly trodden on some pretty tender corns, and he had the ability to attack a problem that some people would have preferred to leave untouched.

There was not in fact any initiative to change this negative situation until the establishment of the CAS. This was to be the first signal of a turn in the right direction. And it was characteristically Hernes himself who was the driving force. He chaired a Royal Commission on reorganizing higher education and research in Norway (NOU 1988:28 *Med viten og vilje* [With knowledge and will]), in which he proposed the establishment of a centre for advanced study in Norway. In furtherance of this he took the concrete initiative to establish a Norwegian centre for outstanding research (or, if one prefers the term, elite research). His approach on this to the Norwegian Academy of Science and Letters gained a positive response. The Academy placed itself right behind the establishment of the research foundation, the Centre for Advanced Study, and appointed a board that clearly showed that here research experience and insight were to mean more than geographical background and political affiliation. When the first board was nominated in 1989, Gudmund Hernes himself

became the chairman, a position he held until he was appointed Minister of the Church and Education in 1990. Dagfinn Føllesdal took over the leadership after Gudmund Hernes, and became the next chairman of the board, until the baton was passed to Vigdis Ystad in 1992.

Throughout this process Gudmund Hernes had referred to Princeton's Institute for Advanced Studies (IAS) as a clear ideal. It was a bold vision, the fact that he wanted to create an equivalent institution on Norwegian soil. The first application to the Norwegian Research Council in 1991 concerned funding to operate a centre manned by the most highly qualified researchers from Norway and abroad. Many people in the research communities were overjoyed that it was precisely an outstanding researcher and politician who was at last taking the initiative to ensure that quality research was to be given good conditions and be highly rewarded. But soon the Norwegian research world's joy at all this was to have a powerful damper put on it, as the financial grants for running the centre were below what was necessary, and the struggle to procure sufficient funding was to be tough and it encountered great difficulties.

Nevertheless, in September 1992, three years after its foundation, the academic activity at the Centre for Advanced Study was able to commence. By then Gudmund Hernes had become the Cabinet minister responsible for Norwegian research, and he had a brutal meeting with his alter ego, because as a Cabinet minister he was bound by the ministerial budget policy, and this meant that he could not manage to give the CAS the necessary funding for sound operation. Dagfinn Føllesdal and later Vigdis Ystad, who had both chaired the board after Gudmund Hernes, invested a great deal of their time and energy in securing the Centre's economy. It turned out to be a heavy task.

Not only Norwegian research officialdom but also the Norwegian universities had adopted a wait-and-see attitude to the establishment of the CAS, and it is no secret that there were clear signs of serious doubts about its establishment at the universities that were not located in the capital. When the management of the CAS wanted to invite outstanding researchers from these universities as visiting fellows at the Centre, it turned out to be difficult for the candidates in question to be granted a sabbatical year or to be given other forms of leave. Vigdis Ystad took this matter up with the Universities Council, and in the winter of 1994-1995 an agreement was put in place with three of our four universities that entailed a promise that those university researchers who were invited to the Centre should automatically be granted a sabbatical by their own universities. This would mean indirect financial support for the Centre on the part of the universities, but at the same time, after these researchers went back to their own institutions, the universities would get value for money in the form of new insights and new competence that would benefit both students and colleagues. In this way the universities could invest in their own future.

Nevertheless the grants from the Research Council, the Government and the three universities, Oslo, Bergen and Trondheim, were still not sufficient for sound operation of the Centre. Its economy continued to be an active brake on what could be done when it came to composing the research groups. A great deal of work was therefore put into informing the business world in Norway about what the Centre stood for, but the result was not in proportion to the efforts. The Norwegian business world's lack of understanding of the value of basic research has been one of the most depressing experiences in the history of the Centre.

From March 1994 Torstein Jøssang took over as the Chairman of the Board of the Centre. In 1994 a strategic plan and a goal structure were produced for the Centre. During this work the

Board had the thought-provoking experience that all expressions describing "excellence" and "elite" – central ideas behind the establishment and purpose of the Centre – must be toned down and rewritten. These concepts were still not *comme il faut* in our Norwegian understanding of the realities of research policy. In other words the reactions in the Norwegian community responsible for research policy contributed to weakening the Board's planned presentation of the Centre as a top-level international research institution. The result was a strategic document that could not to a sufficient degree express what the Board wanted the CAS to represent.

However, work on assuring the quality of the Centre's research continued tirelessly. From 1995 an international evaluation system was introduced under which all proposals for projects and research groups went for evaluation to a minimum of five international experts in the field. If their report and recommendation were clear, they were followed up by the Board of the Centre when new research groups were nominated. No other considerations could compensate for these purely academic standards of quality.

After the Centre had been operating for four years, in 1996-1997, the Norwegian Research Council then decided, in co-operation with the Ministry of the Church, Education and Research, that the Centre was to be the object of an academic evaluation. Among researchers there was some surprise that a basic research institution should be evaluated after such a short time, but the Board nevertheless contributed actively in proposing a number of internationally highly reputed researchers as suitable candidates for the work of evaluation.

The evaluation committee that was appointed by the Research Council was constituted on the basis of other criteria, perhaps because it was not given the task of carrying out any internal academic evaluation in depth. In the evaluation report *Åndenes hus – på Drammensveien* [The house of spirits – in Drammensveien] (1997) the emphasis was instead placed on an evaluation of external features of the Centre's activity. The CAS came out of the evaluation with honour. Everything was described in glowing terms, apart from one thing: namely the fact that the composition of the Board was dominated by the Norwegian Academy of Science and Letters. This fact had already been met with negative criticism in advance from the Universities of Bergen, Trondheim and Tromsø, which argued for a different nomination process on grounds relating to regional development policy. On this point the evaluation led to the fact that geographical spread was also ascribed weight when subsequent boards were appointed.

When we chaired the Board of the CAS we also held the view that the members of the board of an institution like the CAS must be familiar with and understand the standards that top international research has to satisfy. This is best achieved with members who themselves have top-level research experience and have published in internationally prestigious research publications with recognition by colleagues in the field within the international research community. The reason that the CAS right from its tender start and through financially difficult years of operation has managed so well must be that the composition of the Board ensured that research considerations were the crucial factor in the composition of research groups. The CAS *dared*; the Centre invested where it saw talent, instead of spreading scant research funding geographically and bureaucratically.

In spite of all the difficulties and all the hidden opposition, the Centre for Advanced Study has demonstrated its clear right to existence, and a great deal of outstanding research has been done in the course of the ten years since the Centre was established. In the building in

Drammensveien researchers from the four corners of the Earth have been able to meet one another for a free exchange of knowledge and insight, for exciting co-operation that has sent the sparks flying and triggered new insights within a number of central areas of basic research. Because the Centre always has as its foremost aim the researchers' well-being and working conditions, liberated from bureaucratic interference and hampering duties, the CAS has – in spite of its financial difficulties – been able to stand forth as a living research community at top international level.

It provides food for thought that one of the institutions that at the start showed clear signs of doubts about the establishment of the Centre for Advanced Study, namely the Norwegian Research Council, now at last appears to have realised the value of such an institution. This cannot be interpreted otherwise, given that the Research Council has now taken the step of advertising funds for the establishment of a number of so-called Centres of Outstanding Research, as they are literally called in Norwegian, or Centres of Excellence, to use an international term. The idea behind these centres, and the selection of researchers and subject communities, must have been inspired by the CAS – but their establishment and organisation is taking place in a different manner from the governing principle for the CAS. Considerations for research bureaucracy and policy seem here to be receiving considerable emphasis, and instead of a concentration of the investment, it is here being spread over a large number of new centres with highly dissimilar subject profiles.

The situation in Norway is that so to speak all basic research must be conducted with the help of public grants. Norwegian firms and the Norwegian business world have never shown any active interest in basic research, and it has been virtually impossible to obtain research money from private funds. The competition for the available public funding is therefore keen. In such a situation we in Norway should not behave in such a way that the very few and really good, but vulnerable communities we have, suffer injustice. On the occasion of the celebration of the first ten years of the CAS, it is therefore our hope that the Centre can continue to exist on the basis of the philosophy that led to its establishment. It will and must continue to be a *unique* institution in the Norwegian research-political landscape. The responsibility for the Centre's future life and well-being rests to a high degree on the Norwegian research-political community. The quality of its research we can ensure ourselves.

Quality research in Norway

Dagfinn Føllesdal, Professor, University of Oslo and Stanford University

When Gudmund Hernes proposed a Center for Advanced Study at the November 10, 1988, meeting of the Norwegian Academy of Science and Letters, I supported the proposal, on the condition that the Center be different from centers in other countries. While other centers invite fellows from many different fields and aim for cross-disciplinary contact, I maintained that most Norwegian researchers come from small institutions where they have few colleagues in their own field, and what they most of all need are opportunities to work together with top people in their own field.

When Norwegian researchers have an opportunity to take a year off, they should go to the best research centers in their field where they can get informed criticism and stimulation. I therefore proposed that the planned Center should be organized in groups, each group consisting of researchers from one field who together would make the Center one of the top places for that particular field that year. With twenty fellows there should be room for three such groups each year, each consisting of 6-7 fellows. In order to achieve opportunities for cross-disciplinary contact I proposed that each year there be one group in the humanities and theology, one in social science and law and one in natural science and mathematics.

Each group should include at least two of the most outstanding researchers in that field. In some few cases, the best people in the world in that field would come from Norway, but normally they would come from institutions that are at the high end of the salary scale, paying salaries that are about four times the normal Norwegian salaries. Would it be possible to get a budget for the Center that would allow for this sort of expense?

Fortunately, all the various ministers of research we have had during the ten years of the Center's existence have been very positive to the Center. They have seen that unless the Center has a budget that allows it to invite top foreign scholars, Norwegian researchers would be better served by going abroad than by going to the Center. The Center's budget has gradually been increased so as to make a high-quality Center possible. A most decisive contribution has been the willingness of the Norwegian universities to give the Norwegian participants in the various groups an extra sabbatical, so that the Center does not have to pay their salaries. This, together with the extraordinary frugality of the Center's administration, has made it possible to channel a major part of the resources of the Center into inviting fellows from abroad. The Center is still not at the stage where each group can invite two fellows from top foreign universities for the whole year, most of them can be invited only for part of the year. One of the attractions of the original plan was that inviting two top people together would increase the chances that they would accept. Now one usually has them one at a time.

The great understanding the Center has been met with by our various ministers of research makes us, however, hope that the budget of the Center will soon reach a level where it can live up to the original vision, that it shall each year be one of the top places in the world in three fields of research.

Norway has long been an egalitarian country, with a distaste for the elite. Sport has been an exception, and also anything else that has an entertainment value. The establishment of the Center for Advanced Study is an important first step towards acknowledging that there are other activities and other values that are important for the material and spiritual future of our

country. Fortunately, the ten years that have passed since the Center was established have brought several encouraging developments. I will mention some of these.

First, there is the establishment of the National Research Fund. In the mid 1990s the Norwegian Academy of Science and Letters urged the Norwegian Government to earmark a part of the steadily growing oil fund for research. I am quoting from a letter in 1997 from the Academy to Jon Lilletun, who was at that time Minister of Research: "a part of the oil fund should be earmarked for fundamental research and research in the humanities and social sciences. The part of the yield that need not be added to the principal to compensate for inflation, will ensure a stable stream of funds into these areas of research, where it takes long to build up competence and where continuity is important." Mr. Lilletun, who was one of the most attentive ministers of research we have ever had, responded very positively, and the contact continued, with a review of how similar research funds have been organized in Sweden and Denmark.

A further idea that was brought up in connection with such a fund was that this would be a good way of marking the Abel bicentennial in 2002. It now turns out that we can have our cake and eat it too. A research fund was created in 2001. It has now reached 1,300 million Norwegian kroner. In addition, an Abel prize in mathematics, of the size of the Nobel prizes, has been established in connection with the Abel bicentennial, with a fund of 200 million. This prize, which came about through good cooperation between the Ministry of Research and several mathematicians, is a boost for mathematics in Norway and it will increase the international awareness of the many remarkable contributions to mathematics that have come out of our small country.

Another departure from the traditional Norwegian egalitarianism is the recent establishment of centers of excellence, centers where groups of top researchers can pursue their research without wasting much of their time on paper work and grant applications.

The research prizes that have been instituted by some of our universities and also by the Research Council are further ways of channeling funds to prominent researchers who without applications and paperwork can pursue their own research, invite visiting researchers and in other ways strengthen research at their institutions. This is a way of delegating decisions about the use of research money from a board to selected individual researchers.

What more can be done to get quality research? Here is one suggestion: Let senior researchers get research money mainly on the basis of what they have published in major journals and with publishers with good international distribution. This has long been done in simple and un-bureaucratic ways in various university departments and it should be done on a nationwide scale. Junior researchers should be supported the way they are now, through doctoral and postdoctoral fellowships.

What then with the research programs, which are supposed to ensure that we get research in fields that are important and useful to our nation? In fields where we have no or too few researchers, we do not get good research by giving money to people who have never or only rarely been able to get their work into quality journals. Statistics seem to indicate that one reason that Norway gets exceptionally little out of each of the very few kroner it spends on research, is that too much money goes into programs and too little is distributed on the basis of quality.

Of course, we have to strengthen research in many areas where we lack competence. But we do not do this by establishing research programs. Instead one should establish programs to build up competence in such fields, with scholarships and comprehensive course programs. The Norwegian Research Council has done this, for example in the case of ethics. In my opinion, this is the way to go: have programs for building up competence, but let the further research support be determined by achievement.

Norway and the 'Center for Advanced Study'.

Ivar Giaever, Professor, Rensselaer Polytechnic Institute and University of Oslo

I have had the opportunity to spend the last 14 summers at the University of Oslo as a STATOIL Professor supported by VISTA. VISTA is an organization that was created by an initiative from STATOIL and the Norwegian Academy of Science and Letters. It has been both a rewarding and frustrating experience. Rewarding because I find that a few dedicated people still do good science in Norway, but frustrating because science is so little appreciated. In official documents and in newspaper articles in the last few years, Norway has several times been described and positioned as a "Knowledge Nation", but unfortunately this dream has at present no basis in fact.

