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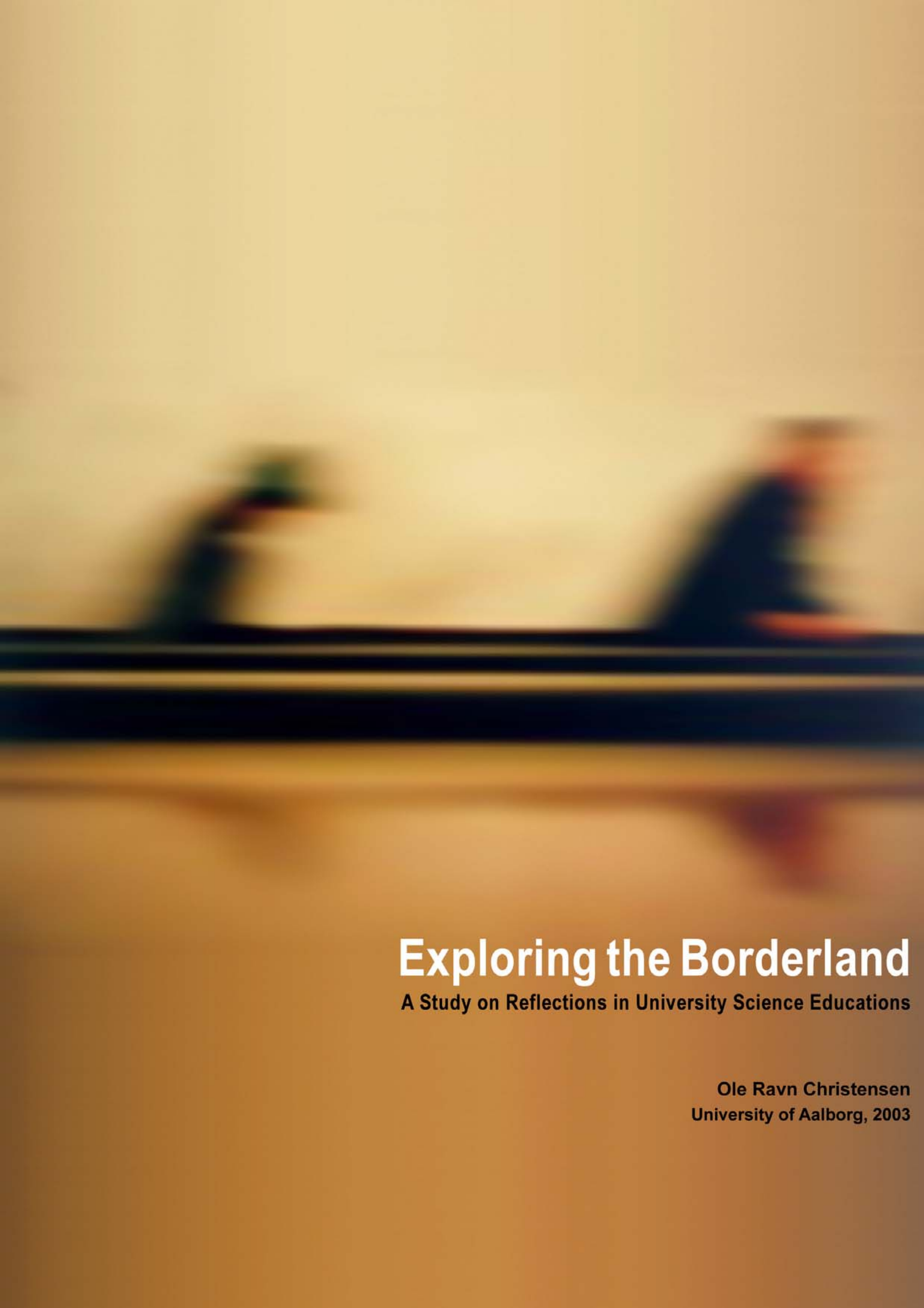

Exploring the Borderland

A Study on Reflections in University Science Educations

Ole Ravn Christensen

University of Aalborg, 2003

Exploring the Borderland

A Study on Reflections in University Science Educations

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Theme I and III of Part II were first presented at the Nordic Summer School in 2001 and 2002. Pages 117-135 are a further development of a paper written in connection to an unfinished Pædagogikum education. The core of the arguments concerning Wittgenstein's two conceptions of language (pages 156-158 and 162-169) are slightly changed versions of sections in my master thesis *Wittgenstein's Influence on Contemporary Philosophies of Mathematics* (1999). Theme II of Part II will be part of an upcoming anthology stemming from the Science Philosophical Forum at the University of Aalborg.

In the text, I use notes to signify what I have translated from Danish to English. The translation notes can be found at the end of the thesis.

Ole Ravn Christensen
Aalborg, November 2003

Introduction

1. A Study on Reflections in University Science Educations

From the middle of the 17^{th} century, the breakthrough of modern science gradually led to a mechanistic conception of nature in European culture. Before this, the conception of nature was another. A few years ago, Tove Kruse wrote her dissertation on the *Wholeness and science in the natural scientists of the sixteenth and seventeenth centuries* (1996). The title did not refer directly to the Renaissance, as it is often regarded as starting in Italy centuries before, but the dissertation concerns what we might call the late Renaissance – the beginning of modernity in the period before the later rationalistic phase won through. In the scientists of this time of unrest and upheaval, differing conceptions of nature clashed. On the one hand, a conception of nature was prevalent that involved humans as being an integrated part of nature. The language used to talk about nature involved concepts of the human body and vice versa – water was referred to as the blood of the earth and the human anatomy was likened to different aspects of nature. Human life was inextricably connected to nature to the degree that it was reflected in the organisation of social life. On the other hand, the scientists of the 16^{th} and 17^{th} century were standing on the verge of comprehending nature as something that could be formed and analysed as a thing or an object – not as connected to human life, but as an autonomous realm that was different from the human realm and could be investigated in its own right and thus severed from the whole.

As Kruse points out, the leading scientists of this period have been depicted as pioneers of a radical break with medieval misconceptions. In opposition to this view, Kruse explains that different types of association between wholeness and science flourished. Either the scientist established a synthesis or a compromise between these opposites. Paracelsus (1493-1541) and the contemporary David Bohm (1917-1993) are shown to be advocates of a reductionist synthesis. This means that they emphasise the fundamental harmonious unity of all things and reduce the world to a homogeneous universe. In the reductionist synthesis, visions of wholeness and scientific analysis are interchangeable approaches that can be used to prove each others findings. In Bohm's case, a special conception of order at quantum level is used as the ordering principle of all spheres of life and world. Tycho Brahe (1546-1601) and Johannes Kepler (1571-1630) are chosen as examples of an expansive compromise that opens up the possibility of the universe having complementary spheres, and where wholeness- and scientific perspectives are complementary approaches to conceive of the world.

Aksel Haaning has also been occupied with the conception of science in this period. In *Naturens lys* (2001) [Nature's light], he touches upon a similar theme with regard to Giordano Bruno's worldview. In Haaning's interpretation, Bruno (1548-1600) was burned at the stake because his conception of nature was a threat to the Catholic Church. His thought that nature is not a soulless sphere put man outside the centre of the universe, and thereby conflicted with the ideas of Christian thought at this time. In many ways, Bruno exemplifies the diametrical opposite to Descartes, with regard to conceptions of nature, but Bruno's philosophy of nature certainly shows that strong alternatives existed in this turbulent period.

Today the debate between wholeness or holism and scientific analysis has grown stronger throughout the 90's. Interest in holistic theories about the earth as an ecological system, about the human body in medical studies etc. has underscored the importance of developing an expansive compromise in the scientist. These interests are not symptoms of superstition re-entering culture at the end of the millennium, rather they point to a much deeper level of conflict that involves different conceptions of science.

Brahe, Kepler and Bruno lived in a culture that was markedly different from ours, but we may not gain the full scope of their insight by dividing their work into their "strange worldviews" on the one hand and their renowned scientific results on the other. These scientists can be said to have been highly reflective, in the sense that they tried to balance scientific analysis and visions of wholeness in their approach. Maybe they were great scientists, exactly because of their reflections upon this relation?

In the beginning of 2001, the former Minister of Education Margrethe Vestager made an agreement with the rectors of 11 Danish universities to implement a new course in all university educations. This course is called ‘Fagets videnskabsteori’ (translatable to ‘Theory of science in the particular field of study’) and its content is related to reflections upon the science in question, as opposed to a university science course going deep into the basic theory of a given discipline.

The agreement was presented by the former Minister of Education in a letter to each of the rectors as 10 guidelines for Fagets videnskabsteori. Fagets videnskabsteori, as the minister’s guidelines present it, does not contain many suggestions to the actual construction of this new aspect in university curricula (see Appendix I). It is explicitly stated that the board of study of every local department or institute having the responsibility for a particular education should decide what would be a reasonable content in relation to their unique education. This, however, presents several practical problems for the departments under the science faculties, as reflection courses have been largely downplayed since the days of the Filosofikum institution in Denmark, and competencies are often scarce in relation to these matters. The deadline for implementing the Fagets videnskabsteori course is September 1st 2004.

An investigation into the justification for and content of Fagets videnskabsteori courses (in the following FV-courses) therefore seems to be much needed as a step towards bringing FV into action. This investigation is the task that I will undertake in my thesis, and two central reasons support this choice. Firstly, as mentioned above, the implementation of FV-courses – often referred to as the new Filosofikum – is at hand, posing several implementation problems. Secondly, the investigation fits the general aim of my institutional enrolment under the Centre for Educational Development in University Science, and this thesis should be considered a contribution to the study of the educational quality in university science educations.

In the following section, I will try to demarcate the field of study that deals with reflections in university science education. This subsequently leads me towards formulating a problem statement for the thesis. Later on, I will present the methodology used to answer the problem posed.

1.1 Problem Statement and Research Objective

Calling to mind that decades ago, Danish university students attended the reflection course called Filosofikum, it would seem reasonable to ask whether a new Filosofikum-like aspect of science educations is appropriate today. It is certainly politically backed, but the question remains whether it will be welcomed by the science faculties. As mentioned, what is often called the Filosofikum debate has recently been raised again with the forthcoming FV-courses, and as I see it, the discussions reveal the need to transcend the old Filosofikum-model as well as the name Filosofikum itself, as this name bears with it several unfortunate connotations from its long past. The name of the new courses to be implemented – Fagets videnskabsteori – also has some unfortunate connotations pointing in the direction of methodological courses. I will therefore refer to the field of study, of which arguments and reasoning supporting or rejecting courses like the Filosofikum and FV-courses are possible outcomes, as *the study of reflections in university science educations*.

As we shall see further on, many different points of view on the content of reflection courses in Danish university educations have been proposed and defended throughout the history of the Filosofikum institution. These points of view I shall refer to as answers to the *question of content* in the study of reflections in university science educations. As stated above, one of my initial reasons for doing studies in the field proposed is the lack of guidance that the new ministerial request displays. I will therefore focus on this particular question in what follows.

The recent Filosofikum debate, however, has shown that there are great differences of opinions when it is discussed whether reflections are needed in science educations.

Therefore, I cannot and shall not ignore this aspect of the debate, which must to some extent proceed and corroborate the question about relevant reflection content. I shall call this part of the study of reflections in university science educations the *question of justification*.

In the field of reflections in university science educations, a combined answer to both the question of justification and the question of content will be referred to as a *position* in the field of study. As a result of the foregoing considerations, my problem statement, as well as my research objective, can now be outlined in the following form:

Are reflections in university science educations needed and if so, what should be the content of these reflections? My research objective will – in order to answer this problem statement – consist in the attempt to establish a viable position within the field of study on reflections in university science educations.

I will later go into detail about the method I employ in order to establish this position. The task ahead calls for an investigation into the reasons for implementing reflections in university science educations and, in connection to this, the establishment of a reasoning concerning the proper content of such courses. 50 years ago, the answer to the problem statement could have been, firstly, that science students needed, say, training in scientific methodology and, secondly, that the curriculum of the Filosofikum institution could provide these skills, but the time seems ripe to ask the question once again.

In relation to the problem statement, a number of subsidiary questions follow. What are the different types of reasons that could be given for implementing such reflections? Should reflections be focused on epistemological issues rather than aspects considering sociological perspectives on science, or maybe completely different perspectives should be brought to the fore? This is the type of questions that I will engage throughout the thesis.

In addition to this sort of discussions, there also seems to be a dominant type of questions in the Filosofikum debate concerning the sometimes lacking recruitment to science educations at university level. How can we ensure a growing number of students in science studies, so that the economical growth of our society is not put at risk? Are university science educations too restricted to purely technical aspects, leaving no room for self-realisation through university studies, thereby making students choose educations at the competing faculties? This type of question shows that there is a range of political issues and questions connected to the more philosophical considerations about reflections in science education. I bring this up because I want to clarify that the focus of my work will be philosophical rather than political, and emphasis will be on philosophical aspects of the ongoing educational debate. The aim, thus, is to produce philosophical arguments that will enable me to suggest a position in the field of study. I do not attempt to give a complete account of the practical implementation of a future Filosofikum or FV-course as an answer to the problem statement. Rather, I attempt, through the establishment of a viable position, to produce inspirational guidelines of thought. These guidelines or directions could ideally aid the process of implementing new FV-courses in the curricula of university science educations.

Let me add a few more comments on the demarcation of my problem statement and research objective. First of all, my exclusive focus is *science* and I take this concept to include the natural sciences, mathematics, computer science and the technological educations including the disciplines of engineering and several new cross facular disciplines of research, such as artificial intelligence, nanotechnology and biotechnology. In addition to this limitation, I shall only be interested in finding arguments concerning the *justification* and *content* of reflections in science educations, as opposed to the structural and pedagogical issues accompanying the implementation of new elements in a curriculum. The implementation process is, however, deeply connected to the practical realisation of future FV-courses, including, for example, deliberations as to who should teach these courses. Even though my answer to the problem statement will not engage these issues directly, I shall seriously consider and comment upon the practical problems of introducing this new course. However, the Danish universities are at the moment very differently structured with regard to reflections in science educations and also in a great many other respects. I will therefore sustain from taking the particular situation of a certain university as the outset for my writings. The guidelines I aim to produce are, in my opinion, important for all science educations and are meant to inspire the content of new and old courses alike.

Another issue worth considering with regard to the problem statement and research objective is the concept of '*reflection*' in university science education. The term reflection is, in this setting, used to underscore the connotation that something is added to a practice by reflecting upon it. In this sense, reflection is an activity that engages a broader perspective with regard to the matter at hand. This broader perspective can be given different focus. I would like to argue that, historically, the focus of reflections in university science educations could, through a reasonable simplification, be said to comprise five categories, namely:

1) Theory of science: Reflections on what characterises the structure and truth of the body of knowledge within science, as well as the characteristics of the scientific methodology used in obtaining this knowledge
2) History of science: Reflections on the history of science
3) Philosophy of science: Reflections on philosophical problems within science
4) Sociology of science: Reflections on sociological conceptions of what it means to be doing science
5) Ethics of science: Reflections on ethical issues in relation to society, but also ethical issues within the science community

I will use these five categories in what follows in order to compare the different positions I shall examine. Historically, as will be clarified during Part I of the thesis, types 1), 2) and 3) above were dominant types of content during the time of the Filosofikum institution. In general, most reflection courses in recent Danish history have been focusing on the first two outlines of reflections in science but I shall try to show that strong arguments can be given for taking seriously other types of reflections as well. The two first types of reflections have in addition been occupied by questions internal to the scientific practice and less – if not totally omitting – by external questions and issues. I will return to this dichotomy between internal and external reflections also, and try to explain this division in a theoretical setting.

Let us now leave the explication of the problem statement and instead turn to the method applied in answering this problem.

1.2 Methodology

To take on the project of producing guidelines for reflection courses in science educations is a task that will inherit certain limitations from the outset. In some of the following chapters, I will try to present a picture of science and its relations to its exterior that will support my recommendations. This picture will inevitably be my picture with the implicit limitations of my knowledge and my position in the academic world, leaving out many alternative perspectives. What follows is therefore meant to illustrate how one could relevantly think about the foundation of reflections in university science educations but is not an effort to find the unique and absolute answer to the problem at hand. All this to say that what I shall now present as my approach to answer the problem statement is directed by my own personal bias and profession as to what is the most beneficial way to gain insight into the field of study.

The method through which I will pursue the problem statement outlined above is based on three different approaches, constituting the three parts of the thesis. These are Part I: Historical approach, Part II: Critical approach and Part III: Positional approach. Each approach deals with the problem statement but in a particular fashion. Each of the three parts therefore has a certain degree of autonomy to it but in a way that makes the entire thesis into more than the sum of its parts. Let me visualise the core structure of the thesis below:

Part I: Historical Approach: Main objective is to analyse the reasoning behind positions on reflections in historical university courses

Part II: Critical Approach: Main objective is to present a critique of a specific position that holds reflections in university science education to be irrelevant

Part III: Positional Approach: Main objective is the construction of a position on reflections in university science education

Each of the three parts reflects a certain philosophical approach. In Part I, I will try to bring forward the positions supporting the different historical courses examined. Hence, the philosophical method applied in Part I is of an analytical nature in its effort to excavate the arguments – hidden or explicated – of a given reflection course. In Part I, I will make an effort to support the consistency and lucidity of the points of view in question.

In Part II – the critical approach – I will turn to a more critical philosophical stance. Here the aim of the philosophical method is to criticise a position that rests on the conception of science in modernity and which claims reflections in science educations to be irrelevant. It will not be a critique, however, that tries to leave science in the postmodern ruins of indifference. On the contrary, my aim is to formulate a critique that has the potential to transcend modernity's conception without underestimating the importance and strength of science.

In this way, Part I of the thesis is a gathering of positions concerning reflection courses in university science educations – in a certain sense an empirical study in the field of study – whereas the second and critical part is a theoretical study on conceptions of science. Part I will analyse and reconstruct historical positions from the Filosofikum debate, and Part II will establish a critique of a particular position within the field supported by an imagined radicalised version of modernity's conception of science. In Part III, the arguments and positions gathered throughout Part I and II will be used to support the construction of a position within the field. It is fair to say that I sketch out the field of study in Part I, engage the question of justification in Part II and take on the question of content in Part III.

In addition to the three approaches of the thesis, I have chosen to incorporate a reflective element in my own work. This element is constituted by a number of excurses that function as windows to the world outside the philosophical realm of the thesis. One might argue that these windows do nothing but reflect the light from the text they were meant to enlighten. They do, however, in my opinion change the scope of the thesis by referring to different kinds of events that give the philosophical arguments and discussions their justification. They may even be seen as reflective elements in this field of study in parallel to those being suggested for science later on.

Let me now go into further detail on the method applied in the three parts of the thesis separately.

1.2.1 Part I: Historical Approach

The historical approach of this study will primarily engage in clarifying the different kinds of reasoning behind the historical courses of Filosofikum. This approach shall therefore be an effort to 'collect' positions regarding reflections in university science educations. This is the primary objective of Part I, but it will be supplemented by two other objectives. I will investigate the philosophical foundation of the Filosofikum from the time of its first appearance, and the third task I undertake is a clarification of the historical event of the revocation of the Filosofikum. Let me stress that these objectives for my historical approach do not apply a methodology borrowed from the discipline of history. As elsewhere in this thesis, the method applied is philosophical in its core.

The historical approach will, in its broadest outline, be a chronological account of the history of the Danish Filosofikum institution from the Middle Ages till today. This means that the University of Copenhagen will be given special attention, as it is the only Danish university going back centuries. A pre-20th century account will be given, as well as a deeper positional account of the Filosofikum models of the 20th century. The approach in Part I will thus be of a gradual increase in detail as we move closer to the revocation of Filosofikum by 1971. As the level of detail is increased from the beginning of the 20th century, the work of establishing exacting positions in the field of study will commence. The following precursory description of the influence of logical positivism on the Filosofikum courses serves as an example of the philosophical analysis performed to establish such positions in the historical approach.

An interesting aspect of the history of the Filosofikum from approximately 1930 is the influence stemming from the logical positivistic theory of science. The main character in the Danish wing of this movement was Jørgen Jørgensen. His theories and books were an integrated part of the Filosofikum courses at the University of Copenhagen until 1971. The task I shall undertake will be to reconstruct the position supporting the specific Filosofikum lectured by Jørgensen. What were the reasons for choosing the content that was lectured? How was the course structured? Could one make connections between this course and certain philosophical standpoints? Investigations like the one sketched here will hopefully give us a clearer picture of what Filosofikum actually rested upon theoretically in the past but also bring about a deeper historical understanding of the discussions surrounding the agreement on FV-courses.

The historical approach will, in addition to the focus upon historical positions, be concerned with the socio-political discussions surrounding the Filosofikum. I shall comment continuously on the history of this discussion with special focus on the beginning and the termination of the institution of 1971. This investigation will consider what made the Filosofikum disappear and leave behind curricula at several science educations with no obligatory reflection content.

1.2.2 Part II: Critical Approach

In the pursuit of an answer to my problem statement it will be essential to decisively confront the question: Why should there be reflections in university science educations? In relation to this question, my critical approach aims to pose a critique of the conception of science in modernity, which in some respects could be seen as still existing within science today. This point of view holds, in a certain radical version, that science is in principle a practice that can be separated from the rest of the discussions going on in society. Science is of course thought to influence and benefit the development of society through technological possibilities, but scientific work is done best by exclusively focusing on the field of study rather than mixing this with possible political, economical, ethical, philosophical and social aspects of the scientific endeavour. As a consequence of this conception of science in modernity – which I shall later formulate as the conception of seclusion – reflections in science education curricula are not indisputably supported, and this poses opposition to any positive answer to the question of justification – an opposition that must be taken very seriously.

The initiating event for the critical approach is the political disposal of Filosofikum in 1971. From this year on, no general national guidelines regarding reflections in university science educations have existed. This revocation of reflection courses inspires me to formulate a position in the field of study that will defend the reason of this historical event. I shall call this the ‘irrelevance position’. Hence, the irrelevance position will be a construct of my own based on a radical version of the conception of science in modernity and motivated by the socio-political reasons for the revocation of the Filosofikum.

Let me say a little bit about the term ‘modernity’ used above. By modernity I refer to the tradition stemming from the French Enlightenment-movement in the 18th century and the even earlier breakthrough of the natural sciences with the work of people like Galileo, Newton, Bacon and Descartes. The science-dominated worldview developed by these prominent scientists and philosophers is often grounded in what is called the classical interpretation of science. From this worldview, we have the notion that science has a method that may be the sole supplier of mankind’s rational knowledge about the world it inhabits. This theme, science as the dominant or even exclusive source of rationality, in my interpretation reaches its peak with the logical positivist movement, and it is this theme that I focus on when I refer to the conception of science in modernity.

I will engage in the critique of modernity's conception of science through a thematic approach that involves arguments from several disciplines – e.g. from philosophy of language and philosophy of science, as well as from sociological perspectives on science and the research within science itself. The critical approach aspires to reconfigure modernity's understanding of science with respect to the concepts of 'reducibility', 'formalisation' and 'progress'. The three concepts under critique are the focal points of three separate studies or themes that aim to undermine what I define as the conception of seclusion supporting the educational irrelevance position. This thematic critique is partitioned according to three of the major subdivisions of philosophy, namely ontology, epistemology and ethics.

1.2.3 Part III: Positional Approach

Based upon Part I and II of the thesis, I shall turn my study in a constructive direction of developing a position in the field of study. The positional approach consists in the effort to bring forward a number of general inspirational guidelines for the content of reflections in science educations. The guidelines will, to some extent, originate in the critical approach but will continuously be confronted with the findings of the historical approach as well.

This way, it is my aim in Part III of the thesis to construct a basic framework of ideas – a position in the field of study – in parallel to those presented in Part I of former Filosofikum courses. Earlier on, I exemplified my approach in analysing historical positions. In Part III, I will attempt to produce a similar framework myself, but based on what I see as contemporary, viable concepts and understandings of science. In this sense, Part I is a study that tries to bind together philosophical conceptions of science and educational positions in history. Part II focuses on philosophical conceptions of science, whereas Part III consists in the formulation of an educational position.

In the process of this formulation, I will use several excurses to bring ideas from contemporary courses and contemporary culture into my construction. As part of this, the starting point for my positional approach will be a closer examination of the FV-agreement between the Danish Conference of Rectors and the Ministry of Education.

Additionally, I have tried to locate the courses that are, in my opinion, the most progressive taking place today.

1.2.4 Methodological Considerations

A key question in the development of an answer to my problem statement concerns the overall philosophical method I make use of. Different philosophical standpoints will inevitably create different answers to the problem posed. But one could even contest the use of philosophy as the proper disciplinary approach to the study of reflections in university science educations. The matter gets even more complicated as the role played by philosophy in relation to science will show to be deeply connected to the problem statement of this thesis. Later on (Chapter 6), I will go into further detail regarding the role and conception of philosophy in this thesis, but I will make a few remarks on it here.

My problem statement is concerned with the question of the proper content of reflections in science educations. It is by no means a sufficient answer to this problem to determine a general philosophical interpretation of science, which can then be lectured as the content of a future course. Philosophy is one of the disciplines that might be considered useful as an element in the building up of a reflection course and because of this it plays a double role in this thesis – as possible content in a future Filosofikum and as a method for investigating what content would be reasonable. In other words, it will to some extent be its own judge in these matters.

Therefore, I aim to pursue the points of view in other disciplines as well in the critique in Part II. This will mainly be the disciplines of sociology, the history of science and recent developments in the sciences themselves. The specific philosophical considerations will include the sub-disciplines of language, epistemology, metaphysics and philosophy of science of direct interest to the initiating problem. When I call my overall method of investigation philosophical, this is therefore to be taken in its widest possible sense of the word. Philosophy in this sense is not limited to disciplinary philosophical debates on, say, Aristotle's writings or the concept of mind, but can if necessary engage in this sort of inquiry.

'Philosophy', as I use the term here, is meant to represent a methodological process rather than a closed methodological set of rules that can be applied to a given field of study. It is also used in the sense of being the methodology that does not delimit itself from any approach from the outset when engaging in a new problem.

What I have called my philosophical method is hence to be understood as the process towards bringing the three approaches – the historical, the critical and the positional – into a consistent and relevant way of thinking about reflections in science educations. In its specific form here, it is a method that uses an amount of empirical data in the shape of philosophical standpoints that support educational positions with respect to the field of study at hand but also a method that gains insight through a philosophical critique of the foundation of a certain position in the Filosofikum debate. It finally combines these approaches in a constructive positional approach.

Let me also touch upon a few points in connection with the critical nature of the general approach that might be in need of further explanation. Why am I including a critique of the conception of science in modernity in the overall approach to answer the problem statement? It would have been possible, for example, to analyse the positive features of doing science and from this extract guidelines for a reflection course that focused on the ability of science to uncover nature's secrets or its positive influence on the development of society in history. In other words, I could have focused my study on the importance of promoting scientific rationality. As I see it, this would not, however, be a fruitful method as the scientific worldview is already the predominant force in our culture. Georg Henrik von Wright, whose writings we shall pay closer attention to later on, describes the position of science in Western societies of today in the following quotation. He positions it according to what he sees as the four major "potencies" of civilisation.

> *If one asks which of the earlier mentioned four "potencies" – state, religion, art or science – most deeply influences modern life, the answer can be no other than science. We live in a most "scientific" era. This is already proven by the changes that the adapted science, technology, has brought about in mankind's exterior conditions of life in our century. Of the other three potencies of civilisation, we may say that they exist under the influence of the power of science. […] We need not investigate here, whether the mastery of science is more for the good or the bad. The mere knowledge of the existence of this mastery ought, for any alert*

> *person, to be an admonition to seek to learn something about the philosophy that lives, so to speak, with its face turned to science.* (von Wright 1971, p.23)[1]

I completely agree with von Wright on this issue. State, religion and the arts are today under a tremendous influence from science. Therefore, a reflection course that teaches science students why, crudely speaking, astronomical knowledge is better than astrological is not as pressing as a course that deals with the cultural position of the scientific worldview. Hence, my theoretical perspective confronts a radical position that would not agree with this. My critical stance must pave the way for the argument that von Wright is here on to one of the deepest foundational reasons for reflection courses in science educations – namely the reign of science and its relation to the culture of which it is part. What I have defined as reflection types 1) and 2) above have often disregarded this point. They have, as did the Filosofikum in several forms, been focusing on the interior of science: the development of scientific theories, the connection between empirical data and theories, etc.

von Wrights comment was first published in 1957 and his point is even more relevant today, when science shapes our form of life even more drastically after the breakthrough of information and communication technologies, not to mention the growing impact of biotechnology as well. The task for reflections on the scientific practice must be to discuss the borderland of science, while keeping in mind its unprecedented impact on society. This general reasoning has, to a large extent, been a deciding factor in the choice of the suggested approach to answer the problem statement.

Let me finally reflect upon a chronological feature that supports the structure of the thesis. The overall structure can be viewed from a certain founding idea, namely the idea that reflection courses in university science educations have been undergoing a certain development. The old Filosofikum courses were, to a large extent, grounded in a reasoning depending on tradition. This foundation met substantial critique from society in the late 60's, which ultimately led to the disband of obligatory reflection courses in science curricula. Filosofikum was interpreted in the public opinion as the foremost reactionary force within the university. Today, the politicians have called for a reformulation of the Filosofikum and a new foundational reasoning is needed for future courses. Therefore the three-staged development in the socio-political sphere surrounding the field of study – from supporting an obligatory course to rid it from the curricula and finally wanting to re-install it – is parallel to the development of the thesis in the scheme: what was in the *past* –what is *present* – what could be in the *future*. Hence, the socio-political events in connection to the field of study run as an undercurrent through the thesis.

