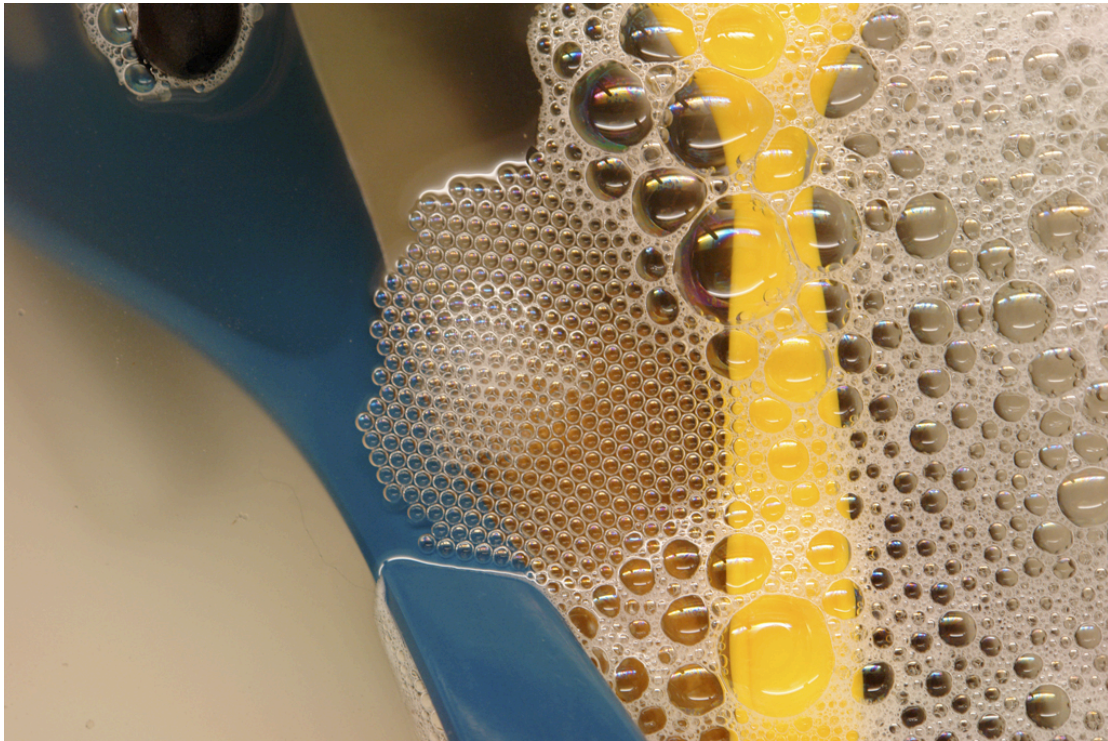


2005 Activity Report:

PHILOSOPHY OF NATURE AND SCIENCE STUDIES

The Annual CPNSS Report
Center for the Philosophy of Nature and Science Studies
at the Faculty of Science, University of Copenhagen
www.nbi.dk/~natphil/
(January, 2006)



Strange patterns in the washing-up bowl
(by courtesy of Anne Gry Haugland, photo by Sune Kliborg Lyng)

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Mia Trolle Borup (Ph.D. student)
Charbel Niño El-Hani (Guest researcher)
Mette Høst (Artist in residence)
Claus Emmeche (Associate Professor, head of centre)
Jens Morten Hansen (Adj. Professor)
Tom Børsen Hansen (Guest researcher, external lecturer)
Anne Gry Haugland (Ph.D. student)
Anders Frøslev Jensen (Guest researcher, teaching assistant)
Mikkel Willum Johansen (Guest researcher, teaching assistant)
Marie Svarre Nielsen (Guest researcher, teaching assistant)
Svend Erik Rugh (Visiting fellow)
Henrik Zinkernagel (Visiting fellow)

Introduction:

Philosophy of nature is a cross-disciplinary field, involving science and the humanities, addressing general questions about the status of scientific world views, the nature of rational inquiry, ontological and epistemological aspects of human understanding of the natural world, and the limits scientific knowledge. Traditionally these questions have been approached either from the natural sciences or from such disciplines as philosophy of science, history of science, sociology of science, and philosophy of language and mind. Philosophy of nature is an attempt to integrate findings from these disciplines into a more coherent picture and to investigate the roles of such a picture for civilization. Within this general field of research, specific and focused projects dealing with particular aspects of philosophy of nature can be defined.