So where does Norway excel? The Norwegians are very good in the Winter Olympics, both as organizers in 1994 in Lillehammer, and as participants in Salt Lake City this year. And Norwegian soccer players are stars in many European clubs. The sports figures enjoy high prestige and receive on average lots of money. This proves that Norwegians are great organizers and competitors, and are willing to work hard to succeed if paid well. So when there is a will, Norwegians can succeed.

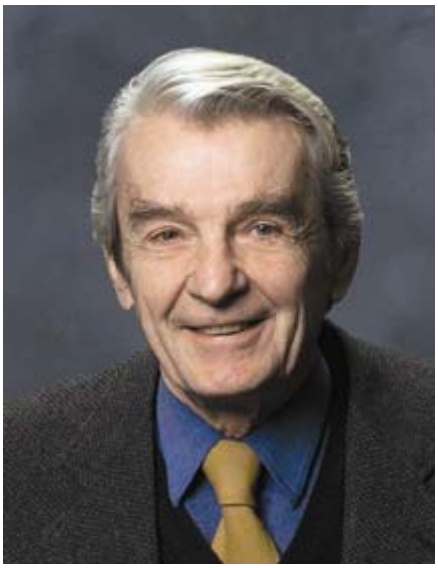
Unfortunately when it comes to science and education Norway is unwilling to pay the price. Clearly we care about sport because of the entertainment value, it is exciting to watch it on TV. So why should we care about science, as it has little or no entertainment value? We should because science creates wealth; it improves human conditions on almost all fronts. Patents protect new technology for a period of 20 years, but science enjoys no such protection. The strangest fact about science is that it is freely available to everyone, whether you live in Jerusalem, Kirkenes or Bangkok. But truly to understand and use science it is necessary to be educated and employed as a scientist. Simple Simon and Smart Alec are no longer relevant; all the information out there can only be used if you have sufficient education.

How can Norway position itself better in the world of science? The obvious answer that no politician likes to hear: by spending a sufficient amount of money. One heroic attempt was the creation of the Center for Advanced Study (CAS) about ten years ago. The purpose was and is to attract outstanding scientists from all over the world to study a special field or subject together with Norwegian scientists.

I have obtained information about the CAS from the Internet and also from my colleague and friend Torstein Jøssang. He served as its director for a long period. I know he always set the highest standards for himself and therefore also for the Center for Advanced Study. I was not surprised when after the first 5 years the official evaluation of the center was very favorable.

Will the CAS continue to be successful and in the lead in encouraging Norwegians to appreciate science? Can the Norwegians accept an elitist organization? Is it accidental that the Norwegian Research Council is finally establishing new “Centers of Excellence”? Has the time arrived when Norwegians will embrace science? As for the last question, unfortunately I do not think so, but I do believe that the CAS has helped to show the way, and has played a significant role the last ten years. Thus, let me end by congratulating the Center for Advanced Study in Oslo on its first successful ten years and wish for many, many more! I hope it will continue on the road so carefully staked out: to become not only a Norwegian elite institution,

but also an international elite organization and thereby enhance Norway's scientific reputation.



Professor Ivar Giaever received the Nobel prize in physics in 1973. He was born in Bergen and graduated from the Norwegian University of Science and Technology 1952. He emigrated to USA a few years later, and joined the General Electric Research and Development Center in 1958. In 1988 he became an Institute Professor at Rensselaer Polytechnic Institute and he is also a professor of physics at the University of Oslo.

CAS and the first groups in mathematics, 1993-95.

Olav Arnfinn Laudal, Professor, University of Oslo

Norway has over the years fostered a long line of great mathematicians, very few of whom are well known in their home country. Most Norwegians will, however, know about the two Giants from the 19th century, Niels Henrik Abel and Sophus Lie, but names like Sylow, Thue, Heegaard, Brun, Skolem, Ore, Nagel, Selberg and Selmer, held in great esteem in international mathematical circles, will most certainly go unnoticed outside the small group of professional scientists, in Norway.

Recently the mathematical community, aligning all four Universities and with support from many of the different Colleges that were established at the end of the 20th century, was determined to do something about this situation. Of course, the fact that few Norwegians know that Sylow is a name that all serious mathematicians, physicists, astrophysicists, chemists, all those who have to know something about symmetry and therefore about groups, in this case finite groups, have to learn, is not in itself so shameful. What concerns us is that this lack of biographical facts shows that mathematical science as such is considered a closed book to most people today, and one that many, even culturally keenly interested people, would like to see lost.

This situation has its historical reasons, not so different in this nation from what we see in most industrial societies today. Mathematics has lost its visibility, everywhere, and the sciences that are still seen by people, are those that harbour personalities with special relations to the media. And, of course, Big Science, the industrially interesting immediately applicable science, is publicised everywhere.

One of the most effective means to make the wonders of mathematics shine on the Norwegians is therefore to use the two lighthouses, Abel and Lie, and keep them activated.

This was the purpose of the Sophus Lie Memorial Week 1992, celebrating the 150 year anniversary of Lie, and this is the purpose of the Niels Henrik Abel Bicentennial, and its Conference in Oslo June 3-8, this year. Both arrangements were beautifully seconded by the monumental biographies of Abel and Lie written by Arild Stubhaug.

During the preparations for the Sophus Lie anniversary in 1992, an old idea came up again, that Norway deserved a Mathematical Research Centre, an Abel-Lie Institute. Denmark has its world famous Niels Bohr Institute, Finland has its Nevanlinna Institute, and Sweden has its Mittag Leffler Institute, Norway had nothing like it.

Then, in the rapidly decaying ruins of the Soviet Empire, there were people trying to survive, struggling to continue the work of the great mathematical schools of Moscow, Leningrad, Novosibirsk, Kiev, Minsk etc. Some of them got together and established an International Sophus Lie Centre, ISLC, in Minsk, with the purpose of promoting doctoral training, and research in differential equations along the lines proposed by Sophus Lie in the 1880s, but later abandoned, because of the complexity of the necessary computations. The new computer technology turned out to be an efficient tool to progress in the direction of research, opened up by Sophus Lie.

Professor Komrakov, one of the founders of the ISLC, contacted the organising committee of the Sophus Lie Memorial Week, and the Department of Mathematics at the University of Oslo

decided to apply for money allocated by the Government for supporting education and research in the defunct Soviet Union, to support part of the activity of the ISLC.

The Department got a share of this money, and when, some time in the Fall of 1992, the then President of the Board of the CAS, Professor Vigdis Ystad, proposed that I organise a year in mathematics at the CAS, starting in the Fall of 1993, some of the funds needed for this project were already available. But, in contrast to the situation today, where the CAS has a budget providing the research groups with a fairly good economy, the situation during the two years, 1993-1995, when I organised the Mathematics group, required a constant uphill battle against the Norwegian Research Council, the universities, and the ministries concerned.

My own application for a partial Sabbatical during these years, was turned down, by the Department of Mathematics, due to lack of support from the University of Oslo.

Finally, with a generous economic guaranty provided by the University of Oslo, of which the University lost a large part, the mathematics program could be pulled through. During the four semesters 1993-1995, the CAS was host to 49 mathematicians from 13 different countries, working on Lie theory, Algebraic Geometry, Analytic Manifolds, Singularity theory, Differential Geometry, K-theory, Operator Algebra, Group representations, Applied Mathematics, and Theoretical Physics.

The guests wrote 38 papers while at the CAS, several book projects got under way, or were completed, and the invited guests gave, together, more than 50 lectures, at the CAS or at the Department of Mathematics, in Oslo, Bergen, Trondheim or Tromsø.

As I have hinted at above, it is very difficult to give a serious account of what the subjects studied at the CAS during these two years, were really about, at least while keeping the interest of a general audience. Let me just choose one example. Most people know that there are problems related to solving polynomial equations in one variable. Niels Henrik Abel was the first to prove that the equations of degree 5 or higher, in general, have no solution that can be expressed as a radical function in the coefficients, i.e. as a function combining only addition/subtraction, multiplication/division and root-extraction. He also introduced what later became the Abelian part of Galois theory, a *symmetry group* associated to any polynomial, from which one can read out when the polynomial equation has solutions which are radical functions of the coefficients.

Sophus Lie knew the result achieved by Abel, and attended Sylow's lectures on Galois theory at the end of his studies in Oslo, then Christiania. He understood some years later that there is an analogous *symmetry group* for any system of differential equations, from which one can read out properties of the solutions of the system. These groups have since been named after Lie, and there is today no serious University in the world that does not offer a course in Lie theory, teaching mathematicians and physicists and chemists about the inner workings of Lie groups.

As related above, the study of these symmetry groups for various systems of differential equations was the main idea behind the teaching and research offered at the ISLC, and the co-operation at the CAS between Norwegian mathematicians and the guests linked with the ISLC brought new insights into Sophus Lie's integration method back to his homeland.

The guests were unanimous in their praise of the CAS, the working conditions, and the services rendered by the then administrator, Mrs. Unn Hagen.

I was a little surprised by the low level of criticism, since I still think that the lack of a scientific library is a negative feature of the CAS. Compared to the research conditions at the Mittag Leffler Institute, or at the German Oberwolfach Institute, with their magnificent mathematical libraries, the CAS has little to offer a working mathematician. Nevertheless experience has shown that the CAS functions as a secluded workshop and as a meeting place for scientists and researchers having to cope, at least during lunch breaks, with people with completely different agendas. In 1993-1994 mathematicians and Ibsen researchers lived together and became friends.

This year, 2001-2002, mathematics has come back to the CAS. The subject is this time Non-commutative Geometry, including Operator theory, Representation theory, and Algebraic Geometry. I am sure the final report of this group will be as positive as the one for the starting years 1993-1995.

Now, can one draw some further conclusions from the experience, so far, of the CAS as an institution, apart from the interpersonal ones expressed above?

Seen from the point of view of mathematics, a science that, to a great degree, is still independent of technical equipment, the meeting place is our laboratory.
That is why the workshops abound these days, financed by a plethora of international and European programs and projects. It is obviously a common good to meet and learn. But there is also an obvious need for longer periods of independent work, and for collaboration between two or a few researchers, to cook up new ideas.

New ideas are very rare indeed, and their gestation may be very long and agonising. A university professor, with the daily duties of teaching and administration, not to mention the almost daily paperwork needed for reporting and fund-raising, has today little chance to carry it through to birth, even when he or she is clearly pregnant with a new idea.

Here is where the research centres like the CAS come in. They provide an essential escape from the daily routines, a haven for thinking.

On the national level, the net result that I can see clearly, stemming from the activities of the mathematics groups at the CAS also includes, together with a lot of mathematical co-operation between Norwegian mathematicians and former guests at CAS, at least three mathematical imports, resulting from the appointment of Valentin Lychagin, a prominent guest during 1993-95, as a professor at The University of Tromsø.

In the future I would hope that the CAS can stay economically alive and sound, and in the spirit of the Bjørgo Report, § 11, evaluating the first years of the CAS, function as this haven for thinking, and as a much needed meeting place, providing contacts between international and Norwegian research, as we wait for an independent Abel-Lie Mathematical Research Centre.

The lemming cycle

Nils Christian Stenseth, Professor, University of Oslo

Lemmings – and in particular the Norwegian lemming found in the Scandinavian Peninsula and Kola – are known for their extensive and fairly regular fluctuations in individual numbers.[1] There are folklore stories about these lemming cycles – as they are called. And there is a large body of literature on this phenomenon. Indeed, why lemmings (and other small northern rodents) exhibit such fairly regular cycles remains by and large an unsolved scientific problem – one of the classic problems in ecology.[2]

The modern scientific study of lemmings started with work carried out by the Norwegian Professor of Zoology Robert Collett, who at the end of the 19th century gathered a great deal of information about lemmings – and their variations in numbers. But it was not until the work of the British ecologist, Charles Elton, that the study of the lemming cycle saw its modern form. With the publication of Elton's paper[3] in 1924 the modern study of lemming cycles started.

To try to understand why lemmings fluctuate both regularly and extensively is indeed an important problem in ecology. Not only is such fluctuation found in several rodent species of the north. It is also found in other species, such as the Canadian snowshoe hare.[4] It is also of conceptually great value: as long as we do not understand the lemmings – and the other so-called cyclic species – we cannot claim that we understand population dynamics, the study of dynamics and regulation of populations.

The Norwegian Lemming – a key study animal in the field of population ecology. (Erika A. Leslie)

During the academic year 1996-97, an international team of scientists worked on this problem at the Centre.[5] The overall aim of our work was to analyse long-term data on lemmings and other periodically fluctuating species in order better to comprehend what the patterns to be explained are. Statisticians and ecologists worked together – and during the process developed new statistical models.

Among the discoveries during this period was the statistical documentation of phase-dependencies: during the increase phase of the population cycle, animals have a different dynamic structure than during the decrease phase. This had been a claim for many years – supported by experimental data – but never documented on the basis of statistical analysis of long-term population data. In a series of studies we demonstrated that such phase-dependency could indeed be found in natural systems.[6] This finding was a result of statisticians' favouring a particular form of non-linear models (the so-called threshold autoregressive models, essentially being piece-wise linear models[7]) and meeting up with ecologists working on the population cycles of northern mammalian species. Furthermore it was through long discussions – profoundly facilitated by the Centre-setting – that we were able to interpret biologically what the statistical results told us. These phase-dependencies could also be confirmed through our analysis of demographic data on survival and reproduction – primarily in a huge data set made available to us by Finnish colleagues.[8]

Another discovery – made after the period at the Centre, but conceived during the work at the Centre – is the importance of the length of the winter in the generation of the regular population cycles seen in lemmings and other northern rodents. This was understood by analysing data on the grey-sided vole in Hokkaido – a similar species to that found in Scandinavia. Again analysis of large amounts of time series data[9], made it possible for us to single out season as a key factor in the generation of the population cycle. As long as there is a so-called delayed density-dependence (which can be generated in a variety of ways, including through closed interactions between predators and the small rodents, as well as through closed interactions between small rodents and their vegetation), changing the length of the winter will change the population dynamics: in regions with short winters the populations may be stable (which indeed is observed), whereas in regions with long winters the dynamics may be lemming-cycle-like (again as observed). This is an interesting and important result, not least since scientists have been arguing – almost fighting – over the underlying reasons for the regular population cycles seen in lemmings and other small northern mammals. Our results suggest that it may not matter whether there is a closed interaction with the rodents involving predators or vegetation (over which scientists have been fighting) as long as one or the other link exists; what matters is the length of the winter (relative to the length of the summer).