Part I

HISTORICAL APPROACH
POSITIONS ON THE FILOSOFIKUM

2. Introduction

In one of his early writings, *Vom Nutzen und Nachteil der Historie für das Leben* (1874), Nietzsche engaged the issue of value and lack of value in dealing with history. History is part of the living in three different ways in Nietzsche's analysis – as the monumental, the antiquarian and the critical. All three approaches are necessary and can serve life if properly used, but all three can also be devastating for life if we engage ourselves in them excessively. In Nietzsche's day, historicism dominated the philosophical landscape, and his work was therefore first of all a warning against exaggerated adoration of tradition and its achievements. His warnings concerned the historical analyses that were monumental and focused on the continuity of history and its constant and necessary progress. If the monumental approach reigns over the antiquary and critical approaches, it will harm life by levelling the differences and heterogeneities of the past. It deceives with enticing analogies between past and future. Nietzsche also finds that the antiquarian approach to history too often mummifies the past when it is unimpressed with the freshness of new and budding life. Its strength is the ability to preserve and to admire the events of the past, but this, too, can be overdone. The two approaches to history – the monumental and the antiquarian – must be accompanied by yet another approach: the critical. This type of account revolves around the idea that one has to criticise and dissolve the past in order to serve life. The danger residing in this approach, however, is that condemning the past may make us think that we are a cut above history. We are of course descendents from it, and Nietzsche instructs us that people and times that judge and destroy their past too much are always dangerous as well as vulnerable.

One could say that the situation in which we deal with history is entirely different today, as tradition stands at the crossroad of being thrown out of our lives entirely and, in other instances, of being worshipped as the right way back, so to speak. Having this dilemma in dealing with tradition and history in today's cultural landscape, we could still, in my opinion, learn quite a lot from Nietzsche's ideas. In

Part I and II, I engage in a historical analysis with respect to reflections in university science educations. Using Nietzsche's terminology, Part I is perhaps best seen as dominated by an antiquarian and monumental account of history. It is supposed to give us some grasp of the justifications supporting the Filosofikum and of the content that students were taught. Only in cooperation with Part II and III do I hope to balance my engagement with history by incorporating a critical element.

In this first part of the thesis, my aim is to elucidate the historical background for the ongoing Filosofikum debate. As explained in the introduction, three research objectives are pursued. The main objective is to establish positions supporting historical reflection courses in science educations. In addition, the early history of the Filosofikum institution will be investigated, as will the revocation of the arrangement.

Firstly, I will review the historical roots of the tradition upon which the Filosofikum institution rested until 1971. This history spans the 500 years that have passed since the first Danish university saw the light of day, but even earlier influences, as far back as the ancient Greeks, seem worth considering. This historical exposition will conclude in a more detailed description of the time up to 1971, when the Filosofikum arrangement was made non-obligatory at the Danish universities. At this point, I will attempt to bring forward three positions in support of the Filosofikum from its last century. Finally, I discuss the revocation of the Filosofikum, and the historical approach will thereby engage the three research objectives in chronological order. Focus will be on the positions on the Filosofikum curricula through time, but it will also, to some extent, draw a picture of the pedagogical outline of these courses. I will do this in order to clarify what the extent and structure of these courses were, as compared to the courses proposed today in the FV-agreement.

The conclusions of Part I should ideally illustrate the ballast to be found in the history of the Filosofikum in relation to the current discussion on the justification and content of reflection courses. In other words, Part I is to uncover historically important positions related to reflections in university science educations, having posed the question: Why and how a new Filosofikum? Scholars have produced answers to this question throughout history, and if we aim to formulate the prime features and justifications of a new reflection course, we should engage in the discussion with a clear understanding of earlier features and their justifications in previous eras. The recent Filosofikum debate has not, in my opinion, been significantly engaged in this type of historical considerations, thereby leaving out a broader range of perspectives.

3. The Filosofikum prior to the 20th Century

Terms like ‘university’, ‘studium generale’ and ‘filosofikum’ have roots that reach all the way back to the first medieval forms of universities, and in this chapter I shall try to shed light on these historical conditions in order to enrich our conception of the Filosofikum institution. I will go about the matter chronologically, beginning with the background of the earliest Filosofikum educational programmes. I shall examine the long line of university reforms that have, over time, contributed to shaping the Filosofikum institution now associated with the term ‘Filosofikum’, namely the arrangement in use immediately before the revocation in 1971. In this approach, I will pay special attention to the development of the relationship between, on the one hand, the disciplines conglomerated at a given time in history under the name of Filosofikum – deeply influenced by the disciplines thought of as belonging to philosophy – and, on the other hand, what we consider today to be the disciplines of science. I will later aim to show how the decline in the perceived importance of this relationship was a strong factor in the removal of the Filosofikum institution. During this exposition, it is of vital importance to always keep in mind the changing historical conditions for the terms in play.

Let’s turn our attention to the founding ideas of the Filosofikum and trace its position in the educational structure from the time it was first introduced – in the medieval universities.

3.1. Scholasticism

Towards the end of the 12th century, the first universities appeared in Europe, and it followed from the power balance of that time that the institution to largely dominate these early educational establishments was the church, which wanted to educate students for the ministry.

The institution within which these educational programmes were taught and studied was called 'Studium generale'. At that time, i.e. from the beginning of the 13th century, 'universitas' was not an abstract notion of a place for education and research. Instead it meant an assembly of people or a guild, e.g. 'universitas magistrorum', as the assembly of teachers was called. The abstract name for the university was thus 'Studium generale' (Ellehøj 1980, vol.I, p.7). The name, Studium generale, covered several resolutions. In order for something to be a Studium generale, at least one of the higher faculties, constituted by medicine, law and theology must be taught there, and this by teachers holding a Master's degree. However, the most important aspect of the Studium generale was that the school would be open to students from around the world, and in this way, the university was originally an institution without any particular regional focus. The 'generale' part thus refers to the openness of the institution and not to the broadness of the curriculum (Ellehøj 1980, vol.I, p.8). Hence, the university originates in the idea of freedom for all (men) to study side by side in the respective universities that all taught the same curriculum. It was an international organisation given a centrally controlled form and a well-specified content by the international power of the church.

During the Middle Ages, as a consequence of the international organisation of the universities, Danish students studied abroad. In the beginning, they travelled mostly to Paris and later to the many German universities to be founded towards the end of the 14th century and in the beginning of the 15th century. The overall number of Danish students has been estimated to around 2000 in the years 1372-1535 (Ellehøj 1980, vol.I, p.23). By far the most of them finished only a basic degree at the faculty of artes liberales, which was subordinate to the three higher faculties. To be able to commence studying at one of these faculties, one had to first acquire the Baccalaureus degree, which could be obtained at the faculty of artes liberales. This degree was to compensate for the grammar school educated students' lack of proficiency.

This basic education that the faculty of artes liberales offered was also known as the seven free skills, divided into 'Trivium' and 'Qvadrivium'. Here, one would study first the Trivium, composed of grammar – more specifically Latin studies – dialectics, which focused on logic and finally rhetoric, which included letter-writing skills. Then followed the Qvadrivium, which included arithmetic, geometry, astronomy and music (Ellehøj 1980, vol.I, p.23). Thus, the Trivium was about different knowledge associated with the word, while the Qvadrivium revolved around the number. Teaching in the Baccalaureus degree was usually weighed towards the Trivium subjects, the natural choice in the education of priests (Blegvad 1977, pp.11-12). Schooling for the holy orders typically took two to three years of study (Blegvad 1977, p.12).

As we shall see, the historical predecessor of the Filosofikum institution is the Baccalaureus education just described, and in that light, one might say that many of the first Danish university students only ever completed a Filosofikum. From the 16th century on, the artes liberales faculty was called "Facultas artium quae vocatur philosophica" following a tradition of jointly naming the seven free skills under the artes liberales faculty philosophy (Blegvad 1977, pp.11-12). Hence I will call it the faculty of philosophy in the following. We know very little of the content of the teaching at these faculties, since no early writings from them are preserved. There is no doubt, however, that the philosophy of Aristotle has played a central role in metaphysics and logic studies (Ellehøj 1980, vol.X, p.4).

The influence of the ancient Greeks was not only to be found in the content of the teaching, which rested on a large part of the Aristotelian world picture. The division into Trivium and Qvadrivium thus originates in the Pythagorean School. The Pythagoreans can be said to be the first to separate theoretical education from general education disciplines adapted to society's customs and its need for civil servants. This was achieved through focusing on mathematics as the nature of things and the Pythagorean community realised this search for "pure" knowledge by living in seclusion from the surrounding society. Archytas of the Pythagorean School has described the influence of abstract knowledge on the school by explaining how mathematicians have

> *…handed down clear knowledge of the speed of stars and their rising and setting, and of geometry, arithmetic and spherics and not least music, for these studies turned out to be sisters.* (Archytas in Pedersen 1979, p.20)[2]

Thus focus was on such abstract disciplines, which were organised by a model that – as we have seen already – would greatly influence the first European universities' faculties of philosophy. The disciplines mentioned above by Archytas are exactly those that would later be called Qvadrivium (Latin for the fourfold way) and the Pythagoreans imagined their interrelations as presented in the following table (Pedersen 1979, p.20):

	In itself	**In nature**
Discrete numbers	Arithmetic	Music
Continuous entities	Geometry	Astronomy (or spherics)

With the incorporation of these the highest and most fundamental disciplines from the Pythagorean School in medieval universities, the precursor of the Filosofikum (the Baccalaureus study at the faculty of philosophy) was turned towards abstract philosophical and scientific knowledge independent of public utility. The Pythagoreans did not aim to train skilled writers or the like, but rather to achieve insight into divine and eternal knowledge, and this was reflected in their favourite disciplines. The structure implemented at the first European universities sustained a concept of knowledge that was more or less detached from public utility in the narrow sense. Rather, the Baccalaureus degree was aimed at the teaching of knowledge of the most general and universal legalities of the world, at least when it comes to the Qvadrivium teachings.

The Foundation of the University of Copenhagen

In time, it became increasingly interesting for national sovereigns to establish their own Studium generales, since these were increasingly used to educate civil servants, as opposed to earlier, when education was primarily directed towards ministration.

Eric of Pommern (1382-1459) was the first Danish sovereign to initiate the establishment of a Danish General study. Adhering to the rules of that time, in 1419 he petitioned for the establishment of a Nordic Studium generale from the papacy, who approved of his plans. For unknown reasons, they were never carried out (Ellehøj 1980, vol.I, pp.28-30). Such capsized plans to build universities were not uncommon, where ambitious sovereigns tried to meet the national need to produce magistrates for the administration of the state. In 1479, King Christian I (1426-1481) succeeded in founding a General study, which was even allowed to teach in all three higher faculties (though licenses to build theological faculties were seldom given, since this entailed a reordering of power relations concerning the universities).

The king then gave a delegate authority to bring back university teachers from abroad for the most important posts. They were thus brought here from the university in Cologne and an inauguration ceremony was held on June 1, 1479 (Ellehøj 1980, vol.I, p.34). However, it was not until 50 years later that the university was a success with continuity and a good number of students, because most of the imported teachers soon went back. At the same time, students kept crossing the border to go to the old foreign universities. All the same, the Filosofikum as a Danish institution can be said to have begun in 1479, since from this year on, artes liberales was taught at the faculty of philosophy in Copenhagen.

3.2 The Renaissance

The Lutheran reformation of the university and its more permanent establishment in Copenhagen from 1537 onwards did not change the abovementioned study structure. The precursor of the Filosofikum was still to be found in the preparatory faculty of philosophy. During the 16th century, however, the Renaissance made its entry through several teachers' lectures, and the teaching content was thus changed at the faculty. This change constituted a return to many of Plato's thoughts about the layout of the world as a counterweight to the Aristotelian teachings. For example, Anders Krag (1533-1600) taught both Aristotle's *Metaphysics* and Plato's *Parmenides*, thereby softening the Aristotelian predominance in the education (Ellehøj 1980, vol.X, p.8). Krag's contemporary, Tycho Brahe (1546-1601), was also an ardent Platonist and consequently taught in accordance with the conviction that geometry was the fundamental scientific discipline (Ellehøj 1980, vol.X, p.6). He based his arguments for this position on those works by Plato that were most inspired by the Pythagoreans.

These progressive forces, which were pointing away from the Aristotelian conception of the world, are also found with Brahe's contemporary, Niels Hemmingsen (1513-1600). With Hemmingsen, Renaissance humanism really started entering the Danish university. The basic idea in this early form of humanism is closely tied to the notion of natural right. This right rests upon the presupposition that man, as opposed to animal, has a share in divine reasoning, and he can therefore deduce moral rules for human conduct in society through reason. Thomas Aquinas (1226-1274), however, would have concurred to this also, but the Renaissance humanist saw these rights as something belonging to each individual, whereas Aquinas would have refrained from thus emphasising individual rights.

The universities generally opposed the outlined initiatives towards reforms with regard to content of education. One of the results was the 1619 introduction of a new, independent subject, metaphysics, which consisted of lectures in Aristotle's book *Metaphysics* (Ellehøj 1980, vol.X, p.11). The subject was introduced in the faculty of philosophy's MA degree and not the Baccalaureus degree. The MA degree, which qualified the holder for a teaching position at the faculty of philosophy and opened the possibility of becoming principal at the higher schools (Blegvad 1977, p.12), was expanded in 1646 to include the subject 'philosophia practica', a term covering what is nowadays called ethics (Ellehøj 1980, vol.X, p.15). One should remember that this "reactionary" Aristotelian expansion of the disciplines at the faculty of philosophy was not in opposition to a movement critical of religion. Rather, the people who built their philosophy on a Platonist view construed the religious texts in a way that differed from scholasticism's traditional interpretation.

Let us now focus on the form of examination at this time. In the 17th century, one could enter for the Baccalaureus at the faculty of philosophy or obtain an MA degree. The three higher faculties' precedence was still apparent in that this was the only place one could do a doctor's degree. There was no well-defined exam at the faculty of philosophy except for a proficiency test for the attainment of the Baccalaureus degree, for which the philosophy professors were responsible (Ellehøj 1980, vol.X, p.15). This exam system proved to be of limited use. Experience had shown the need to ensure that anyone leaving the university must meet certain demands before taking on teaching positions, for example. Already in 1604, it was decided that the teachers at the higher schools must have taken the Baccalaureus degree, but this measure had little effect in practice (Blegvad 1977, p.12). The problem was solved by the powerful statesman Peder Griffenfeld (1635-1699) who worked out a reform of the university. If one were looking for the starting point of the actual mandatory Filosofikum education in Denmark, the year 1675 would be a reasonable choice. This was when Christian V – on the initiative of Griffenfeld – introduced the decision that all university students were to take an exam, 'Examen philosophicum' that ensured a certain knowledge of the philosophical disciplines. Griffenfeld's reform stipulated that,

> *…no one may, after this day, be trusted with the place of either hearer or Rector in higher or lower schools, or be permitted to attend the Attestation or examen Theologicum before they are, in examine Philosophico, deemed competent to enjoy the privilege of being priman in Philosophia lauream, and have become promoti Baccalaurei.* (in Ellehøj 1980, vol.X, p.15)[3]

With Griffenfeld's reform, the Filosofikum got a more restrictive character as regards activities in the surrounding society and not just in the university education. Also, this was when the name 'Filosofikum' (Philosophico) was coined. After the introduction of Examen philosophicum, the Baccalaureus degree slowly but surely lost its importance but existed until 1775. It was harder to obtain, since the appurtenant exam included a thesis, which was not the case for Examen philosophicum (Blegvad 1977, p.12).

3.3 The Enlightenment

As regards content, Denmark was slow to incorporate the ideas that blossomed in the 17th century with thinkers like Galilei and Descartes. The new evolving natural sciences and the philosophical conceptions belonging to these made rather a small impression on the new Filosofikum (Ellehøj 1980, vol.X, p.11). It was not until the 18th century that the Filosofikum began to show traces of this current. In the 18th century, the Filosofikum was composed of "cathesis" (the shorter catechism, a textbook in Christianity), "loci communes" (Lutheran dogmatism), Hebrew, Greek, Latin, logic, metaphysics, ethics, history, geography, geometry, arithmetic and astronomy – with varying emphasis. This broad spectre might lead us to believe that this was an almost impossible exam to pass, but the exam protocols show that one could squeeze through with rather bad results, especially in the mathematical subjects (Ellehøj 1980, vol.X, p.16). Besides this examination syllabus, the students were also taught scientific method, which was trained through discussion themes. The method trained was still traceable to the medieval university, where philosophical concepts and problems were treated from a speculative and theological point of view. Ludvig Holberg (1684-1754), who was a professor of metaphysics, complains about this approach to philosophy in the teaching of metaphysics in the following:

> *…I run into mysteries which will, in spite all effort, always remain mysteries to me... It would be nice if those engaged in the finest of philosophical subjects would imitate the modesty and carefulness that Newton shows in mathematics, that is, they should refrain from demonstrations a priori and abstain from defining the nature of souls and spirits. I wish they would stop examining the qualities of spirits and speculating about how souls are formed and how they function... I wish they would keep from these speculations which torment the mind and which move in areas where we fumble in the dark, and that they would stick to facts and concrete things.* (Holberg in Ellehøj 1980, vol.X, p.18)[4]

The background of this critique points towards the incipient influence of the new science. Time had left behind discussions of scholastic character, and Holberg, among others, was of the opinion that an empirical, scientific method was the way ahead. Thus, in the 18th century, we see that the philosophical debate and the concomitant debate on the design of the education were slowly but surely severing the natural sciences from the religious conceptual universe. The notion typical of the Enlightenment, that man was capable of arranging himself sensibly in the world by his own rational effort was making its entry.

In 1732, a radical alteration of the Filosofikum subjects was made. A new basic course, ‘Examen artium’, was introduced and took over a number of subjects that had hitherto belonged to Examen philosophicum. The reform was due to the fact that new students’ Latin skills were too poor, and the Examen artium was what is nowadays called a supplementary course. This change also meant a new content for the actual basic course at the university, Examen philosophicum. Here, general education of future priests came to the fore, while the artium exam dealt with the technical disciplines necessary to complete a university education (Blegvad 1977, p.12).

From 1675 on, Examen philosophicum was composed of grammar, logic, physics, ethics and the old Qvadrivium subjects except for music. Following the socalled charter of 1732, the Filosofikum also included history, and in the meantime, Hebrew, geography and metaphysics had come to form part of the course. In the 1732 charter, however, the purely philosophical disciplines – that is ethics and metaphysics – are not mentioned and must have receded into the background after that year (Blegvad 1977, p.13).

During the last part of the 18th century, the Filosofikum underwent further reform, moving a number of disciplines to Examen artium (Ellehøj 1980, vol.X, p.32). Ove Høgh Guldberg (1731-1808) was responsible for additional changes when, in 1775, the preparatory courses at the university came to consist of a Filosofikum as well as a Filologikum. The Filologikum included Latin, Greek and history, while the Filosofikum was composed of mathematics and physics plus theoretical and practical philosophy. This new version of the Filosofikum was thus similar to the models from the 20th century in that it was dominated by philosophy subjects and the more abstract of the natural sciences. Moreover, a preparatory period of nine months was introduced, as compared to the eight months it had been.

In 1788, a more extensive university reform was decided upon, but it did not significantly change the form and content of the Filosofikum. It was decided, though, that examinations in Filosofikum would be held twice a year, and that this philosophical exam would be divided into two parts, one consisting of mathematics and philosophy, one of language and history (Ellehøj 1980, vol.X, pp.32-33). In argumentation for these exams it is said that,

> *According to the actual purpose of the exam, and because it is general, one must at said exam demonstrate the proficiencies that may be necessary and useful for all, whatever main subject one has decided upon; and since these are partly philosophy and mathematics, partly linguistic proficiency and history, students should be tested in both at the Philosophical exam.* (in Blegvad 1977, p.13)[5]

Thus general education for more advanced studies was still the main argument for the Filosofikum course, which was at the same time becoming more and more detached from its earlier function, i.e. the education of priests.

In the following anecdote, we witness a famous Danish student's exam in the beginning of the 19th century:

> *When H. C. Andersen sat the Filosofikum, he was questioned by Ørsted, who asked him with a little smile: "Tell me what You know about electromagnetism!" "I do not even know that word!" Andersen replied. "Try to remember, now! You have henceforth answered so splendidly and You must know something about electromagnetism!"*
> *Andersen had to make confession and admit that he had attended all the professor's lectures except for the one in which this question had been treated. This confession amused Ørsted who nodded and said: "It was a shame that You did not know, since otherwise I would have given You præ, now You get laud – for You have answered very well!"* (Web assistens)[6]

This illustrates the fact that the examination syllabus corresponded to the material in which the philosophy professor concerned had lectured. It is also apparent that, in Hans Christian Andersen's day, natural science subjects were taught in the Filosofikum. Around Høffding's time by the end of the 19th century, a syllabus was employed that was closely bound to specific textbooks, thereby eliminating the problem of lecture based examination requirements. However, as we shall see, the fact that different philosophy professors taught different material in their respective courses remained a problem later in the history of the Filosofikum.

3.4 Romanticism

On the content-side, the Filosofikum material was, for the first half of the 19th century, influenced by the idealistic philosophy, inherited largely from the German universities. To illustrate this, I will now briefly describe Professor of Philosophy Frederik Christian Sibbern's (1785-1872) philosophy and the essential material on the understanding of the nature of science, to which he introduced all new students.

In Sibbern's teaching, the influence of the German idealism on the Danish Filosofikum is evident. In his introduction to the academic study *Om Erkjendelse og*

Granskning (1822) [On Understanding and Examination], speculative thought is given precedence over an empirical approach to science.

> *In order to show what anyone who aspires after true understanding and science should bear in mind, the first and most important thing to consider is what understanding and science are. But at the root of all understanding is thought.* (Sibbern 1822, p.V)[7]

Neither psychology nor logic is of any help when it comes to the introductory study of thought. What Sibbern calls the general philosophical introduction to studies is also of little importance in this connection. Rather, as can be seen from the quote above, the proper introduction to academic studies is an examination of how thought distinguishes itself as the basis of understanding.

Understanding is based on reason rather than empirical sources and is thereby a priori and implies an a priori construction (Sibbern 1822, p.XIV). The material of thought is the 'Idea', which is the basis of all science. Understanding is the Idea's producing itself in consciousness, and through science, the Idea subsequently acquires external life and continuance.

> *First in all true science is the idea itself, as the centre and all determining soul of science. In the understanding of this and in the grounding of all understanding in this, the speculative and the philosophical in the sciences reveals itself.* (Sibbern 1822, p.XV)[8]

The progression of speculation or thought happens through a dialectic movement that is a philosophical art of destruction of ideas, which simultaneously generates new a priori constructions of ideas. Via the opposition of an idea and its negation, a synthesis emerges which establishes a new idea that in turn produces its negation and so on, and in this way, cognition is driven to ever higher stages. Through this movement, the idea reaches our collective consciousness and is thereby materialised (Sibbern 1822, p.XVI).

It would be beyond the scope of this chapter to further go into Sibbern's perception of the foundation of science, but it should be evident that his thoughts are deeply influenced by the German idealism, and Schelling's philosophy has been particularly inspiring to him. In Schelling's philosophy, the focus is on the identity between spirit and material, and he strives to show that rational thought reflects reality a priori. Hegel formulated and further developed this view on cognition in his notorious slogan

"All that is real is rational; and all that is rational is real", and Sibbern's meeting with Hegel, who at the time of Sibbern's grand tour (about 1813) was a high school headmaster in Nürnberg, also influenced Sibbern's thinking (Web adl).

This idealistic line of thought reflects a general tendency in the university milieu at this time. Sibbern's position is ultimately a religious one, where an ideal religious power controls the world, which comes to be conscious of itself through human intelligence. Among Sibbern's students at the Filosofikum course was Søren Kierkegaard, who would later radically break with the harmony seeking perception of Christianity that the German Idealism represents.

The Reforms of the 19th Century

In 1847, another reform was made of the studies that were a qualification for university and the Filosofikum subsequently consisted of logic, psychology, ethics and the history of philosophy including propaedeutic philosophy. In 1871, ethics seized to be an independent discipline for practical reasons. In this way, the exam was purely philosophical, as it was viewed at that time. The other subjects to have been included in the Filosofikum arrangement over time were moved to the Examen artium, which was moved to the school system. The school system had, during the 19th century developed to a level that made this transition possible (Blegvad 1977, p.14). Moreover, one could draw a parallel of this transfer of subjects to the schools from the Filosofikum with the events following 1971, when philosophy was introduced in high schools with the discontinuation of the obligatory Filosofikum.

The exam for this new philosophically focused Filosofikum consisted of oral exams in all four subjects plus the holding of a written test. Shortly thereafter, this comprehensive form of exam was, however, reduced (Blegvad 1977, p.14). The written test was abandoned in 1851, and as mentioned above ethics seized to be an independent discipline (Blegvad 1977, p.15). These limitations to the exam did not, however, mean that there was an actual diminution of the weighting of the Filosofikum at the university. As in the foregoing centuries, students were still supposed to spend their first year of university at the faculty of philosophy.

The reform of 1847 gave rise to an increased importance being attached to scientific research as opposed to employment arguments in the choice of the content of the Filosofikum. The ministry responsible for church and education no longer motivated the Filosofikum as an institution providing general education for future priests and civil servants. By the mid 19th century, universities had reached a stage on which research at the university itself was central. Thus, in a comment from the ministry, the goal of the course is stated in this way:

> *…to attract students' attention to the task and importance of the philosophical understanding in relation to scientific research in general, to give a provisional orientation with regard to the more specific bearing of this task and finally, formally to strengthen thought and make it used to independent exercise in the treatment of pure concepts.* (in Blegvad 1977, p.14)[9]

With this formulation, the reasoning behind the Filosofikum is moved from general education to the development of research competence such as training abstract thinking and insight into the general condition of the relation between philosophical understanding and scientific research. The step was taken towards the theory of science courses including training in formal logic and scientific methodology as they were to be found in the courses of the 20th century.

The next and in many respects final reform took place in 1871, when the Filosofikum was radically reduced. The pressure from each field of study towards making use of the first year of study for specialisation purposes had become far greater, and it was a common fact that many students went through the Filosofikum year too easily (Blegvad 1977, p.16). Lecture time in the Filosofikum was reduced to half, following the recommendation of a committee, and from then on there were four hours of lectures weekly for two semesters. Before 1871, there were 8 weekly hours of lectures, and between 1775 and 1850, there had even been as much as two or three daily lectures for the duration of the eight or nine months long preparatory period (Blegvad 1977). Comparatively, at the time immediately before the closing down of the Filosofikum, there were four times 45 minutes of lectures at University of Aarhus, and professor Hartnack even advised against a suggestion to make that 2 times 90 minutes, because students' lack of concentration was a problem.

Furthermore, in 1871 textbooks obtained a strong foothold in the university education, making it theoretically possible for students to complete their studies without attending lectures. The material used to make up the syllabus is thus available in print from this time forth and this separation of the syllabus from the lectures no doubt played a role in the reduction of lecture hours (Høffding 1918, p.56). The 1871 reform also introduced a term for the Filosofikum; 'the common philosophical test' [den almindelige filosofiske prøve], which lasted the following century until the revocation of the institution. Yet there was another reform in 1927 that was officially in force until 1971. Compared to that of 1871, the changes were minor. Concerning the content of the Filosofikum, paragraphs §1 and §2 of the 1927 arrangement state that:

> *Any student, who wishes to present himself for one of the final university examinations…or for an examination for an MA/MSc degree, must have passed a test in philosophy prior to this.*
>
> *The object of the philosophical test is philosophical propaedeutics, such as this has been rendered by one of the philosophical professors in a course that is shared out between the two semesters of the academic year with four weekly lessons in each.* (Appendix II)

Passing this philosophical course would earlier have earned you the title cand. phil., but after 1930, this title was no longer used (Blegvad 1977, p.19). It had become too easy to acquire a title on the background of a single, now less than extensive course.

I will let the above law text round off this account of the early Filosofikum. The quotation demonstrates the fact that it was an obligatory course, which was to be taught to all students regardless of their chosen line of study. Furthermore, it is indicative of the reason why the individual philosophy professors came to leave their own very different marks on the content of the Filosofikum.

3.5 A Recapture of pre-20th Century Filosofikum

In the depiction of the historical road towards the Filosofikum arrangement that was closed down in 1971, one point to make is that from the start, the intention with the course was to offer students the proficiencies that they were lacking when entering the university. It should be noted, though, that this was merely the practical reason and that content-wise, the Filosofikum institution rests for a large part on the way the ancient Greeks laid out the most important knowledge in specific disciplines.

In this way, the reasoning behind the content of the Filosofikum has gone far deeper than to let the Filosofikum simply be in the nature of a technical preparatory course. In the period towards the beginning of the 20th century, the content of what was taught has had aspects of general education. The disciplines of the Filosofikum were to ensure that schoolteachers and others who had spent time at the university acquired the most important basic knowledge about the world, whether it was to prepare them for acting in society or for acquiring higher knowledge at the higher faculties of the university.