The activity forms a part of the Center for the Philosophy of Nature and Science Studies at the Faculty of Science, University of Copenhagen (in Danish: Center for Naturfilosofi og Videnskabsstudier, CNV), a centre hosted by the Niels Bohr Institute (website: www.nbi.dk/~natphil). It was initiated in 1994 by the Faculty of Science as a network of researchers interested in philosophy of nature and theory and history of science. The centre includes a few persons doing full time research and associated staff from the Faculty's institutes who devote part of their research and teaching to this field (see webpages). The centre aims to develop philosophy of nature and science studies as an integrated research and educational activity at the Faculty of Science, and to create an intellectual milieu for empirical and foundational studies of science.

For students who started in 2004 or later a course in Theory of Science specific for each bachelor programme (in Danish, Fagets Videnskabsteori) is mandatory. The centre coordinates the development of these courses at the Faculty of Science in cooperation with the individual study programmes. For more information (most in Danish), see www.nbi.dk/~natphil/FVT

Science Studies is research into the special sciences and their structure of communication, history, philosophy, sociology, and ethics. Philosophy of nature includes reflections upon the concept of nature in relation to scientific, philosophical and metatheoretical insights, i.e., not only ontology as a special field of philosophy, and not in the sense of a romantic Naturphilosophie. Inspired by the philosophy of Niels Bohr, philosophy of nature has been given a new

meaning, signifying critical dialogue (as experienced in teaching courses on philosophy of nature and science studies at the Niels Bohr Institute) bringing together students, scientists and scholars from the humanities and science studies; crossing the boundaries between science and metascience without dissolving crucial differences of theory, approach, and research object, but furnishing an open kind of discourse and a deeper understanding.

This is the first distinct CPNSS Activity Report, as we formerly reported our activity as part of the NBI reports. However, due to a restructuring of the physics institute NBI gave up its activity reports by 2004 (see <http://www.nbi.dk/ACTREP/2004/>). The URL of the present report is <http://www.nbi.dk/~natphil/rep/cpnss2005.pdf>

Projects

Christian Baron

Project:

Should paradigm theory be expanded?

The concept of paradigms is a core notion in Thomas S. Kuhn's theory of normal science as the stable phase of a research field. This project attempts to deepen a Kuhnian understanding of natural science in other fields than physics and expand the characterization of a paradigm (or disciplinary matrix) in the light of recent science studies, especially historian of science Lorraine Daston's analyses of central ideas of scientific values, such as the concepts of fact and objectivity. This investigation will be based on case studies drawn from evolutionary biology, such as famous controversies within the modern neo-Darwinian synthesis.

(Participants: Christian Baron).

Christian Baron

Project:

Epistemic and moral values in post-normal scientific practice.

The project aim at improving our understanding of the epistemic and moral values that constitute the moral economies of post-normal scientific practice. The move from "Academic Science" to "Techno-Science" (Lyotard) with the establishment of disciplines as biotechnology, nano-science, nano-technology, health science etc. is used as a setting for studying the changes and transport of epistemic and moral values between the spheres of science and the public.

(Participants: Christian Baron).