Much further work is certainly required. However, we all feel that the work at the Centre provided the right platform and setting for generating these results. It is encouraging, though, that a detailed theoretical modelling study – also started during the period at the Centre – has confirmed the above predations.

So, can we say why there is a lemming cycle? Probably we can: it is most likely a result of a combination of either predation or interaction with its own food supply *combined* with the short summers (and long winters) in the regions where they live.

It is worth adding some more personal reflections on the importance of the Centre for Advanced Studies. My own experience is that it provides an ideal platform and atmosphere (involving hard work in the study chambers, relaxed and challenging discussions around the sofa table and short intensive workshops) for creative work. I for sure have benefited profoundly from my stay at the Centre – hopefully the scientific community may see some effects as well.

Notes:

[1] Stenseth, N.C. & Ims, R.A. (eds.). 1993. *The biology of lemmings.* Academic Press, London.

[2] Boonstra, R., Krebs, C.J. & Stenseth, N.C. 1998. Population cycles in small mammals: the problem of explaining the low phase. *Ecology* 79, 1479-1488.

[3] Elton, C.S. 1924. Periodic fluctuations in the number of animals: their causes and effects. *Journal of Experimental Biology* 2, 119-163. See also: STENSETH, N.C. 1995. The long-term study of voles, mice and lemmings: homage to Robert Collett. *Trends in Ecology and Evolution* 10, 512. Stenseth, N.C. 1999. Population cycles in voles and lemmings: density dependence and phase dependency in a stochastic world. *Oikos* 87, 427-460.

[4] Stenseth, N.C. 1995. Snowshoe hare populations: squeezed from below and above. *Science* 169, 1061-1062.

[5] Among the core members of this group was Nils Chr. Stenseth (Norway), Rudy Boonstra (Canada), Nigel Yoccoz (France and Norway), Charles J. Krebs (Canada), Howell Tong (Honk Kong and England) Kung-Sik Chan (US) and Takashi Saitoh (Japan).

[6] Framstad, E., Stenseth, N.C., Bjørnstad, O.N. & Falck, W. 1997. Limit cycles in Norwegian lemmings: tensions between phase-dependence and density-dependence. *Proceedings of the Royal Society of London, B* 264, 31-38. Stenseth, N.C., Chan, K.-S., Framstad, E. & Tong, H. 1998. Phase- and density dependency dynamics in lemming populations: statistical and mathematical modelling of periodic temporal fluctuations with a fixed periodic component sustained by environmental stochasticity. *Proceedings of the Royal Society of London, B* 265, 1957-1968. Stenseth, N.C., Falck, W., Chan, K.-S., Bjørnstad,, O.N., O'Donoghue, M., Tong, H., Boonstra, R., Boutin, S., Krebs, C.J. & Yoccoz, N.G. 1998. From ecological patterns to ecological processes: phase- and density-dependencies in the Canadian lynx cycle. *Proceedings of National Academy of Science, Washington* 95, 15430-15435. Stenseth, N.C. Chan, K.-S., Tong, H., Boonstra, R., Boutin, R., Krebs, C.J., Post, E., O'Donoghue, M., Yoccoz, N.G., Forchhammer, M.C. & Hurrell, J.W. 1999. Common dynamic structure of Canada lynx populations within three climatic regions. *Science* 285, 1071-1073.

[7] Stenseth, N.C., Chan, K.-S.1998. Non-linear sheep in a noisy world. *Nature* 394, 620-621. See also Yao, Q., Tong, H., Finkenstäd, B. & Stenseth, N.C. 2000. Common structure in panels of short ecological time series. *Proceedings of Royal Society of London, B*. 267, 2459-2467.

[8] Heikki Henttonen has been a long-lasting collaborator of us, although he was never proper part of the Centre. Prévot-Julliard, A.-C., Henttonen, H., Yoccoz, N.G. & Stenseth, N.C. 1999. Delayed maturation in female bank voles: optimal decision or social constraint? *Journal of Animal Ecology* 68, 684-697.

[9] Stenseth, N.C. & Saitoh, T. (eds.) 1998. The population ecology of the vole *Clethrionomys rufocanus*. *Researches on Population Ecology* 40, 1-158. Stenseth, N.C., Kittilsen, M.O., Hjermann, D., Viljugrein, H. & Saitoh, T. 2002. Interaction between seasonal density-dependence structures and length of the seasons explain the geographic structure of the dynamics of voles in Hokkaido: an example of seasonal forcing. *Proceedings of the Royal Society of London, B* (in press). See also Hansen, T., Stenseth, N.C. & Henttonen, H. 1999. Multiannual vole cycles and population regulation during long winters: an analysis of seasonal density dependence. *American Naturalist* 154, 129-139.

Gravitational lenses

Sjur Refsdal and Rolf Stabell, Professors, University of Oslo

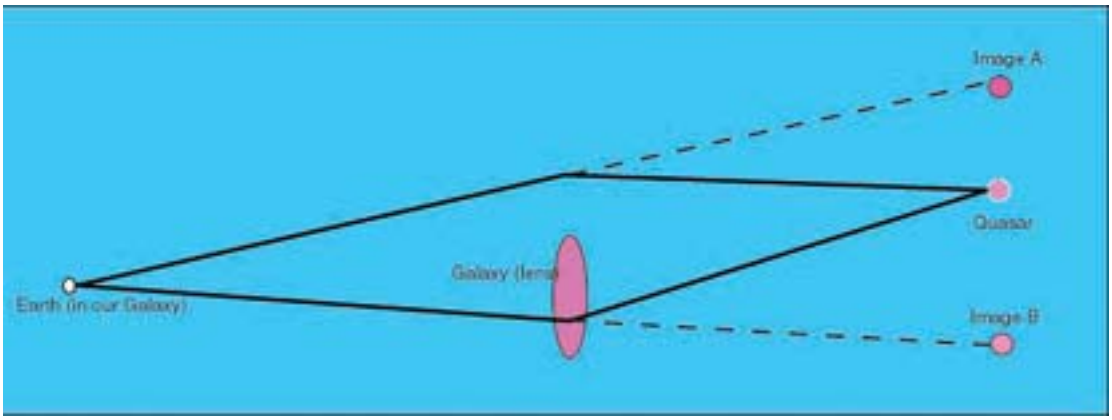
How rapidly (or slowly) does the Universe expand?
How old is the Universe?
How much matter does the Universe contain?
What are the mysterious Quasars?

These were some of the questions that a group of astrophysicists were trying to answer during their stay at the Centre for Advanced Study in 1997 to 1998. The group consisted of people from Denmark, Estonia, the USA and of course Norway. We all had a marvellous year and the friendly and efficient staff (Marit and Unn) made life easy for us.

In his General Theory of Relativity Albert Einstein showed how light would be deflected by a gravitational field. The effect of bending light rays by the gravitational field of the sun was measured during a solar eclipse in 1919, and in fact this was what made Einstein world famous. He also investigated the possibility of lensing effects from the gravitational field of a star bending the light from another star far behind. He concluded that such lensing effects (focusing, magnification and splitting up in two or more images) were hardly possible to observe.

Many years later, when the quasars were discovered, Sjur Refsdal was able to conclude that not only should lensing effects be possible to observe, but they could even be put to practical use. They could, among other things, be used to determine the mass of the lensing object, distances in the Universe, the rate of expansion of the Universe and the age of the Universe.

Another 15 years elapsed before the first gravitational lens system was serendipitously discovered in 1979. A team of British and American astronomers found an unusual “double quasar”. The two quasars had almost identical spectra, showing that they were likely to be two images of the same quasar. After some time the “lens” was also discovered. The astronomers found a galaxy, nearer to us, that lay between the two images of the quasar, just in the position where the lensing galaxy should lie.



Two images of a single quasar may be observed when the light rays from the quasar are being bent by the gravitational field of a galaxy. The deflection (and therefore also the angle between the images) are strongly exaggerated. In reality the angle is of the order of arcseconds.

Since then many different types of lens systems have been discovered; many where a galaxy acts as a lens and some where the lens is a whole cluster of galaxies. Magnification and splitting of the source into two, three or even four images is quite common. Lens effects have also been observed where the lens is a single star or another small compact object.

The best observed lens system is by far the first observed case, the so-called Double Quasar. Our group had access to a quite unique series of observations of this system, so it was natural to use these data to make comparisons with our theoretical predictions.

Many quasars vary in brightness, and the Double Quasar is no exception. When we look at the figure illustrating a typical lens system giving two images of one source, we immediately see that the light paths are slightly different. Hence we should not expect to see the two images change their brightness at the same time. A change in the luminosity of the quasar should be seen first in one image and some time later in the other. This time delay can be measured and is crucial for our determination of the distance to the lens. By comparing the two observed lightcurves (the change in brightness with time) for the two images, we were able to determine this time delay. This, however, was not an easy task. Due to different types of interference in the data, advanced statistical methods had to be used. The difference in light travel time was found to be only about 14 months, in good agreement with other investigations.

By means of this time delay one is able to determine the light travel time. The time the light has taken to reach us turns out to be directly proportional to the time delay. The light forming the two images has been under way for about 10 billion years. That in turn gives the distance to the lens. This elegant way of determining a distance in the Universe was known more than 15 years before the first gravitational lens was observed; it is called the Refsdal method.

We were now in a position to pin down the rate of expansion of the Universe, the Hubble parameter, H. Since the redshift of the lens is known, we practically know the expansion velocity, v, at the distance, d, where we find the lens. The famous Hubble's law tells us that the expansion velocity is directly proportional to the distance; $v = Hd$, with the constant of proportionality, H, telling us how much the velocity increases with distance. The result was not very surprising; we found that $H = 20$ km/sec per million light years, a value lying snugly in the middle of earlier estimates.

This result together with a fairly good idea of which cosmological model is best for describing our Universe, gives us a good estimate of the age of the Universe. We found it to be about 15 billion years old. This value is also in good agreement with other estimates using quite different methods.

In systems where the gravitational lens is a whole galaxy, as in the case of the Double Quasar, individual stars and other compact objects (planets or black holes) in the galaxy may act as small lenses. Due to transversal motion we may then observe variations in the light source on time scales of years. This is called “microlensing” to contrast it with “macrolensing” by the smoothed-out gravitational field of the entire galaxy. In our data there was one such case of a microlensing effect, and we found a method to use this effect to constrain both the mass of the microlenses and the size of the quasar. Two quite interesting results followed from our analysis.

1) The observed microlensing effect could easily be explained by ordinary stars, but in special cases even planets (!) could give similar effects.

2) The size of the quasar is probably of the order of a light day!

This small size confirms the most popular hypothesis for explaining the quasar phenomenon: A giant black hole with a mass of about a billion solar masses is lurking in the center of a galaxy and is swallowing the material (in the form of stars, gas and dust) that comes too close.

GLOSSARY:

Black holes: A region of space where the gravitational forces dominate over all other forces. It is formed when a mass undergoes a complete collapse.

Galaxy: Large systems of billions of stars (plus some gas and dust). Our Galaxy contains about 200 billion stars and has a diameter of about 100 thousand light years.

General Theory of Relativity: Einstein's famous theory of gravitation from 1916. It describes gravitation by means of geometry of space-time. All tests are in excellent agreement with the theory.

Quasar: Extremely energetic “Active Galactic Nuclei” in distant galaxies. It occurs where a giant black hole is swallowing surrounding matter.

Redshift (cosmological): The shift of spectral lines towards longer wavelengths observed in the spectra of distant objects. It is caused by the expansion of the Universe.

Focus on Ibsen

Vigdis Ystad, Professor, University of Oslo

When activity started at the Centre for Advanced Study, there had not been very much time beforehand for the planning of the research groups that were going to make use of the new premises. In such a situation the Board chose to look around in the Norwegian research landscape for subject areas in which Norway had already distinguished itself, and in which there was at the same time a highly qualified international network of researchers that could be built on when the first groups were being composed.

Within humanistic research there was immediately one area that stood out, namely the literary production of Henrik Ibsen. Ibsen, whom it must be reasonable to reckon as one of Norway's most important exports, has for one and a half centuries put his stamp on world literature and on the theatre all over the world. Within Norwegian literary research there has also been a strong research tradition with Ibsen as its subject, a tradition that had, however, been weakened in the course of the 1970s and 1980s, when for some time it was considered less relevant to explore the classics and the canonical literary texts. At that time Ibsen, together with colleagues like Wergeland, Hamsun, Undset and others, had undeservedly been overshadowed by topics such as regional literature, workers' literature, women's literature and so forth.

This was something the Board of the Centre for Advanced Study took seriously. The choice that was made to go in for Ibsen research as part of the very first activity at the CAS was connected with the fact that there was a desire to strengthen and resurrect Norwegian efforts in this field, at the same time as there was a wish to contribute to enabling Ibsen researchers abroad to get into closer contact with the sources, i.e. with Ibsen's texts in their original linguistic form, and with the Norwegian society and the literary and theatrical history that constitute an important context for Ibsen's production.

What was called the Ibsen Group came to acquire a strongly international stamp. It brought together researchers from four continents and from countries like Japan, Kenya/Zimbabwe, England, Germany, the USA and Norway. Their areas of interest covered a wide spectrum, from societal analyses to Bible language. But common to them all was a powerful interest in what happens to a literary text (and a national or European theatre tradition) when it is translated and adapted to new cultural contexts. What is it about Ibsen's texts that makes it possible for them to communicate with people all over the world, and that makes them just as relevant today as they were at the time they were written?