This historical retrospect shows that one can justifiably trace the beginning of the Filosofikum institution back to the earliest courses at the philosophical faculty of the University of Copenhagen. The general education aspect that the Baccalaureus degree had from 1479 on is present in all Filosofikum models all the way to the end of the 19th century. On the other hand, this general education, the purpose of which was originally in the nature of community service, gradually became more about scientific general education. The university developed, during the same period of time, from having primary focus on the education of priests to that of civil servants and after that mainly scientists. In the following chapter, we will see that this development towards educating scientists in the foundation of science dominates the Filosofikum in the period from the end of the 19th century to 1971.

I should like to bring forward three milestones in the history of the Filosofikum on the background of these general remarks. The Baccalaureus education on the first Danish faculty of philosophy, which was established in 1479, is in purpose and form quite closely related to the Filosofikum models of later times. The many and sometimes drastic changes in the content of the Filosofikum throughout the centuries should not be forgotten, but no revolutionary transformations of the institution itself as a preliminary course that provided students with the most basic of knowledge took place. By choosing 1479 as a milestone, I am emphasising the strong bond of the later Filosofikum institution to a 500-year-old history.

For another milestone I would propose the reform of 1675, which is viewed by many as the beginning year of the Filosofikum. The most important aspect of the 1675 reform must be said to be the fact that it made the Filosofikum obligatory and qualifying for a great number of occupations. In choosing this year I am underlining the broad social and regulatory significance that the institution acquired from this year on.

The last event to be pointed out is the reform in 1847, when the justification for the Filosofikum changed from general education aimed at non-university occupations to general scientific education. This development is interesting in relation to the problem posed in this thesis, but furthermore, the 1847 reform was the point at which, content-wise, the introduced Filosofikum resembled the final 1971 model, in all essentials.

With regard to the disciplines that have been included in the Filosofikum, there is another point worth making. It is apparent from the previous, that like the different disciplines have been separated from philosophy throughout history (when only centuries earlier, philosophy included all natural sciences and many humanistic sciences and – for the part of the ancient Greeks – all sciences), so has the Filosofikum lost more and more broadness and ended up in the middle of the 19th century consisting only of what was then called the philosophical disciplines (i.e. including psychology).

As we shall see, strong forces also endeavoured to separate Filosofikum from psychology during the course of the 20th century, thus making the Filosofikum a purely philosophical undertaking by the standards of that time. For that reason, the history of the Filosofikum is also the history of what has been considered the most fundamental philosophical disciplines, or put differently, which philosophical content was considered important for all education. I will return to this point after my investigation of the Filosofikum models of the 20th century and relate the discontinuation of the institution to the epistemological position acquired by philosophy in the course of the 20th century. There is a lot to suggest that it was philosophy's declining credibility as a fundamental discipline among the sciences – or at least the perception that this was the case – that made the continuation of the Filosofikum as a study preliminary activity impossible.

As became clear from the early history of the Filosofikum described above, between 1871 and 1971 the reforms of the Filosofikum arrangement were scarce. The reasoning supporting the Filosofikum education in this epoch will be our next focal point. I will use the three perhaps predominant individuals that shaped the Filosofikum education during that time as a guideline for the grounds, implicit as well as explicit, that has been ascribed the Filosofikum in the period. Chronologically, these people are Harald Høffding, Jørgen Jørgensen and Justus Hartnack. In the next chapter I will elucidate how each of these professors of philosophy has shaped the content of the Filosofikum arrangement and the arguments for the curriculum and clarify their positions on reflections in science educations.

4. 20th Century Positions on the Filosofikum

It is now time to try and identify some of the positions in the field of study that supported the Filosofikum institution during its last hundred years. As outlined earlier, I have chosen to concern myself with three positions, namely Harald Høffding's, Jørgen Jørgensen's and Justus Hartnack's. Before we begin the search for each of these philosophers' positions, I will add a few remarks on the approach I take in this work.

I do not apply the same approach to all three writers, mainly because they have not all to the same extent commented directly upon the questions of justification and content. Hartnack has addressed these issues, whereas Høffding and Jørgensen only deal with them indirectly. Therefore, my treatment of Hartnack's position differs significantly from the treatment of the first two. It is developed from the idea that Wittgensteinian influence can be traced in Hartnack's position, whereas the first two positions are primarily developed from studies of the actual content of the courses. Hartnack's position does, in other words, not need to be deduced as he has written about it himself, but instead it can be fruitfully put in a Wittgensteinian perspective.

It should also be mentioned about my approach that a lot is said about philosophy of language and Wittgenstein in this chapter. A few comments may be relevant to argue for this aspect. During the 20th century, I find it is fair to say that language philosophy turned out to be the basic philosophical discipline, and from here came some of the great theoretical breakthroughs that became significant in other areas of and outside philosophy. Thus, many have talked of "the linguistic turn" in philosophy, and it therefore seems natural to some extent to investigate the treated positions behind the Filosofikum models from the viewpoint of their conception of language. For that reason, Wittgenstein's thoughts on language suggest themselves. Besides the fact that he produced two radical and groundbreaking understandings on the field – understandings that are in direct contradiction on several counts – he is often considered the greatest philosopher of the 20th century. There seems to be ample reason, then, to look closely at his discoveries and their influence on the different Filosofikum models. In Chapter 8, I will, as part of my critical approach, elaborate on the conception of language in the later Wittgenstein's philosophy, as well as his earlier philosophy.

4.1 Høffding's Filosofikum

In 1883, Harald Høffding (1843-1931) followed Rasmus Nielsen (1809-1883) as the professor of philosophy at the University of Copenhagen. Throughout the 33 years in which Høffding was active in this post, he came to have an immense significance, not only for Danish philosophy, but also for the sciences and Danish spiritual life in general (Ellehøj 1980, vol.X, p.75). Additionally, Høffding was known on the international philosophical scene and above all, his influence meant a lot for the philosophy that was to dominate the generations after his. In the following, I will firstly describe some of the general features of his thinking and thereafter give a closer description of the material he taught in the Filosofikum study.

4.1.1 Høffding's Philosophy

Many of the philosophers to go before Høffding in the professor post had philosophised in the speculative way on account of the prevailing Hegelianism in the mid and late 19th century (which Sibbern was part of, as described earlier in Section 3.4). In Hegelianism, the construction of abstract thought systems were central, and one often perceived of the sensuously given as an outright distraction when attempting to see through to the underlying a priori reality. In Høffding, Danish philosophy had a theorist that took the exact opposite direction. For Høffding's philosophy was strongly influenced by positivism as formulated by August Comte (1798-1857) and empiricism as formed by John Stuart Mill (1773-1836). The empirically given was made into the building stone of understanding by Mill, while

Comte showed specifically how the only purely scientific approach to understanding – empiricism – was the historical apogee in a development that had gone from religious conceptions of the world to speculative metaphysical thinking. In the historical process, these approaches to understanding were bound to finally be replaced with an epistemology that takes as its starting point the positively given, that is, what man can observe to be the case.

Høffding ascribes great importance for philosophising to the lay-out of the human psyche, and one can get an impression of this by considering the main problems into which he divides philosophy. According to Høffding, there are four such problems: The problem of consciousness [bevidsthedsproblemet], the problem of understanding [erkendelsesproblemet], the problem of existence [tilværensproblemet] and the evaluation problem [vurderingsproblemet] (Jørgensen 1932, pp.440-449). Of these problems, the problem of consciousness is the central one, and Høffding's thoughts on this are determining for a great part of his contemplation of the others.

Thus, characteristic of Høffding's philosophy is his perception of our understanding as something connected to psychological laws. For that reason, his philosophy is called psychologism, and the fundamental categories from which understanding is built are not, as Kant has it, linked to space and time and the 12 categories of understanding but rather to our psychological arrangement (Lübcke 1983, p.201). The psychological layout is not a permanent condition for humanity, but an element in constant evolution dominated by the concepts and categories that reflect the stage that human thought has reached at a given point in time.

> *Already pre-scientific consciousness spontaneously used certain basic concepts (I call them the fundamental categories) which science in its development more closely elaborates according to the demands of the items.* (Høffding in Faye 1979, p.44)

On the other hand, Høffding's quest for categories also shows that he was influenced by Kant's basic views. Man does not have direct access to the outer world or 'Ding an sich', and the categories through which we apprehend the world form the sense material that we receive. The most important difference between Høffding's conception of the categories of understanding and that of Kant is that to Høffding, they are not a priori given but, quite on the contrary, they change over time. One example that he gives of such change is to do with the concept of substance, which he considers a dying fundamental category in the process of being replaced by other fundamental categories.

Thus, Høffding's categories are a posteriori categories of understanding, and his philosophy can be characterised as an empirically and positivistically inspired theory that takes Kant's Copernican Revolution seriously. Hence, Høffding says of epistemology that it has been about uncovering conditions after Kant (Faye 1979, p.40).

4.1.2 The Filosofikum Course

When Høffding became professor of philosophy in 1883, a significant reform and cut down in the Filosofikum course had been carried out 12 years earlier (see Section 3.4). It was in this reform that psychology and logic lost their independent course of tuition and the exams belonging to it, and instead they came to be parts of a Filosofikum course with a joint exam. The textbooks that Høffding used for this course were his own psychology textbook, a book on formal logic and finally a very brief overview of the recent history of philosophy (Ellehøj 1980, vol.X, p.77).

The former is his *Psykologi i omrids – paa Grundlag af Erfaring* [*Outlines of Psychology – On the Grounds of Experience* (1891)], which was first published in 1882. Later it was translated to French, Russian, German and English, and is considered a classic in psychological history as being the first thorough and educational book on the new emerging understanding of psychology in the years after the evolutionary works of Darwin (1809-1882) and Spencer (1820-1903). After a number of revisions, a shorter and more concise Danish version was published in 1917. The content is, however, much the same from 1882 to 1925, when the 10th edition was published. Høffding covered the logic syllabus with his own *Formel logik – til brug ved forelæsninger* [Formal Logic – for Use in Lectures], and finally for the propaedeutic material in philosophy, he used a brief introduction to the history of philosophy, *Kort oversigt over den nyere filosofis historie* [A brief Introduction to the History of Modern Philosophy], which is written specifically for the Filosofikum tuition, and is a shorter version of Høffding's more comprehensive and internationally recognised *History of Modern Philosophy*. In the following, I will use these three volumes as a basis on which to take a closer look into Høffding's Filosofikum.

The Psychology Syllabus

As a starting point to understanding the psychology syllabus with which Høffding presented the students, it is important to have insight into what psychology means to him. Therefore I will now look more closely at his conception of psychology in relation to the speculative thinking to which he was opposed and in relation to what he considers to be pure philosophy.

According to Høffding, it is part of human nature to infer conclusive ideas for a worldview and this in itself is not a weakness. It will become a weakness, however, when speculation or metaphysical thinking intermingles with everyday experience.

> *...the really superior metaphysician is the one who lets his ideas move in the direction in which empirical experience's principal traits are already pointing. […] In this way he will not come at odds with it even though he goes beyond it. He seeks an ultimate, conclusive hypothesis, but the foundation is the same for him as for the empiricist.* (Høffding 1882, p.16)[10]

In this way, psychology as Høffding has it is what he calls a "psychology without soul", since nothing is postulated about the existence or true nature of the soul. It would not be possible to give metaphysical contemplations on these subjects a foundation in experience and they are therefore not acceptable where Høffding is concerned.

This point leads us on to the second crucial point in Høffding's understanding of psychology. It is an experimental science, which has as its field the inner life of consciousness in opposition and parallel to the natural science disciplines that take material entities in space as their object of investigation. Therefore, psychology is not actually part of philosophy, which Høffding characterises as a search for a worldview. Together with the experimental sciences that deal with external nature, psychology is something that forms a basis for philosophy and which precedes philosophy, and as part of philosophy, epistemology (Høffding 1882, pp.17-18). Hence, where for example the foundation of ethics and logic is concerned, he has it that,

> *Psychology forms the ground on which the ideal spiritual sciences, logic and ethics, build. What is true and good can only be decided from the current human*

> *stage and cannot be understood without knowledge of Man's actual nature.* (Høffding 1882, p.34)[11]

In other words, this means that when logic attempts to set up the general maxims for the epistemological potential of the human consciousness, it cannot do so without insight into the development of our conceptional life [forestillingslivet], which only psychology can provide. With respect to ethics, psychology does not hold any form of assessment of the good. It deals with what is and can not deduce from this what should be, but through psychology's collection of experience, illusions can be revealed or a long evolutionary process of some of the most valuable psychological phenomena, namely the ethical ones, can be discovered (Høffding 1882, p.34).

In *Outlines of Psychology*, students of the Filosofikum are given insight into the already mentioned conditions of the role of psychology. From the book's starting point, psychology is considered to be the theory about the soul, and Høffding now aims to clarify what this means. He starts from the perceptions (or yet non-existent perceptions) of the soul experienced by the child, the wild (the child of nature) and the beast. In this way we are led with a greater insight towards what Høffding calls "the grown European's standpoint" ["den Voxne Europæers Standpunkt"] in the conception of the soul, where it becomes clear that insight into mental life comes to us only through linguistic analogies with the concepts we have for the outer world, e.g. 'grasp' and 'feel' (Høffding 1925, p.3).

In Høffding's account, the from earlier times common conception of mental capabilities in all organic phenomena has been pushed aside in favour of a new mechanical explanation of nature, summoned by Descartes' philosophy. Descartes restricted "The Land of the Souls" ["Sjælenes Land"], and according to Høffding, we can realise this shift in the conception of nature by taking a physiological standpoint (Høffding 1925, p.10). Physiology seeks to explain the organic phenomena from chemical-physical laws without depriving the conscious mental life [bevidsthedslivet] of its autonomous scope – in contrast it attempts to explore the possibility of material movements being connected to consciousness in certain cases, e.g. with regard to reflexes or instinctive actions (Høffding 1925, pp.10-11). But physiology cannot explain the laws of the consciousness, one reason being that consciousness phenomena are not present in space where they could be mathematised. The reality of the autonomous existence of the consciousness is, in Høffding's opinion, untouchable. No one could deny the existence of experiences of emotions, will, sensations etc., and so he provides a specification of the initiated definition of "the theory of the soul" in taking the soul to be the sum of these experiences, as a starting point (Høffding 1882, p.14).

Psychology must, rather than resting on mathematical quantification, rest upon qualitative descriptions. Since history has shown that other human beings and animals have had a variety of unsure construals of the consciousness, Høffding's aim is to build solely on what we can consider certain ground in the study of the soul – the conscious mental life.

> *If we want to become acquainted with conscious mental life, we must first and foremost study it where it is* immediately *accessible, namely in our own consciousness. The physiologist, too, draws on this immediate experience when he seeks to determine the bearing of the different brain organs on the mental life. It is the solid starting point of all our knowledge of the spiritual world; it is in this that we grounded the conclusions of analogy upon which this knowledge depends.* (Høffding 1925, p.12)[12]

Thus, it is only through introspection that we can subject consciousness to a scientific analysis, but at the same time, this raises a number of difficulties. First of all, the phenomena of the consciousness are transient by nature, which makes the observation of them problematic. Secondly, the fastidious self-inspection might in itself change the content of the consciousness, but in Høffding's opinion, this problem can be overcome through memory and cautiousness. A bigger problem for the self-inspection as a scientific methodology is that individuals are different and there is consequently no guarantee that they will arrive at the same conclusions. (Høffding 1925, p.15). There is no way of avoiding this problem, though we should not regard it merely as an impediment for psychology, since it is also a valuable given quality of the objects of psychology.

Because of the aforementioned problems, Høffding also feels that we must make use of the so-called experimental psychology. When it comes to elementary elements of consciousness like inclination and disinclination, these can often be subjected to psycho-physical experiments, where not only a qualitative analysis of consciousness is in play, but also a quantitative one. However, more complex phenomena such as conscience can not be triggered for experiments, and on the whole, Høffding is of the opinion that one must be careful interpreting the results achieved through this method (Høffding 1925, p.20).

In further describing conscious mental life, Høffding divides it into a number of part elements, which he emphasises are analytical categories designed to ease the scientific research rather than actual entities. These are the element of will; the element of emotion and the element of understanding. From a concept of psychical energy and a self, who form a whole or a synthesis, Høffding seeks to emphasise that any activity of the consciousness always contains aspects of all part elements of consciousness (Høffding 1882, pp.103-119). As follows, there is no such thing as "pure" reason without interference from emotional life and will, and the same goes for the other two types of consciousness elements. Thus, when we speak of a mental state as a part of our emotional life, it means that the element of emotion dominates over the two other elements – it can never exclude them entirely. The will is the first and most fundamental element of the consciousness according to Høffding, and this reflects a tendency in the last part of the 19th century that we see also in Schopenhauer's (1788-1860) 'will' and Nietzsche's 'will-to-power', the tendency to point out the will as the primordial phenomenon of consciousness.

The Logic Syllabus

I have followed at some length the main aspects and arguments of the philosophy Høffding tried to advance on the basis of his psychologism. The preceding section could considering the importance Høffding attributed to the importance of psychology with some cautiousness be thought of as the main content of his Filosofikum. He did however also present two other topics for the students, namely formal logic and propaedeutic philosophy and we shall briefly consider these.

The formal logic Høffding taught followed the inspiration he found in the works of Leibniz (1646-1716) and Boole (1815-1864), among others. It is the so-called identity- and content logic, and Høffding stresses this presentation in preference to the one used earlier, which is content-wise closer to Aristotle's original design of logic (Høffding 1894, preface).

The field of logic is the form of correct reasoning independent of the objects in question. Whereas mathematics investigates the formal relationship between entities, logic investigates differences and likenesses between conceptions in general, and it is therefore a precondition for mathematics (Høffding 1894, p.6). We have already seen that Høffding also investigates human understanding in psychology, especially when it comes to the understanding element of consciousness, but there it is about shedding light on the origin and following development of understanding.

The starting point of logic is the theory of the concept. The range of a concept tells us with how many phenomena the concept fits, and it is therefore inversely proportional to the content of the concept, which constitutes the characteristics and attributes of a phenomenon (Høffding 1894, p.10). According to Høffding, it is the content of the concept that is the focus of reason. When logic, as he presents it, is also about identity, this is due to the fact that when the consciousness attempts to preserve its identity with itself through the forming of resolved ideas, it will also seek an identity in the transition from one idea to another (Høffding 1894, p.14). The identity between logical propositions can be either partial or absolute or one of these under certain circumstances.

Wherein lies, then, the novelty of this presentation of logic? Høffding explains how earlier, attributable to Aristotle's theory, logic has been based on the range of the concept, which has made it hard to break away from the interspersing of subject and predicate in the grammatical sentence, which must not be mistaken for the logical content of the sentence. Besides, a presentation of logic that takes as its starting point the content of the concept is preferable, in Høffding's opinion, because it is closer to the natural understanding of the topic, according to his idea about the attempt of the consciousness to transit from one idea to another.

Taking Høffding's foundation for logic, there is no use for the Aristotelian division into particular, universal and singular judgments, nor for the division into positive and negative judgments (Høffding 1894, p.20). I shall not go into detail about the formal outline of Høffding's logic as this would be beyond the scope of this chapter, but simply remark that Høffding's logic reflects an interesting developmental step away from Aristotelian logic, which depended on a conception of the world in which everything belonged to particular classes or species, and where a subject-predicate logic was adequate.

The Propaedeutic Syllabus

Høffding's history of philosophy is also a brief introduction to the four main problems that he considers at the core of philosophy. He therefore makes it his business to show that these four main problems are indeed what the last 400 years of philosophy has been about (Høffding 1932, p.1). It is interesting to see how, in this propaedeutic curriculum, Høffding does not include older thinkers like Plato and Aristotle, whom he mentions only sporadically. Instead the starting point of the philosophical development is "The origin of the new philosophy" – a designation that reflects the Renaissance's discovery of Man and the new science of that time, the new mechanical view of nature and of the world.

With this starting point, the students are lead through chapters on formation of systems (e.g. Descartes and Spinoza), empiricism (e.g. Hume and Locke), enlightenment philosophy, Kant and romanticist philosophy, ending up finally with positivism and newer treatments of the four fundamental philosophical problems already mentioned above.

In Høffding's textbook, the historical development is attributed with a natural drive. When it comes to the great system constructing thinkers, their inspiration has been exactly the new mechanical view of nature, which seeks to unify the new world picture with intellectual life in a holistic view (Høffding 1932, p.18). In this way it is demonstrated how, in a progressive movement, philosophy comes up with new explanations of its main problems and develops through a symbiotic movement with science.

It should be noted that Høffding markedly gives Kant's philosophy an especially thorough description in the book, thereby emphasising his importance for the advancement of philosophy. Furthermore it is interesting that Høffding does not view positivism as a reaction to romanticism, but rather sees them both as different forms of critique of the 17th century's enlightenment and criticism (Høffding 1932, p.75). Høffding describes this using among other things the close relationship between

Comte's and Hegel's ethics, but also Mill is described as being inspired by Coleridge's and Carlyle's romanticism (Høffding 1932, p.77).

4.1.3 A Recapture of Høffding's Position – Psychologism

Let us now consider what position can be attributed Høffding within the field of study. Høffding does not to my knowledge explicitly comment on the question of justification. The content of his course, however, shows us many considerations about the necessity of a Filosofikum course. Philosophy is not really the main occupation for Høffding in the Filosofikum course. Rather it is the experimental psychology and, in parallel, the experimental sciences of material entities that are prior and fundamental to the philosophical disciplines including any epistemological considerations. It is this conception of psychology and experimental science in general that is the main message of Høffding's course. The fundamental categories of the human cognitive layout are determining to the worldview we have, the way we rationalise logically and otherwise and it significantly shapes the way we perceive the world. The fundamental categories are not a static condition for humankind as was the case with Kant's categories but rather categories that change over time. Because of this the outline of these psychological categories at any given time must be considered the fundamental study with which to begin any scientific study. In this way Høffding aims to bring what is given – the positivistic aspect of his thinking – to the fore of his Filosofikum course in order to keep at bay any fall to unfounded metaphysical thinking.

The content of Høffding's Filosofikum was in accordance with these general views of the interplay between psychology, the additional experimental sciences and philosophy. I think it is fair to say that his presentation of the logical propaedeutic syllabus was shaped in a way as to strengthen the overall argument in favour of the emerging experimental sciences and the fundamental assertions of his psychologism. Logic was presented in a way, which to a large extent rested on the idea of the psychological need of preserving identity in the transition from one state of mind to another. The propaedeutic philosophical syllabus was formed with a clear emphasise on the relationship with the progression of the experimental sciences. There is in

Høffding's position overall a strong emphasis on modern scientific methods of understanding which gives the impression of a course which is meant to break with the misconceptions of traditions misunderstandings.

Any trace of general education cannot be found in Høffding's course. Even though the syllabus he presents to students would benefit the general educational level the justification for the course clearly rests on the effort to improve the epistemological understanding on how the different university disciplines are related. We are therefore presented with a philosophical explanation of why psychology and experimental science constitute the foundation of human understanding, and I find that a covering term for Høffding's position would be the position of psychologism. With respect to the type of reflections his course engaged in, they could be thought of as types 1) and 3) referring to the scheme of Section 1.1.

4.2 Jørgensen's Filosofikum

Jørgen Jørgensen (1894-1969) is and was recognised as a leading logical positivist in Denmark as well as in the North in general. For many years his textbooks were certain to be included in the Filosofikum courses on Danish universities, and the material to go through was strongly inspired by his logical positivist way of thinking.

Jørgensen's Filosofikum lectures thus contained a number of foundation problems in mathematics and logic, including the heavy formulaic material with which many humanistic students had trouble coping (Blegvad 1977, p.18). His style of lecturing was stodgy but the content extraordinarily thought-through and on that score he went his own way in comparison to his colleagues, Kuhr and Brandt. In spite of this, he was greatly influential with regard to the Filosofikum teaching material at University of Copenhagen and the new emerging universities, which makes his thoughts on the modelling of the Filosofikum institution inescapable. Because of these differences and the disparate content encountered by different students at the respective professors' courses, Jørgensen was in time pressured into teaching by the same pattern as the other lecturers. It is therefore important to note that I will be treating Jørgensen's early and most radically thought-through course in the following.

In this section, I will bring forward the justification arguments for the Filosofikum institution formulated by Jørgensen himself. Besides this I will be drawing on one article in particular by Otto Neurath (1882-1945), another of the logical positivism's leading international figures, an article that contains a going through of Jørgen Jørgensen's Filosofikum model. First, though, we will look at the science-philosophical trend that Jørgensen's philosophy and educational theory was part of.

4.2.1 Logical Positivism

The logical positivists advocated their views from the end of the 1920's to about 1950, and as is evident from the name, they were part of the positivist tradition (Lübcke 1983, p.277). One of the initiators of this movement was Otto Neurath, whose views on the Filosofikum institution we will examine further in the next section. Neurath helped establish what has been known as the Vienna Circle, a name given to the weekly meetings in Vienna, where scientists and philosophers discussed the new dominant theories in mathematics, logic and relativity theory that each in their way confronted the theory of science during the first decades of the 20th century.

In 1929, the Vienna Circle became publicly known when its members – including Neurath, Hahn and Carnap – presented an article, *Wissenschaftliche Weltauffassung der Wiener Kreis*, at an international conference (Lübcke 1982, p.119). From this year on, logical positivism established itself as a broad scientific world picture that strongly influenced many of the leading scientists of that time.

The logical positivists' aim was to construct a solid foundation for the scientific knowledge that we believe ourselves to possess. More precisely, the project was to establish a unified scientific theory from which subjective values and other relative social constructs and conceptions could be eliminated.

Their notion of truth was integrated in the so-called verification principle, which was believed capable of separating epistemologically meaningful sentences from meaningless ones. According to the logical positivists, cognitively meaningful propositions are either tautologies or empirically verifiable propositions. These verifiable propositions must convey a potentially observable thesis about reality that can be deemed either true or false when confronted with an empirical observation. Propositions that are in logical relation to simple, empirically verifiable propositions also belong to the class of meaningful propositions (Lübcke 1982, p.126). All other propositions than these – e.g. ethical or ideological propositions – are considered cognitively meaningless propositions by the logical positivists.

A natural consequence of this way of thinking was trying to prove that mathematics is reducible to logic or, in another sense, to be thought of as a formal logical structure, since the logical positivists maintained a clear distinction between logical relations on the one hand and empirical facts on the other. Therefore the goal was to show that mathematical propositions express analytic a priori knowledge rather than synthetic a priori knowledge, as suggested by Kant. An important part of this work is pursued in what is known as the logicist programme in the philosophy of mathematics for which Bertrand Russell (1872-1970) was the leading advocate. His main contribution to the project is presented in the three-volume work *Principia Mathematica* from 1910-13 that was written in collaboration with his colleague, Whitehead (1861-1947) (Lübcke 1983, p.377).

The work at reducing mathematics to logic and the general theory of science of logical positivism would later be fundamentally criticised by Wittgenstein, as we shall see further on in this thesis. His criticism of the movement was aimed at the conception of language maintained by logical positivists – a conception that, ironically, found perhaps its clearest formulation in the early Wittgenstein's own *Tractatus* from 1921 (for a more thorough description of both of Wittgenstein's positions, see Chapter 8). In this work, the early Wittgenstein derives the conditions for a functioning language in agreement with the general views of the logical positivist movement. Wittgenstein attended several of the Vienna Circle's meetings, and his work exerted a considerable influence on the members of the group. Though they were critical of part of his language theory – the Picture Theory – it provides a good understanding of the basic views that made logical positivists suggest a worldview in which science is the sole provider of human understanding.

4.2.2 Jørgen Jørgensen's Philosophy

After having commented briefly on the philosophical and science-theoretical milieu that Jørgen Jørgensen was part of, it is time to look more closely at the specific outline of his Filosofikum course. I will recurrently draw parallels from this course content to the general philosophical view treated above, which is a ground for many of the course's elements.

This section builds mainly on the material that Jørgen Jørgensen and other Filosofikum teachers used in the 50's and 60's. For Jørgensen's own part, the use of this material goes all the way back to 1926 when he became professor of philosophy at University of Copenhagen. More specifically, I am talking of the works *Filosofiske forelæsninger* [Philosophical Lectures] (published in instalments from 1926 to 1927 and rewritten several times), *Indledning til logikken og metodelæren* [Introduction to Logic and Methodology] (published in 1942 as a rewriting of older material), and *Psykologi paa biologisk grundlag* [Psychology on a Biological Basis] (published in instalments for the first time from 1942 to 1945). Through these works it is possible to gain insight into Jørgensen's philosophy and, at the same time, see its bearing on the Filosofikum course. Especially in *Psykologi på biologisk grundlag*, however, Jørgensen's dissociation from several of the basic assumptions of logical positivism starts to become apparent, which should be taken into account in the following, this chapter's aim being to examine the position of the early Jørgensen's course.

In *Filosofiske forelæsninger*, Jørgen Jørgensen begins by presenting philosophy to the Filosofikum students. He takes as his starting point the historical fact that the ancient Greeks' notion of philosophy originally contained all the sciences, and that the branches of science have gradually broken away from and become independent of philosophy. To Jørgensen, this connection between philosophy and the branches of science is all-important. It means that philosophy is naturally left with a number of unsolved, perhaps even unsolvable problems. The branches of science are seen as solution models arisen from a similar original situation, when philosophy first began to be studied – as tradition has it, first by Thales of Miletus (Jørgensen 1962, pp.3-4). According to Jørgensen, philosophy therefore presupposes as thorough knowledge as possible of the interrelation between and the epistemological foundation of the branches of science. The deepest insight into our knowledge is obtainable through philosophy, as it concerns itself with exactly these questions (Jørgensen 1962, p.8).

