Research in Biology and relevant areas of Biochemistry in Norwegian Universities, Colleges and Research institutes

A review

Panel 2

(Physiology, neurophysiology,
neurochemistry, anatomy,
toxicology and pharmacology)

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Preface

In 1999 and 2000 the Research Council of Norway carried out a comprehensive review of Norwegian basic biological research, including biochemistry and biotechnology at Norwegian Universities, Colleges and Research Institutes. The review covers research groups in the natural sciences, medicine, agriculture, fisheries and environmental disciplines.

Because of the large number of scientific groups and disciplines involved in the review, three different international panels of experts were established, each of which reviewed one of the following subfields:

- Panel 1- zoology, botany, ecology, plant physiology, marine zoology, marine botany and limnology
- Panel 2 - physiology, neurophysiology, neurochemistry, anatomy, toxicology and pharmacology
- Panel 3 - microbiology, molecular biology, cell biology, genetics, biochemistry, immunology and biotechnology

This is the report of the international expert panel formed by the Research Council of Norway to review the research in physiology, neurophysiology, neurochemistry, anatomy, toxicology and pharmacology.

To the Research Council of Norway

The members of the Review Panel 2 for the evaluation of basic research activities in biology and relevant areas of biochemistry (anatomy, physiology, zoophysiology, neurophysiology, neurochemistry, pharmacology and toxicology) at Norwegian Universities, Institutes and State Colleges submit the following report. The committee was unanimous in its recommendations, assessments, and conclusions.

Stockholm July 1st 2000

Sten Grillner
Chairman

Cynthia Carey

Bertil Fredholm

Helmut A. Greim

Christopher Henderson

Stefan Nilsson

Bengt Saltin

Patriq Fagerstedt, Department of Neuroscience, Karolinska Institutet, Stockholm, acted as scientific secretary of the evaluation committee.

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General introduction

The Research Council of Norway has as part of an evaluation of "Basic Research activities in Biology and relevant areas of Biochemistry" appointed three evaluation panels, one of which should review anatomy, physiology, zoophysiology, neurophysiology, neurochemistry, pharmacology and toxicology. The Research Council had appointed the following committee:

Professor Sten Grillner, chairman. Nobel Institute for Neurophysiology, Department of Neuroscience, Karolinska Institutet, Stockholm, Sweden

Professor Stefan Nilsson, Department of Zoophysiology, University of Göteborg, Göteborg, Sweden

Professor Cynthia Carey, Department of Environmental, Population and Organismic Biology, University of Colorado at Boulder, Boulder, Colorado, USA

Professor Bertil Fredholm, Department of Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden

Professor Helmut A. Greim, Institut für Toxikologie und Umwelthygiene, Technische Universität München, Neuherberg, Germany

Professor Christopher Henderson, Motoneuron Development and Pathology, INSERM U-382 – IBDM, Campus de Luminy, Marseille, France

Professor Bengt Saltin, Copenhagen Muscle Research Center, Rigshospitalet, Copenhagen, Denmark

Patriq Fagerstedt, Nobel Institute for Neurophysiology, Department of Neuroscience, Karolinska Institutet, Stockholm, acted as scientific secretary of the evaluation committee.

The committee met near Gardermoen between February 27th and March 4th 2000. During this week we had the pleasure of meeting representatives for all research institutes/department/groups that we were evaluating. The mandate from the Research Council for the entire evaluation is appended to the report. To summarize, we have attempted to evaluate the quality of the basic research carried out, as well as the research training and the organization of this heterogeneous group of research establishments. In this evaluation we did not consider political strategies, industrial development, needs for advice to government or undergraduate teaching.

The individual research groups were ranked as belonging to one of the following descriptors, based on the following criteria:

Excellent Research at a very high international level; of great international interest with broad impact and with publications in internationally leading journals; the researchers are among the leaders in the field.

Very good Research at a high international level; of international interest with impact within its sub-field and with publications in internationally leading journals; the researchers are among the leaders in the sub-field.

Good Research at a good international level with publications in internationally well known, specialized journals; the researchers have a good international reputation within their sub-fields.

Fair Research that only partly meets good international standard and only partially published in well-known international journals.

Not acceptable (Poor) Research of insufficient quality without national or international scientific interest.

General recommendations

Although there are a number of excellent research groups in Norway, who are international leaders in their respective fields, panel 2 has found that within the area of anatomy, physiology, zoophysiology, neurophysiology, neurochemistry, pharmacology and toxicology there are several structural problems that deserve attention.

- A lack of ***scientific leadership*** is often apparent. Sometimes the scientists with little scientific authority serve as chairmen. The departments have in many cases significant resources in terms of staff, like engineering positions that are distributed equally to all groups regardless of scientific achievements. All resources including space should rather be allocated according to needs related to scientific accomplishments. Many departments seemed proud of their "horizontal" hierarchical structure, which seems often to have worked well in human terms. However, the Panel was not convinced that this was the best solution to allow the best research to develop fully, especially in a difficult financial climate. A department head who is also a clear scientific expert would facilitate many aspects of scientific life, by:
  - negotiating difficult decisions concerning reassignment of research personnel and facilities within the department;
  - co-ordinating joint efforts to fund core facilities and equipment;
  - being able to: (a) lobby funding sources; (b) discuss possible strategies for resource sharing or joint applications with other departments or institutes; (c) symbolize the strong critical mass represented by the department.

  In many other countries, this has provided an effective solution for enhancing funding of dynamic departments, while preserving scientific autonomy of individual research groups.

- In many departments the ***research staff is fragmented*** into a large number of small groups with a very limited research contribution. Moreover these groups often try to achieve by collaborating broadly without a specific goal. In many cases it appears that the work becomes very descriptive without a clear formulated problem or hypothesis. The Research Council and the different faculties/universities should try to organize research such that the groups become larger to obtain a critical mass. The departments should in general try to have fewer and more focused research groups. An aggregation into larger groups within a faculty, or networks within the country could be stimulated by e.g. bi-annual national workshops, significant competitive intra- or interfaculty grants for collaboration or sharing of resources etc.

- Research groups should strive to publish in the leading, more general journals. Too often, this is not the case.

- ***Doctoral students.*** It is of critical importance that the positions for doctoral students are directed to the best research groups. These positions should be distributed by competition, such that committees (faculty or Research Council), once or twice a year evaluate applications for such positions based on scientific quality of the doctoral project. Groups that are awarded fellowships can then select the most competent candidate. It is our impression that researchers in areas that appear comparatively weak, train a relatively high number of Ph.D. students. In the worst case this can lead to a perpetuation of non-competitive research environments.

- ***Postdoctoral career.*** A major problem influencing the attractiveness of the research training is the lack of a good organization of the postdoctoral career. There are few postdoctoral training positions, and furthermore they are in general not thought of as opportunities for training in laboratories other than these in which their doctoral training was received. In most western countries the post-doctoral training is intended to broaden the methodological and conceptual expertise of the postdoctoral student. It is strongly recommended to develop a postdoctoral training program. Too many scientists spend their whole career in one single department.

  A career consisting of assistant professor positions that can become tenured after a thorough evaluation would seem desirable. Tenured positions at associate and full professor level should normally be reached only at a stage when a candidate has a well established research record that is as a rule after 8 – 10 years. It is realized that in small countries like the Scandinavian ones, it is desirable to concentrate the resources to a few laboratories in each area. For that reason, it is even more important that the recent Ph.D.s receive training in other laboratories abroad or in Norway.

- ***Nonflexible funding system*** within universities/departments. It would seem important to develop a more flexible system in which a given university department/institute can use its resources for what is optimal in a given situation. In many cases it appeared difficult to create new technical positions when needed and abandon old technical staff that were not needed, for instance to create a new position as animal keeper, when a secretarial position is less needed. Similarly, as indicated above, the organization of academic positions would profit from being revised.

- ***Funding Basic Research.*** In general the funding for basic biomedical research in this area of biology appears surprisingly limited, whereas applied research areas like aquaculture receive very extensive funding. Many of the leading research groups in basic science complained bitterly, and seemingly justified, about the funding situation. They claimed to rely to a large extent on European funding. We had, however, some difficulty in evaluating the extent to which the complaints were justified. Some of the research departments, e.g. Bergen and Tromsö, had made a very complete record of their funding situation, whereas some scientifically prominent departments in other cities were, very surprisingly, unable to document their funding in a transparent way, although occasional members of the departments provided this information.

- ***Review committees.*** A number of scientists were unsatisfied with the evaluation process of the grant proposals directed to the Research Council of Norway. Whereas research proposals in the medical area are evaluated by a peer review committee, the proposals in the non-medical area are not. These applications were instead sent out to experts that rated a given application, but they saw only one application, rather than all proposals in a given field. The administrative staff of the Research Council then ranked the different proposals based on the individual reports. This would seem a very unsatisfactory process, since the wording of experts from different "scientific and national subcultures" may differ markedly. It is advised that also in this area one or more peer review committee is formed. In most countries the peer review system works in a very satisfactory manner. Measures can easily be taken to avoid problems that arise from a possibility that peer review members may see themselves as representatives for individual universities or fields of research (as claimed to be a problem in Norway), rather than being loyal to a system distributing funding to the best research groups.

Review of the individual research groups

University of Oslo

Faculty of Science
Department of Biology

Division of General Physiology

The staff of this department consists of 6 permanent academics, 2 technical staff and 3 Ph.D. students. Of the scientific staff, two (Fugelli and Døving) have passed 60 years of age. The department excels in electrophysiology/neurobiology/sensory physiology, and projects also include work on cell volume regulation, hearing in fish and molecular muscle biology. The panel was impressed by the clear structure of the current and future research efforts as presented by the departmental chairman and deputy chairman (Gundersen and Nilsson). The future of this unit remains reassuring.

Chemoreception in vertebrates

Description: The work of Kjell Døving (age 63) is focused on chemical communication between animals, mainly sensory systems in aquatic vertebrates. An important aspect of the work has been the functional organization of the chemosensory systems, and the anatomically distinct tracts involved in mating, feeding and alarm reactions. In later years, the group has also contributed to the physiology of the vomeronasal organ (Jacobson's organ). Also included in the scope of the group, is the homing behavior of migratory fish such as Atlantic salmon.

Evaluation: The group has several international links that spark collaborative work of good quality. The publication record is good, with twelve papers on record for the past five-year period, and the overall grade therefore ***very good*** to ***good***.

Cell volume regulation

Description: Kjell Fugelli (age 67) and his co-workers were among the first to study the mechanisms responsible for osmotic balance and volume regulation in individual cells. The work focused on amino acids, notably taurine, using fish erythrocytes as model. In later years, the work has come to include also mammalian systems (cell cultures). The work is strongly focused on, but also severely limited to, the taurine channel.

Evaluation: Dr. Fugelli currently supervises two M.Sc., but no Ph.D. students. The publication profile shows few contributions in the past five years, with only four papers in refereed journals (although these journals are of good standard) leading to an overall grade of ***fair.***

Molecular muscle biology in vivo

Description: Gundersen studies skeletal muscle cells which are plastic and where the electrical activation of the muscle fiber can induce marked specific phenotype expression. By injection of DNA expression vectors in single muscle cells or oligo-nucelotided to inhibit the synthesis of specific protein, attempts are made to identify genes or transcriptional factors critical for the adaptive response. Major effects have been obtained by over-expressing myogenin, which appears to be a transcriptional factor for inducting mitochondrial proliferation. In addition, studies on the role of neurogulines have shown that they do not only regulate genes coding for synapse formation, but also appears to induce muscle nuclei proliferation.

Evaluation: The group has powerful tools for their study of gene regulation in skeletal muscle, which they use to study essential biological questions. The group has successfully identified specific growth and transcriptional factors regulating gene expression in skeletal muscle related to muscle hypertrophy and to oxidative capacity. The overall rating of the current research is ***excellent***.

Sensory cells in fish

Description: Dr. Karlsen (associated with the physiology section) is involved in several disparate projects, but perhaps his most dominant occupation is that of running the Drøbak Station. Of the three papers listed for the period from 1994, two deal with the effects of infrasound on aquatic animals.

Evaluation: It appears that the major responsibilities of Dr. Karlsen lie in areas other than research, and the current scientific level is therefore ***not acceptable.***

Neurobiology and respiratory physiology of vertebrates

Description: Göran Nilsson took up his current position in Oslo (originally associate professor, later transformed to professor) about four years ago. Despite the fact that a move from Uppsala to Oslo may be expected to transiently decelerate publication rate, Dr. Nilsson's publication record shows no dips listing 37 publications for the past five years, most of which occur in leading international journals in the field.

The general theme of the research is a mix of neurobiology and respiratory physiology. Dr. Nilsson's work on the mechanisms allowing vertebrates to survive total anoxia is now classical, notably his work on the crucian carp (*Carassius carassius*). Rather than the "standard" vertebrate glycolytic pathway, where lactate is formed during hypoxia, the crucian carp produces ethanol in the slightly modified glycolytic pathway. In addition, the Nilsson group has produced first-class work on blood flow profiles in fish gills. The techniques used involve a novel water-immersion microscopy technique coupled with video recording. Using this ingenious technique, Nilsson and

his colleagues have been able to directly observe and record the branchial vascular responses to a number of putative regulatory substances, furthering the understanding of how fish regulate their functional branchial area during different demands. In collaboration with colleagues in his former department in Uppsala, Nilsson has investigated the role of, e.g. serotonin in control of behaviour during female-male transfer in the ballan wrasse (*Labrus berggylta*).

Evalution: The work of Göran Nilsson is characterised by both technical and conceptual elegance, and a strong driving force. He currently supervises eight M.Sc. and one Ph.D. students. Göran Nilsson is the co-ordinator of a strategic university program, which will allow him to further expand his activities. The overall grade for the work is ***excellent.***

Cellular electrophysiology and aquatic bioacoustics

Description: The most successful work of the group of Sand and Enger (emeritus) has been the electrophysiological properties of endocrine cells, studied with various classical electrophysiological techniques including patch-clamp. The group is relatively well equipped for the work. A second line of work is in aquatic bioacoustics, looking at the swimbladder as an auditory organ, and the functional role of the lateral line system and directional hearing.

Evaluation: The publication record is very good, although the scientific quality of work appears higher in the electrophysiology work than in the recent studies on infrasound detection. Overall, this group is rated as ***very good.***

In addition, two other research projects, run by staff associated with the division, were briefly presented, but not evaluated. A. Poléo study aluminum toxicity (funded by Statkraft S/F), and E. Reimers study influence of high voltage power lines on reindeer behavior.

Faculty of Medicine
Department Group of Basic Medical Sciences

Comments on the Departments of Anatomy and Physiology

The Panel was struck by the considerable scientific overlap between these two Departments: both have groups working on the glutamatergic synapse, and both have groups working on immunology. Given that they are located in adjacent laboratory space, the Panel felt that the division might be artificial. If they were to join forces, this would constitute a world-level ensemble in neuroscience, and could considerably strengthen and focus the effort in immunology. We felt that such a laboratory would also benefit from the election of a clear, scientifically eminent, head of department. This person could direct and coordinate the necessary internal changes (groups, personnel, choice of scientific themes, resources, teaching assignments) over the coming years. Furthermore, he/she could design and defend a shared fundraising program to ensure that the facilities available to these researchers reach the level of those in other departments where such a strategy has been implemented. This will necessarily involve a new system of accounting since, in spite of vociferous complaints regarding research effort from members of both the Anatomy and

Physiology departments, the Panel was not able to obtain figures for overall research funding (or indeed for most individual groups) in either of these departments.

Department of Anatomy

Neurocytochemistry

Description: Storm-Mathisen has had an outstanding track record over a long period, and has trained many young scientists, two of whom (Ottersen and Danbolt) are now Professors in their own right within the Department Group of Basic Medical Sciences. Danbolt's recent appointment in the Department of Physiology means that he and 7 other fellows/students will leave the group during year 2000. Their projects continue to be closely interwoven and collaborative, but it is expected that they will gradually separate, while remaining complementary. With Storm-Mathisen will remain 1 post-doc, 3 research students, 1 graduate student and 1 technician (40%).