Translation problems and reception studies came to be central for a number of the researchers and were the subject of constant discussions and seminars. Professor Fritz Paul (University of Göttingen) is one of Germany's central Scandinavian scholars and an internationally famous Ibsen researcher. He worked on a survey of which directions Ibsen texts took when they went out into the world, often through as many as three or four languages, before they reached their destination. It is obvious that in such cases we may have moved pretty far from the original meaning of the original texts. One of the Nestors in European Ibsen research, the British Professor John Northam, also worked on translation problems, and devoted much of his time at the Centre to translations of Ibsen's poems and of his dramas in verse *Brand* and *Peer Gynt*. Through discussion with his colleagues at the Centre, John Northam arrived at translations that better than any earlier ones also take account of the *formal* characteristics

(versification and rhyme system) of the original texts, at the same time as the content of Ibsen's original choice of words is better preserved than ever before.

Ibsen's influence on the modern theatre was first felt in the countries of the west, where his realistic living-room drama is considered to be epoch-making in the history of drama and the theatre. But this influence extends much farther, and has also reached African and Asian countries with completely different theatrical traditions from our own. In Africa Ibsen became very popular and after the colonial period largely took over the role Shakespeare had earlier played within the universities and other educational institutions. Plays like *An Enemy of the People* and *Hedda Gabler* have furthermore been of crucial importance in former colonial states, inter alia through being on the programme for travelling theatre groups who have performed Ibsen at festivals, through performances by independent theatre groups, through student productions and in other ways. The researcher Kimani Gechau (originally from Kenya) was particularly interested in the role Ibsen's dramatic works had played in his home country as a demonstration of the content and consequences of what is called modernity: a new form of society, marked by a new perception of the state, new relations between individuals, the market and communication between actors. New ideas and values have replaced the old ones, and Ibsen's drama shows itself as being particularly well suited to presenting such transitions, and what they mean for the people affected.

Kimani Gechau worked closely with Helge Rønning, who was studying the Ibsenian view of society in relation to Norwegian and European conditions in Ibsen's time.

The Japanese researcher Mitsuia Mori was also working with related problems. His interest particularly concerned the important role played by law and the understanding of justice in Ibsen's dramatic works, compared with what is, and what was, the case in the Japanese society that received these texts from the beginning of the 20th century onwards. The differences between varying views of justice constitute an important field of study for all who are interested in what causes Ibsen, in spite of all these differences, nevertheless to become a classic and also popular in societies that are remote from his own. Mitsuia Mori was also concerned with general problems of translation, both theoretical and practical, and he has incidentally himself translated all of Ibsen's contemporary plays into Japanese, at the same time as he is a much used stage director in his home country, with many Ibsen productions to his credit.

The translation aspect was in addition actualised by the Norwegian researcher Arnbjørn Jakobsen's studies of Ibsen's allusions to the Bible and his biblically marked forms of expression, a field that is as a rule overlooked when the texts of Ibsen's plays are translated into other languages. Arnbjørn Jakobsen revealed in his studies that such elements in Ibsen are far more numerous than anybody had imagined, also in the realistic living-room dramas and in the late symbolist plays. This insight ought to have consequences for all subsequent publicising of Ibsen, both in Norway and internationally.

The female researchers at the Centre, Inga Stina Ewbank from England, Sandra Saari from the USA, and Vigdis Ystad from Norway, dealt with questions linked to Ibsen's female characters. Sandra Saari worked most consistently with this topic and related it to the development of society in Ibsen's own time. During her stay Inga Stine Ewbank worked mostly on the concept of intertextuality in connection with Ibsen's literary production, and pointed to many textual elements where this is important for our understanding, while Vigdis Ystad linked her studies of female main characters to a background in the history of ideas,

where an attempt was made to trace notions of femininity back to more general frames of reference.

What is it then about Ibsen that is the specifically "Ibsenian". This question may be said to have been paramount for all the participants in the Ibsen Group. During his stay Professor Asbjørn Aarseth laid the foundation for his new book on Ibsen's contemporary plays, where he was particularly interested in the dramaturgical characteristics of the plays and arrived at a "glass-cupboard dramaturgy" as being crucial. Professor Thomas Van Laan from the USA worked on an investigation of Ibsen's relationship to the classical genres – in particular tragedy. In the course of his stay at the Centre, Professor Van Laan wrote a comprehensive thesis on Ibsen as a writer of tragedy, and argued that it could be stated that this genre feature is one of Ibsen's strongest characteristics.

Asbjørn Aarseth's dramaturgic studies, Professor Van Laan's genre studies, Kimani Gechau's studies of modernity, Mitsuia Mori's investigations of views of justice and Sandra Saari's studies of the female roles all formed part of discussions on Ibsen's anchorage in terms of ideas, a field that evoked interest among researchers such as Per Thomas Andersen, Rune Engebretsen and Vigdis Ystad. The connection between philosophy and literary production was central to their works, at the same time as they could benefit from the other researchers' study of reception problems.

The work in the Ibsen Group was experienced as exceptionally fruitful by all the participants and it has resulted in a number of books and articles. One of the central aspects of the group's work, linked to understanding and reception, brought us perhaps some steps further towards an understanding of what lies hidden in the depths of Ibsen's texts – plays that are felt to be just as relevant, no matter where in the world they are performed and read. Another important result was the strong network that was thereby established within international Ibsen research. Here lasting contacts were forged between researchers, and the foundation was laid for further co-operation within numerous fields. All those who were members of the Ibsen Group are deeply grateful to the Centre. When one of them was due to leave the place at the end of his stay, he wrote a farewell letter containing the pregnant words that he would hereafter feel himself "cut off from Paradise". They could have been said on behalf of us all.

Nemzeti Színház, Budapest 1958
"Peer Gynt", Troll
Directed by Endre Gellért

Buddhist Manuscripts in the Schøyen Collection.

Jens Braarvig, Professor, University of Oslo

The Buddhist manuscripts found in the Schøyen Collection are a set of material which contains valuable information about how Buddhism developed in India, but also how this religion from early on, even before the beginning of our era, but especially in the first centuries A.D., blossomed in the rich culture that was associated with the Silk Road. On these trade routes between China and the West, between India and the West, as well as between India and China, and India and the Mediterranean areas, the soldiers of conquering armies came and went, and with them traders bringing luxury goods from the great kingdoms of the East and the West throughout the millennia. But also the flow of culture along these routes is amply documented, that of Greek art which influenced Buddhist art, that of the writings of Nestorian Christianity which were translated into Chinese, as well as Manikeism which was translated into the Chinese idiom, developed by the process of translating the Buddhist scriptures into Chinese. This process of translating the Buddhist scriptures took place between the second and eleventh centuries A.D., and the travelling involved in bringing the scriptures to China, as well as translating Buddhist thinking, religious practice and culture into what became the Chinese, Korean and Japanese expressions of Buddhism, took place along these routes.

Now, one of the very important stops for the Silk Road caravans was the Bamiyan Valley in Afghanistan. This place recently became very well known when the Taliban destruction of the huge Bamiyan Buddhas was televised throughout the entire world. The site of these Buddha statues is surrounded by caves, and in one of these caves were found the manuscripts we now have as they are preserved in the Schøyen Collection – the result of the effort of Mr. Martin Schøyen in acquiring these manuscripts systematically through purchase from Afghan tradesmen through London antiquarians.

What exactly the collection represents, being the remains of a great ancient collection of Buddhist scriptures, and what function and status this collection had, has not yet been decided with certainty. It had, however, been kept in the cave where it was found in the early nineteen nineties, since as an original collection it was destroyed in the early 8th century A.D., possibly by the then invading Muslim armies from the West. Thus the collection is, unfortunately, fragmentary. So the cave in which it was found just less than ten years ago probably served as a deposit from what once formed a huge library, that is, unless all the disconnected leaves originally formed pious gifts offered by passing pilgrims for the safety of their journey - a practice also documented elsewhere on the Silk Road.

The material has been dated by paleographical criteria as from between the late first and early eighth centuries. The script is mostly historically developing variants of the so called Brahmi script - the script that has mothered all later Indian types of script - as well as the Kharoshti script which was much in use in early times, but which disappeared around the middle of the first millennium. Paleographically sorting and dating the materials according to these criteria have been one of the main tasks of the research group, now at the CAS, in the earliest stages of the publication project.

The language of this collection is mostly Sanskrit in its special Buddhist form, but there are also a few examples of the Bactrian language, written with a variant of Greek letters. Of the Bactrian documents there is one which has a Buddhist topic, while the others are letters. There is also a trade contract from about 200 A.D., which is written on a tree plank in Sanskrit with

Kharoshti writing. This is a particularly interesting piece, since most of the literature found in the collection is Buddhist religious literature from all the main Buddhist genres, those of a) monastic rules, containing the historical and fictional literature of Buddhism (Vinaya), b) the speeches of the Buddha (Sutra), and c) the scholastic and learned literature (Abhidharma). The earliest manuscripts are written on palm leaf, which is the most usual writing material in India, while the later writing material is mostly birch bark, which is the "paper" mostly used for Buddhist literature in the north-western areas of South-Asia, today's Afghanistan, Pakistan etc. A few pieces, mostly medical texts, are written on leather.

Thus the manuscripts represent all genres of Buddhism. Much research work remains to be done to understand the history of all these texts, and their affiliations to the various sects of Buddhism - being from such a great time span, as well as from a very extensive geographical area. The material represents a very broad spectrum of what Buddhism is, both as concerns what are the Buddhist ideas, as well as their historical development. Some of the texts have parallels in Tibetan and Chinese, being translated into these languages on the introduction of Buddhism to these countries, but many of the texts are hitherto quite unknown and are as such completely new historical evidence on Buddhism. From this last mentioned category there are a great number of unidentified Abhidharma fragments. Both the two main traditions of Buddhism are represented, those of Mahayana and the traditional Thera- or Sthaviravada traditions. There seems to be an overweight of materials from the so-called Mahasamghika sect, that of the traditional sects mostly connected to the Mahayana. Thus among the insights we hope to gain are those of a better understanding of the origin of this important movement of Buddhism.

There are a few complete manuscripts in the collection, e.g. a very good manuscript of the Vajraccchedika Prajnaparamita ("The Diamond Cutter Sutra), and the Samghatasutra, as well as sizeable parts of the Buddhist monastic codex, but apart from these there are about 2000 sizeable fragments from whole pages down to 5 or 6 cm2, while there are more than 5000 microfragments smaller than this.

Cataloguing the material on the basis of paleographical criteria was to some degree accomplished by the core members of the group at an earlier stage. During the project year at the CAS one has produced a digitalized version of the material, but the main task of the group is at present to bring in specialists on the various aspects of Buddhism for the publication, translation and historical treatment of the texts. This process will go on for many years from now on, but the project year at the CAS has to a very great degree made possible a very intensive research period, in which the very best specialists on Buddhism from the whole community of this discipline have had the chance to give their contribution to the huge research work involved.

The collection is undergoing what could be styled a complete scientific treatment in the way that the materials are being taken through virtually all stages of manuscript research. Firstly, the materials are catalogued with assigned library numbers according to the type and date of script - scripts dating from the 1st up to the late 7th century A.D. As such the collection presents a complete documentation of the early Indian manuscript types. A relatively small part is written in the Kharoshti type - a script that died out about 500 A.D., while the main part of the collection is written in the so-called Brahmi script - the script which is the ancestor of the modern Indian alphabets as well as the alphabets of Tibet and other South and South-East Asian scriptual systems. A complete treatment of the styles and ages of the different types of both Kharoshti and Brahmi writing is being prepared by the group.

After sorting the manuscript fragments, of all sizes from complete folios to micro-fragments numbering more than 10.000, into temporal categories according to paleographic criteria, the fragments are transliterated. In this process the fragments are brought together and made into reconstructed folios or parts thereof - the process appears as a huge jigsaw puzzle. The colour and quality of the writing materials - those of palm leaf in the earlier manuscripts from central India, and birch bark which has a preponderance in the later materials from the north western areas - are also able to guide us on how to assemble the fragments into more or less complete folios. After transliteration into Latin letters, the transliterations are reconstructed into as full texts as possible, and this is done by means of comparing and identifying the texts with their Tibetan and Chinese translations when extant. Such translations are a great help for identification and reconstruction of the original Sanskrit or Indic text, and parallel versions in Sanskrit, Tibetan, Chinese of our material are also reproduced in the final publications, along with English translations made by the group. In many cases, however, the Indic texts have no parallel Tibetan or Chinese versions, and are often extremely difficult to identify. Especially these texts often belong to hitherto unknown traditions of Buddhism, and have as such particular interest.

With the texts reconstructed as far as possible on the basis of the criteria of historical text criticism, the historical placing of the texts is undertaken, that of age, genre, sect affiliation, with the purpose of analysing their historical, religious and philosophical impact on the Buddhist tradition. Efforts have also been made to try to understand the collection as a whole: Is it a consciously constructed library of a certain sect of Buddhism in Bamiyan, or was it randomly put together by monks and pilgrims travelling along the Silk Road? We have not yet reached any definite conclusion on these questions, but several hypotheses connected to the question have been made. Apart from the manuscript materials mentioned, there are also a few examples of inscriptions on copper plates, or copper "scrolls", in the collection - one of which has great historical value, in recording a dated gift from the Huna king Toramana to a Buddhist community in the year A.D. 492. This, among other important pieces of the collection, helps us to get a better understanding of Buddhist history - as is well known, exact historical information on Indian history is exceptionally scanty. Thus, through its scientific treatment, the collection is giving us substantial and important new insights into the history of the Buddhist tradition and its development throughout Asia.