> *Thus philosophy is an advantageous supplement to education in the branches of science that often leads to a very strong specialisation. As a counterweight to this, it is probably beneficial to have a general overview of the human knowledge in its entirety, and such an overview can be provided exactly by philosophy and only by philosophy. The following propaedeutic course will therefore fall naturally into two main sections, of which the first is concerned with the material of philosophy consisting of the existing branches of science, and the second is concerned with the philosophical treatment of said material.* (Jørgensen 1962, p.8)[13]

In this way, the Filosofikum course is divided into two main areas – the branches of science and philosophy's work with the branches of science. As is apparent, there is an encyclopedic quality to Jørgensen's Filosofikum course and to his philosophy in general, and I shall elaborate further on this in the next subsection where we will consider Otto Neurath's evaluation of Jørgensen's course.

What philosophy, then, lies hidden behind Jørgensen's focusing on the relationship between the sciences and philosophy? One can find part of the answer to this question in *Indledning til logikken og metodelæren*. In this textbook, he goes through the development of logic from the earliest Greek versions, over syllogisms and all the way to modern theories, logical algebra and logistics. In this survey, he lays emphasis on the advances that have taken place historically throughout this development. The concluding chapter of the book points towards Jørgensen's conception of the relationship between logic and scientific method and states the reason for teaching formal logic in the Filosofikum. Knowledge of the physical world is here divided into the main stages, observation, formation of hypothesis, deduction and verification of the results of deduction. The logical system of concepts built up throughout the first chapters of the book is now used in order to show how scientific method rests upon this system. Jørgensen thoroughly treats the deductive method in this initial work, and in addenda he reflects on the validity of induction. He stresses the connection between logical theory and the method of science and says the following about physical systems:

> *The physical theories are in other words deductive systems at the head of which are the most general laws and definitions: but they are not purely formal systems, as the sentences included in them are presumed to express true*

> *propositions about physical objects, and one endeavours to warrant this by having them imply consequences that are verifiable directly through sense datum.* (Jørgensen 1963a, p.133)[14]

The basic material for the natural sciences is thus, in Jørgensen's opinion, sense datum and observation, as these constitute the final judgment on the verification of a hypothesis about the world. This emphasis on sense datum reflects the fact that Jørgensen was one of logical positivism's supports in Denmark, and in this theory of science, there is yet no notion of scientific research paradigms as Kuhn, among others, later described them. It holds true of the logical positivists, as described above, that they focused very strongly on the empirical nature of the sciences and radicalised this aspect of scholarly character not only to determine if something was good or bad science but also to separate cognitively meaningful use of language from its opposite. Within this understanding, the logical positivists also sought to prove that there exists a scientific method that is *the* scientific method. That Jørgensen's is a unified scientific methodology is apparent from the fact that there is no differentiation between the modes of operation of the various sciences.

Another characteristic of Jørgensen's logical positivistic conception of science is the unified science approach. It is not just that the movement tried to find one scientific method to cover all the sciences. It also strived to show that the sciences' results were part of the same edifice, in which it only remains to be explained how the yet unclear languages of the different disciplines could be translated into one another. The early Wittgenstein's language theory with its compositional theory of elementary sentences prepares the ground for this way of thinking. The basic discipline in this project was naturally enough physics, as it describes the most elementary conditions of the world's phenomena. Chemistry had to be reducible to purely physical descriptions if the fundamental perception of language and the world held good. With Jørgensen, this view on the relationship between the sciences, often referred to as the reductionist view on science, comes to the front when one looks at another textbook from his Filosofikum course – *Psykologi paa biologisk grundlag*. The later editions of this work do exhibit a turning away from the logical positivistic way of thinking and towards psychologism, and one should be aware of this in the treatment of Jørgensen's early Filosofikum course, that is the frame of this investigation.

Nevertheless there are several features of the book that support the reductionist view on the sciences and the earlier mentioned focusing on the historical advances of the sciences.

The starting point of *Psykologi paa biologisk grundlag* is an etymological examination of the word 'psychology', which originally meant 'science of the soul' (Jørgensen 1963b, p.5). The first 50 pages of this bulky work is mainly devoted to showing that psychology today can no longer base itself on unscientific notions such as 'soul' or different ability explanations of phenomena of the consciousness; i.e. that we can see because we have vision. The books introductory chapters go through the history of science and learning from the science-of-the-soul conception over the scientific advances in the area to our own time, and this historical dimension is used to provide current support of Jørgensen's views. Against these historical inadequate understandings of psychology, Jørgensen attempts to find the right system of concepts for dealing with psychology. Jørgensen's over-all purpose with the work is for it to be a philosophical clarification of the epistemological foundation of psychology, a foundation that can render it a prolific field of investigation so that it can be subjected to the scientific method. Several times he indicates that his goal is to reformulate a number of the central problems and notions within psychology, so as to permit a scientific approach and exclude pseudo-explanations of phenomena of the consciousness (Jørgensen 1963b, p.34).

According to Jørgensen, it is important that psychology find assistance in physics, chemistry and biology in explaining the phenomena of the consciousness. In that connection, he starts out with an investigation into the debate on vitalism vs. mechanicism, and even though he adduces historical arguments for both views, his sympathy is clearly with the mechanicists. In Jørgensen's view, however, only the scientific research of the future can settle the score, and it is imperative that one does not, until then, postulate illusory notions in psychology and biology that will only serve to lessen the discussion.

> *Just like the other manifestations of life, phenomena of consciousness cannot be explained from the intervention of unknown factors, for the very supposition of such factors only poses a problem, and as long as they are not proven and their nature is not further clarified, they can't explain anything at all. They are really*

> *only expressive of the fact that the appearance of phenomena of consciousness is yet unexplained.* (Jørgensen 1963b, p.34)[15]

Jørgensen's standpoint, to my mind, can be summarised to seeing the human organism and consciousness as entities so complex that our knowledge of them today is quite limited, but at the same time believing that there is nothing to suggest that physical-chemical explanation models might not be able to describe biology and psychology in the future (Jørgensen 1963b, pp.32-45). However, Jørgensen makes certain reservations for this reductionist view, reservations that are of great consequence to his later position. It has to do with Niels Bohr's thoughts on the epistemological implication of quantum mechanics, or more precisely the unbridgeable gap between macroscopic and microscopic descriptions of the world, e.g. with regard to a living organism. Jørgensen feels that it may be the case that there is a fundamental complementary relation in the description of biological and psychological conditions, and he is thus, at least in his later thinking, quite open to the possibility of an anti-reductionist understanding of science (Jørgensen 1963b, p.46).

After these descriptions of the central points in Jørgensen's own Filosofikum material, I will examine, in the next section, how Otto Neurath sees Jørgensen's contribution to science-philosophical pedagogy.

4.2.3 Neurath's Perception of Jørgensen's Filosofikum Course

In his short article, *Encyclopaedism as a Pedagogical Aim: A Danish Approach* in "Philosophy of Science" (1938), Otto Neurath discusses the Danish Filosofikum model. Neurath first explains what he means by encyclopaedic knowledge and defines it as

> *…the systematically pursued activity within the Unity of Science Movement, devoted to the collecting of scientific statements of the logic of science (synonymous with "Philosophy of Science" for Carnap and other representatives of modern Logical Empiricism) logic, mathematics, physics, biology and other sciences, including all the "cross connections" between the given disciplines.* (Neurath 1938, p.484)

In other words, what Neurath calls encyclopaedic knowledge is the unity of science pursued by the logical positivists. Neurath's concern with regard to this unity of the sciences is that it is quite rare that university students receive any help in searching for it. In that connection, he considers the courses held by Jørgensen for all students at University of Copenhagen to pioneer. Neurath explains how the course is obligatory for all students in Copenhagen, and that the shape of the course depends on the lecturer. He subsequently focuses on Jørgensen's courses, which had existed for 11 years (since 1926-27) at the time when the article was published.

The aim of the course, as Neurath sees it, is to give students an understanding of what is general in scientific thinking (Neurath 1938, p.487). The first 450 pages in which Jørgensen lectured, covers the subjects mathematics and logic, physics, biology, psychology, history and social sciences. The last approximately 100 pages of the curriculum are about the problems of European philosophy.

Among the course themes that have caught Neurath's attention is the development from anthropomorphic science through history to modern science. Jørgensen also goes through Greek philosophy, but with the development of the sciences as the pivot. The Pythagoreans are thus taken up with regard to their mathematical discoveries and not – as Neurath so pointedly puts it – to whether or not they ate beans (Neurath 1938, p.487)! Neurath brings forward these examples of general ways of presenting the teaching material in order to bring to light the pedagogical method of the course, which leans closely on the development of the sciences.

> *Similarly he goes into the problems of modern physics, biology, psychology, and social sciences,* always combining historical explanation and logical reasoning. (Neurath 1938, p.488)

In Neurath's opinion, Jørgensen's method is focused on the lessons to be learnt from the history of thought and science, by always relating to the logical advances reflected in this history. A large part of the course is therefore concerned with mathematics and logic and the relation of these disciplines to the other sciences. When Neurath considers Jørgensen's course to be based on encyclopaedic pedagogy, the reason is to be found in Jørgensen's method focusing on the development of a unified science that develops through logical advances.

Besides these overall thoughts on the course, Neurath also gives a detailed description of its theoretical content. In the following I will consider what exactly defines this content.

Throughout the course, Neurath informs us, the student will acquire knowledge of Descartes, Frege, Peano and Russell's logical and mathematical work, and from here the course is lead towards logic in scientific explanation models, including induction and deduction. From there, the course proceeds to what Jørgensen undoubtedly considered the most well-founded natural science, namely physics including its newest theories, e.g. quantum mechanics and relativity theory. All in all, this mathematical-logical and physics part of the course is presented to the students as a finished whole.

This is not the case for other of the course's subjects, such as biology, sociology and psychology. Where these are concerned, Jørgensen considers the scientific development still limited and with many competing theories building on questionable grounds. For this reason, he does not attempt in the lectures to give a unified scientific survey of these disciplines. Neurath explains this from the understanding that Jørgensen is sceptical of the position of these sciences.

> *…this is significant of a more sceptical opinion that psychology and related disciplines are in a situation similar to that of physics before Galileo and chemistry before Lavoisier.* (Neurath 1938, p.488)

However, the knowledge acquired by the students about psychology and its related disciplines is subsequently used for examining and criticising various metaphysical theories, such as theology and vitalism (Neurath 1938, p.489). Psychological and biological knowledge is ascribed rather a great significance, only it is considered inadequately ordered and developed to be properly presented within a unified scientific and encyclopedic pedagogy. Jørgensen's own *Psykologi paa biologisk grundlag* described above is a work that in this perspective tries to order the field of psychology.

The second part of the course is, as mentioned, about philosophical problems. Jørgensen's empiricism is evident in his treatment of this material, where he brings forward the principal lines in the history of philosophy. Ethics and aesthetics are among the subjects treated in this part of the course.

Important influences

Neurath sees the development of Jørgensen's Filosofikum course as influenced by the competent Danish research environment in the tension between philosophy and science. He points out two people as having been great sources of inspiration to Jørgensen; Niels Bohr and Harald Høffding.

Neurath believes that Jørgensen is influenced by Høffding's early anti-metaphysical psychology and understanding of modern empirical science. Furthermore, Neurath stresses that Høffding had extensive knowledge of Ernst Mach's theories at a point when they were hardly acknowledged in Germany. In this way, Høffding indirectly shared responsibility for the fact that logical positivism and the Unity of Science movement developed early in Denmark, in Jørgen Jørgensen among others. Another point on which Høffding has been influential is his understanding of the significance of the relativity theory to the way one thought about the sciences. In Jørgensen's lectures, Neurath sees traces of both the Machean inspiration and an understanding of the revolution that modern physics must bring about (Neurath 1938, p.491).

According to Neurath, Niels Bohr has also had great impact on Jørgensen's thinking. This influence is to be found in Bohr's focusing on the role of everyday language, and Neurath says that

> *Joergensen emphasizes that all the complicated and most important scientific theorizing* starts *with the experience and language of our daily life, that we also have to* test *all the theoretical results of all the sciences by means of the same aids. Joergensen gives in his lectures not only a program of the Unity of Science but he also shows this Unity as an actuality.* (Neurath 1938, p.492)

The thought of unity is very central to Jørgensen's perception of the sciences, in Neurath's view. The new trends in physics that Bohr among others helped develop did, however, leave a special mark on Jørgensen's thinking. The thought of an artificial language for science's objective presentation of conditions in the world – a project pursued especially by Carnap – recedes into the background in comparison to the conception that Bohr stated as the consequence of the gambols of quantum mechanics. Descriptions of experiments in the micro world of the physicist showed that the significance of everyday language is essential to the models of explanation in science, and this insight has had an effect on Jørgensen. However, according to

Neurath, Jørgensen takes the impossibility of avoiding natural language as the very reason that the sciences are bound together. Since the starting point of all sciences is the same – our everyday experiences and use of language – it is the same scientific method that should be used in all disciplines.

What Neurath expresses in the above quote is thus not only Jørgensen's connection to Bohr, but also his own admiration for Jørgensen's course, which he sees not only as an explanation of the unity of the sciences, but as the very creation of this unity. Neurath sees great potential in Jørgensen's course and would like to spread it to many levels of teaching.

> *I think that many people who are interested in the Unity of Science movement and Logical Empiricism will also be interested in* Encyclopaedism as the actual representation of the Unity of Science movement. *An increasing number of scientists have sympathy for all these activities.* (Neurath 1938, p.489)

The basic idea in Jørgensen's course, as Neurath has it, must be to present encyclopaedic knowledge, and the logical positivist program is theoretically tied up closely with this method of presentation.

4.2.4 A Recapture of Jørgensen's Position – Scientific Encyclopaedism

It is clear from the previous investigations that the elements of Jørgensen's Filosofikum course were closely connected to his philosophical position, logical positivism. Within this philosophy, the thought of a unity of the sciences is a recurrent theme. There exists one scientific method that leads to well-founded knowledge and the correlation and logical connection between the branches of science are strongly highlighted. Within logical positivism, it is the task of philosophy to clarify conceptions where this is needed in scientific work. Jørgensen's *Psykologi paa biologisk grundlag* is an example of this and a part of the approach often called analytical philosophy.

There can hardly be a more thought-through Filosofikum as a consistent answer to the logical positivist philosophy than that of Jørgen Jørgensen. A central concept for the shape of the course is, as we have seen, the encyclopaedic aspect. For the logical positivist that has a well-founded theory of the unity of the sciences and an analytical attitude it will suggest itself to focus not merely on the historical problems of philosophy but also on contemporary scientific knowledge. Philosophy has only this scientific material to work with, and furthermore it gives the student an opportunity to gain insight into the unity made up by the sciences. Another point should be recaptured with regard to the question of justification. Jørgensen emphasises that philosophical studies are able to provide students with a broader perspective on science to counterbalance their specialisation.

An important aspect of the course which dominated its content was the strong focus on mathematical-logical issues. This subject matter is pivotal to the logical positivist since it constitutes the kernel of the scientific method and students must be acquainted with it before the scientific method is learnt. With regard to science's influence on and function in society, Jørgensen does not consider these issues relevant in a Filosofikum. Ethics is treated as an examination into different people's perception of ethics at different times by way of the scientific method. The course is about teaching the students what is objective knowledge and not what one can subjectively say about ethics, politics or religion. In general Jørgensen's course implements reflections mainly of type 1), 2) and 3) with a strong emphasis on the connection between the logical development of science and the history of science and philosophy. I propose to call his position the science encyclopaedic position.

4.3 Hartnack's Filosofikum

Focus will now be pointed towards Justus Hartnack's position on the Filosofikum. As opposed to Høffding and Jørgensen, Hartnack directly confronted the questions of justification and content in 1966 when the Filosofikum institution was under threat. This makes my approach to Hartnack's position differ from the approach of the two previous sections. The task in the case of Hartnack is therefore turned towards providing a broadened perspective on Hartnack's own account. I shall do so by emphasising his keen interest in the work of the later Wittgenstein.

In the 20th century, many areas in philosophy took an important turn towards the later Wittgenstein's thoughts. His works and entire approach to philosophy came to be of crucial significance, not only within philosophy in the last half of the century, but also in the further development of many other disciplines. In relation to the previous section, it is an important feature of this Wittgenstein's new philosophy that, among other things, it settled with logical positivism, with which Wittgenstein's earlier theory was in close relation. In Section 4.2, I therefore referred to the earlier Wittgenstein's language theory as support and reason for a logical positivist form of the Filosofikum. In this section, I will similarly be referring to the later Wittgenstein's understanding of language, this time in connection with Hartnack's conception of philosophy and his own positional account supporting the Filosofikum.

In Denmark, the leading Wittgenstein interpreter around the middle of the century was Hartnack, who gained an international reputation on the area, for one thing because of his book, *Wittgenstein and Modern Philosophy* [*Wittgenstein og den moderne filosofi* (1960)]. At the same time, Hartnack was deeply involved in the Filosofikum institution, owing to his professorship in philosophy at University of Aarhus. I will base my expounding of his view on the grounds for the Filosofikum on his essay from 1966, *Filosofikum: Hvorfor og hvordan?* [Filosofikum: Why and how?]. I will start out by citing some principal aspects of Wittgenstein's later philosophy, so that Hartnack's thoughts on the Filosofikum can be read with these philosophical ideas in mind. I believe this approach should enable us to conceive in a deeper perspective the way in which Hartnack taught the Filosofikum.

4.3.1 The Later Wittgenstein's Philosophy

As mentioned, the later Wittgenstein's philosophy is characterised by being occupied with language. Whereas much of the earlier philosophy takes metaphysics or epistemology as its basic project, Wittgenstein is of the opinion that the basic discipline of philosophy is the philosophy of language. A main theme is the question of how the words and sentences of language gain meaning to us. He claims that a classical stance to this question is that the words in our language ultimately correlate with things in the world. By this understanding, we learn the meaning of new words by reference to a physical thing or a phenomenon. Wittgenstein turns against this basic perception of the meaning content of language after having adduced a number of strong arguments against it (see Section 8.2). Instead he suggests that words and sentences gain meaning for us on the grounds of what use we make of them. In other words, this means that the use of a word determines its meaning. Wittgenstein is therefore of the opinion that the circumstances under which a word is used not only influence but determine its meaning. 'Worker' means different things depending on who utters the word and in what year the utterance was made.

These conclusions lead Wittgenstein to coin the term 'language game' in his philosophy. Words and sentences only have meaning content when uttered in relation to a language game, i.e. a frame and practice in which the words and sentences are used. As Wittgenstein has it, this makes it problematic to maintain that there exists only one strictly scientific method and one scientific language, which is what several leading logical positivists were aiming for. Wittgenstein's thoughts on rule-following show how our ability to communicate meaningfully precedes correlations between language and reality. Language is part of a way of life constituted by language-games that are each governed by different rules. The meaning of these rules can only arise from a social group – not from an individual. Therefore Wittgenstein would argue that the different historical processes of formation, the different vocabularies and the different objects and practices of the various sciences make their linguistic anchorage and method more or less incommensurable. It is not, however, impossible to construct unified approaches of science but from Wittgenstein's perspective one must keep in mind that this is only a subsequent abstraction and not something that strengthens the consistency of our knowledge. Wittgenstein's later perception of language has it that there are crisscrossed likenesses between the individual sciences, which he calls 'family resemblances', but at the end of the day, they do not share an essential feature that would bind them together with a common method and a common essence.

Where philosophy is concerned, Wittgenstein takes a rather critical stance – he has even been called the anti-philosopher, and he argued that his contemplations were not to be confused with an ordinary philosophical theory on language. This is due to Wittgenstein's perception of philosophical problems as language problems.

Philosophical problems arise when we use our words detached from any practice that gives them a content of meaning, and Wittgenstein gives the sentence “How can I be absolutely sure of my knowledge?” as an example of this in *On Certainty*. In the light of his perception of language, Wittgenstein postulates that, strictly speaking, this sentence is meaningless in the philosophical connection in which it is uttered, and thus the true task of philosophy is not to make up strange questions to solve, but rather to show that there is no ground beneath such philosophical questions – as Wittgenstein puts it: To show the fly the way out of the fly-bottle created by misuse of language.

Hence, according to the later Wittgenstein’s understanding of language, philosophical problems exist that one should know of and know the meaning of. When, in the following, we look at Hartnack’s defence of the Filosofikum institution, it has several traits pointing towards a propaedeutic course in philosophy to attend to this task.

4.3.2 Hartnack: “Filosofikum: Why and How?”

After this presentation of the main themes of the later Wittgenstein’s language theory, I now turn to what I interpret as the Wittgenstein-inspired Hartnack’s stance on the Filosofikum. Hartnack’s essay on the foundation of the Filosofikum is from 1966. His point of departure is, as he makes clear in the introduction, to let a professor of philosophy express his opinion in the debate over the Filosofikum. The counsels appointed in this debate had not, according to Hartnack, been adequately informed by philosophy itself. Hartnack speaks with the authority of being a professor of philosophy himself, as well as having taught the Filosofikum from 1954 to 1966. He also mentions that members of staff at the department of philosophy at University of Aarhus agree with his views on the Filosofikum in outline.

Hartnack gives an account of the foundational discussion of the Filosofikum in the light of the role of the universities in society. Part of this role has to do with the preservation of tradition. Tradition is described as being of value in itself. Change and renewal should not occur for their own sake, but only to achieve improvement (Hartnack 1966, p.7). As Hartnack has it, the university represents an important cultural inheritance and cultural factor that should only be changed when one is certain of the benefit to follow. The goal in the following is to examine Hartnack's opinion of the Filosofikum institution within this framework.

Why Have a Filosofikum at Universities?

Hartnack's initiating question with regard to the question of justification of the Filosofikum is this: Why do we seek knowledge? He emphasises what he sees as two poles in the views on our connection with science. On the one hand there is Plato and Aristotle's point of view that Man is a rational being who must seek knowledge in order to realise his potential as such and for his nature to be fulfilled. In this conception, Man possesses an Eros or a love of knowledge (Hartnack 1966, p.11). On the other hand there is the point, represented by Bacon, that science is about exploiting nature. In order to do this optimally, we must know its laws. Therefore only science that is instrumental in this process is legitimate (Hartnack 1966, p.11). Hartnack sums up these two extremes as the difference between understanding and skill, or *paideia* and *techne*. He concludes that no one will deny the importance of either of these aspects in our connection with knowledge.

Hartnack then goes over the relationship between the sciences and philosophy, as he sees it. He sets forth a number of classical problems faced by scientists who pose questions about deeper reasons why the world meets us as it does. It is illustrated, how all branches of science are connected to philosophical problems deriving from the fields of ethics and epistemology. Notions like consciousness, time, laws of nature, right/wrong are among the inescapable terms that scientists must consider if they seek an intellectual understanding of our knowledge (Hartnack 1966, pp.14-15).

To Hartnack, philosophy remains the discipline in which one has always sought the highest degree of understanding knowledge. As such, philosophy is tied to the very nature and fundamental idea of the university, since it also constitutes the difference between universities and what he calls 'institutions of tertiary education' [højere læreanstalter]. Hartnack remarks on this difference:

> *The difference, however, lies herein: A university would not be a university if it were not, besides being to some greater or lesser extent Baconic, also Platonic. The other institutions of tertiary education would, in contrast, not necessarily seize to be institutions of tertiary education, were they exclusively Baconic – they*

> *would probably be poorer institutions of education, but not on that account loose their nature of being institutions of education"* (Hartnack 1966, p.13)[16]

Philosophy as searching for understanding (the Platonic) is thus the discipline that raises our knowledge above mere skill (the Baconic). However, there is another reason why philosophy in education is important. Philosophical problems will, as mentioned, inevitably arise as the sciences develop, and a philosophically unschooled scientist may, in situations like these, become a misleading person in the public sphere. Layman will believe that solutions to these problems – that are really philosophical – are to be found in the scientist's authority within his field.

With the previous, Hartnack believes to have established a basis to postulate that philosophy is an integral part of the university education. His argument even suggests that what characterises the university as the highest institutional level in searching for knowledge cannot exist without incorporating philosophy. It then remains to figure out the right philosophical content and structure of the institution.

How to Have a Filosofikum at the Universities?

First of all, Hartnack wants to avoid previous ideas of the connection between philosophy and science leading people to think that the physicist can make due with the philosophy of the natural sciences, the law student with legal philosophy etc. (Hartnack 1966, p.18). His counterargument simply views philosophy as an organic whole where the philosophical problems of history and the suggested solutions are so deep that they are necessary for the understanding of contemporary philosophy. According to Hartnack, it is not until one has been given a general introduction that one is capable

> *…of assessing and seeing in perspective the solution suggestions that contemporary philosophy has reached. This is, and should be, the core of philosophical schooling that has since days of old times been called philosophical propaedeutics.*
>
> *Without a thorough philosophical propaedeutics, the necessary prerequisites for a satisfactory understanding of the philosophical problems of the various sciences and their prospective solution are not present.* (Hartnack 1966, p.19)[17]

The connection between the philosophical problems is thus central to Hartnack's argumentation. He calls attention to the fact that his age has seen a break with the positivistic and descriptive view on what constitutes a meaningful sentence. This perception and Hartnack's alternative perception of the nature of language permeate all the disciplines and problems of philosophy. Therefore it is – regardless of the positive in that students learn about the philosophical problems of their field – more important to give them a general understanding through a propaedeutic course (Hartnack 1966, p.20).

The propaedeutic course can focus either on a historical account or an account that revolves around the central philosophical problems. Hartnack argues for the latter. Focusing on history could easily result in a rather superficial insight into the philosophical problems that deal with the most fundamental conceptions of our thinking. And it is the entire purpose of the Filosofikum, for the reasons mentioned, to familiarise students with the character of exactly these problems. There is no need for psychological and biographical arguments for the reasons why individual philosophers thought as they did, but only for philosophical arguments. An additional advantage of this approach is that students hopefully become acquainted with the characteristics of the philosophical method (Hartnack 1966, p.24).

Argumentation against Other Views

After this positive definition of a reasonable Filosofikum content, Hartnack adduces arguments against two points of view that he often runs into in the Filosofikum debate. Firstly, the Filosofikum is often, in this debate, motivated through its function as general education. Secondly, it is often argued that the Filosofikum should introduce the scientific method to the students.

Hartnack proclaims that though the Filosofikum may very well work to cultivate the students, this has nothing to do with the justification for having the Filosofikum. Suggestions to introduce natural scientific elements into the education of humanists and vice versa can neither replace or contribute to the Filosofikum as Hartnack has conveyed it. Only a basic course in philosophy can handle that task (Hartnack 1966, p.31). But what, then, are the educative gains of a Filosofikum shaped to Hartnack's wishes? What has general educational meaning is not knowledge of historical philosophical facts etc., but rather

> *… to be capable of perceiving the various views and standpoints as* philosophical *views, i.e. as views reached through philosophical argumentation. It has significance to understand and acknowledge that there are problems and arguments that differ fundamentally from all other kinds of problems and to understand that these problems, which are unavoidable, are general; for they are tied up with the fundamental concepts of thinking – concepts that are therefore common to all intellectual activity.* (Hartnack 1966, p.32)[18]

If students achieve this insight, they will not only be able to treat the philosophical problems of their profession. They will also be empowered to increase their freedom by disengaging themselves from the opinions and prejudice of their environment and acquiring well-founded points of view. According to Hartnack, no other discipline besides philosophy can train students in this general educational quality, which means that the general educational aspect is a consequence of, rather than a justification for, philosophy (Hartnack 1966, p.34).

To return to the other theme of the debate – that students should be educated in the scientific method – Hartnack ardently advises against this suggestion. There simply does not exist a scientific method that is *the* method. For the same reason, he argues that students should not take the Filosofikum too early in the course of their education. Since there is no fundamental method to learn before devoting oneself to one's specialist studies, students are better off having matured as much as possible before taking on the Filosofikum. At the time of Hartnack's article, not all universities allowed students to postpone the Filosofikum a couple of years, and the course was traditionally taken as the very first of one's education (Hartnack 1966, p.37).

Besides the general educational aspects and the introduction to the scientific method, Hartnack also argues against syllogisms and symbolic logic being a part of the Filosofikum. Symbolic logic is a mathematical discipline that does not belong in the Filosofikum. If it is considered important that all learn such fundamental logic, it should rather be placed in the school years before a university education. Also psychology has traditionally been part of the Filosofikum, but according to Hartnack, psychology may be directly detrimental in this connection, as opposed to logic. Even if you are not a Wittgensteinian, as Hartnack calls himself in the essay, this does not change the fact that psychology cannot in any way contribute to the solution of philosophical problems (Hartnack 1966, pp.28-29). While psychology concerns itself with *how* we actually perceive, think etc., philosophy exclusively deals with the logical problems to do with the notions perception, thinking etc. According to Hartnack, students often find it difficult to differentiate between these essentially different approaches, and therefore, psychology is not part of Hartnack's Filosofikum.