Recent focus has been on the coexistence of glutamate and aspartate in glutamatergic nerve terminals (using amino acid immunohistochemistry), and on identifying glutamate and glutamine uptake carriers in astrocytes and neurons. This has been done by Storm-Mathisen's fellows Gundersen and Chaudhry, sometimes in collaboration with outside groups. Work from Danbolt is summarized elsewhere (Department of Physiology). Storm-Mathisen will continue his emphasis on the glutamine transporters, as well as using an approach in nematodes to at last identify the vesicular glutamate transporter. Furthermore, he will look at the potential effects of aspartate on glutamatergic neurotransmission. This continues to be focused, cutting-edge work.

Evaluation: Storm-Mathisen is an extensively cited biologist (7 articles since 1995 cited more than 25 times) at a world level, and will undoubtedly continue to make significant contributions. He uses collaborations in a strategic manner to generate high-level publications. The work of the group was rated as ***excellent.***

Molecular Neuroscience

Description: Ottersen and colleagues (Professor Rinvik, Haug; 4 postdocs; 5 Ph.D. students; 4 engineers) have built up a very impressive methodological repertoire in their laboratory consisting of cutting edge technology for analyzing in particular the glutamatergic synapse utilizing ultrastructural immunogold techniques together molecular biology and imaging techniques (2 photon confocal microscopy). The methodology allows a localization of different molecules, receptors, transporters in the pre-, and postsynaptic compartments at a quantitative level. They also have an organotypical tissue culture laboratory. In addition to glutamate synaptic transmission they have made very important contributions to the K^+ dynamics around the synapse, by documenting the presence of acquaporin molecules in glia cells and associated K+ channel subtypes. In addition to the relevance for basic neuroscience they also contribute to the important clinical problems related to brain oedema and ischemic cell death.

Evaluation: The group is very productive, and is publishing in the best journals in the field. They have a very extensive collaboration with excellent European and North American laboratories. The overall rating of Ottersen and his laboratory is ***excellent.***

System neuroscience

Description: Jan Bjaalie has built up an impressive methodological repertoire for 3 D reconstruction of the detailed neuroantomical organization that can be derived from utilizing different anatomical markers. His software is now used in a number of laboratories. The main interest is the pathways between the cerebral cortex via the pontine nuclei to cerebellum. He has initiated collaboration with several foreign groups with complementary expertise (neurophysiology, modeling etc) to address this field. By being able to implement the 3D reconstruction he has revealed a much greater specificity in the connectivity been the two structures. Jan Bjaalie continues the work on the organization of the cerebro-cerebellar pathways that his previous mentor Per Brodal had started. In addition he has collaborated with a number of groups that have utilized his skills to solve their specific systems-oriented problems from the insect brain to auditory pathways.

Evalution: Jan Bjaalie's particular strength is the neuroinformatics tools that he has developed, in combination with the focus on the cerebro-cerebellar pathways. His current contribution is very promising and has been rated as ***very good*** to ***good***. Per Brodal is currently reviving his research efforts after having been responsible for developing a new curriculum for the medical students.

Developmental neurobiology

Description: The group is made up of Professor Glover, 1 unpaid post-doc and 1 research student (50%). There are also 4 m asters students, and the group has access to help from 2 part-time technicians. The group is therefore too small to constitute a truly competitive unit, and the reasons for this were not clear to the Panel. Professor Glover travels often, which is obviously useful in running the group's many collaborations, but must further reduce the critical mass in Oslo.

The research of Joel Glover aims at understanding the normal and abnormal development of the nervous system, primarily the brainstem and spinal cord. His group has thus far focused on the study of gene expression in identified neuronal populations, axon outgrowth, and regeneration after prenatal spinal cord lesions. Glover has a very good record of regular publications, particularly concerning axon tracing of different peripheral and central projections within the spinal cord, and the role of retinoids in the spinal cord and hindbrain. Glover directs his research ward to the study of spinal interneurons, which have major roles in controlling motor and sensory function, but have been considerably less studied than motor or sensory neurons themselves, especially by embryologists. His project is entitled "Interneurons in vertebrate motor circuitry: development, anatomical organization and function". Its aim is to link developmental parameters of specific populations of interneurons with their subsequent localization, projection patterns and dendritic morphology. These will then be correlated with the function of each class, as defined by the neurotransmitter they express or by activity measurements *in situ*. This is clearly an important area of research for the coming decade, and one to which several major groups are directing their attention internationally. Given the lack of local resources, Glover's strategy is to collaborate with other groups worldwide.

Although few details were given, one example of a project in which Glover will be involved is aimed at identifying the embryonic origin of interneurons involved in the central pattern generator for locomotion. Goulding (San Diego) is making Cre-lox mice in which neurons having once expressed a given transcription factor (e.g. engrailed) will permanently express a reporter protein (e.g. GFP). The reporter will allow the subsequent morphology and projections of these neurons to

be determined. In parallel, Kiehn (Copenhagen) will use multiphoton confocal microscopy to follow rhythmic activity in interneurons labeled using dextran amines.

Evaluation: The intrinsic quality of this group is not in doubt, but the Panel was not convinced by the very wide-ranging strategy for the coming years. The text provided concerning the strategy (6 lines) was clearly insufficient, and far too general. It is undoubtedly true that understanding the relationships between molecular identity and cell function in CNS neurons will require a multi-disciplinary approach of the type outlined by Glover, and the group has been active in searching out high-quality collaborators internationally. However, we felt it important that the group focus on 1 or 2 specific projects in which they could play a central role; this would better allow them to affirm their own identity. Overall evaluation: ***Very good*** to ***good*.**

Immunobiology - NK-cell research

Description: This is a comparatively large group headed by two professors (Fossum, Rolstad**)** and one senior scientist (Maghazachi). In addition there are some postdoctoral students and about six Ph.D. students. The group is funded by the institute, the cancer fund, private foundations, and by the Research Council.

The focus of research is on receptors on NK cells that regulate their activity and their targets. The basic idea is that there are extremely complex multimers of receptors and that all members need to be identified. The interest in NK cells started from the anatomical characterization of a very rapid transplantation reaction and the realization that NK cells are involved. By comparing human and murine genome data the group has *cloned* human *orthologs of receptors* previously detected only in mice, and conversely. They have expanded the studies to rat, and even identified novel family members. The rat has interesting advantages of the classical experimental organism in immunology, the mouse: non-classical class I molecules possibly encoded by the NK-gene complex are present. One part of a cloning strategy has been to *breed novel congenic mouse strains* and to identify cross-over points. These mouse strains should also be valuable in studies of the role of NK cells in autoimmune arthritis and CMV infections. They have also *generated monoclonal antibodies to several mouse and rat NK cell receptor proteins* to be used e.g. to quantitate receptors, to examine receptor interactions with other proteins, and to study expression patterns. Conversely fusion proteins of receptors expressed in bacteria have been used to examine cellular proteins that might act as natural ligands. There are also plans to explore the signaling events starting with NK cell receptors and to examine how they interact with G protein receptors including those for chemokines.

Attempts are made to immunize against NK cells - generate monoclonal antibodies - identify thereby NK-cells specific molecules. This represents rather classical immunology. On the other hand, stated aims to clone novel chemokine receptors, which do not represent traditional immunology, are clearly not reasonable! The human genome will be available in a year or so and there are already some 30 orphan receptors with similarities to known chemokine receptors.

Evaluation: This is a successful scientific group that publishes in good to very good journals in the field and there are three papers cited more than 40 times. There have been several Ph.D. theses awarded, some of them of superb quality. There are clear research goals and the members of the group are well aware of the intense international competition. In fact several international collaborations are established. Although the group is of sufficient size to allow them to maintain a presence in this field of immunology, it is unlikely that this can be achieved if all the different research lines are followed up. Furthermore, in order to do truly competitive research in signal

transduction, which was one stated aim, new competence must be added. The overall rating is ***very good.***

Biological anthropology

Description: Professor Holck examines cremated bone-skeleton, using advanced computer reconstruction techniques. This expertise is also used for expert services in regard to identification rendered in criminal cases and after fire disasters. At times, two part-time researchers from outside the department pursue some research activities in the area of forensic medicine and osteo-archaeology. The group has had 3 visiting guest researchers within the last three years. A collection of bone-skeletons (the Schreiner collection) belonging to the University is placed at the department and Professor Holck is in charge of its maintenance.

Evaluation: Only little original research has come out from this group in recent years. The publications relate to folk medicine, shaping the development of the medical profession in Norway, and anthropological matters. Furthermore there are many contributions to medical lexicons. The service activities of Professor Holck are of importance in Norway, supplementing ordinary forensic medicine. The department should obtain permanent funding for the handling of the Schreiner collection in addition to the annual funding of the ordinary teaching and research activities. Moreover, the costs for the services rendered should not burden the ordinary budget of the department. The rating is ***fair***.

Department of Physiology

This large department (12 professors and one emeritus) had provided the panel with incomplete background material. The oral presentation was less well organized.

Visual processing in thalamus and cerebral cortex

Description: Paul Heggelund with Dr. M-C Perrault and 2 Ph.D. students is at present focusing on the detailed visual processing in thalamus. He has since the 1970ies worked on vision and the cortical cellular mechanisms that are used to interpret the signals arriving from the eye and produced a series of interesting studies. At present he has decided to take up a novel and demanding approach. Heggelund and associates will perform a detailed cellular analysis of the processing in thalamus by simultaneous recordings from presynaptic interneurones and target relay cells: In addition, they will use dual patch recordings of these neurons to analyze the processing taking place in the dendrites. These experiments are conducted on slice preparation, in vivo and in the form of mathematical modeling in collaboration with G. Einevoll. These new projects are of critical importance for an understanding of the intrinsic function of thalamus and visual processing. The group is recommended to continue this approach and should receive appropriate funding. The overall rating is ***very good***.

Long term potentiation, hippocampus and memory

Description: Per Andersen (born 1930) and his research associates (Hvalby and 6 additional collaborators) continue to play a leading role in elucidating the molecular and cellular mechanisms in activity-dependent hippocampal synaptic plasticity. They have close collaboration with leading laboratories such as those of Bert Sakmann, Peter Seeburg, and Paul Greengaard.

Evaluation: Per Andersen's contribution continues to be ***excellent***, being a leader ***in this dynamic field, which he has initiated.*** It is recommended that that the group receives continued financial support from the Research Council at a high level.

Cellular neurophysiology - potassium channels

Description: Professor Johan Storm has a research group consisting of 3 Ph.D.-students and 1 - 4 postdoctors. It was established in 1997. Storm has for many years worked in the previous department of neurophysiology. He is a well-established expert on ion channel function, particularly in hippocampal neurons and the role of different subclasses of potassium channels. The impact of modulation of different subclasses of ion channels is in the focus of interest, as well as synaptic physiology including plasticity and a computational approach to somato-dendritic processing. Storm has established collaboration with a number of leading research groups in Europe and United States. He is a coordinator of one EC grant, and participant in another.

Evaluation: Storm is in the process of building up a new excellent laboratory with a variety of novel and powerful techniques. Their current activity is rated as ***very good.***

Glutamate transmission

Description: Danbolt has worked for many years within the group of J. Storm-Mathisen, but was recently appointed Professor in the Department of Physiology. He will move there with 7 collaborators once equipment and space become available, but set-up funds are severely limited, and so the timing of the operation is still not certain.

Within the Storm-Mathisen laboratory, Danbolt has been very productive. He was the first to purify a glutamate transporter; these molecules play several different roles in removal or uptake of glutamate by different cellular partners at the glutamatergic synapse. In recent years, he has been senior author on several excellent publications produced by his research students. He has also managed well an intricate collaboration network internationally.

The future strategy was exceptionally well structured and presented. It was centered around four clear scientific questions concerning the regulatory role of glutamate transporters in synaptic function. The experiments proposed take advantage of the rather unique expertise of Danbolt in handling and purifying these membrane proteins, and were nicely integrated into a hypothetical scheme.

Evaluation: This is clearly first-class work, and Danbolt has the potential to become a strong independent researcher. The role of glutamate transporters in different aspects of synaptic function is a good choice for development over the coming years. Nevertheless, it will be important for Danbolt to fund his laboratory correctly if this is to be competitive. The transporter EAAT2 is

strongly implicated in the neurodegenerative disease amyotrophic lateral sclerosis (ALS), and there is much need for high-quality basic/applied work of the type Danbolt could supply. The Panel recommends that a part of the project be oriented toward ALS; this could open several avenues of funding. Overall evaluation: ***Very good.***

Establishment and maintenance of neuromuscular junctions

Description: The group is currently made up of Terje Lømo (b. 1935), Professor A. Njå, 1 post-doc, 2 Ph.D. students and 2 engineers (50%). Three postdoctors and 1 Ph.D. student, responsible for some of the work presented, recently left.

The group works on different aspects of establishment and maintenance of the neuromuscular junction. Recent productive areas have been: labeling and molecular characterization of different motoneuron subpopulations within the spinal cord, new methods for gene transfer into adult muscle, role of CGRP in maintenance of neuromuscular junctions. A particular emphasis has been placed on molecular manipulations of the components of the nerve-muscle system. Particularly striking results were presented to the Panel concerning a potential role for muscle agrin (which is not involved in clustering of acetylcholine receptors) in organization of the cytoskeleton of the muscle fibre. The patent on the muscle electroporation technique for gene transfer has already been granted in the US, and licensing negotiations are underway with several pharmaceutical companies. The strategy for the coming years is to focus on different uses and applications of the electroporation technique. This will involve in particular using the technique as a means of immunization, for tuberculosis (collaboration UiO) and autoimmune disease (UiTø).

Evaluation: The Panel were impressed to see the degree to which this group, which has a long-standing world-wide reputation, has invested itself in modern cutting-edge technology and new mechanistic questions concerning the formation and stabilization of the neuromuscular junction. Lømo has been very successful in attracting external grant support and in setting up collaborations with partners abroad. Although not all new approaches have yet formed the basis of published articles, the data presented to the Panel were of considerable novelty. The decision to put emphasis in the future on the patented gene transfer technique seems a good choice. Concerning the future of the group, however, the Panel were concerned with the recent publication record of Professor Arild Njå, mentioned as co-leader of the research group, and it was not clear to us how he will contribute to the group's work over the coming years. However, this did not prevent our overall impression from being very positive. Overall rating: ***Excellent.***

Cardiovascular and respiration physiology

This research group consists of four professors, T Berg, A. Hauge, G. Nicolaysen, and L. Walløe, who, however, work independently. The research topic is the regulation of the systemic blood flow and its distribution to as well as within various organs and tissues of different species including humans.

Critical for the success of Professor L. Walløe's group has been the development of methods that can be applied to intact (conscious) animals or to humans. In particular the Doppler technique to measure red cell velocity in various vessels combined with ultra sound measurements of vessel size have opened for novel studies of old problems not only of descriptive nature, but also of the reflex regulation of heart rate and peripheral resistance of various vascular beds. The very high time

resolution offered by the Doppler technique is a critical asset for these studies. The very first studies describing the systemic blood flow and its distribution to various organs of the human body was provided by this group. The mechanisms for the resetting of the operative blood pressure of the baroreceptors is studied and so is the reflex control of peripheral resistance induced by the low pressure mechano- or baroreceptor system.

Professor L. Walløe has, together with various collaborators in his group and especially Dr. Morten Eriksen, pioneered the development and use of the Doppler ultrasound techniques to obtain quantitative measurements of blood flow velocity and vessel size in intact humans. This work was unique. Thus, ***the group has made excellent contributions*** to the understanding of cardiovascular regulation in intact humans, but their role is not limited to that. With their work they have stimulated and guided others in the field outside their own institute, thereby revitalising the studies of cardiovascular regulation in intact animals, including humans. The present overall rating is ***very good***.