The Schøyen collection does not contain only Buddhist materials, but scriptual materials from virtually all the great historical traditions of the world. So far the following publication projects have been initiated: Pictographic and cuneiform tablets; Greek papyri; Coptic papyri; Buddhist manuscripts; Aramaic, Mandaic, Syriac and Pahlavi incantation bowls; and English medieval stamp seal matrices. A digitalized copy of these materials too is being partly completed by the project at the CAS. All the projects will be published in a series especially established for the purpose, viz., The Manuscripts in the Schøyen Collection Series (MSCS). Scholars from these other disciplines are also attached to the project at the CAS - thus extended multi-disciplinary activity is taking place on the basis of the collection as a whole.

The Public Opinion Group 1997-1998

Ola Listhaug, Professor, Norwegian University of Science and Technology

When I submitted the proposal for a year at the CAS I optimistically chose the title "The Foundations of Public Opinion" for the research that we planned to do. I thought that a research group at a center for advanced study needed an ambitious agenda. Looking back at what we actually did during the twelve months, it seems fair to say that we did not quite fulfill all the goals that we set out to achieve. However, we definitely made some progress in important areas of research and initiated further collaborative work that has matured in the years after the CAS.

The study of public opinion is a vast field that is academic as well as applied. We kept the applied aspect somewhat in the background, although on occasions we supplied comments and interpretations to the mass media on current events in Norwegian politics. Among our contributions was a major presentation to the government's Values Commission on trends in social, political, and moral values in Norway. Although I thought at the time that we did an excellent job, our contribution did not save the Commission from its fate of becoming an arena for infights between well-articulated pressure groups and professional opinion makers, and not a forum for the creation of a new value consensus in society.

On the strictly scholarly front the work progressed on four research questions: The development of new models to explain the impact of issue opinion on electoral behavior, the study of causes of shifts in opinion, the investigation of the interaction between elites and mass in the formation of opinion, and the search for explanations of value differences between countries.

Issues

In 1957 Anthony Downs published what was to become a classic study of voting behavior. The book, An Economic Theory of Democracy, argued that parties should move to the political center if they wanted to win elections. His theory was developed for the two-party system of the United States. In this system, Downs argued, parties would tend to moderate their views and become quite like each other in ideological terms. The battle was always for the voter in the middle. In an influential article published in 1989, George Rabinowitz and Stuart Elaine Macdonald launched a competing theory. They argued that parties did not move to the center, but kept distinct ideological profiles to make the voters aware of what was unique and special about each party. According to this directional theory a voter was more likely to form a favorable impression of a party if the party and the voter were on the same side of a political issue, and both took an intense, and non-centrist, position on the issue. Rabinowitz and Macdonald showed that their directional theory had empirical support in the United States. The next step of their work was to develop the theory for multiparty systems. They chose Norway as their main case, and have continued their work on Norwegian elections for more than ten years, including contributions to the CAS public opinion group. It probably comes as no surprise that parties in Norway to an even stronger degree than parties in the United States operate under the logic of the directional model. The powerful Rokkan-Valen model argues that each party commands a set of core issues. Success at an election will depend on the ability of the party to put its core issues at the top of the voters' agenda. Two examples will suffice. In 1993 the question whether Norway should join the European Union dominated the election campaign. The Center party had the most intense position against membership and was rewarded with a record high vote at the election. In 1997 the EU question was not on the political agenda, and the Center party lost about the same number of

votes that the party had gained at the preceding election. The long-term decline of support for the Liberals (Venstre) can be explained by the fact that the party has not found new core issues to replace the issues that were either lost through the major victories of the party - the establishment of an independent and democratic nation; or taken over by other parties as the introduction of proportional representation in 1921 opened up the way for an agrarian party, and, later, a specialized religious party.

Causes of shift in opinion
Public opinion is normally responsive to economic conditions. When times are good, citizens tend to form favorable impressions of government. When economic fortunes decline, voters become more negative to government. Voters' trust in politicians and political institutions follows this logic. In her work based on data from EU countries, Beate Huseby shows that the economic effect is asymmetrical. The effect of negative evaluations is much stronger than the corresponding effect of positive assessments. It is easier for trust to decline than to improve as a consequence of changes in the economy. In a major extension of previous work, Huseby demonstrates that voters' evaluations of government performance on the environment and in social policy (care for the elderly and public health) have similar effects to economic evaluations. The explanation for this is that all policy fields – the economy, the environment, and the welfare state – constitute arenas where voters are in consensus about goals. They will then reward or punish government on the basis of performance and less on assessments of which means governments use to deliver the goods.

Mass-elite interaction
Can political elites influence the formation of opinion among citizens? This question goes to the heart of democratic theory. Most scholars probably take the position that the strongest flow of opinion should go from mass to elites, and not the other way. In some intriguing research, Sören Holmberg concludes that opinion formation in Sweden is strongly top-down, voters tend to follow political leaders to a higher degree than leaders adapt to the political views of the voters. Fortunately, the studies by Valen and Narud, fail to corroborate the Swedish results for political representation in Norway. But Norway is not free from the impact of elites.

In contrast to parliamentary elections some theorists see referendums as a political institution that is more favorable for the direct influence of mass over elites. It is fair to say that the two Norwegian referendums on membership of the EU can be interpreted in this way as at both time points, and especially in 1972, most parties and other elite groups, including the Cabinet, were for membership while the majority of voters said no. A closer look at the opinion dynamics of the referendum campaign reveals, however, that elites had considerable power in moving mass opinion. Research by Anders Todal Jenssen and collaborators shows that when voters were in conflict with the party they supported, voters were more likely to change their position on EU membership than to change party. This shows that parties had persuasion power in the referendum campaign.

Making sense of comparative opinion
Norway is often portrayed as a country where equality is dominant. Studies of income equality and other objective indicators give support to the equality proposition. But research on comparative public opinion has at best given mixed support for the proposition. On a number of studies the Norwegian public is not strikingly egalitarian in value preferences when compared with other countries. In an attempt to solve the puzzle, Toril Aalberg makes a distinction between terminal and instrumental values of equality. Terminal values state the

absolute goals for how much equality one prefers, while instrumental values tap into the support for the means to achieve the goals. Based on an extensive analysis of comparative survey data Aalberg finds that Norway is on top or close to the top when it comes to public support for egalitarian goals, for example about how large differences in pay between occupations are acceptable. When it comes to support for taxation and other means to achieve egalitarian goals, Norway places itself in the middle of the comparative rankings. The interpretation is that the public has reacted against the egalitarian policies and regulations that have been used to enforce equality. Means are not as popular as goals.

On a concluding note I am especially proud that the youngest members of the group have had success in their post-CAS years. Toril Aalberg and Beate Huseby both received the NSD Stein Rokkan Prize for their dissertations, and Toril was also awarded the Royal Norwegian Society of Sciences and Letters Lykke Prize for promising scholars below the age of thirty. I am quite confident - although I cannot scientifically prove it - that the year in Oslo contributed to this achievement.

Explaining Regime Effectiveness

Arild Underdal, Professor, University of Oslo

Many of the major policy challenges facing governments today are in some sense collective problems calling for joint solutions. Effective co-operation can, however, be hard to establish and maintain. It therefore becomes important to understand why some efforts at developing and implementing co-operative solutions 'succeed' while others 'fail'. Our group was convened to address exactly that question.

Before we can start searching for an answer, we have to define more precisely what we mean by 'success' and 'failure' in this context.[1] We adopted the conventional solution, which is to define success in terms of *effectiveness*. In a common sense understanding, an international regime - i.e. a set of rules and norms designed to govern a particular system of activities - is effective to the extent that it performs a particular function or solves the problem it was established to solve. Although useful as a point of departure, it soon becomes clear that this definition is not sufficiently precise to serve as a useful tool for systematic comparative research. What we need is a precise and generally applicable standard of measurement that, firstly, defines a point or trajectory against which actual performance can be compared, and, secondly, provides a common metric that can be applied across a wide range of cases. In this article I shall have to confine myself to a few words about the former aspect.

The actual performance of a regime can be compared against two points of reference. One is the hypothetical state of affairs that would have come about had the regime not existed. This is clearly the standard we have in mind when arguing that 'regimes matter'. The alternative option is to evaluate the actual state of affairs against some idea of what constitutes a 'good' or 'optimal' solution. This is the appropriate standard if we want to know whether or to what extent a problem is in fact 'solved' under present arrangements. These two standards can easily be combined, as suggested by Helm and Sprinz (1999). Their formula (below) measures the effectiveness of a regime in terms of the extent to which it *in fact* accomplishes all that *can be* accomplished.

$$\frac{\text{Actual regime solution} - \text{No-regime counterfactual}}{\text{Collective optimum} - \text{No-regime counterfactual}}$$

By this logic, we would consider regime X as more effective than regime Y to the extent that it succeeds in tapping more of the joint gain *potential*. For comparative research, such a standardised notion of *relative* effectiveness is particularly attractive in that it helps solve the common metric problem. But any attempt at measuring regime effectiveness involves causal inference, requiring that we separate changes that can be attributed to the existence and operation of the regime itself from those that have been brought about by other factors. This is by no means a trivial exercise.

How, then, can we *explain* variance in regime effectiveness? Previous research has searched for answers along two main paths. One leads us to examine the character of the problem itself: some problems are intellectually less complicated or politically more benign than others and hence are easier to solve. This leaves us with the challenge of specifying what distinguishes benign problems from those that are more malign and determining the impact of malignancy. The other path focuses on the elusive notion of problem-solving capacity, the basic argument being that some systems or institutions have greater capacity than others to solve particular kinds of problems. The challenge here is to specify what distinguishes high-capacity systems

or institutions from those that have low capacity, and to determine how much of the variance in outcomes can be attributed to these properties.

These are not mutually independent explanations. Beyond a fairly high level of generality, what constitutes capacity can be determined only with reference to a certain category of problems and tasks. Thus, it is by now conventional wisdom that the skills and institutional tools required to solve malign problems are in part different from those required to solve problems that are basically benign in character. For example, control over the system of activities to be regulated (in technical terms, 'basic game power') is more important in the former setting than in the latter.

The most comprehensive empirical study examining the merits of the two paths of explanation that has been published so far was finished at the Centre (see Miles et al., 2002). At least some of its conclusions must be considered good news to those who are working to establish co-operative solutions. Although optimal solutions seem to be very rare, most regimes do make a significant difference. Particularly encouraging is the fact that we find a fair amount of success in dealing also with malign problems. Both uncertainty and political malignancy can - up to a point - be overcome. The combination of high uncertainty and strong malignancy can, though, be lethal. Capacity seems to account for as much of the variance observed in outcomes as type of problem. Organisational capacity to integrate and aggregate actor preferences - expressed in decision rules and active roles for secretariats and chairs - makes a significant difference in dealing with (moderately) malign as well as benign problems. Informal entrepreneurial leadership by delegates or delegations is an important supplement to - and sometimes a substitute for - organisational capacity. However, when the going gets tough, power seems to be the ultimate tool. In dealing with strongly malign problems, basic game power accounts – at least in our study – for more of the variance in outcomes than any other single factor. There is an interesting flip side of the coin, though: in dealing with benign and mixed problems, basic game power seems to be largely ineffective or even counterproductive. There is clearly no simple cure-all treatment.

Note:

[1] For an attempt at developing a framework for a more comprehensive analysis of regime consequences, see Underdal & Young (forthcoming)

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The architect's challenge

Pål Strøm, Architect MNAL, Amdahl Strøm & Cappelen Arkitekter AS

The house at 78 Drammensveien was built during the years 1876 to 1878 for Hans Rasmus Astrup, who in addition to being a Cabinet Minister must no doubt be described as one of our country's richest individuals at that time. The villa is a result of a competition for architects that was won by the architect H.M. Backer.

The residence was built in neo-classical style and was to form a dignified frame around the political and social activity of one of the most influential men of that time.

The Norwegian Academy of Science and Letters took over the property in 1910 and since then the building has been marked, through alternating periods, by decay and lack of maintenance as well as restoration and development. On the occasion of the celebration of the CAS' 10th jubilee it is natural to focus on the last word, namely development.

The structural and "cosmetic" alterations that have been made in the course of time were on the whole monitored and followed up by antiquarian authorities, especially over the past 20 years. The building is worthy of preservation, it is on what is called the yellow list of the Director General of Historic Monuments and is as such very largely protected against physical alterations.

With this as a sounding board our firm of architects was engaged in 1990 to make things suitable for an international research centre in the building's unused areas in respectively the basement and the attic storey. For us as young architects excitement and dubious self-confidence conquered awe and respect for the superb piece of contemporary architecture Backer had drawn roughly 120 years earlier.

The areas in question in the basement had in their day contained inter alia the main kitchen in the house and various service rooms and storerooms. The attic story contained, in addition to a turret room for Astrup's children, on the whole unused and cold areas without any natural light. Seen as a whole these areas made a seemingly depressing impression.

Gravity and despair, and sometimes regret at having taken such a task upon ourselves, were slowly but surely overcome by inspiration from the building's soul and intrinsic value as well as the never flagging enthusiasm of those who had commissioned us.

There was a kind of naturalness in the notion that the centre's architectonic expression and planning must be subordinated to the original structure and aesthetics of the building. Functional solutions and choice of materials were thus adopted with an eye to providing a discreet contrast with what was there already, where the original is always dominant.

Every attempt was made to satisfy today's requirements for technological facilities, and not least air-conditioning, in a workplace by integrating service equipment into new constructions so that it is to the least possible degree noticeable in the visual whole.

Superordinate quality considerations and different strategic challenges found their solution in dialogue and co-operation with those who had commissioned us, at the point of intersection between economics, functionality and least possible future maintenance. Only the future will provide the answer to whether this has been successful.

In conclusion, in deep gratitude for having been shown the trust that lay in being allowed to contribute to the designing of the centre, we want to wish the CAS "Many happy returns of the day" on the occasion of its 10th birthday. The house in Drammensveien and the life within it will always be dear to our hearts.