4.3.3 A Recapture of Hartnack's Position – Philosophical Propaedeutics

I will now try to further adduce the connection between the later Wittgenstein's philosophy and Hartnack's thoughts in favour of a Filosofikum. As stated above, Hartnack explicitly argues that his views are not restricted to gain support from Wittgensteinians, but is a general outline of the importance of philosophy in university educations. I have to disagree with Hartnack on the generality of his argument, as many other philosophical standpoints would not be completely consistent with his reasoning. He would, for example, be at odds with the content that Jørgensen proposed for the Filosofikum, due to their philosophical disagreements. In addition, I shall later discuss the claim that philosophy has the ability to construct new concepts that make us see the world differently, and this would clearly be at odds with the more analytical understanding of philosophy that Hartnack defended (see Chapter 6). Unless one wanted to rule out anything but a very restricted definition of philosophy, I therefore maintain the connection between Wittgensteinian philosophy and Hartnack's position.

Let me gradually connect Hartnack's position with the Wittgensteinian point of view. The later Wittgenstein argued that the classical language theories postulate "meaning-elements" that determine the extension of a word. Instead he advocates the view that the meaning of a word stems from the use we make of it. Thus, he sees language as a collection of tools, by means of which we can do different sorts of things. Language is intertwined with different forms of practices, language-games, and can only be used meaningfully within these language-games, as they constitute the frame that gives linguistic expressions their meaning.

One consequence of this is that different sciences work and function by means of different sets of rules that govern the methods of the individual science. This is the case in the strictest of senses, which makes the endeavour to find one and only one scientific method seem an artificial project that has nothing to do with the way in which the sciences function. Wittgenstein's theory thereby interrupts the idea of developing *the* scientific method, an idea that Hartnack also rejects. Thereby a great deal of the logical empiricist ideal of the unity of sciences with a universal research method must be abandoned, as far as Hartnack is concerned. In the end, this also means that Hartnack's justification for the Filosofikum is not concerned with logic or scientific methodology but instead with unmixed philosophy. He argues that philosophy is vital for scientists' highest understanding of their knowledge.

The special character of philosophical problems is an important point of Hartnack's. In concordance with Wittgenstein's philosophy, the right philosophical procedure is always the same, regardless of the particular philosophical problem. Viewed in that light, Hartnack's argumentation for learning the basic approach to philosophical problems – the propaedeutic course in philosophy – seems a natural standpoint. Hartnack focuses on how insight into philosophical problems comes from the propaedeutic course teaching students the special character of these problems. In his essay, it becomes clear that this special character has to do with philosophical problems being conceptual problems that the sciences will never be able to solve, and that one can only attempt to solve through analyses of the ways in which we use language. The philosophical method of conceptual clarification is thus an important element in Hartnack's answer to the question of content.

Besides this, Hartnack ties the Filosofikum institution to the very idea with universities, that they should develop understanding and not merely skill. This idea is in turn tied to the Platonic knowledge conception, in which it is Man's highest purpose to seek a deeper understanding of knowledge about the world. Hartnack gives up any justification resting on general education of the students. This does not mean that the Filosofikum model he advocates is not indirectly educative, but the motivation for its existence rests exclusively on the necessity of learning the philosophical method, once we acknowledge that skill without understanding is not only unfruitful, but also culturally undesirable.

Recapturing these points, Hartnack's answer to the question of justification rests on the argument that philosophy is the necessary and sufficient tool to reach the highest level of knowledge possible, and the content of the course exclusively consists in propaedeutic philosophy. This way, the reflections he suggests to be incorporated in science curricula, among other educations, best resemble type 3), but with the important point that they are not really reflections on science, but rather on knowledge in general. I propose to call Hartnack's position "philosophical propaedeutics".

5. The Revocation and Conclusions

In this chapter, we shall look more closely at the revocation of the Filosofikum arrangement in 1971. First, I will focus on the initiatives discussed since the 1930's to improve and reform the Filosofikum institution. As we know, this story leads up to the crisis of the institution throughout the 1960's and, eventually, its withdrawal. Following this account, I will describe the views of philosophy professors Hartnack and Favrholdt in the late 1960's, since they reflect several interesting aspects of the discussion about the abolishment of the Filosofikum – aspects that I find relevant in connection to the current debate. I close the chapter with my conclusions regarding the historical approach.

5.1 Initiatives for Reforms in the 20th Century

Even though the 1871 reform and the revision carried out in 1927 held until 1971, there were many initiatives to change the Filosofikum institution on the way. One incentive for this was, throughout the period of time, the disparity of the individual professors' courses. Most pronounced was, as earlier mentioned, the difference between Jørgen Jørgensen's courses and those of his colleagues. Thus, throughout the years, education committees pointed out that the courses should be given a more homogeneous content. In 1939, a commission suggested as much and furthermore wanted to make the content of the Filosofikum course into a broader introduction to university studies in general, at the expense of the dominance of philosophy. The commission's report also touched upon a problematic theme that was topical until 1971, namely the question of whether to have large classes with hundreds of students attending each lecture. The over-all recommendation of the committee was, however, voted down at the teacher's assembly at University of Copenhagen, and the Filosofikum carried on as before (Blegvad 1977, p.21).

With the commencement of the war, there were naturally no Filosofikum reforms for a number of years. Not until 1955 did the Ministry of Education appoint a committee to investigate the possibility of new changes to the institution. This committee suggested that a stay at a folk high school could take the place of the Filosofikum course at the university, but after serious pressure from philosophy professors, this idea was given up (Betænkning 1957, p.9).

In 1959, a new committee under the ministry focused on a general shortening of university studies. It was proposed that the Filosofikum be halved to a curriculum of 200-300 pages and with only two weekly lectures as compared to four. In return, there would be three hours of teaching in smaller classes, by instructors. The cut-down in the syllabus consisted in doing away with psychology and letting the content consist of history of philosophy and scientific methodology (Blegvad 1977, p.22). The four responsible philosophy professors at the universities in Copenhagen and Aarhus were heard in the matter, and especially Jørgensen was unfavourable to the idea of abolishing psychology from the Filosofikum, since his thinking revolved increasingly around this discipline. Hartnack was more doubtful of the justification of scientific methodology and furthermore warned against letting other than philosophers teach the Filosofikum – another of the committee's suggestions (Blegvad 1977, pp.22-23). Also this committee's work ended up not having any direct impact on the organisation of the Filosofikum.

In the beginning of the 1960's, a development started, however, that would have far-reaching consequences. From the beginning of the decade, the great addition of high schools that had come about after the war resulted in an increasing number of students coming to the universities. From 1960 and until 1971, the pressure of student numbers on the obligatory Filosofikum institution was therefore enormous. To meet this challenge, a large number of temporarily engaged teachers and assistant professors were hired at the philosophical departments to handle the teaching of the Filosofikum. Yet classes remained very large, and they started teaching evenings to cope. The intake of Filosofikum students at Danish universities in the beginning of the 1960's clearly illustrates what may be called a student explosion: In 1960-61, there were 1652 Filosofikum students at the University of Copenhagen, gradually increasing to

3957 in 1965-66 (Blegvad 1977, p.24). These numbers can be put in perspective by comparison to the approximately 200-250 students per year in the 1860's and 1870's at the time just before Høffding became professor (Liste over de studerende, 1854-1874). This remarkable expansion in the number of students prompted the appointment of new committees locally at the universities. Various reform suggestions saw the light of day, and the ministry set up a common committee for all three universities to make searching inquiries into the matter. One philosophy professor from each university participated; from Odense it was David Favrholdt, from Aarhus Egmont Christensen and finally Blegvad from University of Copenhagen. Besides the philosophy professors, student representatives and other university employees were on the committee, and especially the students were, from the beginning, in favour of a total abolishment of the Filosofikum (Blegvad 1977, p.26).

The work of the committee got public attention partly because of student demonstrations in Copenhagen against the Filosofikum, and as we shall see, Hartnack and Favrholdt were, at this time, very active in the definition of the role of philosophy in relation to society and the university, something that was materialised in their standpoint with regard to the Filosofikum institution. In spite of these circumstances, the committee still agreed on a reform suggestion. The Filosofikum would consist of two disciplines, namely theory of science [videnskabslære] and philosophical propaedeutics. The three philosophy professors in the committee together wrote about the exact content of these disciplines. Thereby, the committee had tried to solve the problem of heterogeneous courses, as far as possible. Also, weekly lectures would be reduced to three instead of four, and one of those lessons was reserved for discussion oriented teaching in smaller classes. With this initiative, they hoped to curb the ineffectiveness of courses with lectures for up to 300 students at a time (Blegvad 1977, p.26).

The agreeing representatives of three universities was not, however, enough to keep the Filosofikum institution alive at this point. The case had become a hot potato politically, and without notable reason, Minister of Education, Helge Larsen (the Radical Left), decided in May of 1971 to revoke the obligatory Filosofikum at the universities. Thus, the Filosofikum institution was not abolished as such; rather it was made non-obligatory, which in effect became an abolishment.

5.2 The Philosophers on the Revocation of the Filosofikum

In the time towards its revocation, philosophy, and therefore the Filosofikum, became less and less consistent with the general view of proper science, as compared to earlier. At least this is the impression one gets from reading two of the Filosofikum teachers of the 1960's, Justus Hartnack and David Favrholdt. In 1966, Hartnack wrote his essay on the justification for the Filosofikum arrangement, *Filosofikum – Hvorfor og hvordan*, treated above, while Favrholdt had a book published on the societal significance of philosophy, *Filosofi og samfund* [Philosophy and Society] in 1968. Below, I will summarise the view of these philosophers on the general situation for philosophy and the Filosofikum in the late sixties. I outline the historical relations in which these two writings figure and try to relate them to the abolishment of the Filosofikum arrangement only a few years later.

One can form an impression of the Filosofikum institution of the 1960's from summing the practical circumstances under which the education took place. Approximately 6000 students had to follow the course annually, and it took two semesters and had final exams in May and June. The Filosofikum students were first year students, and both Favrholdt and Hartnack complain that students were too immature to make themselves acquainted with philosophical problems (Hartnack 1966, p.36; Favrholdt 1968, p.139). Teaching was in form of lectures held by philosophers (among many others Favrholdt and Hartnack at this time), and there could be as many as 300 students in every class. Hartnack and Favrholdt both indicate that this is a pervasive problem for the Filosofikum institution in the 1960's (Favrholdt 1968, pp.143-44; Hartnack 1966, pp.39-40). A main theme of Favrholdt's book is thus the argumentation for educating more philosophers to handle the Filosofikum teaching under more appropriate circumstances, where the students can be more involved and lectures do not, at best, have the appearance of entertainment (Favrholdt 1968, p.145).

Favrholdt and Hartnack completely agree on the usefulness of the Filosofikum, even though they philosophically belong to different camps. If one looks at their philosophical standpoints, Favrholdt has always emphasised a philosophical way of thinking that revolve around the role and positioning of the sciences in relation to philosophy. For example, he would consider a philosophy insufficient that attempts to clarify the concepts of time and space while not taking into consideration the relevant scientific theories on these issues. Hartnack, on the other hand, was in the 1960's heavily influenced by the philosophy of the later Wittgenstein, wherefore such an approach would seemingly be more questionable to him. Favrholdt praises Hartnack's mentioned justification for the Filosofikum, but at the same time, he must be considered a philosopher with very different philosophical views than Hartnack's at that time. They nevertheless agree on the value of philosophy.

The agreement on the role of philosophy in relation to the sciences is also clear enough. Philosophy is about analysing concepts and explaining – or, in the Wittgensteinian's case, virtually dissolving – some of the general and basic philosophical questions that have implications for all who do science. That there is disagreement on the right method for this philosophical analysis of concepts is secondary. This is asserted with Hartnack's comment on the independence of his argumentation on Wittgenstein's philosophical points (Hartnack 1966, pp.28-29), and Favrholdt's approval of Hartnack's general argument.

All this points towards an interpretation that, at the time of its abolishment, the Filosofikum was, according to philosophers, an introduction to and conceptualisation of philosophical problems – what has been referred to as a propaedeutic course in philosophy. Thus, it was the important philosophical cultivation of the learned – for example the scientist – that was the main purpose of the course.

The reason for the revocation of the Filosofikum may partly be found in the opposition to Hartnack and Favrholdt's understanding of the significance of the Filosofikum. With both philosophers, their deep-rooted love of knowledge is, at the end of the day, what drives their perception of the role of philosophy in society. However, Favrholdt also gives a detailed argumentation for the utility value (or what he calls the Baconic argumentation, in accordance with Hartnack's distinction, see Section 4.3) of the societal meaning of philosophy, but ultimately, this is only to get into a dialogue with the reader:

> *Hence it has been a bit taxing for me in the previous to talk about philosophy as if I only saluted the Baconic ideal. I beg the reader's pardon that I thought it necessary in order to even make myself heard by him.* (Favrholdt 1968, p.113)[19]

Favrholdt's comment should be seen in light of the fact that, throughout the book, he depicts the Danish society as philosophically underdeveloped. On several occasions, he implies that even in universities, comprehension of philosophy is limited to such a degree that more than a few of the chairs of philosophy would not exist if it were not for the Filosofikum institution (Favrholdt 1968, p.114). If we follow Favrholdt's account, it may very well be that the revocation of the Filosofikum had to do with a general lack of belief in the importance of philosophy. Philosophy had seemingly become an alien element in science educations and the Filosofikum with its long tradition only corroborated that its content was obsolete.

The entire problematic surrounding philosophers' typical interpretation of the role of philosophy in society and the, in Favrholdt's opinion, general lack of appreciation of the qualities of philosophy is rather important in this thesis. It is, as it turns out, quite tricky, trying to establish what in fact made the Filosofikum and thus the originally close bond between philosophy and the sciences go under. Was it that philosophy had been so detached from the increasingly independent sciences that it could no longer function as a preparatory study; or did the fall of the Filosofikum come down to a general lack of appreciation for the importance of philosophy? These are two possible forces behind the abolishment of the Filosofikum among several others (one being the increasing number of students), and the right answer is most likely a combination of these explanations.

I will not go further into the possible answers to this question but instead point to the historical fact that the changes in the turbulent times in the late 60's and early 70's show no signs of being anti-reflectionist with regard to science educations. With the establishment of the youngest Danish universities in Aalborg and Roskilde in this very period of time, new ways of incorporating reflections were established but seldom involved purely philosophical content. I have chosen not to deal explicitly with these in my historical approach even though this was a possibility worthy of serious consideration. Unfortunately, there has been a tendency at these universities to occasionally disclaim responsibility with regard to the new FV-agreement. In certain cases, this disclaimer may be quite in accordance with reality, but less so in other instances. In any case I find that it is just as important to keep the Filosofikum debate alive at these universities as it is for the older institutions. Ideally, the new FV-agreement would spark a reconsideration of the approaches to reflections in the many places where reflections upon science is already a part of the general educational structure.

5.3 Conclusions on the Historical Approach

Three research objectives were brought forward at the beginning of Part I, namely the aim to clarify the early history and the revocation of the Filosofikum institution and most importantly the presentation of three dominant historical positions within the field of study.

In Section 3.5, I have presented some of the, in my view, key points regarding the history of the Filosofikum prior to the 20th century. A few such points are the strong heritage to 500 years of history, the legislative and social meaning that the institution has had, especially since 1675, and the development regarding the question of justification – a development that went from the Filosofikum being meant as an educative and general study aimed at non-university professions to being aimed primarily at further scholarly studies at the universities.

This long tradition of having reflection courses in science university educations inescapably raises the question of whether we have thrown out a vital part of the scientific educations during a heated period of time in the late 60's and early 70's? As was shown in Section 5.1, the Filosofikum element was rejected without much explanation, and this at least shows that hasty decisions were involved. I do not think, though, that it means that the time is right to argue the re-implementation based on e.g. the national board's proposal from the late 60's. More than 30 years have past and it seems much wiser to ask, not whether we threw out the baby with the bathwater, but rather why it was possible to throw out the oldie at the time. In plain language, we have to seize the opportunity created by the vacuum behind the Filosofikum to very seriously question whether the forms the Filosofikum took in its later phase were the right forms.

From the earliest days of the Filosofikum's existence to the years immediately preceding its abolition, its content has gone from being of very broad educative character to focusing on the generally scientific in the 19th and early 20th century, and finally to aiming for that which we could call a 'philosophical cultivation'. The latter is what we saw in Hartnack's position and also, though to a lesser extent, in Høffding and Jørgensen's positions. Especially in Jørgensen's course, scientific methodology was an additional key element in the logical empiricist Filosofikum environment of the 1930's.

In the detailed studies on Høffding, Jørgensen and Hartnack's editions of the Filosofikum, I believe that one could emphasise some similarities. First of all, a shared goal of these philosophers' courses was to make better scientists by clarifying the role of philosophy to that of the sciences. We have seen three different ways of doing this, arguing in favour of different types of scientific methodological and philosophical competencies, depending on the professor's philosophical standpoint. All three positions, leaving out the philosophical differences, aim at providing the science student with a philosophical insight that is important for the understanding of further science studies. In Høffding's case, this was the basic understanding concerning the experimental sciences and the stature of these disciplines in relation to philosophical issues. In Jørgensen's case, the aim was to provide students with a clear understanding of the logical nature of scientific progress and to develop methodological tools that would enable students to participate in the unified scientific undertaking. Hartnack does not quite fit into this pattern of focus on the proper scientific methodology as he denounces the existence of a unified scientific methodology and also does not support the idea of letting philosophy be the servant –

so to speak – of the empirical sciences. Hartnack's main goal of the Filosofikum course is actually the exact opposite, namely to show that philosophy has a very important role to play within the enterprise of doing science, as science cannot avoid being entangled in the fundamental philosophical problems concerned with the meaning of the terms we use.

Above, I have tried to show why we could reasonably refer to these three positions as the psychologistic position, the scientific encyclopaedic position and the propaedeutic philosophical position, respectively.

In Part II, I will work with the set of ideas often referred to as 'modernity'. I shall pay special attention to the conception of science in modernity and especially the idea that the scientific methodology and whole approach can be secluded from its exterior. In Høffding and Jørgensen's positions, we see several traits of a modern interpretation of science. Philosophy is given little epistemological power compared to the experimental method and unified scientific approach. It has been said that philosophy in these interpretations is the maid of science. With Hartnack, we engage a new sort of interpretation of the relation between science and philosophy, where philosophy is given a much more dominant role. Hartnack's position in this sense marks a break with modernity as I convey it by emphasising that scientific methods have important limitations. At the same time, it is however a position which, in my opinion, overrates the role played by philosophy, as I will try to show in Part II and III.

Historically, a dominant component in the Filosofikum has been the element of philosophical content, as we use the term 'philosophy' today in a university setting. The historically close bond between philosophy and the sciences has seemingly waned over time, so that only few people in 1971, outside of the philosophical milieu could see the point of having a Filosofikum. Hartnack and Favrholdt's writings on the question of justification from the late 60's did, however, rest on the indispensable contribution of philosophy to a scientific education, but at the same time, the very existence of these writings proved that this was not a perception shared by the surrounding society. The decline of the Filosofikum institution can therefore be seen as the story about philosophy that has lost ground as the fundamental discipline for all other disciplines. The question about the content of a new Filosofikum that this raises is thus not only about which philosophical content is in keeping with the times, but also – and even more – about which disciplines should be represented in a reflection course. Hartnack's position with its strong and exclusive emphasis on philosophy therefore cannot be left unquestioned.

After the revocation of the Filosofikum institution the question remains: "How should and can philosophy contribute as a discipline to the education of science students?". We have now investigated three historical answers to this question and it seems evident that we must find a qualified answer in today's Filosofikum debate in order to corroborate a contemporary position. Therefore, the struggle over the status of philosophy's relation to the sciences will play a significant role throughout the remainder of this thesis as well. I will return to this issue and my method to approach it in Part II, the critical approach.

In what seems a consequence of the outlined historical deterioration of philosophy's close connection to the sciences, the FV-agreement does not comment on the role that philosophy should play in these courses (see Excurse II). This lack of standpoint in the FV-agreement with regard to the position of philosophy shows that today, university leaders and politicians leave the question of which disciplines and what content should be taught in FV-courses quite open, and therefore it becomes vital to assess and compare the arguments in favour of teaching content from non-philosophical disciplines. In Part III of the thesis, I touch upon the reasoning behind several Danish contemporary Filosofikum-related courses. Examples of the suggestions stemming from contemporary courses include talk of university history, sociology of science and understanding of the special character of the different faculties and fields of study at the universities. Other courses focus on ethical problems and practice-oriented reflections, while still others take the concept of nature and the philosophy of science to be central. It is within this highly crowded field of suggestions, exceeding by far the solely philosophical elements that I will aim to develop, in Part III, some inspirational principles in answer to the question of content.

Let me now finally comment on the analytical distinction between the question of justification and the question of content in the field of reflection courses in university science educations. Through looking at Hartnack and Favrholdt's defence of the Filosofikum, it became clear that the debate concerning the Filosofikum involves at least two general discussions. First, there is the discussion on the worth of reflections – here the broader term 'reflections' is often replaced by 'philosophy' in the Filosofikum debate – in relation to the work within the particular branch of science. We have seen that philosophers, in spite of mutual philosophical theoretical differences, can often agree on the general worth of learning philosophy for the quality of university research. Besides this discussion, which we might call the for-or-against debate regarding a philosophical Filosofikum, we have also witnessed parts of the historical debate about the content of the Filosofikum, where different philosophical theories have fought internally throughout the history of the institution over the right content of the course, and where, at the same time, these philosophical disciplines have competed with several sciences for relevance. In other words the historical approach gives some ballast to the analytical distinction made in the introduction separating the question of justification and the question of content concerning reflections in university science educations. At the same time, I want to underline the fact that, during the 20th century and very likely in the future, reflection courses in science educations have fought and will be fighting a battle for existence that not many other elements of science educations have to. One must keep this raison-d'être challenge in mind in assessing and putting together the elements of a new Filosofikum. In other words, the choice of disciplinary elements is not just a straightforward comparative matter, but must also internalise the very justification of the existence of the institution.

Part II

CRITICAL APPROACH
A CRITIQUE OF THE CONCEPTION OF SCIENCE IN MODERNITY

6. Introduction

Part I consisted in the identification of important historical positions in the field of study, reflections in university science educations. In Part II, I engage the question of justification and I do so in a critical manner. My approach is critical in the sense that it offers a critique of a certain historically dominant conception of science – a conception that I tie together with a tendency towards rejecting reflections in university science educations. I start out by discussing the method used to facilitate my critique, and I shall begin with a perspective on the role played by philosophy in the field of study.

In relation to the field of reflections in science educations and in particular in relation to the new Filosofikum – Fagets videnskabsteori (FV) – philosophy clearly plays a significant role. The content of the former Filosofikum courses was, as shown in Part I, dominated by the philosophical disciplines. In Section 5.2, it was argued that the connection between philosophy and science was quite unclear to people in the late 60's and early 70's as compared to most of the university's earlier history. The role played by and the influence stemming from philosophy in relation to science educations slowly perished, and I found that this was at least partly due to the conceptions of science and philosophy that were dominant at the time. This development finally culminated in the conclusion of the Filosofikum institution of 1971. Among philosophers, the relevance of philosophy in science education curricula was argued throughout the sixties by e.g. people like Hartnack and Favrholdt, but in the reasoning behind the FV-agreement we will see how both the role played by the philosophers and by philosophy in relation to this new reflection course has decreased (Excurse II). It therefore seems a pressing task to investigate what role philosophy could play in the future edition of Filosofikum – both with respect to the question of justification and as an element of content. This role is what I set out to clarify through my critical approach.

During the 20th century, a criticism has been directed towards the set of beliefs often attributed to the concept of 'modernity'. Nietzsche, being one of the major figures in the early formulation of this critique, also made one of the first attempts to criticise the understanding of science inherent in modernity. This type of criticism grew stronger throughout the last century to the point where postmodern deconstructions have been applied, for example, to the scientific paper as a genre. The postmodern critics, along with theorists within several other currents of thought, including the different stages of critical theory, have been concerned with the ability of science to represent the world objectively in a context independent fashion. After this critique being applied and discussed within the humanities and social sciences earlier on, it is only during the last 20 years – an era dominated by postmodern thought – that a full-scale conception of the context dependent nature of all types of human activities has come about.

I would like to adhere to, but also to some extent withdraw from, this tradition of criticising the science of modernity. First of all, my aim is not to engage directly in the epistemological debates between realist and anti-realist points of view in contemporary philosophy of science. In other words, I do not aim to strengthen the arguments of postmodern critiques of modernity's conception of science or, for that matter, to weaken them. What I will attempt to do is try and show how philosophical reflections are in several respects important to the scientific practices and – however modest the contribution may be – to nurture understandings of science that will lead it towards the exit of its, educationally often unchallenged, foundation in modern thought. The critique I present is therefore not a critique of the validity of scientific results but rather of a specific conception of science that is rooted in modernity and its influence on educational issues in science.

The method by which I try to show this, is to identify a position in the field of study that rests on the pillars of modernity's conception of science. This position will be formulated in a way that makes any suggestion of a reflection course in science educations void of relevance. I will use this thought-experiment to undermine an educational anti-position, which I shall call the '*irrelevance position*', with regard to reflections in university science educations. It will gain its momentum from an understanding of science that has been, and perhaps still is, in different shapes, dominant in our culture's understanding of science. I shall be referring to this underlying understanding of science as the '*conception of science in modernity*'.

Hence, my aim is to establish a critique of the 'conception of science in modernity' in order to undermine the philosophical basis of what I call the 'irrelevance position' within the field of study.

The irrelevance position is a construct of mine, but I would like to stress that it is by no means a purely abstract or for that matter arbitrary position. In the Danish Filosofikum debate of recent, several positions have been presented that, to some degree, share and inspire the irrelevance position (see Excurse I), and also in an international setting, especially Paul R. Gross and Norman Levitt's book *Higher Superstition* (1997) has displayed a related position that tries, at all costs, to free the "hard sciences" from what is thought to be the ideological clutches of the humanities and social sciences (Gross & Levitt 1997).

I shall return to the central concepts of my approach shortly, but first let me reflect a little further upon a few aspects of the method used in this part of the thesis. Through the sketched critique of the conception of science in modernity, my use of philosophy will be aimed at generating new concepts and connections between ideas that will enable us to reinterpret the function and nature of science and its relations to its exterior. I have sought inspiration from the work of Deleuze and Guattari (Section 7.1) and their view that the role of philosophy is one of creating concepts, which will reveal new aspects in the phenomena we meet. This conception leads philosophy beyond the limited scope it was given in for example much of the analytic philosophy of last century where concept analysis was a focal point. My conception of philosophy revolves around the idea that it is the placeholder for considerations about our most fundamental assertions about the world, be it with regard to nature, culture, language etc. I do not support the view that philosophy is the fundamental discipline of science or the "servant" of science in the sense that Hartnack and Jørgensen, respectively, could be interpreted as promoting. I promote the idea that philosophy is the discipline that deals with the grey zones of our knowledge – its borders, limitations and interpretations. In this conception, philosophy stands in the midst of the different approaches to knowledge that the university represents. Science is often looked upon as producing hard knowledge as compared to the knowledge of the social sciences and the humanities, even though a strong critique has been raised against the alleged objectivity and a-historical qualities of science. Postmodernity is closely linked to this critique, as its general goal has been to deconstruct any form of authority and discourse claiming objectivity and truth. In a sense, postmodernity could be interpreted as the battle over what faculties are in fact the producers of the hardest knowledge – the science faculties or the faculties of the humanities and social sciences. I explicitly wish not to take sides in this conflict. I defend what might be conceived of as the indismissible value of plural perspectives in understanding the world. It is a truism that the different faculties are dealing with the same world, even though this is at times a quite hidden and forgotten truism. Ideally, they should have a lot to talk about and I find that both sides are lacking in establishing this contact. There must be a mutual interest to grasp the world in its complexity from different perspectives – a complexity underscored by the mere existence of the different faculties – and this interest is of course also what ideally binds together the university as one institution. In opposition to Hartnack's emphasis of the idea of the university as involving the elevation of the knowledge of each discipline to the highest level through philosophy, I would like to suggest philosophy as the intermediate discipline – the placeholder – for the interaction between the different faculties and their approach to knowledge. I do not find that philosophy deals with the highest form of knowledge in itself but rather that it can ideally facilitate the interaction and cooperation between the different approaches to knowledge of which the university consists.

The outlined critique in this part of the thesis will be presented in three themes, each attacking a certain aspect of the conception of science in modernity. There will be no deductive order in the relation between the three themes; the themes will instead refer criss-cross to each other and discuss different aspects of the conception of science in modernity. It is my belief that the core of the task at hand and the complexity of the field of investigation will only be admitted through an approach where the different themes overlap and intersect in multiple ways and that this will be the most fruitful methodology in finding directions for a positive development of a competing conception of science. Also, I aim to incorporate argumentation stemming from a range of disciplines – e.g. ontological and ethical, but also sociological and scientific argumentation. I find that by not limiting the argumentation to, say, narrow epistemological issues, we can hope to promote a conception of science that will reveal some of the complex relations of science to society, nature, ethics, language and so on. For these reasons, I shall present the critique of modernity's conception of science as a thematic critique.

To summarise what has been outlined so far, my critical approach aims to counter an educational position that views science educations as being better off with no reflection elements and, through this, develop preliminary ideas for the formulation of a position in the field of study. I will now comment on the two central notions in this critical approach – the conception of science in modernity and the irrelevance position.