Professor G. Nicolaysen and his collaborators have during the last 10-15 years studied the heterogeneity of the blood flow distribution within a tissue. In the early phase, skeletal muscle was studied by combining microsphere measurements with determinations of the glucose uptake by the muscle. They demonstrated heterogeneity both in the distribution of the blood flow and the metabolism of the muscle fibres. The functional consequence of this mismatch was also evaluated. In more recent years the focus has been on the lung, studying the non-even distribution of perfusion and ventilation. This research has a clinical angle evaluating the role of posture in positive pressure breathing. The early work of Professor G. Nicolaysen and collaborators on skeletal muscle still comprises some of the best studies performed in the field. The present work on the lungs is stringent. However, due to the administrative burden on Professor Nicolaysen, being head of the basic science departments, the publication rate is low although the work performed is still of ***good*** quality.

Professor T. Berg has over the years had a keen interest in the regulation of the blood pressure resulting in several good publications. Due to illness, the research activities have been hampered and the current research is ***not*** of an ***acceptable*** standard.

Professor A. Hauge has a very diverse research interest, ranging from ecosystems in the Amazones to human body reaction to severe hypoxia. The studies are descriptive in nature and the approach is superficial with no attempts to deepen the studies in order to clarify the regulatory mechanisms. This reduces the value of the work, which is ***not*** regarded as ***acceptable***.

Cell physiology and calcium signaling

We have grouped together two small groups: Cell physiology work is concentrated on hematology in the group headed by Haakon Benestad. This group has 2 skilled technicians, but currently no students. It focuses on experimental hematology: Differentiation of stem cells towards functional neutrophils; Functional responses of granulocytes and several collaborative projects. For example there are collaborations between Benestad and the group at the Department of Anatomy. Even within the department there are boundary-transgressing collaborations such as en examination of the role of nerves in regulating stem-cell maturation and bone marrow function and studies of vascular effects of lymphocyte factors.

The limited size of the group means that interactions with other groups are required in order to generate meaningful results. However, this also means a very scattered approach to science. It is

clear that most of the scientific output has rather low impact. Probably a focus on *some* of the ongoing collaborations would increase the chance of significant major findings. The overall evaluation is ***good***.

Calcium signalling is represented by a small group headed by Jens Gustav Iversen. The group is largely technique-driven, but the research can be divided up into four areas: a) Priming and stimulation of Neutrophils - especially effects of γ-interferon; b) Intracellular Ca^{2+} signals induced by coagulation factors; c) Ca^{2+} signalling in T-lymphocytes; d) Ca^{2+} signaling in growth stimulation of hepatocytes. The group has published two high impact papers in JBC (cited 59 and 25 times)related to problem b), but neither first nor last name in list of authors belong to the group. The two next most important publications are together with Thoralf Christoffersens group (problem area d), and again the important positions in the list of authors come from that group. The papers that originate directly from the group have a much smaller impact, but the studies of the effects of γ-interferon are potentially interesting, but elucidation of signaling mechanisms would require inclusion of several additional techniques - and hence collaboration with other groups.. The group thus has good technical competence in the Ca^{2+} area, but in order to fruitfully study important problems it must interact closely with other teams. It therefore does not stand well on its own but would be a valuable partner in joint projects involving several research groups with complementary methodology. Overall rating is ***good.***

Faculty of Medicine
Institute Group of Oslo Municipal Hospital

Institute for Experimental Medical Research

The institute has provided the evaluation groups with good written background material, which together with the oral presentation has given a good insight into the present status of the institute, the on-going research and the plans for the future. The institute comprises four research groups with some 30-35 people at the institute working fully in research with the academic staff also being involved in some teaching of medical students. The financial situation of the institute is acceptable. However, most of the funding is annual, which does not favour long-term planning and initiatives. Although this is the case, the present head of the institute, Professor Ole M. Sejersted has since he started at the institute made a major reorganization with improvements of research facilities and recruitment of new staff with a good background in gene and molecular techniques. Since the establishment of the institute, half a century ago, the contribution from the Jahre Foundation has played a special role. Approximately half the funding comes from the University and the Hospital and the other half from various external sources.

The research focus of both Professor Ole M. Sejersted and Dr. Geir Christensen is the failing heart, which makes it natural to describe their research together while Professor Arnfinn B. IIebekk is studying the dysfunction of the heart after acute ischemic exposure. Professor Morten G. Ræder investigates pancreatic-biliary secretion.

Cellular and molecular biology of myocardial hypertrophy and heart failure

Description: For many years the leader (Sejersted) of this group has worked with the function of the Na, K-pump in the excitation-contraction coupling both in the heart and in skeletal muscle. In previous years this work was to a large extent directed to explain the mechanisms behind skeletal muscle fatigue, which is still an issue. The improved treatment of patients with coronary disease and myocardial infarcts has increased the number of patients with heart failure. It is estimated that in Norway alone there are 100.000 patients suffering from chronic heart failure (CHF), which makes the mechanisms underlying the development of CHF an important clinically related research area. The research interest of the institute has therefore been aimed at this topic in recent years, focusing upon the initial mechanisms by which the myocardium starts to fail due to overload with an emphasis on E-C coupling and myocardial hypertrophy. Using rat and mouse models the main strategy is to work at the gene level and identify critical genes and evaluate functional significance of phenotype expression. A special emphasis is put on mechanisms by which the Na, K-pump is regulated in the healthy heart and the alterations which may initiate and bring about the failing of cardiomyocytes. In regard to the SR-system, Ca-ATPase kinetics and phospholamdan are being studied to evaluate the role of a changed SR-function in various phases of development of the failing myocardium. Genetically modified mice will be used in this work. In addition, signaling molecules of importance in repair and myocyte growth are searched for, where cytokines and especially IL-6 are key candidates to induce hypertrophy.

Evaluation: Ole M. Sejersted has throughout his career produced top level science. While being heavily engaged in revitalising the institute he has been able to maintain his quality of research although the number of publications may have decreased. Important has been the recruitment of Dr. Geir Christensen as senior scientist and Dr. Kristin B. Andersen as post-doctoral fellow. With their training in molecular cardiology they will supplement the institute's previously well-established electrophysiology and in-vitro and in-vivo physiology techniques to evaluate heart and skeletal muscle function. The success of this group will depend upon how good their experimental/animal model is and upon the quality of the physiological evaluation of induced interventions. It is the impression of the panel that the focus is presently much on the gene technologies, but the precision and the depth of the physiological measurements has to be improved to maintain a top rating. The overall rating of the research activity is therefore ***very good*** and the potential is there for harvesting in the near future of the well considered investments in researchers and equipment.

Cardiovascular hemodynamics and metabolism

Description: Professor A. B. Ilebekk heads this group and they study the response of the myocardium to repeated exposure to ischemia. The model is the heart of the pig. Three conditions have been described as an effect of exposing the myocardium to acute severe hypoxia. The conditions are named: stunning, preconditioning, and hibernation. The first condition implies general myocardial dysfunction whereas the second condition includes reduced oxygen demand, thereby causing less irreversible damage due to the ischemia and in the third condition, the metabolism is being further reduced and the cardio-myocytes can resist lack of oxygen supply for an extended period of time. In explaining the phenomenon, the focus is on the role of ATP sensitive K^+ channels, adenosine, and NO. More recently possible beneficial effects of "transmyocardial laser revascularization" have been investigated, as well as the mechanisms by which they may work.

Evaluation: The work on the ischemic heart is of clinical importance and the research of the group has significantly contributed to the description of the myocardial response to acute ischemia. This

group has also contributed at the mechanistic level, however, there are only few results that have made any real impact in this highly competitive field. The overall rating is ***good***.

Cellular and molecular mechanisms of pancreatico-biliary secretion

Description: This small group is headed by Professor Morten Ræder and has two MD graduate students and one technician involved in the studies. The research starts from the observation that hepatocyte canalicular membranes despite being continuously exposed to bile acids that can solubilize phospholipids rarely suffer from structural damage. However, damage can occur and eventually result in cholestasis. As an experimental model the group uses bilirubin overload in pigs. By examining this model the group hopes to identify important pathogenic mechanisms in cholestsis. Effects of bilirubin infusion on bile acid and phospholipid secretion (including which phospholipid species are secreted) will be studied. To study P-glycoproteins antibodies will be used in Western blotting and in immunohistochemistry. Bilirubin overload not only leads to structural damage identified by EM, but perhaps also to alterations in mdr2(3) P-glycoprotein, which is a PC flippase expressed only in canalicular membranes. They also examine how cholic acid infusions may inhibit these effects of bilirubin.

Evaluation: This group must be lauded for their ability to perform interesting, albeit not high impact work, in parallel with heavy surgical duty. It is also an example of research that is directly inspired by a clinical problem. Overall rating is ***good***.

Faculty of Medicine
Department Group of Laboratory Medicine

Institute of Pathology

Laboratory of Toxicopathology

Description: The group of Huitfeldt and Skarpen studies the early processes during tumor initiation and the clonal expansion of these cells during promotion in PAH-induced hepato-carcinogenesis in vivo and in vitro using acetaminofluorene in several initiation-promotion models. The inhibitory effects of many tumor promotors have been studied in primary hepatocytes from normal rats and from foci of AAF-treated rats, which have been synchronized by EGF. After establishing techniques to identify expression and function of enzymes and proteins like HSP involved in differention regulation in individual cells, EGF-receptor activation, expression of intracellular signal transducers through MAP-kinase have been studied in vivo and in vitro. There are plans to develop EM and cytometry besides transfection techniques.

Evaluation: The group studies mechanisms regulating cell proliferation during hepato-carcinogenesis. Sophisticated and up-to-date techniques are used. A sabbatical with Dent in VA is planned, but should have a more specific scientific goal than simply learning transfection. The results are published in peer-reviewed international journals. Professor Huitfeld plans to study the role of tumor suppressor genes like p53 in hepato-carcinogenesis and the possible trafficking of

activated EGF-receptor and its down stream effector erk via the skeleton are interesting goals of future research. The great variety of research directions should be focused on specific aspects of growth regulation in initiated cells during promotion. Huitfeld should seek close cooperation with Christoffersen in mitogenic signal transduction. The panel felt less enthusiastic about the project to link up with a neurobiology group that studies mechanisms of apoptosis induced by oxidative damage, as this would create even greater problems of focus. However, technical collaboration on aspects lacking in the Huitfeld laboratory e.g. transfection would be useful. Overall evaluation: ***Good***.

Department of Pharmacology

This traditionally very strong pharmacology department has suffered from isolation from potential collaborators and from an excessively top-heavy personnel structure. They provided us with quite satisfactory background material and gave a clear presentation.

NMDA receptors in human brain

Description: Historically the focus on signal transduction aspects in the department, and in Norway, depends on the fact that Ivar Øye (born in 1931) was one of the first postdoctors in Earl Sutherland´s laboratory and brought this thinking to Scandinavia. Over the past several years he has directed his research on *NMDA receptors in human brain*. He has used ketamine as a tool to probe these receptors and their role e.g. in pain.

Evaluation: The initial papers were of considerable interest, but recently the activity has been declining, partly because of limited funding. The overall rating is ***good.***

Adrenoceptor-mediated regulation of heart function

Description: This group is headed by Jan-Bjørn Osnes and his former pupil Tor Skomedal and focuses on examining the role of α_1 adrenoceptors in heart function. There is one postdoctoral fellow and some part time technicians. The group was leading in this field for many years - and the fundamental discovery is theirs - but have been unable to keep up with the international competition due to very limited resources and heavy commitments to teaching and community services. Of particular interest in the more recent work are studies on the mechanisms by which α_1 adrenoceptors influence the Na/K/Cl co-transporter. Of potential clinical significance are studies of α_1 adrenoceptors in human hearts.

Evaluation: This group continues to publish well-performed studies, but only rarely in high impact journals. In fact, their papers are surprisingly poorly cited. The basic questions are important. Overall rating: ***Good***. However, some methodological rejuvenation is needed in order really to prove the postulated signal pathways. Such rejuvenation may need new funding and new expertise at the post-doc level.

Mitogenic signal transduction

Description: The group of Christoffersen and Sandnes is the largest and best-funded group of the three. It examines, in competition with some of the worlds leading signal transduction groups, the signaling pathway from the EGF receptor and how G protein coupled receptors may generate mitogenic signals alone or together with EGF receptors. They have been very important in establishing cell culture methodology and signal transduction work in Norway. They will further develop the primary hepatocyte culture method. They have started microinjections and also attempted to use ribozymes in disrupting specific signaling molecules. Regarding the signaling from G protein coupled receptors there is a focus on lipid signals. In particular they will study DAG generation from PLC and the role of different phospholipases.

Evaluation: This group is very knowledgeable and has a good track record. It publishes in good and sometimes excellent journals. The papers are reasonably well cited. The group is well recognized internationally as attested by a good international network of collaborators. The overall rating: ***Very good*.**

Overall recommendation: There is a high level of competence at this department. In order to make sure that this is not lost when some of the professors retire, positions at the level of junior faculty should be created. This new competence could also ensure the methodological broadening that is needed.

Institute of Cancer Research
Department of Environmental and Occupational Cancer

Description: This department has extensive advisory activities for national and international committees, as well as teaching responsibilities at the University of Oslo and the Norwegian Veterinary College. The advisory tasks include studies on mechanisms of carcinogens, development of systems for classification, potency grading of carcinogens, and quantitative risk assessment of human exposure. They also serve as expert witnesses in court cases. The research focuses on SHE (improvement of method) and studies of gap junctions in carcinogenesis, as well as further development of methods (scrape loading/image analysis, GJIC screening for toxicity, flow cytometry) especially for non-genotoxic carcinogens. The specificity of this test system is considered high although the panel questioned the approach of just comparing data without considering mechanisms. Additional studies on connexins include identification of kinases and phosphatases that act directly on connexins, identification of the role of connexins in the Golgi apparatus, of accessory proteins and SH2, SH3- and WW-domain proteins) that may bind to specific sequences of Cx43 and other Cxs proteins.

Evaluation: The group of Sanner, Rivedal, Mikalsen, and Cruciani is relatively small and spends about 50% of its time on advisory activities. The improvement of the cell transformation test is relevant as well as mechanistic studies on the involvement of gap junctions in the dedifferentiation process during carcinogenesis. Considering the acceptable publication list and the expected outcome of the planned research on gap junctions, the overall evaluation is ***good***.

Faculty of Medicine
Institute for Clinical Medicine

Institute of Surgical Research

General description: This institute has a long history of transferring basic science to a clinical setting and no less than 100 students have obtained their Ph.D. equivalent from the institute - of these 6 in 1999. From different public and private sources the institute has generated very good funding. In 1999 close to 31 full time equivalent employees were connected to the institute. Of these 4.4 full-time scientists are financed by the university and the hospital. Besides this - as far as we could evaluate from material given to us upon request - about 5 MNOK is obtained for running costs. Thus the funding compares extremely positively to most other research institutions evaluated.

General evaluation: The evaluation committee was not given material that allowed a general evaluation of the scientific activities either in the written pre-circulated material or during the oral presentation. In the yearly report several of the publications listed as emerging from the institute appeared from the material available to us to be published by scientists associated with other institutions. From the CV's circulated to the committee members it appears that the average quality of the science range ***between fair and good***.

Description: One of the projects, headed by Dr. Hårvard Attramadal, could, however, be evaluated based on the oral presentation and the pre-circulated CV. It is concerned with mechanisms of cardiac failure. It was known that endothelin is one factor that participates e.g. in the process where myocardial stretch is translated into a stimulus for cardiac myocyte hypertrophy. Attramadal and co-workers have demonstrated that Endothelin-1 mRNA is also increased in ischemic heart failure in rats in a well-cited paper. They also show induction during congestive heart failure. Other studies including examination of adrenomedullin expression during ischemic heart failure and use of echocardiography can be used to study rat heart function are also being published.