Mia Trolle Borup

Project:

The Complexity of Genotype-Phenotype and the Human Genome

The project focuses on genotype-phenotype relations in complex biological systems and the molecular biology approach. Following the sequencing of the human genome, which is largely accomplished, lays a huge challenge in understanding the role of these revealed codes in the formation of complex phenotypic traits. Enormous medical and economical interests are at stake in a better understanding of the mechanisms involved in the formation of complex traits, sometimes viewed as solely genetic and sometimes as interplay between genetic and environmental factors. In dealing with these problems, the project integrates views from the emerging cross-disciplinary field of complex systems research where a broader definition of inheritance is proposed – including but not limited to the transfer of genetic information. The purpose of the project is to investigate the systems causality involved in the formation of complex traits, with

particular focus on phenotypes as system states. Especially the phenomenon of "phenocopies", where different causes result in the same overall phenotype is investigated as an example of the non-linear relationship between genotype and the phenotypic state. As part of this project, experimental work on yeast cells is carried out in the lab of Professor Olaf Nielsen, Institute of Molecular Biology, University of Copenhagen, and in collaboration with Dr. Sui Huang, Harvard Medical School and Associate Professor Ib Søndergaard, DTU. (Participants: Mia Trolle Borup).

Claus Emmeche

Project:

Biosystems and their Relation to Physics - Emergence of Biological Processes in Complex Systems

The project investigates the distinctive character of complexity in biological systems and the prospects of reducing biological concepts to chemical and physical ones. Three paradigms of theoretical biology give different answers to this question. It has been argued that the implication of the Neo-Darwinian paradigm of open-ended evolution of replicators (carrying information specifying interactor phenotypes) is that reduction is possible in principle but not in practice. The autopoietic theory (of organizationally closed and structurally open systems), and the biosemiotic approach (seeing intrinsic interpretation of sequence information as a necessary condition for biocomplexity) claim reduction to be in principle impossible. These paradigms are analysed and compared with models of emergence of higher order structures in physical systems. Concepts of causality related to processes at different levels are considered, as well as the implications for a level ontology. It is possible to define emerging properties in models of artificial life, neural networks, cellular automata and other complex adaptive systems. Using this as a case, the relations between philosophy of science and philosophy of nature is investigated.

(Participants: Claus Emmeche).

Charbel Niño El-Hani

Project:

What Is A Gene? A Philosophical and Empirical Study of a Central Concept in Biological Thought and Biology Teaching

This project is embedded in the interdisciplinary field of history, philosophy and science teaching. A high quality scientific education does not involve only teaching the findings of science, but also the nature of science. The project proposed here is thus characterized by a multidisciplinary approach, involving research about science teaching and learning, epistemology, semiotics, and sociology of science. The term 'gene' was proposed by the Danish geneticist W. L. Johannsen in 1909 and, certainly, marked the history of science in the 20th century. Keller (2000) refers to the 20th century as 'the century of the gene', and Grósz (1989) claims that we live in a 'civilization of the gene'. Our objectives: 1. To analyze the gene concept in the light of C. S. Peirce's philosophy of sign, in particular, as applied to biological systems in the context of biosemiotics. 2. To investigate the conceptualizations of the gene (and related concepts) found in the community of geneticists and molecular biologists. 3. To analyze the treatment of the gene concept in higher education genetics and molecular biology textbooks, as a ground for subsequent studies, focusing on concrete classroom situations. 4. To investigate a sample of Brazilian popular science magazines in order to verify how ideas about genes are addressed, checking the levels of simplification and contextualization.

(Participants: Claus Emmeche, Charbel N. El-Hani, Mikkel W. Johansen).

Tom Børsen Hansen

Project:

Academic and Social Responsibilities of Post-normal Scientists

The project deals with epistemological and ethical questions related to post-normal science. The research aims at (i) improving our understandings of the epistemic and moral norms that ground (the institutions of) post-normal science; and (ii) develop the idea of 'the responsible post-normal scientist,' where the focus is on how the individual post-normal scientist *ought* to relate these norms. This research can be seen as a continuation of the PhD dissertation *Between 'Formation' and Paradigm Socialisation - Draft to a theory of 'formation' relevant to chemistry-related university curricula and study programs* (in Danish) from 2003 by T.B.H., as it aims at generalising and unfolding the gained insight in tertiary chemistry education to the post-normal field.

(Participants: Tom Børsen Hansen, Christian Baron).

Project:

Science in Motion – From identifying anomaly to paralogy as the basis for scientific development.