6.1 The Conception of Science in Modernity

Western culture has been dominated by a certain strain of thought during the last couple of centuries that has been given the progressive name of 'modernity'. I will now elaborate on this concept in order to explain why I plan to give it a lot of attention in my critical approach. As Part II unfolds in the subsequent chapters, the defining characteristics of the conception of science in modernity will be further explored.

During the last century sociology, philosophy and philosophy of science among other fields of study, have provided a strong critique of modernity, or what I will alternatively call the 'modern project'. This project is centred on mankind's independence of and liberation from any divine or traditional and predefined world order. Historically, the church has defended a worldview based on these sources of knowledge. From the renaissance and onwards, this conception of the world that the pope-hood rests upon starts to meet criticism from different directions. In the cultural production, Man (instead of God) increasingly became the focal point. The change in the artist's understanding of his surroundings in paintings is an example of this. Another example is the philosopher's move towards an epistemology in a world independent of divine intervention focused on Man's abilities and, to an ever-larger extent, excluding a metaphysical approach in grasping the world. Among the driving forces behind this secularising current of thought were the emerging natural sciences and their outstanding results during the 17th, 18th and 19th century. It has been a prevailing perception of science that it produces a-historical, objective knowledge based on observed facts of the world. The products of science were seen as intrinsically good for the development of society and at the same time replaced the forms of arguments previously used – namely the arguments of tradition, religion and metaphysics. In this way, science played a dominating role in a narrative about society undergoing progress, which has been an intrinsic part of the worldview of Western culture. This type of reasoning is especially prevailing in the political and educational points of view of the Enlightenment, but is clearly still a factor in Western societies of today.

An especially important feature of the conception of science in modernity should be brought forward here. I find that throughout modernity a *seclusion* of science has gradually taken place in a number of ways, thereby undermining the role for reflections to play in science educations. During modernity, the effort to seclude what is hard science from what is not has been an important part of the establishment of science as an authority of knowledge. This has, however, pushed aside the equally important recognition of the affinity with other human enterprises and the benefits that these can provide in explaining the world. It is my special interpretation that the conception of science in modernity is best understood as a *conception of seclusion* that has promoted the effort to excessively seclude science from the remaining university disciplines and the culture of which it is part.

I see this feature as a defining aspect of the modern project, and I shall expand on it in the three succeeding themes in order to clarify and enrich the concept of modernity's conception of science. It is my goal to show, through a philosophical critique, that a strong case can be made for rethinking what I shall also refer to as the conception of seclusion when it comes to both the function of science in society and its epistemological and ontological foundation. This rethinking opposes the anchoring of science in the modern project and in several ways counters the way science is normally thought of in our culture.

6.2 The Irrelevance Position

At the seminars and meetings I have attended concerning the implementation of Fagets videnskabsteori, there has often been an air of uncertainty with respect to the relevance of reflections in science educations. First of all, many have doubts about the connection between, on the one hand, philosophical disciplines like ontology, epistemology and ethics and, on the other hand, the scientific method and whole approach in seeking knowledge. Secondly, there is an uncertainty as regards the relevance of providing science students with a broader perspective on their role as scientists in relation to e.g. other university faculties or society in general. Behind these themes of discussion that come up again and again when debating the FV-agreement seems to lie the very reasonable impression that science is doing an excellent job without any help from philosophical, ethical, sociological or cultural influences.

If a well-founded FV is to be implemented at university level, it is therefore of vital importance to investigate what arguments can be given in favour of the relevance of educating science students with reflection competencies. In other words, it is necessary to show that certain types of reflections have an intrinsic connection to the work of the scientist and are therefore anything but irrelevant to science education curricula.

Excurse I – Contemporary Debate

The Emmeche-Køppe-Stjernfeldt Position

A feature article about the institution of a new Filosofikum often described as the starter of the resumed Filosofikum debate is *Filosofikums nødvendighed* [The Necessity of the Filosofikum] – a feature in the Danish newspaper Jyllandsposten, from January 12, 2000, written by three associate professors at University of Copenhagen, Claus Emmeche, Simo Køppe and Frederik Stjernfeldt.

The authors preface with seeking an explanation for the abolition of the Filosofikum in 1971. They state that this was not the time for the sort of courses that were based on long tradition (in this case since 1675), and that the great number of students entering universities during the 60's was problematic. They further adduce that the educative character ascribed to the institution 30 years ago cannot work as motivation for a university course. It is the aim of high schools to provide general education for students, and there is no reason to elevate this project to university level.

However, there is a different reason why a new Filosofikum is necessary, namely that it would solidify research at universities if students were introduced to the connections between philosophy and the sciences. We shall now investigate the grounds given for this postulate. Three examples provide a basis for the authors' suggestions for the specific content that the Filosofikum course might have and concurrently point to some problems regarding university education today – problems that a new Filosofikum might remedy.

Firstly, the relativistic stance that many students swear by when entering university (it is emphasised that this applies mainly to students in the humanities and social sciences). In order to stamp out this deep-rooted relativism, which has little to do with the existing research methods at the universities, it is necessary to discuss theory of science in a Filosofikum. Investigations into the nature of scientific truth can help macerate unscientific relativism, and theory of science is the only sensible framework within which to deal with that particular type of problems.

With regard to science, other specific reasons are given for instituting the Filosofikum. Here, the authors turn their attention to the communication of science through the media. Especially when it comes to biology and computer science, interpretations of the human body and human thinking as reducible to genetic code and computer calculations are popular. Hence, reductionism is an example of a term that students need to treat theoretically, so that they can distinguish between, on the one hand, the explanations of a new scientific theory that display a totally new (and over-hasty) view of man, and on the other hand, those that merely use a new scientific method to delve deeper into a research problem. Thereby, Emmeche, Køppe and Stjernfeldt have found another element that would enable a Filosofikum based on theory of science to render students better scientists, teachers and communicators in the future.

The feature article uses a third example to underline the importance of a Filosofikum, namely the interdisciplinary quality. Many Ph.D. projects span several of the classical sciences, and research has become increasingly interdisciplinary in recent years. Lest we curb this positive development, future scientists must be safeguarded against the pitfalls of specialist narrow-mindedness and misinterpretation of the nature of research.

Besides contributing these incentives for institutioning a new Filosofikum, the article also treats the more practical aspects of a re-institution. A solution is suggested, where the Filosofikum course is divided into two modules – a philosophical and a science-theoretical module. Instruction in the philosophical disciplines, such as ethics and history of philosophy can best be handled by the departments of philosophy and history of ideas, while it would be appropriate that theory of science and history of science be taught by teachers belonging to the specific faculty in question. The authors underline that there is a lot of developmental work to be done before this outlined model can become a reality. This concerns both the development of the necessary science-theoretical staff in centres etc., and the fitting in of a new course in a study curriculum already pressed for time. On the other hand, such a development is deemed necessary in order to create a Filosofikum that can provide instruction based on research.

The Naur-Frøkjær Position

The debate that flourished after the Emmeche-Køppe-Stjernfeldt article was mainly about whether or not to support a re-institution of the Filosofikum. Thus, one could follow a passionate debate among supporters and opponents in the university paper at University of Copenhagen in 2000 and 2001. The computer scientist Peter Naur lead the effort to avoid a new Filosofikum with his article *Fri os fra filosofien* [Free Us from Philosophy]. I will briefly recount the argumentation behind Naur's resistance from a feature article also written for Jyllandsposten, January 17, 2001.

Under the heading *Filosofi mod videnskab* [Philosophy vs. Science], Erik Frøkjær and Peter Naur introduce a view on the Filosofikum that is in many ways the opposite of Hartnack's contribution and in direct confrontation with the Emmeche-Køppe-Stjernfeldt article. The basic idea in the article – and in many other articles by the same authors in the current debate – is that philosophy is completely irrelevant to scientific work.

The authors start out complaining that there has been a political turn in the Filosofikum discussion on the basis of Emmeche, Køppe and Stjernfeldt's article from February 2000 (Naur & Frøkjær 2001, p.1). The crucial argument for the institution of a new Filosofikum was, as we have seen, that philosophy is important in relation to scientific work. Frøkjær and Naur try to argue against this perception and the coming statutory re-institution of the Filosofikum.

> *But before it comes to that, it should be made perfectly clear what is happening. In particular, it should be made clear that the claim that philosophy is of*

> *relevance to scientists is ungrounded in the facts. It is one of those claims that philosophers are happy to make, and that arise from their imagination alone.* (Naur & Frøkjær 2001, p.1)[20]

Philosophy is not only a waste of time, but actually harmful to scientific work and it is depicted as dogmatic and as promoting obscurity and nonsense (Naur & Frøkjær 2001, p.1). In order to undermine the argument that philosophy is relevant to the sciences, Frøkjær and Naur have completed an inquiry into the significance of philosophical locutions in the work of scientists (professors only) at University of Copenhagen. The argument adduced is that these scientists are the only ones that can tell if philosophy is relevant to science from personal experience. Their views are therefore put forward as a sort of answer book on the question of whether scientists need or use philosophical ways of thinking.

According to Frøkjær and Naur, the result of the inquiry is that only a minority of the respondents attach positive value to philosophical locutions (Naur & Frøkjær 2001, p.2).

> *In conclusion to the inquiry of philosophical locutions in scientific activities, we show how the confusion and muddling found in the answers to our questionnaire stem directly from philosophical misunderstandings and dogmas, from philosophical delusions. The central philosophical fallacy is the dogmatic belief or ideology that there are special people, philosophers, that have insight into the facts of this world without needing empirical support for it. This ideology is in direct opposition to the scientific openness to examining things, and as such it is detrimental to scientific character.* (Naur & Frøkjær 2001, p.3)[21]

The article concludes, in rather harsh terms, with a comparison of the political suggestion to reinstate the Filosofikum to an ideological indoctrination program, as they are known from the history of Marxist-Leninist regimes in the Soviet Union and China. According to Frøkjær and Naur, such ideological indoctrination did irreparable damage in these countries, and for that reason they hope that similar conditions will not be introduced by law in Denmark (Naur & Frøkjær 2001, p.3).

Besides the focusing on the value free science, I believe to have identified an important trademark of this anti-philosophical position, namely that there is nothing to be gained from outside the scientific practice that could benefit the sciences themselves. This is simply so because thinking in itself is a straightforward matter. On the alleged special character of the philosophical ways of thinking (as we saw with Hartnack), they have it that

> *Thinking is not something that can happen in different ways. According to classical psychology, the very background for describing thinking is that thinking goes on. Thinking is not something that someone might undertake in one fashion or the other. Thus, the idea that certain forms of description, such as formal logic, have a special status among the countless forms of descriptions used scientifically is annulled.* (Naur & Frøkjær 2001, p.2)[22]

In this way, the plurality of description forms is underscored, and there is a reference that formal logic – which played a considerable role in the Filosofikum (see Sections 4.1 & 4.2) – does not take precedence over other syntaxes. Thinking, however, is not something one should think about, as it is presented as being a straightforward matter with reference to classical psychology. Considering what has been outlined as Høffding's highly classical (and evolutionary) psychology, this is clearly not a very reasonable argument.

But the message, however, is very clear. There are no sound reasons for reinstating any kind of philosophical or other reflections on science in science educations. Science must at all costs be (kept) secluded from other university activities.

Any argumentation in favour of future FV-courses must be able to reject what I have termed the irrelevance position above. Even though it is an imagined position, it none the less reflects points of view that one could very well meet in today's discussions on FV-courses and also reflects elements of historical positions on this issue. The guidelines for constructing a theoretical foundation of the irrelevance position is my understanding of a radical position of modernity with respect to science, and therefore the irrelevance position is supported by the way I have interpreted the conception of science in modernity – as an effort to seclude science.

Hence, what I have called the irrelevance position poses, in short terms, that educating scientists at university level in reflections upon the practice of doing science is a waste of time. Why is it a waste of time? Because reflections on the practice of doing science is in its core an external matter to the work scientists perform and will therefore only bring them skills that are at best unnecessary – they could even be harmful to the capabilities of a scientist. I suggest that what I have termed the conception of science in modernity is very well suited to foster the irrelevance position. What I see as the culmination of the modern project is the philosophy of science presented by logical positivism. This movement in the theory of science developed its understanding of science with the declared goal of isolating the scientific practice from what was considered extraneous content that would interfere with the strongest possible progress in the gathering of pure, objective knowledge for the benefit of society. When I go on to explicate the foundation of the irrelevance position further, my outset is therefore to bear in mind the idea that science in modernity is thought of as an *enclosure* – it is something that rests in itself and needs to be kept by itself in order to thrive.

The philosophical foundation supporting the irrelevance position will consist of three defining arguments of the conception of seclusion. One argument is that ontological considerations have no bearing in science and are associated with the metaphysical theories of the past. The second argument is that an epistemology can be developed that can provide science with a methodology that assures direct contact with the facts of the world through a formal scientific language. The third argument, which partly rests upon the first two, asserts that modern science can claim to be uninfluenced by cultural and historical factors and therefore is able to deliver unalterable knowledge that will lead society towards progress.

The educational irrelevance position claims, on the basis of these reasons, that reflections in science educations would be a waste of time and that students should instead use their entire period of study on learning the existing body of knowledge, skills and methods of the scientific field.

At this point a clarification needs to be made. Even if I were unable to counter any of the three elements of the conception of seclusion presented above, it would by no means lead to the inevitable conclusion that the agreement on a new Filosofikum would be an unwise decision. As we saw in Part I, Jørgen Jørgensen would find it most important to develop a Filosofikum course that rested upon a philosophical foundation much like the one presented – what I have termed the science encyclopaedical position. He would, as has been outlined in detail, find it highly important to inform science students that there is a basic scientific methodology and to train their skills accordingly in grasping the unity of the scientific approach. Conversely, I would also like to add that even though I believe myself able to provide a thorough critique of the foundations of the irrelevance position, this does not mean that there should necessarily be a reflection course, anyway. Good arguments are needed, and I will try to come up with some in Part III, but I hope, through the following critique, to position myself in a way that makes these arguments worthy of consideration.

6.3 Thematic Approach

Through three thematic chapters, I will try to show how the irrelevance position is inept in several ways. The themes illustrate objections against three aspects of the philosophical basis for the irrelevance position, namely with respect to the understanding of ontological or metaphysical issues concerning our understanding of 'systems' (Theme I); with respect to epistemological issues concerning 'representation', especially focusing on language (Theme II); and finally socio-political and ethical issues with respect to the concept of 'advancement' of science (Theme III). I will now further outline these themes.

Theme I – Ontology

In Theme I, I will look into several ontological developments that support the relevance of ontological considerations within science. It is my thesis throughout the theme that there have in fact been unsubstantiated assumptions involved in the practice of doing science throughout modernity. I try to show how much of science is still rooted in the dominant ontology of the modern project and that, despite its unquestionable success, modern science is being challenged by strong ontological alternatives. If this can be argued adequately, a new grounding for the role of ontological reflections in science educations can be outlined.

In Theme I, focus will be aimed at different understandings of the concept of *system*. The irrelevance position rests on the belief that nature can be analysed in its basic components when research is being undertaken in a complex field of study. From this analysis, a synthesis of the behaviour of basic components can give us complete information on the behaviour of a complex field or system of study through the application of the laws of nature. This understanding can be summarised to rely on a fundamental *reducibility* in the structure of nature. Therefore, the true method of science is the one that can reduce the description of nature to its most basic entities.

The historical roots of this modern point of view can be traced back to Descartes' metaphysical thinking. His book *Discours de la Méthode* (1637) contains the theoretical base for the epistemological method of analysis-synthesis outlined above, which assumes – as an ontological precondition – that nature functions as a reducible mechanical system. The general idea of the world as a reductive system is much older, but Descartes instates it forcefully and with great influence as the worldview of modern science.

Theme II – Epistemology

In Theme II, my point of focus will be different thoughts on *representation*, parallel to the views on the concept of system in Theme I. The part of the conception of seclusion under attack in this theme is the understanding that the defining characteristic of language is its ability to depict. A strong current of thought in modernity has it that our scientific method works by means of a special *formal* scientific language as opposed to natural language. This formal language may not be perfectly worked out yet, but it is an inherent standpoint in the scientific milieu of modernity that this ideal language or formalism is possible and that the results of science can be embedded in it.

The historical roots of this idea that science can develop a formal language that gives it absolute descriptions of the facts of the world goes at least as far back as to Leibniz. Mathematics and logic have often been seen as the disciplines through which this effort has been progressed, and Rudolf Carnap, Bertrand Russell and Gottlob Frege are just some of the people that have tried to structure scientific language in a way that resembles the structure of modern logic with the goal to ensure unambiguous representations in science.

Throughout Theme II, I will show how this modern understanding of representation through the formal language of science has been grounded on a particular theoretical condition regarding language, and that if doubt can be raised about this precondition, another conception of science is needed that exceeds the one supporting the irrelevance position.

Theme III – Ethics

Theme III argues against the conception of seclusion from an ethical perspective. Central here are the different understandings of the *advancement* of science. The irrelevance position is based on the supposition that advancements in science will cause *progress* in the development of society. In other words, the positive conditions for humanity will increase as science produces new and better knowledge of nature that enables new technological advances. The weight of significance attached to ethical considerations is related to this understanding. They are thought to be completely irrelevant with respect to the development of science – the results of future scientific research is already out there or predetermined, so to speak, and it is only a matter of time and effort before we reach them. Hence, the ethical dimension of the conception of seclusion can be said to rest upon an element of determinism with respect to the production of scientific knowledge. Thus, the growth in scientific knowledge is understood as the engine behind humanity's accumulative progress.

Several French Enlightenment philosophers were early advocates of this sort of reasoning. In Theme III, we shall investigate how Condorcet interpreted the relationship between science and society in a way that bears resemblance to later positivist interpretations. G. H. von Wright has, as numerable philosophers of the 20th century, opposed this modern line of thought. Today, von Wright's thoughts on progress are part of our sociological understanding expressed in concepts like 'risk society' and 'aporia' and I will argue throughout Theme III, that the idea of straightforward progress seems to have reached its border.

Throughout the three themes outlined above, I will challenge the modern view on science and extract central concepts and understandings that will enable me to establish thoughts on what possible content future reflection courses could be given. In order to elucidate what has been said above, I present my critical approach in this schematic form:

- Theme I: Ontology – System – A critique of the belief in reducibility
- Theme II: Epistemology – Representation – A critique of the belief in formalisation
- Theme III: Ethics – Advancement – A critique of the belief in progress

Thus, keeping it as my research goal to undermine the irrelevance position, I concurrently search for new ways to describe the relations between science and its exterior.

7. Theme I: Understandings of System – the Belief in Reducibility

The theories I work with in Theme I have been chosen through a focus on the development of the conception of a system in relation to science. I will try to connect this development with modernity's characteristic interpretation of how the systems of nature function. Additionally, I will present alternative understandings of nature and reflect on the impact this understanding has on our interpretation of science. I gather knowledge of the system concept from three different perspectives – one that reflects upon thought and the schemes we are using to understand our surroundings, one that takes its starting point in scientific research and, finally, one that takes a phenomenological approach to understanding the concept of system used by science.

In the first perspective, I consider a philosophical point of view that postulates that our thinking about the world understood as a system should emphasise its extreme complexity, in contrast to earlier conceptions that were limiting our thoughts and theories. In the second perspective, I draw on a theory within the philosophy of science, which bases its conclusions on developments within science and suggests that nature's behaviour is of a highly complex character that is in conflict with what is presented as modernity's interpretation of nature as a simple automat. Finally, I use a theory that limits the role played by causal systems in our explanations of nature. In this phenomenological perspective on science, scientific knowledge is only considered valid within certain boundaries that must always be kept in mind. The two first points of view on the system concept will show significant agreement about the road ahead towards a re-formulated ontology to guide science, whereas the third perspective questions the applicability of scientific research methods to all areas of knowledge acquisition.

The task I undertake in this first theme is that of finding arguments in the three perspectives that can be used to criticise modernity's concept of system which rests on the assumption that nature is to be conceived of as a rather simple system with a high degree of reducibility which enables us to split it up in its most basic components when we describe it. Also, some points of agreement between the perspectives will create a basis for new interpretations of the concept of a system that shows how ontological issues could play a part in reflections in science educations.

What is a 'system'?

To think about what a system is and how it functions is an enterprise that is closely related to ontological thinking. In a certain sense, it is about what types of systems actually exist and how they function. By using the concept of system in comparison with that of ontology, I concretise that a system can be a system of society, of nature, an ecological system, the organisation of a working place, the interaction between particles around the nucleus, etc. What kinds of similarities could possibly be found between systems as different as these? As far as I can see, we cannot expect a lot of similarities, but it is, on the other hand, possible to say a lot about the way we think and have been thinking and understanding the general concept of system throughout history, and to what degree this has been a near all-encompassing understanding of the systems that surround us. It is this aspect – our more or less unaware thoughts about what a system is and how it functions – that I aim to investigate in this theme.

The relation between what I have described as the modern project above and the concept of system within science is, to a large degree, to be found in mathematics. From the beginning of the 17th century, the concept of system within science and the philosophy concerned with science has been understood as a mathematical system in the spirit of Euclid, whose system contained a number of self-evident axioms. On this secure foundation, it was possible to build up a body of mathematical knowledge. This perception of how a scientific system should be built greatly influenced one of the founders of the modern project – Descartes. Euclidean geometry deeply fascinated Descartes who saw that epistemology and scientific knowledge had to go through a process similar to the one Euclid had carried out in mathematics. Descartes' analytical method was the result, and the system of nature he imagined was deeply influenced by the dominating system of the mathematical world. It was a simple system that could be analysed in depth into its basic components (axioms and deductive rules, so to speak) and from these components it was possible – without loss of information – to prove and produce completely determined knowledge about a larger field of investigation. I shall return to this modern understanding of system in the following sections and refer to it as the Euclidean or mechanicist conception of a system.

Since Kierkegaard's rebellion against the philosophy of Hegel, the system concept has been exposed to harsh criticism within philosophy. Towards the end of the 20th century, this criticism culminated with the postmodern movement or current of thought that dominated in the 80's and 90's. In the many different interpretations of postmodernism, it is a basic feature that "the time of the grand systems is over". One could say that postmodernism, in its rebellion against the way Western thought has used the Euclidean model as a basic scheme for understanding what a system is, has not only rejected Euclid's system but at the same time the construction of all others.

During the 20th century, a parallel development within mathematics and science took place that showed itself as a doubt about the theoretical base for the knowledge claimed in these disciplines. In the philosophy of mathematics, the different foundation projects of the early 20th century stranded, and the amount of foundation discussions showed that there were serious doubts about the soundness of the mathematical system. Among others, the later Wittgenstein has argued that there are many mathematical systems of which none can be considered the "true" system. In science, reductionism – especially developed in the logical positivists' theory of science – met heavy resistance as the century progressed. The logical positivists had tried to show that all scientific knowledge can be presented in one connected, artificial language, wherein empirical observations can be made the building bricks for all human knowledge. Thomas S. Kuhn most famously opposed this programme of reductionism in *The Structure of Scientific Revolutions* from 1962 with his concept of paradigms. In this book on the history of science, paradigms were considered to be different research agendas with different scientific ontologies that were incommensurable and relative to each other, and I think it fair to say that Kuhn's unaltered first edition of his principal work is an understanding that entails a postmodern perspective on science.

With these developments in mind, I have found it particularly interesting that in the last thirty years, a new conception of a system has emerged within the sciences, that takes the postmodern critique of Euclidean system thinking seriously but still tries to positively decide what kind of systems best describe our surroundings. What this new understanding refers to is what science has called complexity theory (understood as the study of complex as opposed to simple systems) and which indicates a new ontological perception of nature.

It is this new understanding that I will try to bring forward in the first theme of my critical approach. I will start out by describing some key concepts regarding system thinking that originate from within science. Afterwards, I will give a brief description of the specific theories that will be used in this work, and in the following sections I will try to add to a renewed conception of system in relation to science. My aim in this work is to show the limitations of modernity's seclusion of science from ontological considerations.

General Concepts concerning Systems

I would like to clarify and bring to attention a conceptual framework regarding different understandings of a system. An important starting point for this account is that which is, across scientific disciplines, called complexity theory. A system is, within this theory, considered to have three possible configurations. Systems can be closed and determined, open and chaotic or finally open and "self-organising". In complexity theory, both types of open systems are understood as structures in continuous connection to the surroundings through a flux of mass and energy (Web protevi).

The closed system is typical of the mechanistic perception of reality that has characterised much of science since Newton and Descartes. In the science of modernity, the open and chaotic systems have often been exactly the kind of structure that was labelled "complex" in the sense that they are not accessible through calculation because, for example, too many molecules enter into these apparently haphazard structures. Thus, statistics was a way in which one could predict and study the behaviour of such structures.

The open and self-organising systems, on the other hand, cannot be fitted into a mechanistic perception of the world. The behaviour of such systems is characterised by being first predictable in the short term, then unpredictable and chaotic, but in the long term implicating an overall organisation of the system's elements in a stable order. Statistics is powerless in the face of such systems, since after a chaotic start, they can suddenly display stable behaviour. The very pressing question, therefore, is whether such open, self-organising systems actually exist. Later, we will see Prigogine and Stengers argue that the assumption of the existence of such systems is necessary in order to explain a number of phenomena in chemistry and biology. They even consider these chaotic but finally structured systems the kind that most frequently occurs in nature. If their conclusions are correct, we are faced with the realisation that Newton's mechanical explanation model, including the newer relativity and quantum theories when regarded as closed, determined systems, are simply idealisations of a deeper and more complex reality. In other words, complexity theory involves the possibility of reducing Newton's ontology to epistemology and let something different take the place of a mechanistic ontology.

Besides these three types of systems, there is often talk of a mathematical phase space in complexity theory as developed by Henri Poincaré (1854-1912). A point in the phase space constitutes a state for the system, and the number of dimensions in the space therefore indicates the number of parameters or degrees of freedom in the system. In the phase space, linear and non-linear progresses for the system can then be read. By following the movement of the trajectory of the point in the phase space, it is possible to locate patterns of behaviour for the system. The open, self-organising systems are exactly those systems that leave an ordered pattern in the phase space (Web protevi).

Some of the behaviours that can be observed in this way in connection with self-organising systems are called attractors. A point in the phase space is defined as an attractor if, for an interval of the system's parameters (that is, an area of points in the phase space), it is true that their progress is drawn to this point, i.e. they are attracted to the point. Even turbulent liquids can be expressive of an attractor-state, while rather paradoxically, it is the more ordered and easily measurable distribution of liquid that looks like chaos in relation to reality, seen from a complexity theory point of view.

A bifurcation is another important behaviour in the phase space. This is defined by a leap in the system's state from one attractor to another. It is typical of bifurcations that infinitesimal differences in the initial state of the system or infinitesimal changes of the system from its exterior systems determine the attractor-state the system ends up in. Thus, unpredictability is an inherent quality of open self-organising systems, since, for one thing, we can never be sure if our readings of the system are precise enough to make long-term predictions. As this chapter unfolds, I hope to bring some philosophical discussions into play that can clarify what it means to think of the systems of nature in the three categories outlined above. The concept of self-organisation is still developing within the field of complexity theory, but that of most interest to us here is the ontological move away from modernity's focus on closed determined systems.

System from a philosophical perspective

In Part I of this thesis, the weakening of influence from philosophy to the sciences was investigated, and it was argued that philosophy is in need of a redefinition regarding its relation to science. Gilles Deleuze, in cooperation with Felix Guattari, has some interesting suggestions when it comes to the nature of philosophy and its function. At the same time, Deleuze has developed an ontological position that entails a radical reformulation of modernity's concept of system.

System from a scientific perspective

After the study of the ontological understanding of Deleuze and Guattari, I will examine more closely the recent development of the concept of system from within science. Here, inspiration will be gathered from the work of Stengers and Prigogine and their philosophy of science. These authors provide a detailed investigation of the history of science – especially with respect to ontological questions within science –

and the principal message is that a new horizon has emerged for the sciences with the study of complex systems.

System from a phenomenological perspective

The third section of Theme I investigates the phenomenological approach that K. E. Løgstrup offers in relation to science. Løgstrup does not take the same stance to the concept of system as the philosophers and scientists of the first two sections. Instead he focuses on what he sees as the fundamental difference between looking at the world as a causal system – the basic starting point of science – and looking at the world from a phenomenological perspective. This line of thought makes him suggest that science has a significant role to play, but also that our culture has, to a large extent, overrated the meaning of the causal scientific perspective. In other words, Løgstrup stresses that the causality thinking of science has limitations that must always be kept in mind.

7.1 A Philosophical Perspective on System

In the following, I work on giving a brief account of Gilles Deleuze's philosophy and, in particular, I will try and tune into his complexity concept and his thoughts on what a system is. Complexity is also a central theme in Isabelle Stengers and Ilya Prigogine's work in the philosophy of science, which I will examine in more detail in the subsequent section. The relationship between main themes in Deleuze's philosophy and Stengers and Prigogine's philosophy of science will be a sub-theme in these sections. I shall try and establish that there is a shared understanding of the system concept of modernity as too narrow and that an idea of complexity must substitute a more simplistic notion of a system.