Evaluation: This appears to be a promising group in molecular cardiology: They have the methodological ability and a good animal model. The fact that the group started only recently and the paucity of material for evaluation makes it difficult to rate this group higher than ***good***. In an environment with creative scientists pursuing related questions it is possible that in the future the rating might be higher.

Overall recommendation: Given the fact that this institute is receiving a substantial part of the budget for Norwegian Biomedical Research and yet could not be properly evaluated it is suggested that a special evaluation committee should be set up. It should be composed not only of specialists in the field, but also of representatives from each of the sources of major funding.

Faculty of Dentistry
Institute of Clinical Odontology

Section of Dental Pharmacology and Pharmacotherapy

Description: The Section is headed by Professor L. Skoglund. The research activity is focused on pain, and pain after major or minor oral surgery is a classical model of clinical drug testing. It is used in evaluation of every anti-inflammatory drug. Skoglund has started a company to perform such clinical studies - an activity outside the university framework. Thus, the research is focused on clinical trials and on models for preclinical screening for early drug screening. He is involved in several - even money generating - activities outside the university setting both in Norway and abroad. There is one other group, which is headed by Professor P. Løkken**.** He has clearly contributed very much to awareness of the pharmacology in the dental community - even outside Norway. He has published three scientific papers since 1995. One of these is published after 1998 and appears to be a review article.

This is a small section that has not received any external grants over the past five years. There is support for clinical trials from industry and the activities rely on collaborations with other research institutions including the department of pharmacology in Oslo. The handout material was informative and the oral presentation revealing.

Evaluation: Although Skoglund and Løkken have published extensively, the bulk of the studies reported are minireviews for dental practitioners. In addition Skoglund has published some of the results from the extensive - largely non-university based - clinical trial activities. These activities are important, but are not strictly scientific. The unit is very small. This presents a real problem in terms of critical mass for science. Furthermore, the need for a separate unit to study "dental pharmacology" is unclear. Drugs do not act differently according to whether they are given by dentists or physicians, in particular actions of analgesics are not fundamentally different in these different patient groups. The fact that there are differences in the curriculum for medical and dental students is a very poor reason for establishing parallel research structures. Similarly, the heavy involvement of the head of the unit in non-university clinical trial activities cannot be construed as an argument for the need of a special university section. ***A merger with other pharmacology units is strongly advised.*** Overall the recent scientific impact has been low. Hence our overall assessment of the science performed by the section is ***fair to unacceptable.***

University of Bergen

Faculty of Science
Department of Fisheries and Marine Biology

Aquaculture group

Description: The work of the group of Møller, Pittman, Stefansson, and Vikingstad comprises basic science mixed with applied research, aimed at the development of aquaculture of economically interesting fish species (Atlantic halibut, Atlantic salmon, turbot, cod). The focus is on reproduction and growth, smoltification, larval development, and food quality criteria. Future increase of the number of commercially interesting species is to be expected. The scope of the research and techniques utilized are not unique (light regimes, temperature, recording of various physiological parameters), but put to good use for the questions addressed.

Evaluation: Panel 2 of the evaluation assessed the activities of the "Aquaculture group" only, and the general status of the group within the Department of Fisheries and Marine Biology at the University of Bergen cannot be estimated. However, there appears to be present the more general problems facing rather (or very) small groups, with internal struggle for meager resources. A significant expansion expected over the next few years. The group has good national and international links, and shows a good publication record in journals relevant to aquaculture and fish biology. The group should keep up its established links to the national and international partners. Of particular importance is the interplay with the similar activities at the Department of Marine Research in Bergen. Overall, the research activities of this group are ***good***.

Faculty of Science
Department of Zoology

The Anatomy and Environmental Physiology sections

Description: The sections of anatomy and environmental physiology within the Department of Zoology are considered together. Anatomy has one professor (Kryvi) and one associate professor (Totland), and one unfilled position. Environmental physiology has two professors (Brix, Fyhn) and one associate professor (Rønnestad).

The research of these departments overlaps extensively and centers on fish biology: embryology, development, hemoglobin function, oocyte hydration, development of digestive capacity, and metabolism. This research involves collaborations within these two departments, other departments within the Department of Zoology at the University of Bergen, other institutions within Norway, and international institutions. A new initiative from the University of Bergen, "The early life of fishes" provides a clear focus for research. The applied aspects of this initiative represent both a

potential benefit to the aquaculture industry and a potential detriment to the creative directions that might be chosen by individual investigators.

Evaluation: Although collaborative efforts have been established with the molecular department, the professors in these departments have not been as aggressive as they might be at employing molecular techniques that are currently being used in anatomical and physiological research elsewhere in Norway and Europe/North America. While the publication rate of various individuals appears adequate, the quality of the journals in which some papers are published is less than desired. The faculty do not appear to have established goals to increase their international visibility; they seem content with the status quo. These two departments share equipment that is rapidly becoming outdated. The most urgent need for resources are new equipment, especially electron microscopes, and culture facilities for fish larvae. Problems with recruitment center on the inability to fill the open position in anatomy and with the lack of competitive salaries. Overall evaluation: ***Fair***.

Faculty of Medicine
Department of Physiology

After its start in the 1960's the department has gradually developed into a significant research institution that has contributed primarily in the fields of interstitial fluid exchange/pressure regulation, secretion and neurophysiology. The written material gave a good description of the research activities of the groups presently active in the institute. This was supplemented with well thought through plans for the future. Within the next 5-10 years half the senior staff will retire (~6 professors). To meet this challenge, plans have been made in regard to future research topics, need for equipment and above all, recruitment of top level staff. In parallel the institute will within the next two-three years move into a new research building. The major unifying research topic has been discussed/decided to be "intercellular communication". This is followed up by plans to merge the existing 7-8 independent groups into 2-3 larger groups. Problems are foreseen in regard to the recruitment of top quality researchers both at the junior and the senior level. To be competitive in attracting good researchers and the researchers-to-be, a special program has been worked out. A package will be offered to incoming senior scientists which includes funding to hire a postdoctoral fellow and a Ph.D. student, start-up money for equipment and running expenses for the first years after arrival. Efforts are also made to be allowed to initiate the recruitment well ahead of the anticipated vacancies so that the successful applicants can be part of the final adjustments of the new laboratory facilities and have an input on the equipment investments (~20 million NOK).

Interstitial, renal and circulatory physiology

Description: Professor Knut Auklund (age 70, now retired) has formed this group. His work on fluid and substrate exchange in the interstitial space and the regulation of interstitial fluid pressure is world renown. The work expanded to kidney physiology with studies on blood flow to the kidneys, glomerular filtration, and movement/transport of macromolecules. Research activities within these areas still persist. Professor Reed has continued the work on interstitial space physiology primarily working on connective tissue. Together with Dr. H. Wiig, they have moved

the focus to inflammatory response where the regulatory role of integrins is investigated as well as other compounds such as prostaglandins.

Together with Dr. Tenstand, the work on glomerular filtration also continues at a good level. Methods have been developed to measure glomerular filtration rates with high accuracy of local and total filtration rates, respectively. This has made it possible to elucidate regulatory mechanisms and dissociation and possible differences, comparing superficial and deep parts of the cortex. In addition to evaluating the role of various hormones and compounds known to affect the blood flow, special attention is paid to the role of the permeability of selected small peptides for the filtration rate and its composition. The work on the regulation of the blood flow to the kidneys has ceased.

Evaluation: The work on connective tissue inflammatory response is of great interest. It has attracted international attention as well as good external funding from national sources and from EU and Industry. The collaborative work on fibroblasts and reticolocytes using cell culture and biotechnological techniques appears to be most promising. The present work is ***very good*** to ***excellent*** and the prospects for the future are very good, especially if the plans for recruiting new staff members come through. The work on the mechanisms by which glomerular filtration is regulated is of ***good*** quality.

Oral physiology

Description: This group is headed by Karin J. Heyeraas. She is also the current head of the department. One interesting problem under study is the mechanisms underlying pain occurring at sites of hemopoesis. The idea is that the pain related to pressure changes affects blood flow and capillary filtration and secondly also nerve fibers. While this may be true, the role of cytokine-related factors could be important as well as stem cell maturation. This group also studies the release of neuropeptides from sensory nerves and their vascular effects. Moreover, they have made the interesting observation that there is an effect of recruitment of immunoactive cells and that the neuropeptides appear to induce a trophic response.

Evaluation: The publication record is reasonable given the small size of the unit and the administrative duties of the section leader. Publications appear in some of the best journals related to oral biology, which render the group an overall ***good*** rating.

Neurophysiology - Synaptic plasticity, memory and hippocampal function

This group of Bramham and Srebro utilizes a variety of different techniques to address the question of memory storage and the role of hippocampus. Their techniques range from molecular and cellular approaches to chronic recordings of neuronal activity in behaving animal. One focus is the role of the growth factor BDNF for synaptic plasticity studied in brain slices from control and transgenic animals with a conditional knock out of the gene for BDNF. The different cellular and molecular mechanisms used to induce long-lasting changes of synaptic function is central to understanding memory storage in the nervous system and is addressed in an interesting way. This approach is complemented with in vivo experiments of LTP, and recordings from multi-site electrode arrays with many recording sites from each electrode. These electrodes allow recording and stimulation in vivo and analysis of activity during different behavioral paradigms. The group is well funded and coordinates an EU grant. The group is rated as ***very good***.

Neurophysiology - Pain research

Hole (born 1932) and his group have a long standing interest in pain mechanisms and the role of different aminergic modulator systems. Currently there is a focus on spinal transduction of pain transmission in the dorsal horn, and on different mechanisms of synaptic plasticity. The group is very productive and also rather well funded. Hole coordinates an EU grant on dorsal horn mechanisms. A. Tjölsen was not present for interview. Hole's group is rated as ***very good*** to ***good.***

Sleep physiology

Reidun Ursin's (born 1933) research group consists of a senior postdoctor and a senior consultant in child psychiatry (Ph.D. student) and technical staff. It investigates the physiology of sleep by a combination of methods including EEG recordings combined with microdialysis in different regions of the brain in different sleep stages in animals. The group is well funded nationally and is rated as ***very good*** to ***good.***

Cell physiology

This section of the department is headed by Guldborg Serck-Hansen Søvik (age 66) and Karen B. Helle (age 65). Both groups are small with one technician and occasional junior scientist (Ph.D.) positions. They try to collaborate closely. Five research degrees has been awarded in the past five years.

Karen B. Helle is internationally known for her pioneering work on catecholamine storage particles. Her work is now directed to effects of released chromogranin on endothelial cells as well as on the way that these proteins pass through endothelial barriers. An N-terminal domain of chromogranin was shown in 1994 to dilate arteries and was called vasostatin. They might act by activating K^+ channels, but the mechanism is unclear. Future studies involve structure activity relationships and further analysis of mechanism of action. Despite the fact that her group is very small Karen B. Helle has published several papers in the most recent years. Some of them have appeared in good journals. Her overall achievements are ranked as ***very good*** to ***good***.

Guldborg Serck-Hansen Søvik will also be involved in the study of effects of vasostatins. She also works on insulin effects in chromaffin cells. Thus she is studying the combined effects of two major stimuli - insulin and choilinergic agonists. Their interaction at the level of IEG and catecholamine synthesis is investigated. Another area relates to comparative studies of glucose and amino acid transport in these cells. All together some 7 papers were published since 1994. The papers appear in good, and sometimes very good journals in physiology. Rating: ***Good.***

Medical Image Analysis and Informatics

Also administratively attached to the Department of Physiology (but in fact having little interaction with it) is a section working on functional magnetic resonance imaging of the brain (FMRI) and on image analysis. It is made up of 1 professor (20%) and 1 associate professor, Taxt and Lundervold. They publish fairly regularly, but in specialized journals. The small size of this section is worrying for its continued survival, and in the absence of more information, its prospects can only be judged as ***fair.***

Overall recommendation: The Department of Physiology intends in their long term planning to reduce the number of research groups, in order to gain in strength and in critical mass. The department plans that one out of two research foci will be in neurophysiology. It is recommended that it is centered around mechanisms of synaptic plasticity and memory with work on different organizational levels from the molecular and cellular to the systems and behavioral level.

Faculty of Medicine
Department of Pharmacology

Homocysteine

Description: All the research of the department is focused in a Homocysteine LOCUS. A LOCUS is a group identified as having unique resources and clear long-term potential. It is headed by Per Magne Ueland and in addition has four professors - Helga Refsum, Ernst Lien, Grethe Tell and Stein Emil Vollset (the latter two are not at the department) - two associate professors including Einar Solheim, who acts as departmental chairman.

This research has developed from basic research and the development of unique research tools into patient based and epidemiological clinical research. The research is centered around: a) development of precise methods to measure key variables in patient materials; such as laser-induced fluorescence (LIF) with a customs built super5-sensitive detector developed. This has developed into a multi-injection capillary electrophoresis coupled to LIF useful for genotypic screening of large patient materials. b) Experimental studies on folates, vitamins B12, B6 and B2. The group has shown that Hcy predicts folate deficiency and that the levels are also controlled by anesthesia and renal function. c) Clinical and epidemiological studies: The highest impact (five papers since 1995 cited more than 100 times) has been of the epidemiological studies. In particular, they have shown that homocystein is the best predictor of mortality of patients with coronary heart disease, and that it strongly interacts with other established risk factors.

Evaluation: The members of the research group represent complementary competencies that are required to achieve the research goals. One very interesting ongoing study is an examination of folate administration with potential major health implications. In addition, there are ongoing studies on the implications of polymorphisms and markers of vitamin status on colonic cancer. The group has very strong links with several outstanding international groups, partly via different EU projects. The most striking and impressive aspect is the continuous development of cutting edge analytical methodology and the very clear focus on areas where the group can have a decisive competitive edge to maintain the high international standing. Altogether this group is ranked as ***excellent***. It should continue to receive good funding at a high level. In particular, it is suggested that this group, which provides excellent training, is given one or several open graduate student positions.

Faculty of Medicine
Department of Pathology, The Gade Institute

Description: The staff consists of 11 scientists (about 50% research), 4-5 technicians for research. The current research is divided into four different projects:

Akslen studies gene expression in malignant melanomas, thyroid and other tumors. Other projects include cell proliferation and tumor-suppressor-genes, PTEN using immunohistochemistry, in situ hybridization, PCR to study mutations and protein expression. This research is rated as ***good.***

Mörk focuses on multiple sclerosis. Investigation of the gray matter showed significant loss of myelin in cerebral cortex. The panel feels that these descriptive findings need to be extended to mechanistic and functional studies. Rated as ***good***.

Lærum investigates the biology of brain tumors regarding invasiveness by studying genetic aberrations of p53, the p53 protein, and EGF receptors. General tumor biology is studied in archival material by mapping genetic aberrations to possibly identify changing causes. Other projects are the experimental hematology and stem cell kinetics, growth regulation and chronobiology of human and bovine bone marrow cells. Development of a cDNA library of murine stem and progenitor cells is carried out in cooperation with Seattle, University of Washington.

Vintermyr studies effects of algae toxins, hormones and cytostatics on apoptosis in normal and malignant epithelial cells using conventional methods. Apoptosis marker (TUNEL) and detection of bcl-2 expression loss in squamous cell carcinoma are developed in collaboration with Johannesen.

Evaluation: The research activities are disperse within the institute without co-operation, nor is there group efforts for grant applications. At present Lærum is reinstalling his research activities with ***very good*** prospects. The availability of tissue blocks from 1920-1930 is advantageous for research on retrospective projects using molecular biological techniques. The publication record is good. Overall evaluation: considering the good publication record; ***good*** although deficits occur in some groups. Before starting the studies on the old tissue blocks a specific project must be developed.

Faculty of Dentistry
Department of Odontology

Section for Oral Pathology and Forensic Odontology

Description: The laboratory receives biopsy and fresh autopsy material from, and share equipment with the Department of Pathology in which it is located. It provides diagnostic services to the hospital (2000 biopsies annually) and services in forensic odontology (40-50 identifications/year). Their teaching obligation is to the Faculty of Dentistry. Staff: 2 scientists, 2 postdoctors, 3 M.Sc. students and 1.5 technicians. One professorship has not replaced since 1997, is now announced as an associate professorship.