From the Centre's sitting-room with its fireplace (Amdahl Strøm & Cappelen Arkitekter AS)

The Norwegian Academy of Science and Letters

Inger Moen, Vice-President, The Norwegian Academy of Science and Letters

The first university in Norway was founded in 1811 and established in Christiania. Prior to the establishment of a national university, Norwegian students had received their education abroad. Many never returned to take up careers in Norway, and those who did were too few to form an academic community. In the years following 1811 there gradually developed a circle of scholars and scientists in and around the University. And by 1857 when the Norwegian Academy of Science and Letters was established, this circle was large enough to support the activities of a national academy. It was important for the scientists in Christiania to become integrated in the European scientific community, and to this end a channel for publication was vital. The Academy therefore had as its main aim the publication of scholarly work. A government grant was allocated to support the publication activities.

From 1814, following the Napoleonic wars, Norway had been joined in a union with Sweden. Towards the end of the century a growing opposition developed in Norway to a union which prevented the country from functioning as an independent nation. In 1896 the scientist and explorer Fridtjof Nansen returned from an expedition towards the North Pole. The expedition inspired an unprecedented surge of patriotic fervour. Nansen was celebrated as a national hero, a symbol of strength and independence. To commemorate the expedition a fund raising campaign was initiated, a campaign which resulted in the establishment of a research fund in Fridtjof Nansen's name. The Academy was given the administrative responsibility for the fund. The Nansen Fund was the main financial resource for scientific and scholarly work in Norway until the establishment of the Norwegian Research Council in 1949.

Interior from the Academy (DNVA)

Today the Academy has 219 ordinary Norwegian members and 183 foreign members organised in two divisions, one for the natural sciences and one for the humanities and social sciences. Each division is subdivided into sections for the constituent disciplines. The Academy receives a Government grant-in-aid and administers its own private funds arising from gifts and legacies

Since June 1911 the Academy has been located at Drammensveien 78, a building which was designed by the architect Herman Major Backer and built as a private home for Hans Rasmus Astrup and his family in 1887. The house is built in the neo-Renaissance style and is richly decorated with large chandeliers, elaborate ceilings and wall decorations in the aesthetic

tradition of the romantic Historicism characteristic of the second half of the nineteenth century. Ten years ago the basement and the attic were renovated and turned into modern offices which now house the Centre for Advanced Study.

The Norwegian Academy of Science and Letters, as the founding organisation for the Centre for Advanced Study, is responsible for securing the academic quality of the research groups working in the Centre. The Academy is well qualified for this responsibility. It counts as its members Norway's most distinguished scholars and scientists. Through its collaboration with a number of sister academies in other countries it has established a wide international scientific network. The Academy also acts as the official representative of Norway in a number of international scientific organisations such as *The International Council of Scientific Unions* (ICSU), *Union Académique Internationale* (UAI), *The European Science Foundation* (ESF).

The Academy has as its main aims to represent the interests of scholarship nationally and internationally, to promote and support advanced research, and to further international collaboration and exchange. The Centre for Advanced Study is an important component in the Academy's efforts to fulfil these aims.

A brief history of institutes for advanced study

Björn Wittrock, Principal of SCASSS

The idea of advanced study is the idea of a free pursuit of learning "to the utmost degree that the facilities of the institution and the ability and faculty of the students will permit". This was the stated purpose when the first institute of this type, located at Princeton, was founded in 1930 as a postdoctoral research institution. Like a traditional university it was devoted to the promotion of learning, but its scale was smaller and it did not offer formal instruction. Nor did it have large laboratories. It was to be a place for the most highly specialised research, yet it provided an atmosphere open to intellectual exchange across all disciplinary boundaries. Among the sources of inspiration were All Souls College at Oxford and the Collège de France in Paris.

The IAS at Princeton sought at the same time to embody the Humboldtian idea of a university and an Oxford college tradition of commensality, contemplation and tranquillity. In this the IAS came to play a crucial role and to provide an institutional home for some of the most famous intellectual refugees, among them Albert Einstein, John von Neumann and Kurt Gödel. In the years since its creation, the IAS has achieved a position that is unrivalled in the world of science and scholarship. In all fields where it has been engaged, its contributions have set the standards against which other contributions may be measured. Maybe because of its very success, the IAS was for a long time the only institute of its kind. The idea of replicating an institution of this kind seemed beyond the limits of practical possibility, at least of any European government or foundation in the period after the Second World War.

It was in this context, though, that a second major institute for advanced study was established in 1954 through an initiative of the Ford Foundation. This was the famous Center for Advanced Study in the Behavioral Sciences (CASBS) at Palo Alto. It was smaller in scale than the IAS at Princeton – it did not have a couple of hundred but only some 47 residential scholars each year – and a focus on the social and human sciences rather than on the entire field of human knowledge. However, it was a scholarly domain broadly defined. Its fields "include but are not limited to anthropology, art history, biology, classics, economics, education, geography, history, law, linguistics, literature, mathematical and statistical specialities, medicine, musicology, philosophy, political science, psychiatry, psychology, and sociology". In these fields the Palo Alto Center very rapidly acquired a worldwide renown and was seen as a kind of powerhouse of the transformations occurring in the social and human sciences. Contrary to the Princeton Institute, the CASBS had no permanent faculty but only residential fellows. Scholars could not apply, only be nominated as candidates to fellowships and decisions about invitations were – and are – preceded by a highly selective, competitive, and quite formalised process in which only a small fraction of the candidates are eventually successful.

The experiences of the IAS at Princeton and the CASBS at Palo Alto set milestones for all subsequent developments. The first of these was the Netherlands Institute for Advanced Study in the Humanities and Social Sciences (NIAS) at Wassenaar, under the auspices of the Royal Netherlands Academy of Arts and Sciences. It was clearly modelled on the Stanford Center. This was true of its scholarly focus, of its option only to have visiting fellows, of its size, of its efficient library loans system, and even, one may add, of its volley ball court. Whereas the IAS and the CASBS had been overwhelmingly American institutions in terms of the composition of their fellows, NIAS had always a large component of non-Dutch scholars in residence but these however were also to a large extent linked to projects proposed by Dutch fellows.

Overall NIAS tended, a bit earlier than other institutes for advanced study, to emphasise the need not only to have distinguished individual scholars. It emphasised, more than both IAS and CASBS, the need to create clusters of scholars in the form of so-called research groups working on broad common themes. It is only in the recent past, after about three decades of existence, that NIAS has taken on some features that do not go easily with the Stanford model, such as having some permanent fellows – and of renaming the Director into a Rector.

Parallel to the Dutch developments, innovations were also contemplated in neighbouring Germany. The first such effort was directly related to the creation of what eventually became maybe the most successful of the post-war German universities, namely the University of Bielefeld in Northrhine-Westphalia. In this process a central idea from the very inception was to reinsert the philosophical-humanistic ideals, associated with the Humboldt brothers and early 19th century philosophical idealism, in the setting of a modern university. In the creation of such a new-humanistic university, the prominent German sociologist and educational thinker Helmut Schelsky thought that a centre for advanced study would be a crucial institution. This was the famous Centre for Interdisciplinary Research, or ZiF to use its German acronym, of which Schelsky became the first Director (1968-1971). Like NIAS, ZiF came to emphasise the role of thematically coherent research groups but unlike NIAS and CASBS, it insisted that all fields of knowledge should be included. These features have been characteristic of ZiF up until the present day.

In the latter half of the 1970's two further important initiatives were taken. In the United States, a National Humanities Center was created and could in April 1979 move into an elegant brand-new building in the Research Triangle Park in North Carolina. It was given the form of an independent, privately incorporated foundation with close links to the National Endowment for the Humanities, to foundations, not least, and like the CASBS, the Andrew W. Mellon Foundation, and to many universities and other institutions. Its location in North Carolina also meant that it came to play an important regional role in the United States, and that the history of race relations in America came to be a perennial concern of the Center. The size of the NHC was roughly the same as that of NIAS and just slightly smaller than the CASBS.

At almost the same time, October 1978, a decision was taken by the City parliament in Berlin to establish an international centre for scholarly collaboration. It was explicitly stated that one purpose was "to re-establish the contact, interrupted by National Socialism, and war, with vital intellectual currents that are still underrepresented in Germany to this day". As a consequence the Institute for Advanced Study Berlin, the Wissenschaftskolleg zu Berlin, was founded in 1980. The original financial support mainly came from the City of Berlin and the Volkswagen Foundation. Soon however, the Federal Government, and a range of foundations, came to support the institute on a major scale, and it now occupies an unrivalled position at the pinnacle of German academia. On its governing body, the Members' Assembly, are not only the Presidents of the Berlin universities but also those of the German Science Council, the German Research Society, the Rectors' Conference, the Max Planck Society, the German Academic Exchange Service, and the Alexander von Humboldt Foundation. Recently, representatives from foundations in Switzerland and Sweden have also joined the assembly.

The Wissenschaftskolleg was modelled on the IAS at Princeton. Thus it shared with the Princeton institute a commitment to support all fields of science and scholarship. Most of its residential fellows were invited for a given academic year, but it also had a small number of permanent fellows. In practice most of its fellows tended to come from the humanities and the social sciences, but there was a commitment also to invite natural scientists, and gradually a

strong programme in theoretical biology became one of the characteristics of the Wissenschaftskolleg. Like the Princeton Institute, but even more energetically, it also strove to establish links to music, literature and the arts, and always had prominent representatives of these fields among its Fellows.

Shortly after these events, an initiative was also taken in Sweden, to explore the feasibility of establishing an institute of this type in Northern Europe as well. In 1985 the Swedish Collegium for Advanced Study in the Social Sciences (SCASSS) was established as a national scientific institution located in the old university town of Uppsala. It had a significantly smaller number of scholars than the earlier mentioned institutes but tried to compensate for that by way of a rather ambitious project of international research networks. Despite its name, but like the Stanford Center, it soon became for all practical purposes a centre for advanced study in both the social sciences and the humanities at large. After a ten-year trial period, the Collegium became a permanent national institute for advanced study, chartered by the Government of Sweden and with a nationally composed board. Like its European sister institutes it sought to balance in roughly equal numbers scholars from domestic universities and from universities abroad as well as more senior scholars and exceptionally promising postdoctoral scholars.

In 1992 some of the then existing institutes for advanced study, namely the IAS, the CASBS, the NHC, the NIAS, the Wissenschaftskolleg, and SCASSS, decided to enter into an informal but, as it turned out, ever closer collaborative relationship. This occurred against the background of the momentous transformations in Central and Eastern Europe and the dramatically exposed need of support for high-quality research in this region. However, these institutes also came across growing concerns among academics in Western Europe and North America as well that an emphasis on short-term usefulness seemed more and more to limit possibilities for long-term research constrained only by the competence and imagination of the scholar her- or himself.

It is difficult to exaggerate the importance of the initiatives that have been taken by this group of institutes to support high-quality foundational research in Central and Eastern Europe in the period since then. Most notably, perhaps, the first institute for advanced study in this region has been firmly established as an internationally prominent institution, namely the Collegium Budapest, founded in 1992. It is a Hungarian-based but truly international scholarly institution at the highest level, operating like the IAS at Princeton and at Berlin as an institute devoted to the support of all fields of science and scholarship. There have also been a number of relatively small-scale, but important, institutional endeavours that have been made possible by the so-called New Europe Prize, awarded by the collaborating Western institutes. These initiatives have supported research e.g. in St Petersburg, Bucharest, Budapest, Prague and Krakow. In some instances such as the New Europe College in Bucharest and the Bibliotheca Classica in St Petersburg, the institutions created have become crucial ones in their respective settings. Recently, yet another centre for advanced study, this time in Sofia, Bulgaria, has been created through a similar collaborative initiative.

In parallel, there is a growing number of initiatives in other European countries, but also beyond, including Japan (most notably the International Institute for Advanced Studies in the Kansai Culture and Science City) and China as well as South Africa (StIAS), to establish or to strengthen centres for advanced study.

As a consequence of growing pressures for immediate usefulness, there is an obvious and growing need for free meeting places and for spaces where reflection is not seen as incompatible with societal engagement. Institutes for advanced study provide such spaces where activities in accordance with the inner needs of science and scholarship itself are the pre-eminent concerns. Such needs have been voiced in a number of reports. They have also become apparent indirectly in a variety of ways, e g by the dramatic growth of university based centres, recently involving the transformation of Radcliffe College in Cambridge, Massachusetts, into the Radcliffe Institute for Advanced Study operating in a way similar to the national centres for advanced study.

It is clear that centres and institutes for advanced study are destined to play an ever more important role in the international scholarly landscape in the years ahead. They are uniquely well placed to provide an encouraging and supportive environment for post-doctoral researchers and thus in forming the next generation of leading scholars. Most of all, they are crucial as free intellectual meeting places and as places where scholarly serendipity and curiosity are respected and given the conditions to flourish.

Catalogue of past, present and future projects at the *Centre for Advanced Study* in Oslo

A catalogue of all projects at the centre during the first 10 years. Also included are projects that that have been invited for the next few years.

2003 - 2004:

Food-webs, Stoichiometry and Population Dynamics,
Professor Dag O. Hessen, University of Oslo

Analysis of elemental ratios (stoichiometry) in food webs may provide fundamental information on the uptake, allocation and sequestration of carbon (C) in food webs. The relative abundance of key nutrient minerals like phosphorus (P) and nitrogen (N) is not only instrumental to primary production. Also secondary production (grazers) may be directly limited by the relative abundancy of P and N, and when C:N or C:P ratios are high in primary producers, an increasing share of C will be in excess, relative to grazer demands. This will have implications not only for energy transfer in food webs, but also community composition and system stability. It will also be a major determinant of CO_2-uptake at the base of the food web to yield at the top. This project aims at bringing together leading experts within this field to explore large empirical datasets from lakes and marine areas, and elaborate the existing models on stoichiometric ecology as a predictive tool for elemental flows and ecosystem productivity.

Core members of the group include Tom Andersen (Norwegian Institute for Water Research), James Elser (University of Arizona), Robert W. Sterner (University of Minnesota) and Jotaro Urabe (Kyoto University).