7.1.1 Deleuze's Philosophy

Gilles Deleuze (1925–1995) shares his background with many of the great French philosophers of the same generation. Like Foucault, Derrida and Lyotard, he graduated from École Normale Supérieure and has been inspired by psychoanalysis, Marxism and especially the 1968 rebellion against the established order of society (Deleuze & Guattari 1996, p.7).

One common starting point for the great French thinkers mentioned above is the break with modernity. The modern project that started in interplay with the modern natural science in the 17th century became the initiating signal for certain dogma spanning over centuries. Especially the idea of the individual subject as the starting point for philosophy, as it is most clearly illustrated with Descartes, has been a target of critique by the French tradition. In his principal work, *Metaphysical Meditations* (1641), Descartes deduces, through his methodical doubt, that reason – and thereby the soul – is more closely connected to the concept of existence than, for example, sense perception (Descartes 1991). By even taking the step to question the pre-modern tradition-based knowledge and the authority of the church, Descartes pushed the modern project forward and has become the very personification of this project. Modernity involves, along with this strong focus on an epistemology founded in the subject, a belief in historical progress (a thought that found some of its strongest formulations in different guises with Hegel and Marx) and furthermore the idea of nature as being of a fundamentally different character from Man's defining quality, the soul and its rational qualities as explicitly differentiated by Descartes' res cogitans and res extensa.

The French thinkers in the past century, especially in the period after the Second World War, replaced this world picture of modernity with that which Lyotard called postmodernism – incidentally strongly inspired by the later Wittgenstein's conception of language. The belief in human rationality is sharply criticised in these philosophers' works, and even the rationality and authority of science that is a driving force behind the modern project, they often try to expose as a mere illusion. Postmodernism comes to stand for the equality of status between peoples, eras and different groups of the present day, and for the deconstruction of modernity's identity types to do with gender, social class etc. Thus, the postmodern philosophers seek to reveal how categories or identities within the modern project are the product of material and historical preconditions. Identities form part of a practice that must constantly be legitimised through a discourse whose goal is to maintain identities, e.g.

the male as the dominant sex. The postmodern thinkers in French philosophy can all be said to be part of a project to show how difference produces identity, an idea that is at variance with the modern idea of identities being the starting point of thinking.

Deleuze’s philosophical work can be divided into three main categories, starting with an unusual investigation of the past great philosophers. The early works include analyses of Kant, Hume, Spinoza, Leibniz, Nietzsche and Bergson, to mention some of the most significant. The second phase in Deleuze’s writing consists of the presentation of his own philosophy. The principal work from 1968, *Difference and Repetition*, belongs to this phase. After 1968, Deleuze entered into a long-lasting collaboration with psychiatrist Félix Guattari (1930-1991), which resulted in several works, including *A Thousand Plateaus* (1980) and *What is Philosophy* (1991), and can be thought of as a third phase of the body of his work. The three works I have mentioned here will be the basis of my approach to Deleuze. Below, we shall first look at Deleuze’s contribution to the critique of the modern project, which really began with *Difference and Repetition*.

7.1.2 Difference and Empiricism

In his principal work, Deleuze takes Hegel to be his main opponent, while at the same time, he is deeply impressed with Hegel’s philosophical project. As mentioned earlier, inspiration from Marx and Nietzsche is palpable in French thinking. Part of the explanation for the breakaway from Hegel is to be found in this inspiration, since, their mutual differences notwithstanding, Marx and Nietzsche both try to show how the categories with which society operates are rooted in material and historical conditions. While Hegel lets the logical development of concepts be the driving force in history, Marx and Nietzsche see it as the covering up of unjust social conditions and the expression of a slave moral, respectively (Nietzsche 1993). The development of concepts is then secondary compared to the historical-material state of things, which is in opposition to Hegel’s view. Hegel’s totality thinking does, however, make him difficult for Deleuze to get around, since his dialectic schema is exactly a way in which identity is created from difference. Deleuze’s project, then, is to show how difference produces identity, without it being Hegel's all-encompassing and teleological difference.

A fundamental aspect of Deleuze's difference is his ontology of transcendental empiricism; a point of view inspired by Hume and used to emphasise that identity in our sense experience is secondary to difference. As opposed to Hegel and in concordance with Hume, the empirical is the transcendental precondition for concepts. This first aspect of transcendental empiricism holds that we must provide a generative explanation of the concepts we make use of. In this way, Deleuze's ontology goes against the idea that our concepts can be unproblematically used to describe our experience, as already touched upon. Deleuze talks of the 'radical difference' to which each sensory organ can come close when separated from its coalition with the other faculties (Marks 1998, p.83). The classic sense of the term 'transcendental' is, as we will see below, far from Deleuze's philosophy. He uses the term 'transcendent' here to signify that the subject is active in the sense experience.

> *Transcendent in no way means that the faculty addresses itself to objects outside the world but, on the contrary, that it grasps that in the world which concerns it exclusively and brings it into the world.* (Deleuze 1994, p.143)

This is not empiricism in the classic sense, in which an already complete subject receives sense material. In this respect, it is not Hume's form of empiricism for which Deleuze argues (Marks 1998, p.85). Rather, what Deleuze considers to be central in Hume's philosophy is the notion of the habit that causes a mind construction from an underlying chaos. The synthesis thus formed by the habit is what makes it possible for thinking to arise, and difference can therefore be said to be primary to the categories of thinking.

7.1.3 Deleuze on the Role of Philosophy

In his early period, Deleuze found in the work of the great historical philosophers many themes that came to make up the nucleus of his own philosophy. We have already seen how he gained inspiration from Hume's work. Deleuze has been equally deeply influenced by Spinoza and Nietzsche, among others, and in the following, we shall take a closer look at these influences in order to develop a more thorough insight into the main aspects of his philosophy.

Deleuze speaks highly of Spinoza (1632-1677) and refers to him as the Christ of philosophers, while others are reduced to disciples within this image.

> *Spinoza, the everlasting becoming-philosopher. He has shown, recorded, thought the "highest" plane of immanence, that is to say the purest, the plane that does not give in to the transcendent or give out anything transcendent, what engenders the fewest illusions, base feelings and erroneous perceptions…* (Deleuze & Guattari 1996, p.84)[23]

As it would appear from the quote, the essential point about Spinoza's philosophy is that it does not refer to anything transcendent as a horizon of explanation or lead to any transcendent interpretation. As Deleuze puts it, Spinoza stays at the immanence plane, which means that he refrains from giving transcendent, idealistic explanations and can be considered an empiricist in Deleuze's special interpretation of this term (Deleuze & Guattari 1996, p.71).

According to Spinoza, "God or Nature" is the substance that is in itself and that is understood through itself (Lübcke 1983, p.406). Therefore Deleuze finds support of an immanence philosophy in Spinoza. The history of philosophy is full of what Deleuze calls the illusions of transcendence. Philosophy is, almost without exception, permeated by perceptions that operate with a transcendent level. One model example of this is Plato's world of ideas, but there are many other examples of this fundamental flaw, if less obvious. The illusion of transcendence is always an attempt to make immanence immanent in something. It is often tied to the illusion of universals, which arises when philosophical concepts and the immanence plane are confused (Deleuze & Guattari 1996, p.72). Philosophers have believed that the universal can serve to explain, but according to Deleuze it is exactly that which needs to be explained. Concepts are perceived of as universals that serve to give philosophy meaning and certainty. This illusion of the universal has, as Deleuze sees it, three forms in the history of philosophy: Contemplation, reflection and communication.

Contemplation is characterised by its interpretation of immanence as immanent in the great Object. Plato was an example of this, and Deleuze describes him as an objective idealist. Reflection creates the Subject and thereby ends up in transcendence by regarding immanence as an attribute of this Subject. Kant is the main character in this historical movement. As one might expect, Deleuze calls this the subjective idealism. Finally, communication philosophers transcend the immanence plane by letting the Other be the transcendent level that can explain the plane (Deleuze & Guattari 1996, p.75). Deleuze also rejects this idea of a universal discursive reason and calls it the intersubjective idealism. This idealism is exemplified by Husserl's phenomenology, but also includes different forms of structuralism (Deleuze & Guattari 1996, p.70).

According to Deleuze, Spinoza avoids these mistakes, but one might ask if Hegel is not also a great immanence philosopher. While Deleuze confirmed this, he did, however, think that Hegel failed elsewhere, namely regarding the nature of the philosophical concept (Deleuze & Guattari 1996, pp.30-31). Hegel has it that the philosophical concept contains the sciences and art, while Deleuze considers these activities of a totally different character to philosophy. As opposed to the transcendence philosophies and Hegel, Deleuze's definition of philosophy comes first and foremost from Nietzsche.

> *Concepts do not await us fully formed, like heavenly bodies. Concepts have no heaven. They must be invented, constructed, or rather created, and they would be nothing without the signature of their maker. Nietzsche identified the task of philosophy when he wrote: "(Philosophers) must no longer merely let concepts be handed to them, nor must they just purify and elucidate them, but first and foremost, they must* make, create *them, construct them and allow themselves to be persuaded to them…* (Deleuze & Guattari 1996, p.23)[24]

To Deleuze, philosophy is not, as for example Wittgenstein has it, solely a task of unravelling (linguistic entanglements), it is also the creation of a new reality, an activity that Wittgenstein would probably have ascribed to all other aspects of our life-world than philosophy. Still, when it comes to the perception of language, Deleuze and Wittgenstein share an anti-Platonist, after-modern keynote. Concepts only gain meaning through use, and as Nietzsche puts it, they are not a "fully developed dowry" that only needs cleaning up. Other philosophers' concepts, however, are to be deeply mistrusted, since philosophy is defined exactly by its conceptual innovation. Before Plato could make the mistake of regarding philosophy as the contemplation of the ideas, he had to create the concept of the idea. Therefore, Deleuze holds that philosophers should be judged by the concepts they create and the nature of the events to which these concepts call our attention (Deleuze & Guattari 1996, p.55).

In a decisive way, this definition of philosophy as the creation of concepts is the reason for Deleuze's critique of the transcendence philosophies. Contemplation, reflection and communication have neither of them created a single concept, and it is up to philosophy to provide concepts for these activities (Deleuze & Guattari 1996, p.24).

But how to establish new philosophical concepts, when one is necessarily indebted to earlier philosophers for the concepts one has already? For example Descartes' 'Cogito' has, according to Deleuze, certain preconditions, but this does not mean that the Cogito rests upon these. With the creation of the Cogito, a new autonomous event has taken place and an immaterial meaning has arisen that we can comprehend. The created concept is furthermore composite rather than primary and simple. Deleuze explains this using the Cogito, which in his interpretation consists of the elements to doubt, to think and to be. None of them are primary, but they are gathered in what Deleuze calls zones, in which they mutually define each other and are inseparable. Intensity arises in the concept between its elements, and the zones are alterable and in motion and can have new elements added to them (Deleuze & Guattari 1996, pp.45-46). In this way, the whole of the concept can change, and Deleuze uses Kant's Subject concept seen as a further development of the Cogito to exemplify this.

7.1.4 Deleuze's Conception of System

We have seen how Deleuze considers the role of philosophy the positive creation of concepts that can reveal new aspects of the events we come across. In the following my focus will be on Deleuze's further development of the conception of a system. Through a rethinking of this concept, he paves the way for new ways in which to view the nature of complexity.

The rethinking of the system concept is expressed in the concept of the 'rhizome'. While many postmodern philosophers have proclaimed that the fall of modernity is also the fall of the grand systems, in *A Thousand Plateaus*, Deleuze and Guattari suggest that it is only the understanding of what a system is that must be changed. It is in this connection that Deleuze's post-structuralism finds its clearest expression. Deleuze analogises the system in its classical modern sense to a tree structure. The tree is hierarchically organised and has a foundation upon which the rest of the structure rests, as does the system according to the classical Euclidean conception. This implies the notion of homogeneity within the system. In a historical analogy, one could find the prime example of this structure of thought in the thirty-eight volumes of the *Encyclopédie* of the French Enlightenment thinkers, Diderot and d'Alembert completed in 1772. In this massive effort to subsume all of mankind's knowledge on one shelf, the topics are carefully placed into a tree-structure of different kinds of knowledge.

Deleuze's rhizome, on the other hand, is a centre-less, heterogeneous structure, in which any given point can be connected to any other point – the hierarchical tree structure is thereby dissolved (Deleuze & Guattari 1988, p.7). The "rootlessness" of the rhizome also means that it can survive and rebuild itself even after receiving wide-ranging injuries, unlike the tree, which cannot withstand being cut through. The organisation of ants is an example of an animal-rhizome that will recreate again and again, even after extensive damages (Deleuze & Guattari 1988, p.9). With the rhizome concept, Deleuze tries to show how we have confined our thinking about the world to a far too narrow and inadequate structure. For example, this structure is firmly established in the way in which we perceive of a book (or a thesis!) – as an organic whole with a beginning and an end (Deleuze & Guattari 1988, p.5).

Deleuze further illustrates his conception of the rhizome through his idea of what he calls the 'abstract machine'. Everything is 'machinic', and there cannot exist 'unplugged machines'; a book is a machine that must be plugged into other machines, such as one machine in the subject, a scientific machine, an aesthetic machine and so forth. Man is in no way privileged in this respect, since he is part of larger machines while at the same time being compounded of smaller, organic as well as inorganic machines. We see in this the Deleuzean version of deconstructing the individual subject of modernity. Furthermore, there is no clear distinction between organic and inorganic. What we therefore may call Deleuze's machine-thinking elucidates what the rhizome is and how it is an understanding of the system as something that works relational to other systems. This altered view of the system also brings about a rethinking of the concept of complexity. Complexity is no longer a question of immense branching of the tree, but rather of countless relations to other machine complexes.

Deleuze does not use the machine as a metaphor (Marks 1998, p.98). It is to be understood quite literally, and Deleuze uses it to break down the modern division between vitalism and mechanicism. The mechanicist thinks about the world in the wrong kind of structure (i.e. that of the tree), while the vitalist has the organism to be essentially different from the machine. Deleuze goes against these ways of thinking and begins *A Thousand Plateaus* with an account of how he himself is a multiplicity of machines, and that it is therefore merely old habit that makes him sign the book "Deleuze" (Deleuze & Guattari 1988, p.3).

7.1.5 Deleuze on Complexity

I will now try and identify the connection between Deleuze's philosophy and the concepts of complexity theory as presented earlier on. I will consider the matter, first from a general perspective, and then going into a more detailed study concerning different interpretations of the evolution theory in biology.

There seems to be a certain connection between elementary parts of complexity theory as outlined above and Deleuze's system of concepts. Thus, in his works, one can find terms like 'black hole' that could correspond with 'attractor' and 'line of flight' that could correspond with 'bifurcator', if one wishes to plug this machine onto Deleuze (Deleuze & Guattari 1988, pp.333-334,167-168). The reason these interpretations can be made is exactly that the rhizome is an open system that can describe the degree of complexity in a system in light of the relations this system has to other systems of objects.

We can also conclude that Deleuze's efforts to avoid transcendental principles in his philosophy lead him towards a view that involves the self-organisation of matter. The self-organisation of matter is not possible within modern science's understanding of nature, because a physical system made up of countless individual elements must always obey the movement of each element controlled by the laws of nature on the micro plane. A coalition between the elements can never consist of anything more than the sum of their individual contributions, and any kind of self-organisation of, say, billions of molecules is therefore extreme unlikely. The ontology of modern science ultimately rests on the image of particles flying around and affecting each other, while suggestions, using this ontology, as to how the macrostructures we encounter have come into being have been vague (historically, they have often involved divine intervention). Another trait of modernity's scientific ontology is that the current state of all the elements of the universe can be used to calculate all potential macroscopic states of the universe in all future. The potential is seen as absolutely determined by the actual and in principle calculable from the actual. In order to get around modern science's distinction between the actual and the potential (which for example encourages physicists to promote rather radical ideas in connection with their interpretations of quantum mechanics, such as the multiple-world theory), Deleuze introduces the concept of the virtual. Deleuze's distinction between the actual and the virtual can be viewed as an attempt to bring about new ontological thinking that will disintegrate the modern scientific understanding of nature. I will only briefly try and explain this aspect of Deleuzean ontology within the conceptual framework of complexity theory; a field of study that has been pioneered by Manuel DeLanda in *Intensive Science and Virtual Philosophy* (2002) and also by Brian Massumi (Web protevi).

The actual is the present traits of the system, for example that the system (perhaps a fluid) is oscillating by a certain frequency (perhaps between two colors), while the virtual is defined as the attractors immanent in the system in the form of other oscillations in other parameters for the system. The virtual also consists in the bifurcations with which the system is transformed into having different traits, i.e. where the system changes character as expressed in the transformation from one attractor to another.

The distinction between the actual and the virtual (as opposed to the actual and the potential) aspect of physical systems can thereby be used to understand and explain the unpredictability of certain physical systems (e.g. the weather development in Danish air space). In the conception of the potential it is implied that the actual already holds the one and only possible development. The virtual, on the other hand, shows Deleuze's efforts to interpret the relation between the actual state of a system and the probabilities of its future behaviour. An excellent example illustrating the virtual dimension of a system is the setting in quantum-mechanics before the collapse of the wave-packet. A range of possible future behaviours is an immanent part of the actual system, and not just a single, predetermined potentiality. There is, so to speak, a virtual dimension in addition to the mechanical. Besides this outline of the virtual as the emergent properties of a system, one must also mention Deleuze's idea that the phase space representing the system cannot be considered static. A static phase space may be possible to uphold for certain systems – the closed systems – but for open systems, the state of the phase space can be changed by the behaviour of the actants in the system. The virtual, thus, is also about how the phase space, in which a system is described, cannot be kept static.

I will refrain from delving deeper into these issues, though I find them to be of considerable importance and a source for further understanding. Let me instead give a more concrete example of the use of Deleuze's main ideas presented above. In evolutionary biology, the term complexity theory is tied in with the view that one must revoke the classical Darwinist perception of the relation between organism and environment as a static subject-object relation (Pearson 1999, p.146). It is pointed out instead that evolution must be understood as the mutual development of organism and environment in an inseparable connection.

Complexity theory makes it possible, on the basis of this interpretation of the conditions for evolution, to talk about the organism as an open, self-organising system that must be explained in more dynamic terms than Darwin's theory can. To Darwin, and to present-day neo-Darwinists, the fundamental mechanism of evolution is that the environment chooses the strongest for survival. Complexity theory, on the other hand, takes seriously the organism's capacity for giving feedback. Thus, Brian Goodwin, one of the leading figures supporting this view, calls the organism an immanent, self-regulating or creative force (Pearson 1999, p.146). In Goodwin's opinion, it is not an essence (the DNA), but a dynamic field that is decisive in the creation of the spatial structures that we encounter in the world of biology. This dynamic field, which is the real force behind biological organisation, is as much about various macro-relational interactions in time and space as it is about the properties of the actual molecule. The DNA plays an important part as a stabiliser for the creation of structures in the dynamic field. But the thought of the DNA as the all-determining mechanism that ultimately permits the absolute reduction of biology to chemistry and physics is repudiated. The naked DNA cannot reproduce without entering into a complex, dynamic field with feedback processes and a network of relations in time and space. The mechanicist perception of science that proposes such reductionism seems inadequate when trying to explain complex biological phenomena as being the result of "mechanical coincidences" or the like. Instead, complexity theorists within evolution biology set up a more holistic picture of the processes taking place in nature.

In *A Thousand Plateaus*, Deleuze and Guattari break away from the myth of the DNA in a similar fashion. They concede that the DNA does in fact determine an organism's capacity for reproduction, but this does not necessarily mean to say that DNA is the very mechanism that controls the direction of the development of life. Reproduction is dependent on a foregoing complexity that must be explained through the rhizome. In other words, nature should be studied on the basis of the machine-thinking and the structure of a rhizome. For Deleuze and Guattari, evolution cannot be controlled by a few principles or mechanisms, as Darwinism has it (Deleuze & Guattari 1988, pp.51-53). In this way, they agree with many of the basic ideas that complexity theory builds on in biology. However, the holistic conceptions often imply an understanding of the organism in which the entirety comes before the parts. As Deleuze and Guattari see it, the evolutionary explanation thereby fails to appreciate the complex process of coming into being of which the organism is an expression. In other words, this explanation takes as its starting point the supposed unity of the organism rather than its birth (Pearson 1999, p.149). Such a view is similar to the classical vitalist view that is not easily compatible with machine-thinking. Keeping this in mind, there are, nevertheless, several points of resemblance between the ways in which complexity theory and Deleuze break with Darwinism. And most significantly we see how a Deleuzean ontology can be mobilised to present us with a standpoint that departs from what could be interpreted as a simplistic and reductionist account in science.

7.2 A Scientific Perspective on System

It should be clear that the science-philosophical problem of reductionism I have already touched upon in relation to Deleuze's philosophy is closely connected to the classical debate going back to the 19th century between mechanicists and vitalists. More precisely, the question here is whether the mechanical scientific description of the world reaches from physics through chemistry and to biology. The mechanicist view originates in Newton's systematisation of mechanics. Vitalism denies the adequacy of Newton's explanation model and claims that there is a special life force in all organic life that is not reducible to chemistry and physics. As we have seen, Deleuze represents a view in between these two extremes in the debate. However, his position also revealed how far the debate has moved since the 19th century. Back then, vitalism was still a strong opponent to mechanicism, while later, the belief in a vitalist ontology seems to have broken down, at least in the Western world.

7.2.1 Stengers and Prigogine's Project

The task now is to clarify the thoughts within newer philosophy of science that form the background of the new complexity-theoretical understanding of the sciences that has emerged during the past twenty years. With Isabel Stengers and Ilya Prigogine's *La Nouvelle Alliance: Metamorphose de la Science* (1984) [*Order Out of Chaos: Man's New Dialogue With Nature*], a new scientific frame of understanding began to emerge, especially within chemistry and physics, though mathematics, too, has seen a growing interest in the field. Today it is fair to say that complexity theory is a rather well-established approach to a growing number of problems throughout the scientific community.

In their book, Stengers and Prigogine take the scientific world picture into revision; it is a book that examines closely the theories of the different scientific disciplines and the philosophical understanding ascribed to them. Overall, Stengers and Prigogine's project is to show how the classical science has reached its limits. That it has reached its limits is to say that its notions of intrinsic necessity have been developed to a level where they must break down as a reliable explanation of how the world is organised. What is meant by classical science is, first and foremost, the theoretical system of concepts in physics stemming from Isaac Newton's (1642-1727) principal work *Philosophiæ Naturalis Principia Mathematica* (1687), which in a sense turned physics into the scientific ideal for all sciences to strive for. Classical science rests on what Stengers and Prigogine call the myth of a simple and passive world; a world that stupidly follows certain regularities or, put differently: a world that is one big tautology.

> *The main topic of the present book is the following: our starting point is a nature that is compared to an automatic machine. This automaton is subject to mathematically expressed regularities that coolly and for good determines the future and past processes of nature. Today, however, we are in a totally different situation theoretically, since we have reached a description of nature in which man is placed in the world he describes, and in such a way that this world is opened up. We may, without exaggeration, speak of this transformation as a true* fundamental transformation *of the sciences.* (Stengers & Prigogine 1985, p.33)[25]

Hence, certain features of the scientific milieu of the present day make Stengers and Prigogine hopeful. They speak of how the attempts to move away from the Newtonian myth converge from different sides (Stengers & Prigogine 1985, p.91). For example, it has become clear that, more and more, time is perceived of as an irreversible process, as opposed to the classical theory of the world where development through time is, in principle, reversible. Furthermore, any concept of innovative activity was banned in Newton's world picture. At any time, the gaming pieces were already given, and hence only the calculation process could be a source of complexity. In many newer scientific theories, this reductionist view has been decisively challenged. Also, classical science rests upon the assumption of a homogeneous reality. When we observe differences in our immediate approach to the world, this is merely because we have been unable to reveal the unified movement on the microscopic plane. Stengers and Prigogine advocate – as would Deleuze – that we must think of the world as encompassing qualitative differences in our ontological presuppositions.

If this budding view of science can be brought to flourish, we will, according to Stengers and Prigogine, have paved the way for a science that has in the world an interlocutor as opposed to classical science with its, in the strictest of senses, inane adversary. They believe that this breakthrough might put an end to what C.P. Snow has depicted as a breakdown in the cultural dialogue between the natural sciences and the humanistic sciences (Snow 1993). With the new pact between humans and the universe, a way will not only have been paved for a new and better understanding with nature, but also for leading science back into the cultural context in which, according to Stengers and Prigogine, it belongs (Stengers & Prigogine 1985, p.34).

7.2.2 Newton's Classical Science

Stengers and Prigogine make the development of classical science the starting point of their analysis. What are the strengths, then, of classical science, since its influence has been so radical? The breakaway from the Aristotelian view of science is considered to be decisive in relation to this question. Galileo discovered that one should not pose questions concerning purpose, i.e. ask nature "why". Instead the basic scientific question was a "how" that could be answered descriptively (Stengers & Prigogine 1985, p.93). It was the task of science to investigate the changes that occur when, say, two bodies affect each other or accelerate.

This research principle led science away from the animism traceable in Aristotle's notion of the natural purpose of things. However, it was not until Newton came along that classical science was established. Newton unified Kepler's laws for the orbit of planets on the one hand with Gallilei's laws for free fall on Earth on the other, including them both in his own infinitesimal calculus. Thereby, Heaven and Earth were brought together in a way that would have been unthinkable within Aristotelian science. Here, Heaven and Earth are perceived of as qualitatively different spheres, and it was unimaginable that the same laws should apply for heavenly objects as for those on Earth. Newton's findings would suggest that this was in fact the case. His law of gravity, as it turns out, can be used to calculate all types of influences between bodies. In other words, it is a universally valid law in that it covers all dimensions of reality, cosmic as well as microscopic (Stengers & Prigogine 1985, p.96).

On the basis of this universal principle, the notion arises of reality as a dynamic system consisting of mass points with positions and velocities and a dynamic quality of these mass points controlled by Newton's law of gravity. Within this perception of reality, the task of the scientist is to set up, on the basis of the law of gravity, a number of differential equations that express the relation between the mass points in a given, closed system. The answer, or the prediction of the systems behaviour, is then given by the integration of these differential equations (Stengers & Prigogine 1985, p.95).

It is an important feature of these dynamic systems that the mathematical equations involved in the description thereof are symmetrical, in the sense that time figures as a variable that can be ascribed any value. Given an initial state (any state whatsoever), the entire past and future of the dynamic system is set. In a certain sense, everything is calculable at any point in time. The future and past can be determined from it, or as Bergson put it: “Everything is given” (Stengers & Prigogine 1985, p.96).

If the position and impulse of every mass point in the universe were known, the previous argument concerning the development of dynamic systems brings with it the hypothesis of Laplace’s demon. What better meets the criteria for a dynamic, closed system than the universe as a whole? Laplace’s demon is able to measure the states of all mass points and, on the basis of Newton’s laws, to calculate the future and past of the universe (Stengers & Prigogine 1985, p.116). In other words, we are dealing with strict determinism, which goes against Man’s perception of himself as an active being in the world. Man is alienated in the world within classical science, and the gap between the humanistic and the natural science cultures was on the cards at an early stage.

7.2.3 The New Science

In the 19th century, there was a landslide in physics at the arrival of thermo dynamics. As implied in the name, thermo dynamics has to do with heat movement, and this became an important discipline in the burgeoning industrialisation where there was a need for useful machines running on thermal energy. According to Stengers and Prigogine, this theory began with Fourier.

> *When it comes to the science of complexity, in this sense we do not hesitate to let it “begin” in 1811. This year, while Laplacians triumph and rule European science, Baron Jean-Joseph Fourier (1768-1830), prefect in the Isère department, brings home the Academy prize for his theoretical treatise on the expansion of heat in solid bodies. To no avail, Laplace, Louis Lagrange (1736-1813) and their students joined forces to criticise the new theory, but had to put up with it.* (Stengers & Prigogine 1985, p.151)[26]

The problem for Laplace and his mechanicist supporters was that a new universal complex of laws provided by Fourier contained a phenomenon that was hardly describable in mechanical terms. Just like all molecules in the universe are in gravitational exchange with each other, they also exchange heat. Therefore, one was faced with having to explain the connection between these disciplines, but they are almost immediately mutually exclusive description models. Gravitation affects matter without changing it while heat transforms matter, e.g. in the burning of coal (Stengers & Prigogine 1985, p.152). Furthermore, William Thomson (1824-1907) later made it possible to give this difference a more radical formulation known as the second law of thermo dynamics. It was discovered that, in isolated systems, there is always a movement towards increasing disorder. Results from the then flourishing research into the efficiency of machines had made it clear that even though the principle of the preservation of energy held good, there was always a loss in connection with the transformation from thermal energy to, say, mechanical energy on account of heat expansion. In practice, this means that one always uses a little more energy for the equalisation of temperature than the mechanical energy that comes out of it. Thomson then applied this perspective to the universe (a la Laplace) and realised the eventual heat death of the universe. Because of the inevitable equalisation of temperature, thermo dynamics has provided us with a ranking of energy in which heat is at the bottom. Heat differences will eventually draw level and end all movement in the doing. This is the core of philosophical problems concerning the second law of thermo dynamics. Newton and Laplace's mechanical world was reversible, but thermo dynamics now describes a fundamentally irreversible reality.