Dr. Anne Chr. Johannesen extended earlier studies on inflammation and focussed on immunology of apical and marginal peridontitis since 1990 extending to Sjögren's (Sicca) Syndrome. Cooperation with Broegelmann Research Laboratory. There is an oral cancer project on squamous cell carcinoma of oral cavity by snuffing. Immune histochemistry, in situ hybridization and some molecular biology is performed in the laboratory, and more sophisticated techniques in collaboration with other laboratories (e.g. a development of apoptosis marker (TUNEL) and detection of bcl-2 expression loss in squamous cell carcinoma in collaboration with Vintermyr). So far only done in biopsies. PCR and in vitro systems like mouth epithelial cells will be established. Apoptosis in context with chronic inflammation studied in salivary glands in mice, in patients with Sjögren's syndrome with lichen planus, in oral squamous cell carcinomas and periapical granulomas and cysts.

Evaluation: The overall goal is to study the role of apoptosis and defense mechanisms in cancer development and inflammation with the therapeutic aspect to influence apoptosis. The panel feels that the group investigates biopsies using the available techniques rather than study a specific hypothesis except for the role of apoptosis; here Dr. Johannesen did not seem ideally close to the subject matter. The group is too small, especially given Dr. Johannesen's administrative role, she therefore cannot cover all necessary techniques. Several papers are published in peer reviewed journals with Vintermyr, several others are in preparation. It is recommended that the open associate professorship should be replaced by a person trained in molecular biology to introduce additional experimental tools. Overall evaluation: ***Fair***.

Norwegian University of Science and Technology

Faculty of Chemistry and Biology
Department of Zoology

Zoophysiology group

Research efforts in the zoophysiology unit at the Department of Zoology at Trondheim are centred on four topics: *"Thermophysiology and energetics"*, *"Neurobiology"*, *"Ecotoxicology"*, and *"Aquaculture"*. The thermobiology work is divided between two fields, where the ecophysiological work of Claus Bech deserves special mention. The pheromone-insect work of Hanna Mustaparta and co-workers also deserves to be pointed out.

Thermophysiology and energetics

The work Bech and Zacharissen of the thermobiology group is focused primarily on two areas, which can be loosely designated "energetics of cold adaptation" and "adaptation of insects to low temperatures". The publication record of this group is quite reasonable, and the overall impression is ***very good*** to ***good***.

Neurobiology

The focus of the neurobiology group is insect olfaction, olfactory coding mechanisms including recordings of single neurons. The work of Hanna Mustaparta and co-workers is admirable in that the relatively small group has been successful in attracting international collaborators to supply the necessary expertise to complement the group's own capabilities. The overall grade for this group is ***very good*** to ***good***.

Ecotoxicology

The research of Andersen, Jenssen and Staurnes is divided between "*Physiological adaptations of animals to extreme conditions like climatic stress*", "*Effects of organic pollutants on endocrine and immune systems of seabirds and mammals*" and "*Effects of acid water on physiological processes*". Since 1995, the group has published 26 publications in the usual journals (Ecotox, Chemosphere) mainly on chemical analysis and some effects that represent a rather phenomenological approach. Instead of studying single effects in various animals the groups should merge and focus. The group has the potential of development, but at present the overall grade is ***not acceptable***.

Aquaculture

The fourth group of Nilssen and co-workers contributes a profile of work on Arctic char at Svalbard. The main focus is on endocrinology, also in vertebrates other than fish. Unfortunately, the group also diversifies into ecotoxicology (metals and organic compounds) thereby loosing its focus on central issues. Generally, the publication record is acceptable, and the overall grade is ***fair.***

Evaluation: The zoophysiologists at the University of Trondheim form a laudable team in terms of scope. This varied expertise is very useful for the quality of undergraduate teaching, where students can meet teachers with direct knowledge on different areas of physiology. The formation is, however, not quite as good for concerted research activities, and the Trondheim unit shows the same fragmented research teams as observed at many other places during the course of this evaluation. In addition, the technical staff is undersized, and the ratio between the number of cand.scient. students to Ph.D. students too high.

Overall recommendation: The unit should pursue its ambitions to strengthen and expand the existing research, and stay clear of diversifying further. The researchers should sit down and agree on a lower number of acceptable focal areas, and strive to develop those. This is particularly crucial for the ecotoxicology and aquaculture groups.

Faculty of Medicine
Department of Physiology and Biomedical Engineering

The department contains 8 full time positions split up in three groups and at present they have 3 postdoctors and 11 Ph.D. students.

Basic cardiovascular physiology

Description: Three positions are located at this section, headed by Professor Per Jynge. The other two staff members are Professor Øyvind Ellingsen and Kristin Lossius (the latter recently left). The patho-physiology of the ischemic heart is the main research issue. Advanced ^{31}P-MRS and ^{31}F-MRS are used to evaluate the metabolism of the myocardium in acute ischemia in the cardio-myocyte of the failing heart. This technology can be applied to the heart of the mouse, which is an important development as genetically modified mice are studied. Re-perfusion phenomenon in the heart including formation of oxygen radicals can be measured using electron spin resonance. Another area of investigation is ionic interaction with x-ray contrast media in coronary angiography where a successful collaboration with industry has been established.

Evaluation: Together with his younger colleagues and Ph.D.-students, Professor Per Jynge forms quite an active group, using well-developed and in part unique techniques. They have a good publication record, albeit the work on the ischemic and failing heart is scattered in various directions and often appears to be not hypothesis driven. Professor Ellingsen has only few publications and less time for research, being clinically active and at present also heavily involved

in teaching being the co-ordinator of the problem-based teaching program. The overall assessment of the section is ***fair***.

Gastrointestinal physiology

Description: Professor A. Sandvik is quite productive, and many of the publications are in good journals. One of his areas of research relates to the effect of proton-pump inhibitors on endocrine stimulation and carcinogenesis. The work on classification of gastric carcinomas is well done, but not spectacular. After her return from the US, Professor A. Lægreid has set up a new area of research, which uses advanced technology in the field of functional genomics. This research deviates from earlier research in the department, but the aim is to integrate her work with that of the existing group. This means redirection of focus and strategy. So far nothing has been published in this new area.

Evaluation: Much effort and money are invested into micro-array technology, possibly driven by large-scale government investments. Interesting results may be obtained by using these methodologies in gastric physiology provided that they are matched by a sensible biological input and that specific hypotheses are generated. Overall the department is in a critical phase. It is imperative that the biology is able to keep up with the tremendous investments in technology and the high technological competence. Overall assessment: ***Good***.

Environmental physiology and Clinical cardiovascular physiology

Description: This unit consists of two researchers lead by Professor Brubakk, primarily working in hyperbaric medicine and Dr. Slørdal, primarily doing clinical cardiology with some research on the rehabilitation of stroke and heart patients. The baromedical research relates to the patophysiology of decompression sickness with a special emphasis on bubble formation. Studies are performed on humans and various other species as well as on isolated vessel and endothelial cell preparations.

Evaluation: There is a close co-operation with the oil industry and collaborative work is performed with colleagues in the UK. Professor Brubakk has a good publication record, including a review in the field. Dr. Slørdal is less productive. With oil drilling and work at oil platforms still being a major industry in Norway, it is surprising that basic research is not performed in the field on a larger scale. The more so, as hyperbaric physiology-medicine is an area with great potential at the fundamental as well as the applied level. The overall assessment is ***fair***.

Medical technology

Description: The group consists of Angelsen and Torp. The presentation focused on courses for paramedical personnel and the technical development of ultrasound technology.

Evaluation: Questions are not primarily biology based. However, the competence of this group is very great and it is very important for the continued success of Norwegian cardiovascular physiology. The group has reasonable citations. Assessment: ***Good.***

Faculty of Medicine
Department of Pharmacology and Toxicology

This unit consists of 4 professors and 2 associated professors and 7 postdocs or Ph.D. students. In addition there are several students.

Neurobiological and pharmacological research

This unit under Ursula Sonnevald started in 1997. The unit relies on the long-term collaboration with Arne Schouboe in Copenhagen and depends on the close links with the MR Center in Trondheim. Using MR spectroscopy Professor Sonnevald and co-workers have made important discoveries relating to metabolic changes during cerebral ischemia and on the changes in activity of GABAergic neurons. Her group is interested in neuron-glia interactions, which are studied using a combination of primary cell culture and analytical methods that include NMR. Among the important findings are the demonstration that mitochondria are highly involved in neuronal and glial intermediary metabolism and that lactate is a probable detoxification product of glutamate from astrocyte mitochondrial metabolism. She also tries to investigate the particular role of astrocytes on neuronal cell death several animal model studies are being examined, not only ischemia, but also epilepsy and transgenic animals. There are even several human studies going on.

She has published extensively in recent years often in high-ranking journals, and the focus on metabolism as studied by NMR spectroscopy is good. However, there is an obvious risk that enthusiasm for new possible projects means that resources are over-stretched. Too many new projects are started while already ongoing projects are maintained. A more clear focus on a few specific questions would make the chance of making major discoveries much higher. This part of the departments ranks as ***good*.**

Xenobiotics metabolism and toxicology

The group is headed by Odd Nielsen. They work, partly in collaboration with international partners, on the human cytochrome p450 expressed in brewer's yeast. The risk of airborne pollutants is examined in special equipment for animal experiments. This line of research is a real strength of the department. Based on the above data toxicokinetic modeling will be performed to aid in risk assessment. There is a reasonable rate of publication, but the impact of the papers (or the journals) is not high. This part of the department ranks as ***good***.

In addition there are several other scientists. Dale is 50% employed and interested in the pharmacokinetics of anesthetics and other agents used in anesthesia. He has published little and not in the highest impact journals. Tore Syversen has not published at all in the past five years and in the case of Lars Slørdal no information was given. This part is ***not acceptable*.**

Overall recommendation: This department has problems in that some parts are very active, but unfocused, while other parts are inactive. There are no real synergies. The university should consider a major reorganization, perhaps joining the different “Neuroscience” departments, and it is important that the restructuring that is needed to improve the research is not compromised by undue emphasis on perceived needs for undergraduate teaching**.**

University of Tromsø

Faculty of Medicine
Institute of Medical Biology

The institute has a total number of 230 employees divided into 13 departments. Several core facilities are available including shared heavy equipment. The material presented was informative and it was particularly illuminating to get the data on funding.

Department of Arctic Biology

Description: The leader of this group is Professor A.S. Blix, who has a long and well-established position in the field of zoophysiology. The unit consists of two professors and 6-7 researchers and senior research fellows. A broad range of very good facilities is available, which forms a basis for studies in the field or in a laboratory setting. Examples are a large size well-equipped ship capable of sailing in arctic water, field research stations close to Tromsø and on Svalbard. The basic premises close to the University of Tromsø campus are excellent with very good animal core facilities suited for arctic mammals. There is a broad range of research interests in the department. The physiology of animals like seals, whales, polar bears, and reindeer attracts the main interest, focusing on circulatory and digestive functions as well as biorhythms. Arctic plant ecology is also studied.

Professor Blix has had a long-standing interest in seals, primarily studying circulatory phenomenon. Recent research includes method developments of the ultrasound Doppler techniques to determine "blood flow" in various arctic animals. Advanced instrumenting of the seals is also performed to track their position, number, length and depth of dives. It has been found that the seals not only cover very long distances, they also dive for up to 50 min and at depths of more than 1000 meters. These findings have prompted research on the brain of seals during simulated long dives in cool water. L. Folkow and E. Nordøy work closely with Professor Blix, but they are also active in research on energy consumption and digestive function in marine animals. Professor K-A. Stokkan's interest is primarily biorhythms in arctic animals and the underlying mechanisms.

Some of the researchers in the department work together on joint projects within the above-mentioned fields, but they also have their own profile. Dr. S.D. Mathiesen has very actively studied the digestive function in the reindeer, work in which microbiologists M.A. Olsen and T.H. Aagens have also participated. The botanist, A.M. Odasz-Albrigtsen has interesting projects, studying the arctic flora on the mainland, the coast, and on the islands.

Evaluation: The research activity is high and there is a good collaboration on specific topics. Many of the physiology studies on arctic animals have a spectacular note. However, they are in essence descriptive with few attempts to evaluate the mechanisms behind the observed phenomenon. The work on biorhythms and on digestive functions has more of a mechanistic approach. The research facilities are unique in the world for studying arctic wild life. Efforts should be made in the future to attract foreign researchers to collaborate with the permanent staff to start a good program for

unraveling regulatory mechanisms. In a setting like the one on arctic biology, it is mandatory to find a good balance between describing phenomenon and performing experiments, aiming at the understanding of underlying mechanisms. The area of arctic biology has a long tradition in Norway, and it attracts many students at the undergraduate and the graduate level. This underscores the importance of developing good programs for mechanistic studies. Otherwise new generations of doctoral (Ph.D.) students will graduate with no training within basic biological research. The overall assessment is ***good***.

Department of Medical Physiology

Description: This department is composed of 6 professors, with Terje Larsen being the current head (he is also head of the institute), two postdocs and four research fellows. There appears to be larger funding from external sources than from the University.

The focus of research is on *cardiovascular physiology*, and then especially of myocardial metabolism. This is the particular focus of Terje Larsen and Ole Mjøs. However, recently the latter has become strongly involved in local community politics. In addition to the previous emphasis on whole animal, and isolated tissue work there is now also work on isolated cells. Thus, in terms of experimental preparations the group is in a good position. Recently many of the techniques have been adapted to mice and the use of transgenic mice offer a possible way towards a more analytic phase of the group. The studies of Kirsti Ytrehus on the role of protein kinase C in ischemic preconditioning have resulted in highly cited papers. Professor Rudolph Riemersmaa studies the effects of *fatty acids and antioxidants* in humans using an epidemiological approach. This research has resulted in several high impact articles. Finally James Mercer is studying the particular impact of climate on cardiovascular morbidity. Although the area is of general importance, the current work has not had a large impact.

Evaluation: A large number of potentially exciting projects is in progress. However, they are highly labor intensive and they demand new technologies. It seems important that the entire department is able to set the necessary priorities. The overall rating of the department is ***good***.

Department of Pharmacology

Description: This department has three full professors who each lead a research group. There appears to be much more funding from external sources than from the University.

Membrane receptor group

This group is headed by Svein Dahl, who is also the chairman, and has in addition two associate professors and two graduate students. He returned from France in 1997 where he had acted as research director in Jouvenal. He works on G protein-coupled receptors, but within that area his research covers many different aspects, from theoretical data modeling to clinical pharmacology. The work in recent years has focused on molecular modeling, on a database, and an exciting novel international collaborative approach related to crystallization of membrane proteins for X-ray crystallography. Since 1995 he has published 20 articles in good journals. The best cited presents

the G protein database. The work is carried out in an area where there is intense competition with groups with superior resources, not least from drug industry based scientists. It is clear that focusing resources on an area where competition is less intense to obtain greater depth in the studies would increase the impact. Steps in that direction are being taken. The project to crystallize membrane associated receptors is very high risk, but if it succeeds, the rewards will be very high.

Clinical Pharmacology and drug metabolism

This group is headed by Jarle Aarbakke. A long-term focus has been on pharmacokinetics of drugs used in cancer chemotherapy. In particular Aarbacke has studied the enzyme thiopurine methyltransfrerase. The measurement of this enzyme can be used to optimize azathioprine therapy. The research is relevant for clinical science, it is well focussed and publications are in good, but not excellent journals in the field.

Cyclic nucleotide research

This relatively small group is headed by Georg Sager, and focuses on the mechanisms by which cGMP is exported from cells. Attempts are made to purify, then sequence and eventually clone the transporter. In addition the function of the transporter is studied and how it is modified by gestagenes. The possible usefulness of extracellular cGMP as a marker of malignancy is also examined. In the past, the publication efforts have been very scattered. However, the focus on cGMP transport provides an interesting niche. The general approach is very reasonable and could yield interesting and unique results.