Scientific activities at universities are changing, as Lyotard was one of the first scholars to spot. He defined this change as a move from "Academic Science" to "Techno-Science". In this project we follow Lyotard's line of reasoning, and examine what we call "The New Sciences" (cf. techno-science) as opposed to "The Old Sciences" (cf. academic science). The latter consist of the traditional scientific disciplines: physics, chemistry, mathematics, biology etc. The new sciences have names like biotechnology, nano-science, nano-technology, health science, health mathematics and so on. It has been suggested that these new names only are labels constructed to market and finance the old sciences: That the new sciences are only old wine in new bottles. In this project we present a different account, as we argue that deep internal changes have occurred within the scientific and technological spheres. These changes concern the approach to the epistemic values and the metaphysical assumptions guiding scientific activities. The old sciences normally consider these norms and assumptions as fixed – unless anomalies urge them to change their disciplinary matrice. The new sciences, on the other hand, are by external pressures continuously forced to challenge and change guiding norms and assumptions – and hence develop through paralogy. Hereby the new sciences do not primarily adjust to anomaly (as the old sciences do), but fulfil external utility expectations on the basis of paralogy. In this project we conceptually portray the new sciences, and draw didactical conclusions from this philosophical painting as we address the problem of designing the appropriate curricula for the new sciences.

(Participants: Tom Børsen Hansen, Ole Ravn Christensen [Department for Learning, Aalborg University]).

Project:

The Role of Techno-Scientists in Responsible Governance of Emerging Technologies: The Case of Lifestyle Drugs and Medically-enhanced Normality.

An array of recent philosophies of science argue that a clear-cut division between the pure and applied sciences cannot be upheld, and that new science forms are emerging or being recognised. This project gives a comparative overview of a number of these philosophical

accounts of contemporary science: Techno-science (Lyotard), post-academic science (Ziman), modus 2 research (Gibbons, Nowotny et al.), post-normal science (Ravetz and Funtowicz), and post-colonial science (Harding). The suspension of the division between pure and applied science gives rise to novel ethical conundrums. This project presents a case study on one such techno-scientific conundrum created by the emergence of lifestyle drugs and medically-enhanced normality, which is placed in contexts of the above mentioned philosophies of science. The term lifestyle drug denotes medicines that treat conditions associated with specific lifestyles, and not directed towards curing conventional deceases (weight-loss tablets, anti-smoking agents, impotence therapies and hair restorers etc.) The increased skilfulness of the medico-industrial complex in controlling the human biology and psyche makes it possible to construct lifestyle drugs without or with few side effects. Hence, pharmaceutical techno-science can enhance specific patterns of drug use, which in time might become predominant (i.e. normal), and hence change (our perception of) the Human Nature (if one uses the conceptual framework of Hans Jonas) or the Human Condition (cf. Hannah Arendt). In the light of the case of lifestyle drugs and medically-enhanced normality the role is discussed of techno-scientists in responsible governance of emerging pharmaceutical technologies.
(Participants: Tom Børsen Hansen).

Project:

Reflections on FVT

CPNSS associates hold the responsibility for planning and teaching an array of "FVT courses" (philosophy of science) at the Faculty of Science at the University of Copenhagen. This project systematically investigates: (a) Which skills these courses aim at develop, and (b) whether these skills are actually incorporated into participating students' cognitive networks.

(Participants: Tom Børsen Hansen, Christian Baron, Claus Emmeche).

Anne Gry Haugland

Project:

The Nature in the Mind - the Philosophy of Nature in the works of Inger Christensen

The heart of the project 'The Nature in the Mind' is a study of the philosophy of nature in the works of Inger Christensen. The aim is to fill up two gaps in the research of Inger Christensen: On the one hand the project aims at placing Inger Christensen's philosophy of nature in a framework of history and theory of science, including modern as well as romantic philosophy of nature. On the other hand it recognizes her works as part of a broader tendency of philosophy of nature in Danish contemporary art, not just expressed in literature but also in visual arts, ceramics and studio glass. Thus, the project is fundamentally cross-disciplinary: It places itself in the intersection between art and natural science and deals with their interplay. Although the project has its literary starting point in Inger Christensen's work, it also significantly extends the relations of literature to issues of natural science.