Towards a New Understanding of the Mental,
Professor Bjørn Ramberg and Professor Olav Gjelsvik, University of Oslo

From Descartes until our own time, a central problem of philosophy has been the relation between the mental and the physical, the soul and the body. One way of putting it is that we conceive of a human being both as a physical/physiological system, and as an acting, thinking, and moral/normative system, and that it is far from obvious how something can be both. The present project attempts to work out a new approach for how to think about these issues. In particular we want to address how mental phenomena can exhibit causal powers in the right sort of way; why physical systems like those we presumably are cannot at all exist without intentional phenomena; and also whether the intentional phenomena physical systems bring into the world can exhibit the right sort of subjectivity and normativity, namely the subjectivity and normativity subjects of thought and experience manifest.

International participants in this project include John Perry (Stanford University), Timothy Williamson (Oxford University), Jennifer Hornsby, (University of London), and Pascal Engel (University of Paris).

Towards a Comprehensive Model of Human Memory,
Professor Svein Magnussen and Professor Tore Helstrup, University of Oslo

Errors and distortions of human memory have been main themes in memory research during the last decade. This focus on the qualitative aspect of memory is partly the result of a widespread concern about the reliability and fallibility of eyewitness testimony demonstrated in widely publicized court trials involving alleged serial killings, mass sexual abuse in kindergartens, and in trials based on early memories resurrected in psychotherapy. Most models of memory are based on laboratory research that focuses on the quantitative aspects of memory. The purpose of this project is to develop a model that incorporates the error-generating factors of human cognition and embeds memory in a larger context of cognitive psychology. The project will consider factors such as the effect of post-event information, social aspects of memory and the importance of collaborative efforts for memory formation, the importance of emotional and personality factors in memory, and memory viewed in a meta-cognition perspective.

Principal collaborators are Stephen Ceci (Cornell), Cesare Cornoldi (Padova), Asher Koriat (Haifa), Lars-Göran Nilsson (Stockholm), Jerker Rönnberg (Linköping).

2002 - 2003:

Geometric Integration,
Professor Hans Munthe-Kaas, University of Bergen and Professor Brynjulf Owren, NTNU Trondheim

Geometric Integration is an interdisciplinary area of research which applies modern abstract geometrical ideas within numerical solution of differential equations. Situated in the intersection between pure and applied mathematics, computer science and mathematical physics, it is an activity which in recent years has in a remarkable way combined ideas from these different fields and turned them into tools of computational mathematics. Research in Geometric Integration has several goals. 1) Geometrical structures are fundamental in the understanding of physical phenomena. In many simulations it is crucial to develop numerical solution techniques that exactly preserve important underlying geometrical structures. 2) Object orientation is a fundamental tool in the construction of large software systems involving discrete mathematical structures. It is an important goal to understand and overcome the theoretical and practical difficulties lying in the generalization of these techniques to areas of mathematics involving continuous mathematical structures and differential equations. 3) Through the construction of software, abstract mathematical ideas become more concrete and available to applied mathematicians. Thus a focus on computations and software is contributing to bridging the gap between pure and applied mathematics.

Core members of the group include Arieh Iserles (University of Cambridge), Peter Olver (University of Minnesota), Reinout Quispel (La Trobe University), Robert McLachlan (Massey University).

Aesthetics and Cognition,
Professor Jostein Børtnes and Professor Tomas Hägg, University of Bergen.

The project will study the development of a specific anthropology and aesthetics within Christian Orthodox theology with emphasis on the Cappadocian Church Fathers (4th cent. AD), in particular Gregory of Nazianzus, and their impact on subsequent Byzantine theologians, such as Dionysios the Areopagite (ca. AD 500) and Maximus the Confessor (7th cent. AD). Cappadocian anthropology represented something new: it was based on the mystery of the Incarnation and on the theology of the Trinity as it was formulated by the Cappadocians. A central concern will be the role of the Cappadocians for Byzantine aesthetics and the theology of the icon, an aspect of Orthodox tradition that sets it apart from Judaism and Islam as well as Western theology. The Orthodox doctrine of the deification of man has left deep traces in the anthropology of all Orthodox peoples, not least in Russia; for instance, in the novels of Dostoyevsky and Pasternak this idea still determines the representation of the characters. By studying key texts of these leading Greek theoreticians, the project sets out to illuminate the relationship between anthropology and aesthetics in the early Orthodox tradition.

Core members of the group include John McGuckin (Union Theological Seminary), Edgars Narkevics (University of Riga), Eustratios Papaioannou (Catholic Univ. of America), Philip Rousseau (Catholic Univ. of America), and Torstein Tollefsen (University of Oslo).

Landscape, Law and Justice,
Professor Michael Jones, NTNU Trondheim

The term landscape incorporates a number of differing but overlapping ways in which the complex relationships between human societies and their physical surroundings are conceptualized. The particular focus in this project is the role of law and custom for the allocation, management and use of common resources. The project is organized in three sub-themes: 1) Historical concepts of landscape as an expression of law, justice and cultural practice relating to the community regulation of land and other common resources (cf. the medieval Nordic *landskapslover*). 2) Continuity and change in the landscape as a physical and cultural manifestation of human activity and institutions, focusing on the role of legislation and customary law, in a historical and geographical perspective. 3) Legal implications and landscape impacts of environmental policies for the management of amenity resources and perceived common values in the landscape.

Core members of the group include Ari Lehtinen (University of Joensuu), David Lowenthal (University College London), Kenneth R. Olwig (Swedish University of Agricultural Sciences), W. David H. Sellar (University of Edinburgh), Mats O. Widgren (Stockholm University).

2001 – 2002:

Constitutional Studies – the Constitution as a Norm,
Professor Eivind Smith, University of Oslo

The topic of the project was constitutions, their normative character and the impact of these legal norms in the legal system and in society otherwise. This is an area that has gained

renewed topicality in recent years, inter alia on account of increasing interest in human rights, the debate on European integration, and the process of democratisation in Eastern Europe. This project was interdisciplinary and involved lawyers, political scientists and historians. Among the many topics that were taken up one may mention analyses of different concepts of democracy – such as the will of the majority versus norms that are laid down in the constitution – the relationship between the constitution and other statutes, as well as ways in which the constitution influences political processes and institutions, including the political debate. The project had a comparative aim, and the situation in Norway, for example, was compared and contrasted with that in other countries.

The group included, among others, Jon Elster (Columbia University), Svein Eng (University of Oslo), Trond Nordby (University of Oslo), Bjørn Erik Rasch (University of Oslo), Caroline Taube (Uppsala University) and Michel Troper (Institut universitaire de France).

Buddhist Manuscripts in the Schøyen Collection,
Professor Jens Braarvig, University of Oslo

See separate article.

Non-commutative Phenomena in Mathematics and Theoretical Physics,
Professor Magnus B. Landstad, NTNU Trondheim and Professor Stein Arild Strømme, University of Bergen

We usually learn that "the order of factors is immaterial" and it is true that the sequence of numbers is of no importance when we, for example, multiply two numbers. In other contexts, however, the situation is more complicated: When we get dressed, it does not matter whether we put our socks or cap on first. But when it comes to socks and shoes, the situation is different. In non-commutative mathematics one studies precisely systems in which "the order of factors is not immaterial". Heisenberg's uncertainty principle in physics is a fundamental example of this: We cannot measure both the position and velocity of a particle absolutely exactly at the same time in the same experiment.

This project brought together researchers from many countries to work with different areas of non-commutative mathematics. In the autumn semester the activity was concentrated on non-commutative algebra in different forms with applications in quantum mechanics, group representations and dynamic systems. Non-commutative phenomena in algebraic geometry and string theory was the main topic in the spring semester. The project was part of the marking of the 200th jubilee of the birth of Niels Henrik Abel in 2002.

Core members of the group included Ola Bratteli (University of Oslo), Alexei Rudakov (NTNU, Trondheim), Helmut Lenzing (Paderborn), William Arveson (University of California, Berkeley), Palle E.T. Jorgensen (University of Iowa), Hiraku Nakajima (Kyoto University), Mikhail Kapranov (Northwestern University) and Steven Kleiman (MIT).

2000 – 2001:

Dynamics of Fluid Rock Systems,
Professor Bjørn Jamtveit, University of Oslo

Pores and cracks in the earth's crust are always filled with fluids (liquids and gases), except in immediate proximity to the surface. The interplay between the fluids and the surrounding rock has a considerable effect on the development of the earth's crust, making knowledge of such processes very important to society. In such disciplines as petroleum geology, ore geology, environmental geology and geotechnology, understanding of the transport and deformation processes in fluid-rock systems is fundamental.

In the project, modern statistical physics was combined with knowledge of natural geological systems in such a way as to make it possible to simulate and model the processes in question. One important problem area concerns the links between fluid flow, deformation, and chemical reactions between fluids and types of rock. This include studies of how liquids and gases move through and out of rock when porosity is reduced, and of how they sometimes penetrate types of rock with little or no porosity to start with.

Core members of the group included Jens Feder (University of Oslo), Eirik Flekkøy (University of Oslo), Paul Meakin (INEEL, USA), Yuri Podladchikov (ETH-Zürich) and J.A.D. Connolly (ETH-Zürich).

Editing Medieval Manuscripts,
Professor Odd Einar Haugen, University of Bergen

Publishers of medieval texts have to mediate between often anonymous writers long since dead and present-day readers. This confronts them with a profound dilemma: how can they be faithful to the text while at the same time making it comprehensible and accessible to modern readers? Since this is well-nigh impossible, some choose to normalise the language so as to adapt the text to a broader market, while perhaps publishing a more faithful version as a supplement. Others adhere to the original wording down to the tiniest detail.

Over the past 500 years, editions of early texts have almost always been published as books. New technologies permit medieval texts to be published electronically, with all the attendant advantages such as hypertext and search tools. Good indexes and references to other sources, electronic footnotes, and links to other documents or the Internet, digitalised images and scanning of original hand-written manuscripts are among the many opportunities offered by electronic texts which have not been available from printed books. New information technology was thus a main feature of the project, which concentrated on Norse texts, and especially on Heimskringla.

Core members of the group included Jonna Louis-Jensen (University of Copenhagen), Hubert Seelow (Universität Erlangen-Nürnberg), Jon Gunnar Jørgensen (University of Oslo) and Karl G. Johansson (Växjö University).

Decision Making under Uncertainty,
Professor Stein W. Wallace, NTNU Trondheim

How do you decide when it is best to leave home for the bus stop so as not to have to wait too long, while on the other hand keeping the risk of missing the bus acceptably low? How does an oil company set about choosing a platform solution for the North Sea, and how does a

snowboard manufacturer set the price of his latest model? Though decisions taken in conditions of uncertainty are extremely complicated, that does not stop us from living with them all day without giving them much thought. Some decisions are based on simple rules of thumb which we apply almost unthinkingly, while other are based on complicated mathematical models.

The project aimed at exploiting expertise in both the social and the natural sciences in order to develop better decision-making models for problems in which uncertainty is a central theme. The group focused on the collection, processing and presentation of stochastic data, and worked on how complex stochastic models should be designed to enable users to derive the greatest possible benefit from them and organizations to adapt them to their structures. The group consisted of scholars with extensive experience in the use of quantitative models, in the presentation of data, and in organizational psychology.

Core members of the group included Jan Hovden (NTNU, Trondheim), Julia Higle (University of Arizona), Yannick Frein, (Institut National Polytechnique de Grenoble), Stein Bråten, (University of Oslo), Les Foulds (University of Waikato), and Horand Gassmann (Dalhousie University).

1999 – 2000:

Mesoscopic Physics of Normal Conductors and Super Conductors,
Professor Yuri Galperin, University of Oslo

Physics is about how various components in matter affect each other, and the consequences for the matter's properties. Studies of microscopic systems entail focusing on atom-sized components, smaller than one nanometre, that is one billionth of a metre. Macroscopic systems are considerably larger, and can be observed by ordinary optical microscopes.

The laws of classical physics are based on macroscopic systems. But research in the 20th century has shown that the laws break down for systems that are smaller than one nanometre: hence the development of quantum theory. During the same period, the discovery was also made that, when their temperatures are lowered, certain types of metals, known as superconductors, are able to conduct electricity without resistance. This can only be accounted for by the quantum theory, despite the 50 nanometre distance over which the electrons interact. To arrive at a full understanding of this phenomenon, one needs to apply both quantum theory and classical theoretical physics, in addition to a new theory of statistical physics.

It is this new field of research which has been given the name "mesoscopic physics", because it is located, so to speak, halfway between microscopy and macroscopy. It came into prominence especially after developments in microelectronics made it possible to produce extremely small components, right down to a few nanometres.

The group included, among others, Amnon Aharony (Tel Aviv University), Boris Altshuler (Princeton University), Carlo W.J. Beenakker, (Leiden University), and Yoseph Imry (Weizmann Institute).

Classical Chinese Philology,
Professor Christoph Harbsmeier, University of Oslo

Among the world's highly cultured civilisations, China's was historically one of the most influential and impressive. Chinese history has moreover been documented from as far back as 3,000 years ago, providing a unique opportunity to study the culture. With a number of leading specialists from major eastern and western universities cooperating, the research group carried out a contrastive and systematic description of the traditional Chinese conceptual world. The group discussed selected shades of meaning in the key concepts which dominated and formed traditional Chinese thinking in the fields of politics, economics, poetry, aesthetics and philosophy.

In the source material the group used, there was comprehensive digital documentation of classical Chinese literature from about 800 BC to 100 AD, including 24 books with electronic translations into English. On the basis of this material, it has been possible to build up an electronic synonym dictionary of classical Chinese, covering about 11,000 words. These have been sorted into synonym groups and general semantic categories. The project produced a synonym dictionary of classical Chinese, illustrated by the most recent archaeological finds which shed light on the material environment of the time.

The group included, among others, Kenichi Takashima (University of British Columbia), Qiu Xigui (Peking University), Jiang Shaoyu (Peking University), David Keightley (University of California, Berkeley) and Edward Shaughnessy (University of Chicago).

Explaining Regime Effectiveness,
Professor Arild Underdal, University of Oslo

See separate article.