Evaluation: Each of the groups may seem small, but good collaborative local and international networks offer promise of scientific success. Overall rating: ***Good*** with reasonable promise of improvement.

Department of Experimental Pathology

Description: The group is composed of Sveinbjørnsson, Seljelid, Eskeland, Smedsrød, and Lindgård. Studies on RES, especially macrophages (phagocytosis) and scavenger endothelial cells (SEC) in liver sinusoids in mammals, which perform receptor mediated endocytosis. In lower vertebrates such vessels occur in kidneys and heart endothelium. The group identifies, purifies and clones several SEC receptors and studies intracellular transport of endocytosed ligands to endosomes and liposomes, recruitment of lysosomal enzymes and transformation of the macromolecules into energy rich lactat and actetate.

The current research plans include: Role of SEC and macrophages in atherosclerosis; Construction of bioreactor containing SEC for extracorporal liver system; Studies of inflammatory reactions of macrophages and mast cells (cytokines, chemokines, cycloxygenase products) in a peritonitis model; Macrophages in wound healing in diabetes (cytokines and growth factors); SEC function to anchor tumor cells in hepatic blood levels.

Evaluation: There is a good international cooperation and an impressive publication record in peer reviewed journals. Overall rating is ***very good*** to ***good***. The cytokine related work is of lower

standard and shows less promise unless strongly integrated with the major topic. One small group devoted to body mass regulation have published to a limited degree in poor journals. The scientific rating is ***fair*** to ***unacceptable***.

Department of Morphology

Description: This is a large department with 8 professors (Busch, Ørbo, Stalsberg, Myklebust, Jörgensen, Lindal, Rinne, Rogde). Most of the work relates to clinical pathology as 80% of the staff's time is devoted to this task. However, they also perform research with an impressive publication list on tumor biology and diagnosis, where especially the work of Professor Busch on cancer of the prostate should be mentioned. There is also a focus on cardiovascular pathology, studying the pathogenic mechanisms of disseminated intravascular coagulation and micro-embolism as well as non-thrombogenic mechanisms of the regenerative capacity of the endothelium in graft material. Professor Myklebust provides the skill in the use of modern electron microscopy methods and collaboration with several of his colleagues as well as with researchers from other institutes. A large number of publications has come out of this work.

Evaluation: The morphology unit commands routine and advanced methods in the morphological studies of healthy and diseased tissues. They are descriptive in nature and of clinical relevance. Only little innovation can be noticed except for some of the research on cancer of the prostate and the studies on mechanisms involved in adhesion and incorporation of tumor with endothelial cells. The unit is named morphology. It is true that the basis for the work is the study of tissue morphology. However, although there are worthwhile research activities, the main function of the unit is its clinical responsibilities and it basically functions as a traditional pathology department, which also has a teaching load. A change in name and merging with experimental pathology is recommended. The research rating of the department goes from ***fair*** to ***good***.

Norwegian School of Veterinary Science

Department of Biochemistry, Physiology and Nutrition

Section of Physiology

Description: This department consists of three professors, and one open position. Dr. Aulie has, over the years, contributed leadership in a variety of physiological areas. Dr. Sjaastad has headed the erythropoietin research effort in recent years and Dr. Eliassen has contributed research on polyamines. The combination of teaching duties, administrative responsibilities, the lack of an ability to fill the open position, and the overall age structure in the department have contributed to relatively low research output and lack of vitality in the department.

Evaluation: The unwillingness of the university to fill the open position with any physiologist other than a trained veterinarian is difficult to support. The contributions of a medical or comparative physiologist would greatly expand the breadth and quality of current teaching and research contributions. Since the department apparently has had opportunities to search for a qualified individual and has failed to find a satisfactory applicant, qualified individuals are apparently not being trained. The inflexibility of the university on this issue is counterproductive. The department needs immediate revitalization. The lack of publications over the last five years in quality, international journals is disturbing as is the inability to transform recent grant dollars for the erythropoeitin project into rapid publications. Most important, perspectives and hypotheses for future research are lacking. It would seem useful to integrate the research effort of this section with that of the Department of Animal Science at the Agricultural University of Norway. Overall evaluation: ***Not acceptable.***

Department of Pharmacology, Microbiology and Food Hygiene

Section of Pharmacology and Toxicology

Description: The work at the department represents a melange of drug related matters in several animal species. A majority of the work, including some pharmacokinetics, is done on fish. Much other work is related to marine ecotoxicology. There is little focus either on the animals used or with regard to the problem studied. Totally six Ph.D. theses were awarded in the past years, and recruitment is not a major problem.

Evaluation: The members of the staff (Horsberg, Skåre, Ingebrigtsen, Søli, Underdal) work together extensively. Thus there is no real need to evaluate each of them separately. Several of the problems studied are of considerable importance, for example: the antibiotic load provided by aquaculture and the toxicology of algal toxins. Therefore breakthrough studies would be published

in the highest impact scientific journals in the world. Unfortunately this is not the case. The two most significant papers during the entire period examined are co-authored studies published in Behavioral Brain Research and European J. Pharmacology, and those two studies were performed on rats and do not appear to have influenced any of the other work. Instead of aiming higher these scientists produce numerous reports, which are unlikely to meet any substantial readership. This is taking time from really serious scientific work. It is strongly recommended that this group concentrate on performing a few well-designed studies. It must be emphasized that this general statement is relevant not only to this group, but is widely applicable. The presence of several people focusing on marine aspects at a location far from the major centers of marine biology seems like a strategic error. The scientific activity is at present ***fair***, but given the importance of the topic they should aim much higher.

The Agricultural University of Norway

Department of Animal Science

Section for animal physiology and biochemistry

Description: The group consists of three scientists (Hove, Holand, Haug). It is headed by Professor Knut Hove and closely integrated with the other 19 tenured academic staff members of the department. The staff shares laboratory facilities and equipment. In addition to maintain and update physiological and biochemical equipment and methods, this group has to handle animal welfare and surgical preparation of animals in the department. After the Chernobyl accident in 1986, the burden has been on this group to evaluate possible contamination of caesium and strontium of the food for grazing animals, a task, which hopefully soon will be faced out.

With the size of the group and the limited time for research, a joint approach is planned on 1) lactation in reindeer, and 2) conjugated linoleic acid in cow milk. Øystein Holand heads the reindeer project and some pilot studies have been performed, adapting available automatic milking equipment to be used on reindeer. Oxytocin appears to markedly enhance lactation. There are plans to study how the feeding of the calf can be combined with also milking the reindeer in the spring/summer season.

A dietary recommendation in Norway is to reduce the intake of full milk and dairy products due to their content of saturated fat. Milk contains "good" factors as well. One is conjugated linoelic acid (CLA). Experiments are in progress in which the food intake of the cow is altered in order to obtain a richer CLA content. In this work the intermediary metabolism of the food intake will be studied.

Evaluation: The section is well aware of its limitations and therefore they try to work more closely together and choose worthwhile topics that fit their research experience and facilities. Of the two projects presented, the one relating to obtaining milk from reindeer must be looked upon as congenial for Norway but with a low scientific value. The CLA project has at present a limited focus, but could be of general interest if it gets a broader scope and proper collaboration is sought for. It would seem useful to integrate the research effort of the department with that of the Section of Physiology (in the Department of Biochemistry, Physiology and Nutrition) at the Norwegian School of Veterinary Science. At present the overall rating of the groups is ***fair*** to ***good***.

Norwegian University of Sport and Physical Education

Department of Sport and Biology

Description: When the school of sports and physical education was established some 30 years ago, an affiliation was established with basic science departments at the University of Oslo. The remainder of this arrangement is that the two professorships that belong to the school (Hans Dahl and Ola Wærhaug), physically are located within the Department of Anatomy at the University.

The mechanisms by which skeletal muscle adapts has been a continuous area of interest over the years, but the research activity level has been low in recent years. This work has been performed in close collaboration with Professor Lømo in the Department of Neurophysiology (now Physiology) and more lately with Professor Ottersen in the Department of Anatomy as the research in heart and skeletal muscle on monocarboxylate transporters have been expanded to also include the brain. At present, the main work is performed by a doctoral student (Linda Bergersen). The project is of interest and the early results appear promising.

Evaluation: Ph.D. students have in collaboration with researchers outside the group during the last 5 years produced a reasonable number of articles, published in good journals. The tenured staff have only very few original articles from the same period, which render them a ***not acceptable*** rating. To have a formal contract with the University of Oslo is of critical interest for the Norwegian University of Sport and Physical Education. The value of such collaboration goes beyond the anatomy teaching, as it includes the possibility for sport science students to perform their M.Sc. and Ph.D. studies in basic science environments.

The Institute Sector

Directorate of Fisheries, Institute of Nutrition

Description: This institute is directly associated with the Directorate of Fisheries, which in turn runs directly under the Ministry of Fisheries. The unit works on a very large number of biochemical, cellular, physiological problems and the research is highly applied, geared at legislation. The unit also serves the authorities as responsible for, *e.g.* handing gene-modified compounds or toxins in fish feed. Toxicology work includes both metals (arsenic, cadmium) and organohalogens (PCB/ Dioxin).

The unit comprises five laboratories of, respectively, biochemistry; water-soluble vitamins; fat, carbohydrates and fat-soluble vitamins; minerals and trace elements; and protein and amino acids. The strategy presented to the panel by Drs. Øyvind Lie and Rune Waagbø appears to aim at one student/postdoc per compound/nutrient: vitamin A, vitamin D/K, thiamine, Cu/Cd-toxicity, Hg-toxicity, iodine/boron as trace elements; vitamin B6, collagen, polyamines, lipoproteins, fatty acid catabolism, fish oil, carbohydrate/light, energy utilization. Rather basic metabolic questions.
Laboratory facilities are good, although new instrumentation HPLC/MS, GLC/MS has been applied for and, strange as it may seem, the animal unit of the institute provides limited possibilities for experiments on fish.

Evaluation: The unit is well equipped and shows an altogether reasonable publication record in journals central to the immediate fields of research. Collaboration is exceptionally widespread. The unit would do well to focus on a few important areas of research, while maintaining the necessary competence as a legislator. Similarly, the collaboration should be sharpened to include national and international bodies with true value for the unit. The current rating, which could be improved, is ***fair.***

Institute of Marine Research

Description: The unit is part of the Ministry of Fisheries, given the task of handling marine living resources, the marine environment and aquaculture. The financial basis for the function of the Institute of Marine Research is excellent, and almost 500 employees, 140 of whom are scientists, work with an annual budget of 373 MNOK. The panel was asked to evaluate the work contained in the programs: *"Reproduction and recruitment in wild populations (3)"*, *"Production of juveniles for aquaculture (7)"*, and *"Aquaculture organisms – environment, growth and sexual maturation (8)"*.

Evaluation: This is a large operation, with massive resources. The work is well focused, and the national and international collaboration includes well-chosen partners. Among the applicable success stories of the research group, the advances in feeding of fish larvae can be mentioned.

Another important applicable contribution deals with the early life-stages of scallop in culture. Further well-performed studies include work on melatonin.

The research director of the Austevoll Station, Ole Torrissen, presented the institute, and the current organization and future research strategy of the unit was excellently described by the group leader Geir Lasse Taranger, together and his co-workers Olav Kjesbu and Ingegjerd Opstad. The focus of the research efforts is clear, and the group has chosen to collaborate with a select number of national and international partners.

There is a major strength in facilities and infrastructure, with two well-equipped aquaculture research stations at Austevoll and Matre. The publication record of the group is good, and the prognosis for future positive development excellent. The current overall grade for this group is ***very good.***

Institute of Aquaculture Research

Description: The Institute of Aquaculture Research is part of the Norwegian institute sector. Research focuses on genetics, nutrition and quality, and is carried out mainly on commission from the fish farming industry. The unit may be regarded as a link between the industry and university worlds. The major owner of the institute is the Agricultural University of Norway (AUN), with financial support from Ministry of Agriculture. There is no funding from the Ministry of Fisheries. Funding from sources other industry partners has been declining over the past few years, and the institute is currently running with an economic deficit.

Evaluation: The research strategy of the Institute of Aquaculture Research was clearly presented to the panel by Dr. Ingrid Olesen and colleagues. The scientific personnel are well qualified with about 50% qualified for the level of professor. In addition to the classical Norwegian aquaculture species, new species are being introduced for study: tropical fish species and shellfish. The tradition of the institute rests on genetics and selective breeding, and this field remains a major profile of the unit. The panel also suggests that increasing the over-head charged on industry commission could enhance the quality of research. The right to publish all research findings openly must be a basic criterion for accepting industry-funded projects. In addition the focus of the research should be sharpened, to avoid a loose federation of very small groups working on a plethora of different topics. By increasing collaboration with other Norwegian and international groups on, *e.g.* specific techniques, the unit should become more competitive. Overall, the current work of the Institute of Aquaculture Research is graded as ***fair*****.**

MR Center, The medical research activities

Description: The MR Center comprises some 20 researchers, including Ph.D.-students with Ingrid Gribbestad as research director. The group provides technical expertise in magnetic resonance methodology and cooperates with STFK (South Trøndelag County Administration) and the NTNU

(Norweigian University of Science and Technology). The facilities comprise a wide range of magnets that make human and small animal studies most feasible as well as studies of organs or tissue samples using proton, phosphorous, or carbon spectroscopy. The organization of the center with qualified personnel employed exclusively to work on maintaining and updating equipment, software, and methods has several advantages as these employees also have time for own research and qualified service to clinicians and industry. The division of time between research and service functions appears to be quite acceptable for all "parties".

The group has worldwide recognition in several fields of MR:

1. Breast cancer imaging techniques in co-operation with departments of surgery, oncology, pathology, and several international groups to develop MR technology to improve diagnosis and monitor treatment.
2. In vivo and in vitro MR spectroscopy to study metabolism in cooperation with departments of neurology, surgery, neurosurgery, and oncology to develop diagnostic tools for patients and in tissue samples in these areas.
3. Combination of ultrasound with MR for minimal invasive surgery, especially neurosurgery.
4. Studies in animals and brain cell cultures related to cancer and brain ischemia.
5. Bio-informatics focusing on various protein structures.

Evaluation: The excellent equipment, the enthusiasm and qualifications of the staff, and most importantly the organization of the center make this a unique center within Norway and Europe. Moreover, the integration of the center with the clinic has resulted in close and successful co-operation and application of the techniques in clinical studies. In order to maintain the excellency of the center it should continue to receive adequate support to secure that it can maintain its organization and be able to continuously upgrade equipment and methodology as well as provide adequate time for research. Despite the fact that the publication record is not particularly high, the overall rating is ***very good*** to ***excellent***.

National Institute of Public Health

Department of Environmental Medicine

General description: The institute is requested to advise the governmental agencies on the risks of human exposure to chemicals and physical agents as a result of indoor, outdoor, food and water pollution. The goal is to improve science based risk assessment by basic research in toxicology. The expertise is provided to many national and international committees. Due to the chairmen and the well-trained senior researchers the research activities of the institute are in general focused and successful. The results are published in peer reviewed journals.

Some activities, especially in Chemical Product Toxicology, will be abandoned to focus on specific topics of greater importance. The section for Food Toxicology, which will focus on the toxic mechanisms of heterocyclic amines, the polymorphisms in their metabolic activation and the impact on colon cancer. The institute trains Ph.D. and master degree students in environmental toxicology. Problems are seen in the high average age and relatively few contacts with universities. The relatively poor mobility might be improved by EU projects. A problem for the institute is the poor interest of younger scientists especially. MDs in toxicology.