(Participants: Anne Gry Haugland).

Mette Høst

Project:

Visions of art and science

This project forms a part of my activity as artist in residence at CPNSS and the Niels Bohr Institute, and is started as a pilot-study with the aim of investigating the physical and mental frames for

physics research, realizing workshops on the visual and creative approach to the subject matter of research and to see whether the presence of an artist in different research groups at the NBI may enact new questions and insights across the different research fields. See also: www.artistinresidence.dk (in Danish). (Participants: Mette Høst [& the NBI staff]).

Anders Frøslev Jensen

Project:

The history of Newtonian influences upon in darwinist thinking.

My project belongs under two interrelated domains of knowledge: 1) a study of the theological and philosophical backgrounds of modern science in general, and the origins of the *structure* of Charles Darwin's theory of natural selection (cf. Gould, Stephen Jay, 2002, *The Structure of Evolutionary Theory*) in particular and 2) the development of a new synthesis within theoretical biology. Modern biology is confronted with several deep problems such as the unsettled "level of selection"-controversy, the problems of the discourses of gene action and gene activation within embryological genetics (cf. Keller Evelyn Fox, 1995, *Refiguring Life, Metaphors of Twentieth-Century Biology*) and the emerging practice of referring to constraints ("*sources outside the favoured explanation*", Gould 2002), e.g., *structural constraint* and *emergence*. It is my thesis that these and other problems of biology are caused by Darwin's endeavour to make a universal theory of the species of the earth based on the theoretical structure of Isaac Newton's "theory of gravitation", especially Darwin's choice of a correspondent to a Newtonian "mass atom". In Darwin's theory the species are atoms, and the individuals are - as parts of a species - units of selection. One of the problems of this choice is that the "cell theory" (Theodor Schwann 1838) is left out as a theoretically unimportant level of complexity, not articulated theoretically neither in Darwin's "theory of natural selection" nor in the genetical research program on development. As an alternative to Darwin's solution I propose that the cell should substitute the species as the analogue of the Newtonian mass atom in a new selection type theory, and that genetics, the cell theory and my new "theory of selection" should be integrated into a new synthesis which will constitute a new expanded foundation of biology. (Participants: Anders Frøslev Jensen).

Marie Svarre Nielsen

Project:

Language and reality in physics – entity realism, philosophy of science and philosophy of language.

The project forms a part of the work done for a Masters thesis (in Danish) in the philosophy of physics. It investigates the relation between language and reality from the perspective of debates within philosophy of science about the characteristic status of physical entities, theories and laws; especially the realist vs. antirealist debate. The project is informed by philosophy of language, especially the contributions of L. Wittgenstein and M. Dummett, and the target theories and positions are those given by Ian Hacking and Nancy Cartwright. Also Peter Gallison's and Thomas Kuhn's theories are used as resources. The philosophical discussion is substantiated by examples from physics, and comments are given to the instrumentalist interpretation of quantum mechanics given by Aage Bohr and Ole Ulfbæk. In a critique of Hacking's version of realism it is shown that the use Hacking makes of the theory of meaning in Putnam as support for his entity realism is not coherent. It is suggested that Hacking's position can be re-interpreted as being consistent with antirealism. Finally, a reinterpretation of Kuhn's so-called

ontological commitments as a paradigm component is suggested. The project elucidates hidden connections between philosophy of language and philosophy of science.

(Participants: Marie Svarre Nielsen).

Henrik Zinkernagel

Philosophical Aspects of Fundamental Physics and Cosmology

The purpose of the project is to clarify and critically discuss some of the philosophical aspects of fundamental physics (e.g. quantum field theory) and modern cosmology. For instance, the project addresses to which extent the substantial conception of vacuum in quantum field theory is based on experimental facts rather than theoretical and philosophical expectations. Another part of the project is the question of how much, and in which sense, cosmology and particle physics can be said to be unified.

(Participants: Henrik Zinkernagel, Svend Erik Rugh).

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Claus Emmeche

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