1998 – 1999:

Historical Demography,
Professor Ståle Dyrvik, University of Bergen and Professor Sølvi Sogner, University of Oslo

Today we all expect a long life. A Norwegian boy born in 1996 can expect to live to the age of 75, and a girl born at the same time will probably reach the age of 81, against respectively 45 and 48 years in the 1820s. This is an extension of 30 years of life and in fact the length of a whole generation. The research group in historical demography studied the incipient decline in mortality in Europe in the period 1750-1900. Each researcher had her or his own project, and on the basis of different angles of approach the group wanted to shed new light on this enormous problem area.

The topic is particularly interesting seen from a Norwegian perspective, because Norway is among the first countries in Europe where the traditionally high mortality began to fall. This happened despite the fact that the country was not among the richest in Europe, the conditions of life were tough, and health care was poorly developed. Norway's leading position is therefore mysterious. As far as sources are concerned, the situation is good: Norwegian mortality statistics based on information from church records go back to the year 1735 and form the basis for a description of this development, but the reports on the use of medicines from the 19th century were also taken as a basis. Factors such as the preparation of food,

hygiene, living conditions, the working environment and the position of women were also brought in.

The group included, among others, William H. Hubbard (Bergen), Kari Pitkänen (Helsinki), Frans van Poppel (The Hague), Jürgen Schlumbohm (Göttingen) and Gunnar Thorvaldsen (Tromsø).

The Language of Religion; Shamanhood, Nothern Identity and Mentality,
Professor Juha Pentikäinen, University of Helsinki and Professor Håkan Rydving, University of Bergen

The problematic relationship between language, culture, ecology and religion in northern identity and mentality is an interdisciplinary area, which has hitherto remained outside in-depth scientific interest. The interplay is very intimate in the Arctic area, where languages are in the process of dying out. Experience gained in the project 'Endangered Languages' has shown that when a language dies out, it often breathes its last in religious codes, in man's interaction with the other world. These codes are holy and only become manifest in the mother tongue. They are unknown to those who have no knowledge of messages handed down in such a form of internal communication.

The languages of the northern areas usually have so few speakers and the differences between these languages are so great that the formation of nations took place very late. Ethnicity seeks new forms, in the way that has recently happened with the *Sakha* or Yakuts in Central Siberia, the Nenets and Khantys in Northwest Siberia or the Komi on the west side of the Ural mountains, where pre-Christian folk religion, especially Shamanism, has been declared the official national religion in the region.

The group included, among others, Natalya Koshkaryova (Novosibirsk), Péter Simoncsics (Budapest), Tanya Bulgakova (St. Petersburg), Elena Glavatskaia (Ekaterinburg) and George Charles (Santa Barbara).

A Panarctic Flora Project - the Species Concept in the High North
Professor Inger Nordal and Professor Reidar Elven, University of Oslo

How many species of plant are there in the Arctic? Is a white dryad in Siberia the same as a white dryad in Svalbard or in Alaska? Are there special centres of biodiversity, i.e. evolutionary "hot-spots" in the Arctic? Right up to the last days of the Cold War, Arctic biological research went on in closed rooms – the Russian separated from the West-European and the American. This has led to the fact that different traditions have developed for the definition and labelling of both plant and animal species in the Arctic. So it is impossible to answer the introductory questions. The researchers on the project represented the most outstanding botanical expertise within different Arctic areas: Alaska, Canada, islands of the North Atlantic, and Siberia. They wanted to start a programme which in the course of time would lead to a Panarctic flora project with a universal and united species concept.

The group included, among others, Susan G. Aiken (Ottawa), Bengt Jonsell (Stockholm), Dave F. Murray (Fairbanks), Vladislav Petrovsky (St. Petersburg) and Volodya Razzhivin (St. Petersburg).

1997 – 1998:

General Cosmology and Gravitational Lenses,
Professor Sjur Refsdal, University of Hamburg and Professor Rolf Stabell, University of Oslo

See separate article.

Edvard Grieg in National and International Cultural Life,
Professor Finn Benestad, University of Oslo

Edvard Grieg contributed in the highest degree to creating a Norwegian identity and was an important element in the nation building of the 19th century. Grieg and his music have always had a central place in Norwegian music research. Among important contributions we can mention "Edvard Grieg's collected works" and Finn Benestad and Dag Schjelderup-Ebbe's major biography of Grieg from 1980. There are in addition numerous works dealing with the world of Norwegian music in the period in question.

This project was concerned with Grieg and his achievement in a broader national and international perspective. The Grieg group at the CAS worked on style studies of Grieg's music seen in relation to contemporary European composers, and examined what importance Grieg had for his own time and the period immediately following. Furthermore the music researchers focused on the conditions in Norwegian and European culture that influenced Grieg in his work.

The group included, among others, Hella Brock (Leipzig), Camilla Haugen Cai (Ohio), Nils Grinde (Oslo), Heinrich Schwab (Kiel), Patrick Dinslage (Berlin), Dag Schjeldrup-Ebbe (Oslo), Ekkehard Kreft (Münster) and Arvid O. Vollsnes (Oslo).

The Foundation of Public Opinion,
Professor Ola Listhaug, NTNU Trondheim

See separate article.

1996 – 1997:

Foundation of Intersubjective Communication from New Understanding of Infants' Social Nature,
Professor Stein Bråten, University of Oslo

In the pasts twenty years, discoveries have been made which run counter to traditional theories of children's development. The findings invite us to take a new view of man's social nature, and of the foundations of inter-subjective contact in infancy. Examples include the ability of new-born babies to imitate adults' facial expressions, their early participation in "protodialogue", and their ability to tune in on other people's speech.

In the autumn of 1994, the scientists who first reported the new discoveries met at the Norwegian Academy of Science and Letters to discuss one another's findings in the light of recently proposed theories. They are now attached to the "Teoriforum" network, in which they are currently contributing to a source publication on communication and emotions in

early development. A special objective for the project was to distinguish various levels of inter-subjective tuning in and cultural learning. The relation between emotions and ideas is a special challenge.

The group included, among others, Carolyn Edwards (Kentucky), Paul Harris (Oxford), Karsten Hundeide (Oslo), Mikael Heimann (Gothenburg) and Colwyn Trevarthen (Edinburgh).

Contrastive Analysis and Translation Studies Linked to Text Corpora,
Professor Stig Johansson, University of Oslo

How does an original text relate to a translation? Are there any general features that are characteristic of translated texts in different languages? These are among the questions with which a group of international linguists was concerned in this project. The group focused on two areas in particular. The first was collections of texts, so-called *text corpora*. The study of collections of texts, also known as corpus studies, has attracted attention in recent years. The reasons are not only that linguists are now more inclined to study language in use, but also that modern computers are capable of analysing large quantities of text quickly. The other area that was studied was comparison of languages, or *contrastive analysis*. The researchers were concerned with collections containing comparable texts in two or more languages.

The main purpose of the project was to show how parallel corpora can be used in translation studies and when comparing languages. Descriptions of translation problems and of syntactical, lexical and stylistic patterns in parallel texts form part of this field of research.

The group included, among others, Jan Aarts (Nijmegen), Bengt Altenberg (Lund), Monica Doherty (Berlin), Helge Dyvik (Bergen), Cathrine Fabricius-Hansen (Oslo).

The Mystery of the Lemming Cycle,
Professor Nils Chr. Stenseth, University of Oslo

See separate article.

1995 – 1996:

Ethics - A Just Society,
Professor Dagfinn Føllesdal, University of Oslo

The Centre's Ethics project was concerned with the subject of the just society, looking in particular at questions concerning freedom of religion and just treatment of ethnic and religious minorities. In addition, the group considered justice across national boundaries. How should resources be divided between poor and rich countries? What obligation are we under to give up some of our welfare in favour of the less privileged in our own country and in other countries?

The ethics group included, among others, the following members:
Judith Jarvis Thomson (MIT), Thomas Pogge (Columbia University), John T. Noonan (Berkeley), Samuel Scheffler (Berkeley), Helge Høibraaten (Trondheim), Jon Wetlesen (Oslo) and Knut Midgaard (Oslo).

An Unexplored Collection of Sacred Texts: An Analysis of the Canonical Scriptures of the Bon Religion of Tibet and their Significance for World Literature,
Professor Per Kværne, University of Oslo

The project examined a large but little known collection of the sacred writings of the Bon religion. The Bon religion regards itself as a predecessor of Buddhism. The scriptures were written and edited before the 15th century. The collection, 190 volumes in all, had remained unknown outside Tibet until the mid-1980s with the discovery, in Eastern Tibet, of the only complete remaining set of Bon scriptures to have survived the cultural revolution.

The sacred writings were analysed and their contents described by a group of international and Tibetan scholars. The group was concerned with the possible significance of this body of literature in such philosophical problem areas as logic, epistemology and ethics. Its genesis was also investigated, with a view to contributing to a general understanding of syncretism, cultural combinations and clashes, and the formation of ideologies and world pictures.

The Tibetology group comprised, among others, Tseyang Changngopa (Lhasa), Tsering Thar (Beijing), Namgyal Nyima Dagkar (India), Dan Martin (Indiana) and Donatella Rossi (Rome).

Quantum Phenomena in Lower Dimensions,
Professor Jan Myrheim, NTNU Trondheim and Professor Jon Magne Leinaas, University of Oslo

Great interest has been shown in recent years in special quantum phenomena which can occur in low-dimensional systems. One such phenomenon is the interesting quantum-Hall effect (Nobel Prize 1985), in which an electron gas is confined to an interface between two semiconductors. The electrons, moving in a strong magnetic field, show characteristic and sharply defined plateaus in (Hall) conductivity when the strength of the magnetic field is varied. High-temperature superconductivity is also regarded as a low-dimensional phenomenon, with the motion of electrons mainly confined to two-dimensional crystal planes. At the theoretical level, it has been known for some time that special quantum phenomena can occur in low-dimensional systems, including the possibility of particles with fractional quantum states (Myrheim and Leinaas, 1977). There is a major challenge in finding better links between these theoretical possibilities and phenomena which can be studied in realisable physical systems.

The group included, among others, K. Olaussen (Trondheim), S. Isakov (Moscow), S. Mashkevich (Kiev), A. Polychronakos (Uppsala), U. Lindstrøm (Stockholm), D. Arovas (San Diego), G. Canright (Tennessee), H. Hansson (Stockholm) and R. Varnhagen (Bonn).

1994 – 1995:

Law and Economics,
Professor Erling Eide, University of Oslo

In recent years, Law and Economics has blossomed as an interdisciplinary research area, witness the award of the Nobel Memorial Prize in Economics to James Buchanan (1986),

Ronald Coase (1991), and Gary Becker (1992). The project was intended to stimulate this type of research in Norway.

In research in law and economics, economic theory is applied and developed in analyses of how legal rules come into being, their effects, and the extent to which the results accord with such general objectives as efficient use of resources, etc. The foreign and Norwegian scholars invited to participate in the project concentrated on the interplay between instruments of administrative, criminal and civil law, especially in relation to the environment. The project extended this research, among other things so as to take into account uncertainty with regard to the effects of legal rules.

The group included, among others, Hans-Bernd Schäfer (Hamburg), Roger Bowles (Bath), Roger van der Bergh (Antwerp), Hans Christian Bugge (Oslo) and Endre Stavang (Oslo).

Oslo International Think-tank on Multiple Sclerosis Epidemiology,
Associate Professor Trond Riise and Professor Harald Nyland, University of Bergen

The causes of this serious neurological illness, which attacks some 2 million patients worldwide, are not yet understood. The design of good analytical-epidemiological studies is vital to the determination and subsequent elimination of the provoking factors.

One fundamental problem concerns the relative importance of genetic and external factors, and the particularly high incidence of the disease in the countries around the North Sea basin is especially interesting in that connection. In addition, the project aimed at the establishment of cooperative studies.

The group included, among others, Anne-Marie Landtblom (Lindköping), Alexei Boiko (Moscow), Klaus Lauer (Darmstadt), Enrico Granieri (Ferrari), Harald Nyland (Bergen) and Shalini Bansil (New Jersey).

Mathematics - Lie-Theory (continued from 1993-94)

1993-1994:

Mathematics - Lie-Theory,
Professor Olav Arnfinn Laudal, University of Oslo

See separate article.

Henrik Ibsen's Writings (continued from 1992-93)

1992 – 1993:

Fractal Growth Processes,
Professor Torstein Jøssang, University of Oslo

The physics program started when the Centre was first established and, consequently, there was insufficient time for the careful planning that has preceded later programs at the Centre. Nevertheless, a productive program was organized with full international participation.

"Fractal growth processes" are growth processes that are greatly disordered (the weather, the emergence of geological and biological structures, aggregation, electrochemical deposits, etc.) Fractal geometry is a tool for revealing such order or symmetry as may remain in such disordered processes and structures.

The group included, among others, Jens Feder (Oslo), Paul Meakin (USA), Rudolf Hilfer (Germany), Amnon Aharony (Israel) and Cristopher Barton (USA). The "father of fractal geometry", Benoit M. Mandelbrot, visited the centre for three short periods.

Project BALTICUM,
Associate Professor Arne J. Stokke, University of Oslo

The project concentrated especially on shedding light on polity formation and discussing the role of nation states in a world where political and economic questions are increasingly being internationalised. The project made it possible first and foremost to intensify exchanges with research colleagues from the Baltic countries. Two major international conferences were held on the establishment and government of nation states. Under the sub-projects, several workshops were arranged, and some Baltic staff members were engaged in appointments for shorter or longer periods.

The group included, among others, Per Kristen Mydske (Oslo), Anton Steen (Oslo), Aigars Strupiss (Latvia), Raivo Vetik (Estonia), Einars Semanis (Latvia). Rasa Alisauskiene, Aleksandras Dobryninas and Kornelija Jurgatiene (Lithuania) visited the Centre on numerous occasions as members of permanent working parties.

Henrik Ibsen's Writings,
Professor Vigdis Ystad, University of Oslo

See separate article