General evaluation: Future challenges are seen in the availability of increasingly sophisticated molecular biological techniques. The overall evaluation is ***very good.***

Food toxicology

Description: There are a great variety of research projects in the group of Alexander. The ongoing research activities on heterocyclic amines include development of biomarkers for exposure, mechanism of colon carcinogenesis in mice models, polymorphisms in ACF, mutations and carcinogenic effects in the apc-gene-mouse model and prevention by n-3 fatty acids. The results are very good and have been published in peer-reviewed journals. Other projects include: Mycotoxins in human food; Aluminum in drinking water and Alzheimer; Algal toxins; Trace elements in food and intervention studies; Drinking water chlorination and cancer risk. There is also interesting research on gap-junctions.

Evaluation: Although there is a considerable publication record in the different areas under investigation, it is recommended to reduce the diversity of projects. The rating is ***very good*** to ***good.***

Chemical products toxicology

Description: The group consists of Brunborg, Søderlund and co-workers. Mechanisms in toxic effects like genotoxicity are studied by Søderlund. They include: DNA-damage by 1,2-dibromo-3-chloropropane due to GSH-metabolism investigated in testicular cells from rat and humans; Direct inhibition of DNA-synthesis in testis Paracetamol; Induction of DNA-strand breakage *in vitro* by chlorinated furanone in chlorinated water with humic acids; Development of automatised DNA-strand break detection; and if germ cells are repairing their DNA. Other projects deal with growth regulation of cells where cyclin dependent kinases, EGF stimulation, and p53 and p21 cell arrest by AAF. Apoptosis are studied.

Evaluation: Good research activities with good publication record in the different research areas. Overall evaluation: ***Very good*** to ***good.***

Air pollution and noise

Description: Research activities in the group of Schwarze focuses mainly on pulmonary biology and toxicology to understand apoptotic and inflammatory mechanisms of chemicals. Proinflammatory cytokine production, signal transduction systems in cytokine and apoptosis response to fluoride, Cd and particles, air pollution toxicology e.g. mitogenic effects on lung cells. In humans mostly in bronchiolar alveolar lavage. Lung specific expression of 2B1/2E1 inversely correlated with proliferation. The effect of particles released by tires during road abrasion in the winter investigated are being studied *in vitro*.

Evaluation: The focused projects on pulmonary toxicology results in a good publication record. No major activities on the impact of noise to human health are presented. Overall evaluation: ***Very good*** to ***good.***

Environmental immunology

Description: This section is headed by Løvik and evaluates experimental immunology models of mycobacterial or meningococcal infections, prenatal factors influencing postnatal immune function, particle effects in human monocytes on interleukin release and cell proliferation, and airborne particles and their importance for indoor and outdoor health effects especially in allergy. Ultrastructural identification of particles in aerosols, especially carbonaceous particles that carry animal allergens, is performed. Latex from tires in the environment is studied as an allergen source. In hobby fishermen, elevated PCB, PCDD/F are studied in relation to alterations of immune function.

Evaluation: Good publication record of the 5 researchers. In common with the rest of the Institute of Public Health, the quality of research is good and support seems adequate. Overall evaluation: ***Good.***

National Institute of Occupational Health

Department of Toxicology

Description: The staff consists of Haugen and 3 scientists, 1 physician, 3 senior engineers, 9 technicians. It is similar to the National Institute of Public Health in that the institute performs research to improve the scientific bases for risk assessment of human exposure to chemicals and particulates in the environment and at the workplace.

Gene-environmental interactions are studied where the overall goal is to develop, apply and validate biomarkers of exposure and cancer risk in susceptible populations to improve cancer risk assessment, prevention strategies and elucidate mechanisms of chemical carcinogenesis. There is a specific interest in genetic susceptibility to lung cancer due to polymorphisms in CYP1A1. GSH S-transferases M1 and P1, N-acetyl transferases are studied which modify the levels of DNA-adducts. Effects on signal transduction pathways will be increasingly addressed. Mutations in p53 - and k-ras genes are evaluated as markers for prognosis. Further activities include sex dependent metabolism of PAH by Cyp1A1 in smokers and DNA adducts in the lung. Role of genomic instability in environmental carcinogenesis: microsatellite induction and effects on cells with microsatellite instability are investigated.

Evaluation: This is a remarkably streamlined research, in which all co-workers seem to be involved in focussed projects. Good publications in peer-reviewed journals like Carcinogenesis, PNAS, BBA, AMBO, Mutation Res. etc. Overall evaluation: ***Very good***.

Department of Physiology

Description: In 1993 Professor Sten Knardahl was appointed head of the department. His background is in stress physiology, whereas in previous years the department has had muscle ions, energy metabolism and function as the research theme. There have been some attempts to

reorganize and refocus the research to pain- and psycho-physiology, but as indicated in the 1999 publication list, muscle metabolism is still the dominant research topic.

Evaluation: The studies on muscle carbohydrate metabolism are ***innovative*** and published in good journals. Any other research activities of value are in essence non-existing. This situation is ***unacceptable***, but can hopefully be changed when the group has moved to new facilities. The department has to make a firm decision about its future research goals and implement the necessary changes. The size of the staff hardly warrants more than one research area.

Norwegian Defense Research Establishment

There are three biomedical activities within the Norwegian Defense Research Establishment. It is funded in approximately equal parts from department, military and external grants.

Description: The Neurobiology and Neurotoxicology group is a comparatively large group with one professor, two scientists and several Ph.D. students and is headed by Frode Fonnum. Fonnum has been a pioneer in the area of amino acid synaptic transmission and neuron-glia interactions. He continues to be very active and is working together with leading scientists in Norway and abroad. He also has started a program in neurotoxicology. After an excellent thesis Else Marie Fykse did a postdoc with Thomas Sudhof resulting in superb publications. She now continues the work on the fundamental mechanisms of exocytotic release of transmitters. Bjørnar Hassel has worked extensively with Fonnum and U. Sonnewald to study metabolic aspects in GABAergic neurons with NMR methods. Among the very interesting findings is an explanation of the mechanism of valproate and elucidation of pyruvate carboxylation in neurons.

The second group (Prophylaxis against nerve agents and mustard agents) consists of three senior scientists and 1 technician. Pål Aas has a scattered publication record and the link to the main objective is that some of the publications deal with aceytylcholine release. Avi Ring is interested in theoretical aspects of ion transport. He is now studying effect of cholinesterase activator on K^+ channels.
The third group (Physical and psychological stress) consists of three MDs and two technicians. Opstad studies endocrine and immune reactions to strenuous exercise and/or sleep deprivation. The approach is rather scattered and the hypotheses are not always convincing. Much of this work has not been published.

Evaluation: The publication record of the Neurobiology and Neurotoxicology group is excellent and the international impact of this group remains high. Overall evaluation: ***Very good.*** The other two groups are performing less than optimally. It is probable that the focus of the basic research would benefit from a more clear formulation of the goals of the research program. Overall evaluation: ***Fair.***

Appendices

Appendix 1

Mandate

for

the evaluation panels and the principal evaluation committee

The Research Council of Norway has decided to evaluate basic research activities in biology and relevant areas of biochemistry in Norwegian universities, colleges and research institutes. The reports of three individual evaluation panels and the summary report of a principal evaluation committee will form the basis for the future strategy of the Research Council.

Purpose of the review

The objective of this evaluation is to review the overall state of basic research in the biological and relevant biochemical disciplines in he Norwegian universities, colleges and research institutes. Specifically, the evaluation process will:

- Offer a critical review of the strengths and weaknesses of the scientific quality and organization of biological research, both nationally and at the level of individual research groups and academic departments.

- Identify research groups which maintain a high international level in their research, or which have the potential to reach that level.

- Identify areas of research that need to be strengthened in order to ensure that Norway in the future will possess the necessary competence where this is of importance for the nation and, as one aspect of this, enable the Research Council of Norway to evaluate the impending situation regarding recruitment in important fields of biological research.

- Enable the Research Council to determine whether there are significant differences in the quality of individual sub-fields or areas of research. It will also enable the Council to compare the overall quality of Norwegian biological research with that of other countries (e.g. in Scandinavia, Europe and the USA).

Follow-up of the evaluation

The evaluation will provide the institutions concerned with the knowledge they require to raise their own research standards. They will thus be given feedback on the scientific performance of individual research groups, together with suggestions for improvements and priorities.

The evaluation will improve the knowledge base for strategic decision-making by the Research Council, constitute a platform for future work on developing the disciplines concerned and represent a basis for determining future priorities including funding priorities within and between areas of research.

The evaluation will reinforce the role of the Research Council as advisor to the Norwegian Government and the relevant ministries.

Organisation

Three evaluation panels will be established, each of which will evaluate one of the following subfields:

- Terrestrial, marine and freshwater botany and zoology (including the museums), ecology and plant physiology

- Anatomy, physiology, zoophysiology, neurophysiology, neurochemistry, pharmacology and toxicology

- Microbiology, cell biology (cytology & histology), immunology, molecular biology (including biotechnology), genetics and biochemistry.

In addition to the three evaluation panels, a principal evaluation committee will be appointed, with responsibility for drawing up a summary report based on the reports of the panels and for making an overall assessment of the situation.

Background material

The panels and the committee will be provided with background material which will cover the following points:

- the fields currently represented in Norwegian biological research
- the structure of the academic departments
- the personnel at different levels and its age structure
- the funding of research groups
- the equipment situation
- the situation regarding publication and citations

Mandate of the evaluation panels

Each panel is requested to make use of the background material provided to evaluate the overall state of its subfield, and to produce a report with a set of specific recommendations for the future development of the field. The panels are requested to evaluate scientific activities with respect to quality, relevance and international and national collaboration, bearing in mind the resources available. Specific aspects to be considered include:

General aspects

- Which fields of research have a strong scientific position in Norway? Which have a weak position?

- Is there a reasonable balance between the different fields, or is research lacking in any particular field? On the other hand are some fields overrepresented, in view of the quality or scientific relevance of the research performed?

- Is there a reasonable degree of co-operation and division of research activities at national level, or could these aspects be improved?

- How is the balance between theoretical and empirical studies within the various fields? How does it compare to the situation in other countries?

- Is the biology of today relevant to the needs of Norwegian industry and society? Do the research groups maintain sufficient contact with industry and the public sector?

- Are research groups prepared to solve “tomorrow's problems”, both nationally and internationally?

Academic departments/research institutes

- Are the academic departments adequately organized?

- Is their research carried out as part of an overall research strategy?

- For applied departments and research institutes with groups carrying out basic research: does basic biological research activity form part of the department’s research strategy?

- Is there sufficient co-operation related to the use of expensive equipment?

Research groups

- Do research groups have a strategy and plans for the research which they are doing?

- Are the size and organization of the research groups reasonable?

- Are the results obtained, e.g. number of fellowships awarded and articles published, reasonable in terms of the resources available?

- What role do Norwegian research groups play in international co-operation in individual subfields? Are there significant differences between Norwegian biological research and research in other countries?

- Do research groups take part in international programmes or use facilities abroad, or could utilisation be improved by introducing special measures?

- Is there sufficient contact and co-operation with other research groups at national and international level?

- Are any institutions/research groups candidates for status as “centres of excellence”?

Training and mobility

- Is recruitment to doctoral training satisfactory or should more emphasis be placed put on recruitment in the future?

- Is there a sufficient degree of national and international mobility?

- Are there sufficient educational and training opportunities for Ph.D.s in industrial research?

- Where do the newly qualified candidates go to work?

The committee’s conclusions should lead to a set of recommendations concerning the future development of research in biology and relevant areas of biochemistry in Norway.

Miscellaneous

- Any other important aspects for consideration.

Mandate of the principal evaluation committee

The responsibility of the principal evaluation committee will be to draw up a summary report based on the reports of the three panels and to offer an overall assessment of the state of biological and relevant biochemical research in Norway, taking into account its quality and relevance in an international context.

The committee is requested to evaluate:

- The scientific quality of Norwegian biological research as a whole in the light of the resources available.

- Which areas of research have a strong scientific position in Norway in a national and international context and which are weak? Is Norwegian research ahead of scientific developments internationally within specific areas?

- In view of the scientific importance of the research performed, is the balance between individual fields of research reasonable?

- Is Norwegian research lacking or under-represented in any particular important area, especially in internationally important fields in which Norwegian groups might be expected to make a significant contribution?

The committee's conclusions should lead to a set of recommendations concerning the future development of research in biology and relevant areas of biochemistry in Norway.

Appendix 2

Curriculum Vitae for the committee members

Sten Grillner, chairman

Sten Grillner studied medicine at University of Göteborg, Sweden, and received his Ph.D. in Physiology (neurophysiology) in 1969. He moved to the Karolinska institute in 1975 as professor of physiology, and became director of The Nobel Institute for Neurophysiology in 1987. His research has focussed on the neural control of motor behavior in vertebrates initially mammals, but later utilizing a lower vertebrate experimental model, the lamprey. This system has allowed a detailed analysis of the intrinsic function of the networks underlying locomotion, in particular, but also steering and posture. This analysis extends from the molecular and ion channel level to the synaptic, cellular and network level.

He is a member of the Norwegian Academy of Science and Letters, The Royal Swedish Academy of Science, Academia Europaeae and Honorary professor at the Beijing Medical University. He is a member of the Nobel assembly at the Karolinska institute and has been a member and chairman of the Nobel Committee for the award in Physiology or Medicine. He has received the Bristol-Myers Squibb award for Distinguished achievements in Neuroscience research, New York (1993), and the Greater Nordic prize of Eric Fernström (1990). He has served on editorial boards of a number of journals including Neuron, Physiological Reviews, European. Journal of Neuroscience, and Current opinion in Neurobiology. He has also served on a variety of national and international review panels, advisory boards, councils or planning committees.

Cynthia Carey

Cynthia Carey received her Ph.D. in zoology (1976) from the University of Michigan in Ann Arbor, Michigan, USA. She took a position as Assistant Professor at the University of Colorado in Boulder, CO, USA in 1976 and has remained there ever since. She was promoted to Professor in 1992. Her research field is physiological ecology of animals, and she has worked on questions relating to how animals survive in cold climates, deserts, and at high altitudes. Currently, she is working on the problems concerning how diseases are causing worldwide amphibian declines. Carey has served on numerous editorial boards, National Science Foundation (USA) panels, governing boards of national and international scientific societies (such as Declining Amphibians Populations Task Force and International Ornithological Committee), and advisory boards for various national governmental institutions, such as NASA (the US space agency).

Bertil Fredholm

Bertil Fredholm studied medicine at Karolinska Institutet, where he received his Ph.D. in 1970. After postdoctoral studies in San Diego he returned to the Department of Pharmacology at Karolinska Institutet. Since 1977 he has worked as professor at this department. His major research

interest is on adenosine receptors, which he found was the major target of the most widely used of all psychoactive drugs, namely caffeine. Molecular, cellular, pharmacological and physiological methods are used. He has authored or co-authored some 400 original papers and 130 review articles. He is the president of the Nordic Pharmacological Society and 1st vice president of the International Union of Pharmacology (IUPHAR). He serves on several advisory boards and on the Editorial Board of several journals including Pharmacological Reviews, trends in Pharmacological Sciences, British J. Pharmacology, J. Molecular Neuroscience, European J. Pharmacology and Life Sciences.

Helmut Greim

Professor Dr. med. Helmut Greim has been head of the Institute of Toxicology, GSF-Forschungszentrum für Umwelt und Gesundheit in Neuherberg, Germany, since 1975. He is also chairman of toxicology and director of the Institute of Toxicology and Environmental Hygiene at the Technical University in Munich. Previously Professor Greim was associate professor of pharmacology and toxicology in the Department of Toxicology at the University of Tübingen. He has served on a number of committees, including the German Society of Pharmacology and Toxicology and the Board of Experts on the Environment for the Federal Ministry of the Environment. He serves as chairman of the German Advisory Committee on Existing Chemicals of Environmental Relevance (BUA) of Gesellschaft Deutscher Chemiker (GDCh), is chairman of the Commission for the Investigation of Health Hazards of Chemical Compounds in Work Areas (MAK), and has been a member of the Enquète-Commission Environment and Health of the German Parliament. He received his MD degrees from medical schools in Freiburg and Berlin. In 1998 he received the Arnold J. Lehman Award of the Society of Toxicology.

Chris Henderson

Chris Henderson received his Ph.D. in biochemistry (1979) from the University of Cambridge (UK). After a postdoctoral period with J.P. Changeux at the Pasteur Institute in Paris, he was given a research scientist position at the Institut Pasteur. From 1988-1994 he was a Group Leader at the CNRS institute CRBM in Montpellier, and in 1991-1992 spent a year at Genentech, Inc. (USA) as Visiting Scientist. Since 1994, he has been the Director of the INSERM Research Unit N° 382 "Motoneuron Development and Pathology", which was a founding member of the Developmental Biology Institute of Marseille (IBDM) on the Luminy Campus in Marseille. His research is centered on the development of the nervous system, and in particular the factors that regulate the survival and death of spinal motor neurons during development and in human disease.

Henderson has served on many national and international committees for evaluating the research activities of laboratories and individual scientists, and for job appointments within INSERM. He is on the Editorial Boards of *Neuron*, *Journal of Neuroscience* and *European Journal of Neuroscience*. In addition to consultancies and contracts with several pharmaceutical firms, he is co-founder of TROPHOS, S.A., a start-up company specialized in drug discovery in the field of neuro-degenerative disease.

Stefan Nilsson

Stefan Nilsson received his Ph.D. in zoophysiology (1974) from Göteborg University. After a period as Senior Research Fellow at the University of Melbourne, Australia, he returned to Göteborg University, where he worked as research scientist and associate professor. In 1985 he was appointed full professor and Chair. His research field is comparative physiology of vertebrates, especially fish, with emphasis on neurobiology (autonomic nerve functions) and cardiovascular control systems.

He worked for the Swedish Natural Science Research Council (NFR) (Research Grants Committee for Biological Sciences 1980-1989; Deputy Chairman of the Biology Committee and Deputy Member of the Council 1986-1989; Member of the Reference Committee, "International evaluation of Swedish biology" 1993-1994), the Swedish Forestry and Agriculture Research Council (SJFR) (Committee for Aquaculture/Fisheries Research member 1987-1988 and Chairman 1988-1993; Committee for Organism Biology member 1990-1993; elected member of the Council, 1991-1993), the Foundation for Strategic Research (SSF) (Medical Bioscience 1994-1995), and the Foundation for Strategic Environmental Research (MISTRA) (Chairman of the evaluation committee "Pheromones and kairomones for control of pest insects" both in 1996 and 1999).

Stefan Nilsson is a Fellow of the Royal Society of Arts and Sciences of Gothenburg (since 1986), and of the Royal Swedish Academy of Sciences (since 1989). He was Dean of Biology from 1990-1996, Deputy Dean of Science 1997-1999, and is currently Dean of Science at Göteborgs University (since 1999).

Bengt Saltin

Bengt Saltin studied at Karolinska Institute in Stockholm and defended his doctoral thesis in Physiology in 1964. After a postdoctoral period at the University of Texas Southwestern Medical Center in Dallas and at the John B. Pierce Foundation Laboratory, Yale University, New Haven, he became associated professor at Karolinska Institute in 1968 and in 1973 he was appointed professor of Human Physiology at the August Krogh Institute, University of Copenhagen. In 1990 Saltin was called to a professorship at Karolinska Institute which he held for three years. In 1994 he returned to Copenhagen to become the director of the newly started Copenhagen Muscle Research Centre, which was founded by the Danish National Research Foundation and comprises five research groups consisting of both basic scientists and clinicians.

Saltin has primarily worked in the field of human integrative physiology focusing upon skeletal muscle adaptation and the interaction between skeletal muscles and the heart to secure oxygen (and substrate) supply to the contracting skeletal muscles. He is the author of some 250 original articles and around 125 chapters or reviews. In addition, he is the editor of several textbooks in physiology for medical and postgraduate students. He was Associate Dean and Dean of the Faculty of Science of the University of Copenhagen in the 1980's and served for 10 years on the research council of the Heart Foundation. At present he is on the board of the Novo Nordisk Foundation. He is a member of the Danish Academy of Sciences and letters and an honorary doctor at seven universities in Europe and North America.

Appendix 3

The letter from the Research Council to the Norwegian Universities (in Norwegian)

Til institutt/-avdelingsledelsen ved
institusjoner i følge vedlagte liste

Vår saksbehandler/telefon
Jarle Nygard/2203 7209
jn@forskningsradet.no

Vår ref.
99/01365 JN/sdu
Deres ref.

Oslo, 26. mars 1999

Evaluering av grunnleggende biofaglig forskning

Det vises til tidligere utsendt brev.

Norges foskningsråd ønsker å gjennomføre en evaluering av grunnleggende biofaglig forskning inkludert biokjemi og bioteknologi ved universitetene, de vitenskapelige høyskolene, de statlige høyskolene samt ved relevante forskningsinstitutter. Evalueringen gjennomføres som et samarbeid mellom fire områder i Forskningsrådet: Bioproduksjon og foredling, Medisin og helse, Miljø og utvikling samt Naturvitenskap og teknologi.

Evalueringen vil bli gjennomført ved hjelp av tre evalueringspaneler bestående av internasjonale eksperter, samt en overordnet evalueringskomité. Vedlagt følger mandat for evalueringspaneler og evalueringskomité.

Egenrapport fra forskningsinstitusjonene
Etter anmodning fra fagmiljøene utsettes fristen for egenrapportering fra institusjonene til 15. mai. Rapportering fra institusjonene vil danne grunnlaget for arbeidet i evalueringspaneler og evalueringskomité. Denne henvendelsen sendes til flere organisatoriske nivåer: instituttgruppe-nivå, instituttnivå og til aktuelle avdelinger (i hht. vedlagte liste). Vi ber om at rapporteringen så langt mulig samordnes på instituttnivå eller på annet organisatorisk nivå der dette er naturlig. Ved større institutter der flere avdelinger skal evalueres, bør det leveres rapport både på avdelings- og instituttnivå. I det følgende er ”institutt” benyttet som fellesbetegnelse for det som måtte være naturlig organisatorisk enhet i hvert enkelt tilfelle.

Som angitt i forrige brev er instituttene delt i to hovedgrupper:

Gruppe 1: *Institutter der hele den vitenskapelige virksomheten skal evalueres.*

Gruppe 2: *Institutter der ikke hele virksomheten skal med, men der aktiviteten til enkelte forskergrupper skal rapporteres.*

Fordelingen på ”gruppe 1” og ”gruppe 2” går fram av vedlagte liste.

Ved ”gruppe 2”-institusjonene er det kun den virksomhet relevant for den grunnleggende biofaglige forskningsaktiviteten som skal rapporteres, og institusjonen må selv avgrense hva som er relevant informasjon. I noen av punktene under er dette forsøkt presisert.

Vi ber om å få tilsendt følgende informasjon (10 – 20 sider avhengig av instituttets størrelse) **på engelsk både som papirkopi og på diskett innen 15. mai**:

- Organisering av instituttet
- Beskrivelse av forskergruppene (gruppe 2-institutter: relevante forskergrupper)
- Vurdering av instituttets styrke, svakheter, muligheter og trusler (gruppe 2-institutter: vurdering i forhold til grunnleggende biofaglig forskningsaktivitet)
- Strategi og framtidige planer (gruppe 2-institutter: Strategi og framtidige planer i forhold til grunnleggende biofaglig forskning)

Vi ber om følgende vedlegg

- Oversikt over vitenskapelig ansatte inkludert stipendiater, angi alder og fagfelt (gruppe 2-institutter: ansatte og stipendiater innen grunnleggende biofaglig forskning).
- CV for alle vitenskapelig ansatte; maks. 2 sider inkludert liste over publikasjoner siste 5 år. Legg ved 2 kopier av de 5 viktigste artikler siste 5 år.
- Liste over større utstyrsenheter (gruppe 2-institutter: større utstyrsenheter relevante for biofaglig forskning).
- Oversikt over større investeringer siste 5 år.
- Annuum-bevilgninger siste 5 år.
- Eksterne forskningsbevilgninger siste 5 år med angivelse av kilde.
- Oversikt over uteksaminerte hovedfags- og doktorgradskandidater med veileder siste 5 år. Angi tittel på doktorgrader.
- Beskrivelse av nasjonalt og internasjonalt forskersamarbeid.
- Beskrivelse av samarbeid med industri og offentlig forvaltning.
- Årsrapporter siste 5 år.

Evalueringsmaterialet fra institusjonene vil bli bearbeidet og oversendt evalueringspanelene før sommeren. Som tidligere nevnt vil møter mellom evalueringspanelene og forskergruppene trolig bli avholdt i Oslo i september/oktober 1999, og evalueringsrapportene vil bli ferdigstilt i løpet av høsten 1999.

Med vennlig hilsen
Norges forskningsråd

Nils Marås
Områdedirektør
Naturvitenskap og teknologi

Jarle Nygard
Spesialrådgiver
Prosjektleder

Kopi: Ledelsen ved universiteter, fakulteter og høyskoler i følge vedlagte liste

22.02.99/JN

Evaluering av biofag – oversikt over miljøer i UoH -sektoren:

Miljøene vil bli delt i to hovedgrupper:

Gruppe 1: Institutter der hele den vitenskapelige virksomhet skal evalueres

Gruppe 2: Instituttet der aktiviteten til utvalgte forskergrupper skal evalueres

Universitetet i Oslo – gruppe 1

Bioteknologisenteret

Det matematisk-naturvitenskapelige fakultet

Biologisk institutt
- *Avdeling for botanikk og plantefysiologi*
- *Avdeling for generell genetikk*
- *Avdeling for marin zoologi og marin kjemi*
- *Avdeling for marin botanikk*
- *Avdeling for limnologi*
- *Avdeling for molekylær cellebiologi*
- *Avdeling for generell fysiologi*
- *Avdeling for zoologi*

Botanisk hage og museum
Zoologisk museum
Biokjemisk institutt
Farmasøytisk institutt
- *Avdeling for mikrobiologi*

Det medisinske fakultet

Instituttgruppe for Medisinske Basalfag
- *Anatomisk institutt*
- *Fysiologisk institutt*
- *Institutt for medisinsk biokjemi*

Instituttgruppe for Oslo kommunale sykehus
- *Institutt for eksperimentell medisinsk forskning*

Det odontologiske fakultet
Institutt for oral biologi

Universitetet i Oslo – gruppe 2

Det matematisk-naturvitenskapelige fakultet

Farmasøytisk institutt
- *Avdeling for farmakologi*
- *Avdeling for farmakognosi*
- *Avdeling for legemiddelanalyse*

Det medisinske fakultet

Instituttgruppe for Medisinske Basalfag

Institutt for ernæringsforskning

Instituttgruppe for Oslo kommunale sykehus

Institutt for medisinsk genetikk

Mikrobiologisk avdeling

Instituttgruppe for laboratoriemedisin-RH/DNR

Mikrobiologisk institutt

Farmakologisk institutt

Institutt for immunologi

Institutt for patologi

Institutt for kreftforskning, Det Norske Radiumhospital

Rettsmedisinsk institutt

Instituttgruppe for klinisk medisin-RH/DNR

Institutt for kirurgisk forskning

Pediatrisk forskningsinstitutt

Det odontologiske fakultet

Seksjon for odontologisk farmakologi og farmakoterapi

Universitetet i Bergen – gruppe 1

Det matematisk-naturvitenskapelige fakultet

Molekylærbiologisk institutt

Botanisk institutt (inkl. hage og museum)

Institutt for fiskeri- og marinbiologi

Institutt for mikrobiologi

Zoologisk institutt (inkl. museum)

Det medisinske fakultet

Avdeling for mikrobiologi og immunologi (inkl. Senter for virologisk forskning)

Fysiologisk institutt

Institutt for anatomi og cellebiologi

Institutt for biokjemi og molekylærbiologi

Institutt for klinisk biokjemi

Pediatrisk institutt

Fagområdet medisinsk genetikk

Senter for klinisk molekylærmedisin

Universitetet i Bergen – gruppe 2

Det medisinske fakultet

Institutt for farmakologi

Avdeling for patologi

Senter for internasjonal helse

Det odontologiske fakultet

Fagområdet mikrobiologi

Fagområdet patologi

Andre forskningssentra m.m.
Senter for miljø- og ressursstudier

Norges teknisk-naturvitenskapelige universitet – gruppe 1

Fakultet for kjemi og biologi
Botanisk institutt
Zoologisk institutt
Institutt for bioteknologi

Det medisinske fakultet
Institutt for fysiologi og biomedisinsk teknikk
Gruppe for fysiologi
Gruppe for biomedisinsk teknikk
Institutt for kreftforskning og molekylærbiologi
Institutt for morfologi, avd. for anatomi

UNIGEN

Vitenskapsmuseet
Institutt for naturhistorie
Botanisk avdeling
Trondhjem biologiske stasjon
Zoologisk avdeling

Norges teknisk-naturvitenskapelige universitet – gruppe 2

Det medisinske fakultet
Institutt for farmakologi og toksikologi
MR-senteret, medisinsk seksjon
Institutt for laboratoriemedisin

Universitetet i Tromsø – gruppe 1

Det matematisk-naturvitenskapelige fakultet
Institutt for biologi

Tromsø museum
Fagenhet for botanikk
Fagenhet for zoologi

Det medisinske fakultet
Institutt for medisinsk biologi
Avdeling for arktisk biologi
Avdeling for biokjemi
Avdeling for bioteknologi
Avdeling for genbiologi
Avdeling for immunologi
Avdeling for medisinsk biokjemi
Avdeling for medisinsk fysiologi
Avdeling for medisinsk mikrobiologi

Avdeling for molekylær cellebiologi
Avdeling for virologi
Avdeling for molekylær genetikk

Norges fiskerihøgskole
Institutt for marin biokjemi
Institutt for marin- og ferskvannsbiologi
Institutt for akvatiske ressurser og miljøbiologi

Universitetet i Tromsø – gruppe 2

Det medisinske fakultet
Institutt for medisinsk biologi
Avdeling for morfologi
Avdeling for eksperimentell patologi og anatomi
Avdeling for farmakologi

Norges landbrukshøgskole- gruppe 2

Institutt for kjemi og bioteknologifag
Institutt for biologi og naturforvaltning
Institutt for husdyrfag
Institutt for næringsmiddelfag
Institutt for plantefag
Institutt for jord- og vannfag
Senter for internasjonale miljø og utviklingsstudier – Noragric

Norges veterinærhøgskole –gruppe 2

Institutt for arktisk veterinærmedisin
Institutt for biokjemi, fysiologi og ernæring
Institutt for farmakologi, mikrobiologi og næringsmiddelhygiene
Institutt for morfologi, genetikk og akvatisk biologi

Universitetsstudiene på Svalbard –gruppe 1

Biologisk avdeling

Norges idrettshøgskole – gruppe 2

Institutt for idrettsfag og biologiske fag

Statlige høgskoler - gruppe 2

Høgskolen i Bodø
Avdeling for teknologi og naturvitenskap (forskere innen relevante fag)

Høgskolen i Stavanger
Forskere innen relevante fag

Høgskolen i Sogn- og Fjordane
Forskere innen relevante fag

Oversikt over miljøer i institutt-sektoren:

Alle miljøene tilhører

Gruppe 2: Instituttet der aktiviteten til utvalgte forskergrupper skal evalueres

Fiskeridirektoratets ernæringsinstitutt
Havforskningsinstituttet
Akvaforsk
Norconserv
Fiskeriforskning
Matforsk
Planteforsk
Norsk institutt for skogforskning
Veterinærinstituttet
Statens institutt for folkehelse
Statens arbeidsmiljøinstitutt
Forsvarets forskningsinstitutt
SINTEF/UNIMED
Norsk institutt for naturforskning
Norsk institutt for vannforskning
Jordforsk
Norsk polarinstitutt