Boltzman provided the first fruitful bridging of the gap between the mechanical world and that of thermo dynamics. He realised that statistics could explain why a tremendously big number of molecules display a tendency for groups of molecules with high velocity to be equalised with groups with low velocity (Stengers & Prigogine 1985, pp.173-174). Asymmetries in a system will, with overwhelming probability, balance themselves out, since the number of symmetric states is extremely high compared to that of asymmetrical states. This is an effect that ultimately builds on the fact that, with two dice, one has a better chance of getting a six than the extreme value twelve. There are simply more system states that are equalisations of differences than there are asymmetrical states. Thus, with this probabilistic model, Boltzman could explain how the mechanical description of the world is in accordance with thermo dynamics. The prize for this, then, is that Newton's world picture must accept a probably irreversible reality (though not irreversible in principle!). Stengers and Prigogine point out, however, that with the very introduction of the probability concept, we have moved away from Newton's mechanical description (Stengers & Prigogine 1985, p.177); nonetheless, the clothing that Boltzman gives thermo dynamics is still not enough to explain the organised structures that we encounter in nature and in culture. Boltzman based his theory on observations of equilibrium in closed systems, about which Stengers and Prigogine have the following to say:

> *Once they are formed, they can be isolated and sustained indefinitely without further exchange with their surroundings. If we examine a living cell or a city, the situation is another. Not only are these systems open, they only exist thanks to the fact that they are open. They live off the matter- and energy current coming from the surrounding world. It is quite obvious that cities and living cells do not strive towards a state of mutual equalisation or a state of equilibrium between the incoming and outgoing currents. We can, if we want, isolate a crystal; but a city or a living cell that is cut off from its surroundings, quickly dies.* (Stengers & Prigogine 1985, p.178)[27]

Boltzman is forced to explain such macroscopic formations as miracles or instances of inconceivable improbable sustenance of differences. Science has often introduced a transcendent explanation in exactly this kind of situation.

7.2.4 Dissipative Structures

It is in this connection that Stengers and Prigogine have given a number of chemistry examples that have often, somewhat misleadingly, been considered their "proofs". One such example is that of Benard's cells that appear as a macrostructure in an open system, more precisely through the heating up of a fluid resulting in heat transfer. The macrostructure, which is characterised by hexagonal convection cells, appears at a certain critical value of heat flow induced to the system; the system has been brought out of balance. As it turns out, the case that Boltzman examined is a special case that rarely occurs in nature, namely a closed system belonging within predictable, "symmetrical" thermo dynamics. Benard's cells, on the other hand, appear as open systems whose equilibrium is disturbed and that consequently go through chaotic, unpredictable states to suddenly end up in an ordered state when roped in by an attractor.

Stengers and Prigogine refer to this new self-organisation in open systems as dissipative structures.

> *Benard's cells form the first type of a* dissipative structure*. The term "dissipative" for this structure expresses the connection between the idea of order and the idea of waste and was chosen with regard to expressing the fundamentally novel fact that dissipation of energy and matter – which is normally tied in with ideas of loss of output and with development towards disorder – far from equilibrium becomes a source of order. Dissipation is the source of something that one might very well call new states of matter.* (Stengers & Prigogine 1985, p.195)[28]

With the discovery of this new type of self-organising behaviour for open systems, it is no longer necessary to deduce that life is a mechanical miracle. Life's complex, ordered structures and processes have shown to be compatible with this new type of system. Mankind is thus pointed towards a possible pact with nature in the sense that its existence is describable within this theory of nature, as opposed to the mechanicist one. The ontology of classical science can be replaced by an ontology where difference is primary to the absolute categories, time, space, mass etc. on the basis of which Newton established his system. Neither mechanicism nor vitalism seem to be able to explain the concepts of the new pact that, in many ways, depicts self-organisation as something immanent in matter. Hence, this view seems closer to the ontological categories set up by Deleuze and Guattari pertaining to machine-thinking and the virtual.

> *…G. Deleuze and F. Guattari [set up] as opposites two different views on the organism: the organism regarded as a structural unit (mechanicism) and the organism regarded as an individual and specific unit (vitalism) […] The two authors thus place themselves in an extended (or split) functionalist perspective, which is rather close to the perspective that the theories we go over here may occasion.* (Stengers & Prigogine 1985, p.399) [29]

In this way, Stengers and Prigogine have taken inspiration from the philosophical environment, but we are actually seeing a mutual convergence of ideas resulting in a new perception of reality in between science and philosophy (Stengers & Prigogine 1985, p.382).

7.3 A Phenomenological Perspective on System

In the two preceding sections, I have opened up for an understanding of the system that places man in nature in a way that was in contrast to modernity's perception of man as being outside of and opposite to nature. In K. E. Løgstrup's four-volume work *Metaphysics* (first published from 1976 to 1983), the third part, *Source and Surroundings – Reflections on History and Nature*, takes up the subject in a parallel fashion. I have tried in the two preceding sections to show the direct implication of ontological considerations in science. My treatment of Løgstrup is meant to give a broader perspective on system thinking that does not search for the proper concept of system, but rather for the limits of any systematic understanding of the world. In that sense, my dealings with Løgstrup widen the approach to system thinking considerably.

A few remarks may be appropriate with regard to Løgstrup's *Source and Surroundings*. It was published posthumously and is a patchwork of texts that Løgstrup never finished. In that sense it only represents a rough sketch of the ideas that he wanted to bring forward, but still, I find it to be most original and of lasting value for our understanding of science. I will, however, mention one issue in advance that I find troublesome, namely Løgstrup's treatment of sensation in what follows, and I shall return to this later. Let us first start out by considering the fundamental concepts of Løgstrup's philosophy of nature.

Løgstrup deals with what he calls the conception of man's environment as source and as surrounding and we shall now take a closer look at these conceptions. When the world is perceived as surrounding, man is placed outside of nature – on the edge of the universe – and the philosophical development has shown how we have failed to appreciate the fact that we are still inextricably connected to the universe as our origin and source (Løgstrup 1995, p.14). On the contrary, we have come to regard our positioning in nature as insignificant from our position at the edge of the universe and of nature. We also have serious difficulty reconciling the surrounding- and the source perspective, as European history of philosophy has seen many examples of, e.g. regarding the body-mind duality.

Løgstrup's philosophy concerning this entire problem takes as its starting point the epistemological concepts 'sensation' and 'understanding'. He is of the conviction that modernity's notion of these concepts and its epistemology in general rest on a number of fallacies that ignore the fact that man is part of nature. Throughout his authorship, Løgstrup's main opponent was Immanuel Kant, the philosopher in modernity who has perhaps most clearly formulated an epistemology that secludes man from his origin in nature. In the following, I will describe how Løgstrup attacks the epistemological point of departure behind the modern project and attempts to re-launch a metaphysical description of our relationship with nature.

7.3.1 Sensation and Understanding

With outset in that which he calls a delusion about the nature of sensation, Løgstrup tries to explain the prevalent idea in Western culture and natural science, that man is positioned on the edge of existence. Løgstrup's concept of sensation is closely tied to his concept of understanding, and I will try to elucidate the content of these by relating them to the problems our culture has had with connecting the two perspectives on nature, as our source and as our surroundings.

Why is it that we have not succeeded in reconciling the source- and the surrounding perspective? According to Løgstrup, this is due to a notion of sensation,

> *…that controls us with such matter-of-course that we do not even think to question it – even though it is quite obviously a delusion. We find that sensation is receptive, but it isn't, it is without distance* (Løgstrup 1995, p.15)[30]

That sensation is without distance means to Løgstrup that what we sense may be distanced from our bodies, but it is not distanced from our *sensation* as an experienced phenomenon. A person that calls me from 100 yards away is far from my body, but to my pure sensation, there is no distance and no space of distances. The notion of sense perception that we are presented with here is therefore completely different from the one that natural science has taught us – receptive sense perception – and that, according to Løgstrup, rules our thought even outside of the natural sciences.

Løgstrup places 'understanding' opposite sensation. Understanding works in the exact opposite way to sensation, in that it creates distance. Understanding operates through language, which makes our surroundings something shared, and at the same time, language creates a distance between itself and the subject discussed. While sensation and understanding are absolutely different and contrary ways in which to approach the world, they do, however, work together so intimately that it is virtually impossible for us to sense something we do not already know what is (Løgstrup 1995, p.15).

The dichotomy between sensation and understanding is inevitable, according to Løgstrup, but he does see at least two kinds of people that do not accept it. The artist attempts to eliminate understanding through his work, while the scientist tries to eliminate sensation. In the following, I will examine what exactly is meant by the claim that science ignores the mentioned dichotomy between sensation and understanding, while at the same time elaborating on Løgstrup's concept of sensation.

In Løgstrup's terms, sensation is not only without distance, it is also ubiquitous. By this he means that our sense perception, as opposed to the one-place-presence of the body, moves freely in the space of sensation. We can fasten upon the stars one moment and immediately thereafter on a car far away (Løgstrup 1995, p.19). Certain conceptions within science bypass what Løgstrup calls the simple observation that

> *…the sensed is outside our one-place-present body, but not outside our ubiquitous sensation. […] We cannot help attributing our body's distance to the sensed and the distance between our understanding and the understood to our sensation. It happens to the advocates of the sense data theory, unknown to themselves.* (Løgstrup 1995, p.20)[31]

The theory that Løgstrup calls the sense data theory, and that he finds the logical positivists advocated, says that man receives sense material from his surroundings. Thus, the sense data theory builds on the exact opposite idea of sense perception as that which sees it as distanceless. The creation of distance that Løgstrup ascribes to understanding and excludes from sensation is exactly what sense data theory sees as part of sensation.

To argue against this theory, Løgstrup points to the idea that natural science can only approach the world through a reduction of the way in which nature presents itself to us. A dichotomy of perspectives, through which we can perceive of the world, is presented. One either insists on a causal or a phenomenological perspective (Løgstrup 1995, p.23). The causal perspective is basically the one behind the positivists' sense data theory. In this theory, sensation is conditioned by causal processes in the nervous system and gathered in the brain. The insistence on the principle of causality means that sensing as a phenomenon must be viewed as occupying the same place in space as the conditions of sensation, namely the brain. Sense data theory rests on a fundamental assumption that the principle of causality is the basis for explaining and understanding the world, while it ignores a phenomenological starting point. Consequently, this theory must postulate that the world as we perceive it is an illusion. Løgstrup counters this view by pointing out that sense data theory cannot explain away the peculiarities of sensing – the ubiquity and the lack of distance – upon which Løgstrup builds his phenomenological approach. Furthermore, Løgstrup does not think sense data theory is about sensation at all, but rather about the physiological conditions for sense perception, meaning that sense physiology has arisen exactly because the actual phenomenon of sensation has been eliminated from investigations.

If one takes the principle of causality as a starting point, sensation must be presumed to be heavily processed in relation to reality once nerve paths, neurons, light etc. have been involved in the causal chain of events. In other words, through the principle of causality, we are led to conclude that Kant's well-defined differentiation between 'Ding-an-sich' and 'Ding-für-sich' is inevitable. The advocates of the principle of causality have to postulate that the world we experience is an illusion, but this does not explain away the phenomenon of sensation. Physiology itself proves that it cannot explain sensation, since there is no epi-phenomenon in the brain that corresponds to this illusion. Løgstrup therefore concludes that a theory that takes as its starting point the principle of causality and thus postulates that sensation can be localised as a phenomenon in the brain contradicts not only a phenomenological perspective on sensation but also physiology itself (Løgstrup 1995, p.25).

Let me briefly comment on the argumentation on sensation presented to us by Løgstrup. In an upcoming article, Mogens Pahuus argues that Løgstrup's fundamental assertions about sensation seem to be in need of reconsideration, even though Pahuus agrees with the general aspects of Løgstrup's philosophy of nature (Pahuus 2004). He points out that Løgstrup makes the mistake of thinking that because sensation is without distance, it is also without space. Thereby Løgstrup overlooks the fact that it is quite possible to have the experience of space without the experience of distance. Pahuus corroborates the view that we do actually have two fundamentally different approaches to the world, essentially like the ones Løgstrup advocates. One approach that is about us being active and purposeful in our relation to nature – the causal approach driven by understanding – and one that is about us being involved, self-forgetting and open to nature – the phenomenological approach driven by sensation. But Pahuus sees no reason to portray sensation as distanceless and ubiquitous in itself. This step, in his opinion, implies a metaphysical-religious interpretation in which Løgstrup leaves no boundary between human and nature in sensation. Pahuus argues that our one-place-present-body is a condition that cannot be overcome through sensation as Løgstrup indirectly implies, and I support Pahuus in this reasoning.

One might now raise the objection that Løgstrup's interpretation is about the ideal state of pure sensation that we will never experience because understanding is always part of the balance through which we perceive life. Pahuus' critique matters, however, in the sense that it makes the distinction between whether we are forced to interpret our sensation as having a transcendent giver, or whether it can be described as merely a condition of life. What we see in Pahuus' modification of Løgstrup's ideas on sensation is therefore a downplaying of the religious interpretation that Løgstrup undoubtedly tries to argue, even though he never explicitly states that a transcendent creator is the source of our sensation. I will return to these issues at the end of this section. The remainder of Løgstrup's argumentation about our existence on the edge of nature does not stand any less favourably because of this perspective on his conception of sensation. This argumentation is basically founded upon the complementary relation between the causal and the phenomenological approach to the world that Pahuus with his critique corroborates even further.

7.3.2 Existence on the Edge

Løgstrup sets up the concepts of sensation and understanding as a complementary concept pair. Neither sensation nor understanding can be avoided in our meeting with the world, but epistemologically, we can choose to give weight to one or the other in our self-knowledge concerning our relationship with nature. In this way, an emphasis on sensation in our self-knowledge comes to represent the view that nature is the source of man, while an emphasis on understanding represents the surrounding metaphor. According to Løgstrup, the surrounding metaphor is predominant in our culture because understanding has priority over sensation.

What, then, has made the abovementioned delusion about the receptive sensing possible? According to Løgstrup, it is the basically distance-creating language, which is the medium of understanding. But language will never be able to rob sensation of its leading position in our relationship with nature and the universe. Løgstrup sees the modern, unreserved belief in the power of language as an example of what he calls the illusions of modernity:

> *It is an illusion that language should be capable of drawing us out of our being part of the universe and up to an existence at the edge of it. It is one thing to bring us at a distance from the understood, another to dissociate us from the universe, and language cannot do the latter. The edge existence is the formidable illusion of modernity. The reduction of the universe to merely being the surrounding for our existence at the edge of it – and the conception of sensation as receptivity promote each other and make our thinking irrealistic.* (Løgstrup 1995, p.17)[32]

The distance-creating quality of language thus interacts with the understanding of sense perception as receptive and they reinforce each other. Given that understanding and language have dominated within modernity and the distancelessness of sensation has not been recognised, Løgstrup tries to show that language is far more integrated in sensation and in our being part of nature than we have been willing to acknowledge.

Løgstrup is aware of the ethically laden danger of what he calls our ‘irrealistic thinking’, when understanding dominates sensation. I shall return to this term further on but first take a closer look at the role Løgstrup attributes science.

7.3.3 The Role of Natural Science

The question now is what, more precisely, is the role of natural science in relation to the alleged existence on the edge of the universe. Two conceptions have been presented as the illusions of modernity; firstly the idea that understanding and hence language should be capable of detaching man from his source in nature, and secondly the notion that sense perception is receptive. With regard to the latter, natural science plays an important role. In Løgstrup's opinion, natural science – like all sciences – comes about through a reduction; only the reduction that initiates natural science is special.

Our immediate understanding of the world through everyday language is what Løgstrup calls an unsystematic multiplicity (Løgstrup 1995, p.237). In order to do science, some kind of reduction and abstraction must be made, so as to reduce the complexity of the phenomena under investigation. Thus, the linguist can abstract from e.g. the sounds of language, the way in which it enables us to address others and its meaning content. All these are abstracted away from, as the linguist focuses on the reduced phenomenon that has to do with the formal structure of language. In a similar way, different layers are abstracted away from when a social science or a humanistic science is established.

When it comes to that which Løgstrup calls the exact sciences, the reduction is, however, of another kind. In this case we are not talking about an abstraction from certain relations to a complex phenomenon as we come upon it in our everyday existence, but rather of an elimination of our everyday approach to the phenomenon. From the previous, it is clear that what Løgstrup considers to be eliminated in the scientific approach to the phenomenon is sensation. While the social sciences and humanities always approach the world phenomenologically to some extent (no matter how inspired by natural science they may be), natural science approaches the world from a causal point of view. Reduction, therefore, is not merely an abstraction, but an elimination of the world as it immediately appears to us. Løgstrup's objection in this matter is not to natural science in itself, which must of course be methodical and examine the conditions that are out of sight in our everyday existence. Rather, his dispute is with the interpretation of the method of natural science (and thereby also of its results) that our culture has at the moment. This interpretation ignores a philosophical problem that the method of science poses on philosophy and on our cultural understanding of science. In the following, I will use the disagreement between Løgstrup and Carnap over the interpretation of the scientific method and approach to the world in order to illuminate the philosophical problem that Løgstrup feels our culture has forgotten.

The philosophy of science developed by Rudolf Carnap, one of the leading members of logical positivism, is in contrast to Løgstrup's. With Carnap, Løgstrup finds one of the clearest formulations of what separates the science of earlier times from modern science.

> *With two replacements, science becomes modern. Everyday language is replaced by the number. The world that can be sensed is replaced by the world that can be measured. It is the first replacement that matters, as is shown by Carnap's account. The replacement of sensibility by measurability follows from the substitution of everyday language for the number.* (Løgstrup 1995, p.177)[33]

In Løgstrup's view, this separation of sensibility and measurability and the replacement of one by the other is a problem that science poses on philosophy. However, Carnap's philosophy of science does not address this problem because, according to Løgstrup, Carnap ignores sensibility as an independent phenomenon. Carnap's point in eliminating sensibility is what he sees as the very strength of science. Through quantitative calculations, we obtain a more precise description of, say, colour when we can express the wavelength of light than expressions in everyday language can offer.

Løgstrup agrees that this is the strength of science, but maintains that we are missing the central philosophical question posed by science if we choose to ignore sensibility. This problem has to do with qualitative differences between the reality that can be sensed and the measurable one. The philosophical question, thus, is this: How can the hidden quantitative facts that science unveils beget the qualitative phenomena of sensation?

To Carnap, the difference between what can be sensed and what can be measured is nothing more than a difference in our language between qualitative and quantitative utterances. We may talk about the house being red, or describe the colour of the house in quantitative terms, replacing everyday language with a language of mathematical symbols that stand for quantitative values. To Løgstrup, on the other hand, the difference between the two forms of description is not only a difference in our language, but also a difference in nature (Løgstrup 1995, p.119). There is a difference between the phenomena that are hidden from our senses and that science uncovers and the phenomena we sense.

Løgstrup illustrates this difference using the musical score – an example that Carnap himself uses to describe how the results of science work to explain that which can be sensed. They agree that science does not, like the black-and-white photograph, leave out parts of sensation in its inquiries. But Løgstrup thinks that the scientific description builds on a total exclusion of sensation – as is the case with the relation of the score to the music (Løgstrup 1995, p.120). To Carnap, this is not a problem, since to his mind, one can translate back and forth between the quantitative and the qualitative description, but Løgstrup argues that the precision of the quantitative description is attainable only through the elimination of the sensibility. As with the musical score, which occupies one medium – the visible – while the music belongs to another – the auditive – so there is a qualitative difference between the worlds of phenomena uncovered by natural science and the one we can access through sensation. The two types of phenomenon have nothing whatsoever in common, by contrast to what is normally the case where one conditions the other, as Carnap would maintain. The question of how the quantitative phenomena can beget the phenomena of sensation is therefore unanswered within Carnap's philosophy. To Løgstrup, the gap between the two types of phenomena is insurmountable and cannot simply be ascribed to differences in language. Whether one takes Carnap's stand that claims the unity of these phenomena, or realises the difference between them is, to Løgstrup's mind, a question of whether sensation matters – whether or not we totally eliminate sensation in our description of the world or not.

7.3.4 Irrealistic Thought

We have seen earlier how Løgstrup refers to the thinking of modernity as irrealistic. In explaining this term, he points to the way that our culture sharply differentiates between the empirical and the metaphysical. The difference between these two is, in turn, a difference between what we can control and what is outside our control. The more empirically we proceed in science, the more control we believe to have over a domain, and the more certain we are that our results are correct. But even though we, in our culture, proceed more scientifically and empirically and have more correct results than any earlier culture, Løgstrup maintains that in no other culture has man ever lived as irrealistically as in ours.

> *But the strength of empirical science is also its peril. With the exclusion of viewpoints, important and significant insight is lost. For that reason, it is not ensured against its thinking becoming irrealistic. There is nothing to prevent scientific results from undermining our existence and all life on our globe. The undermining and the irrealism do not weaken the correctness of the results. Quite on the contrary, if irrealistic thinking leads to catastrophes, they only go to prove the correctness of the results. Realistic is not the same as correct. Irrealistic is not the same as incorrect.* (Løgstrup 1995, p.171)[34]

It is clear that our differentiation between correct/incorrect does not correspond with the concept pair realistic/irrealistic. In what Løgstrup calls a technological era, it is therefore not enough that we found our view of life on the scientifically correct results. We must not only think correctly about our surrounding world, but also realistically, and for this purpose, the causal perspective is insufficient.

Using the term irrealism, then, is Løgstrup's way of expressing that we live and think inconsistently with the actual state of things, and for modernity, that is to say at the edge of nature and the universe. Irrealistic thinking means that one forgets that a reduction of phenomena has taken place in order to facilitate a scientific investigation. The strength of science is its ability to exclude sensation, but it also holds the threat of forgetting this exclusion, and thereby becoming irrealistic.

Why is it important to oppose irrealistic thinking and instead to foster a realistic one? Or put differently: if the scientific results are correct what else can we expect of them? According to Løgstrup, it is important because it makes a difference whether we think irrealistically or not, since the way in which we think about our relationship with the universe and nature determines what kind of a culture we are going to have. As Løgstrup puts it: "At the edge of the universe, we will be at odds with nature", and the consequence of this is overexploitation of, indifference to and pollution of nature

(Løgstrup 1995, p.17). Thereby he argues that our epistemological delusions bring with them an inexpedient way of life and culture.

Since, according to Løgstrup, we think irrealistically because we underestimate the significance of sensation, it is interesting to see what has taken its place in the technological era. His explanation rests on the fundamental difference between humans and animals. Humans differ from animals in that their understanding leaves room to make sensation independent of their needs. Løgstrup also calls this phenomenon instinct reduction (Løgstrup 1995, p.47). Both when it comes to sensation and needs, we are dependent on nature, but in completely different ways. In connection with our needs, we are aggressive in our attempts to overcome the distance to whatever can fulfil them, while we are passive and never at a distance in our sensation. Another formulation of this difference could be that we take no initiative in sensation, but we are active in the fulfilment of our needs (Løgstrup 1995, p.48). With the instinct reduction, humans, in contrast to animals, have a space for understanding; a space in which they can develop a culture and a history.

> *The phenomenon that correlates with sensation, and with which man becomes a cultural being and gains history, is understanding. Thus, culture and history is something we get from phenomena that are special to us, temperance and understanding – and that correlate with needs and sensation, which we share with the animals. Culture and history come into being in the tension between conquest and temperance. And we gain culture and history from the interplay between the distanceless sensation and the distanceful understanding.* (Løgstrup 1995, p.48)[35]

The tension between conquest and temperance that Løgstrup believes to be the origin of culture and history is thus very much about needs. They must be satisfied, but also kept in check, and they constitute an undeniable risk to our existence. This is not true of sensation, since it does not threaten our lives in any way, but rather constitutes an aesthetic dimension that has been opened to humans through understanding and which may contribute to strengthening temperance in the fulfilment of needs.

It is Løgstrup's theory that in the modern, Western culture, we have not only let understanding dominate sensation, but we have also allowed needs to be primary to sensation. Using our intelligence, we have invented tools that have, to begin with, made the fulfilment of needs easier; but in time, the intelligent display of force that these technical inventions express has become independent. It is no longer the needs that initiate the invention of tools, but the exact opposite. Our technical power concocts new needs, which must then be fulfilled. This technical power is, according to Løgstrup, a threat to our lives and to nature in particular, if we exercise it without temperance.

Do then, according to Løgstrup, the same demands for temperance apply whether it comes to the relationship between man and nature or that between people? Løgstrup answers no to this question. One can, under certain circumstances, treat nature as a means to achieve some common good, but if one regards the existence and not just the work of a person as such means, one is denying that person any humanity. There is, in other words, a boundary in the relation between people that it would be shameless to overstep (Løgstrup 1995, p.54). There is also a boundary in our relationship with nature that must not be overstepped. In Løgstrup's opinion, two kinds of behaviour towards nature are shameless: to destroy nature without purpose or to treat it as if it does not matter whether or not it exists.

With these contemplations, Løgstrup attacks not only the way of thinking that allows man to view nature as an unimportant object to serve his purpose, but also the stance taken by people who are concerned with the environment and want to preserve it, but wishes to do so for the sake of man and not for nature itself. This position Løgstrup calls a-cosmic humanism, and it springs from the condition that prevails in Western culture, namely the prioritisation of needs over sensation.

> *Humanism means that at the end of the day, everything is up to man, where the visually aesthetic is concerned, to art. But the art forms are grounded in the fact that with sensation, everything is up to the universe, before it is up to the art forms. In the ubiquitous sensation, the universe is unreduced and unmodified, uncommunicated and aesthetically present. From this insight, an a-cosmic humanism excludes itself.* (Løgstrup 1995, p.57)[36]

What was earlier referred to as the illusions of modernity with regard to sensation is here linked to the a-cosmic humanism. The way in which we fail to appreciate sensation in our self knowledge influences our relationship with and treatment of nature and means that we end up in an illusion of man's cultural production as setting the limit for what exists and for what is worth preserving for its own sake.

The humanistic idea rests upon our conception of the self-reliant consciousness for which the great modern thinkers, most importantly Descartes and Kant, have argued. The self-reliant consciousness means that we think about the world as our surrounding environment rather than as our source, thereby seeing our understanding and needs as central to thinking at the expense of the whole – nature or universe. The instinct reduction in Western culture is therefore accompanied by a sort of reservation towards nature, whose usefulness is evaluated from a point of view that has nature to be merely surrounding, and does not concede it any independent value as our original source.

The question is what can be done to turn around this development in our cultural tradition that perceives of nature as surrounding world. One must make sure that the people that yield our technological power are given a sufficiently strong cultural tradition so that they can include in the technological development the abovementioned relation to nature. According to Løgstrup, intelligent technological power display must necessarily be made in close connection with a cultural tradition that acknowledges nature as our source and origin.

> *The perception that what distinguishes man is to make tools and, in time, technology corresponds to a need-psychological perception of human existence. Two shrinkings go hand in hand, the shrinking of the cultural heritage to technical advancement and the shrinking of the view of human existence to need psychology. But nothing threatens our life like the need-psychological shrinking of it. Because if we regard cultural reproduction as nothing more than a prolongation of biological reproduction, we shall not see anything in the cultural reproduction but a development in technology. And the danger of technology, this much we have realised, is that it feeds our needs to death by overfeeding them. This can only be avoided if there is a cultural handing over among the technicians that is strong enough to withstand the tendency to let intelligence alone serve to satisfy our needs. Nothing less will do, due to the extent of instinct reduction. But there are also technicians that, in their technical research, do away with habitual thinking, but they face an opposition that is tough because it is backed by the institutions.* (Løgstrup 1995, p.58) [37]

In this quote, we get a good feel of the abilities that Løgstrup would like a technician to possess if we are to break away from the illusions of modernity. Technicians, including scientists, must have a cultural tradition that is sufficiently strong that they do not let technology alone contribute to the satisfaction of needs. Or, put differently:

a cultural tradition is needed that will enable the scientist to think not just correctly, but also realistically.

7.3.5 The Defence of Metaphysics

We have seen Løgstrup argue against what he sees as delusions about our sensation. The problem of sensation leads the thought in two different directions, Løgstrup says – either towards a theory postulating that sensation is to be found in the brain, which is untenable, or towards what is in his opinion a religious, speculative answer. In Løgstrup's own words, we are thus forced to choose the religious, speculative answer in order to be able to explain the phenomenon of sensation. This alternative seems to me, however, more open than Løgstrup is willing to admit. He gives a similar religious interpretation when it comes to his famed ethical demand that is given through that which he calls manifestations of life (Løgstrup 1991). Similarly, he asserts that sensation is something given, something against which we are powerless, and which is a fundamental condition of our existence; hence there is a clear parallel between Løgstrup's religious interpretations of his own phenomenological investigations regarding these topics.

However, there seems to be nothing to stop us from cutting short the conclusions of the analysis at the word 'given'. That something is given as a condition of our existence in our relation to each other and in our relation to nature, does not mean that we must conclude that there is a giver. In other words, I do not think that it is necessary to believe in a creator in any religious sense in order to agree with Løgstrup's general arguments; rather it is, within Løgstrup's phenomenological perspective, a possibility to consider a deity the founder of the unalterable conditions to which our lives are subjected.

What Løgstrup's arguments do rule out is a strictly postmodern position on the power that man possesses over his world of experiences. Humans must be balanced in between defining themselves through understanding and being aware of the source of their lives that reaches beyond their control. I agree with him that this is a fundamental condition of the relationship between understanding and sensation, and it is therefore a delusion to think that the ethical relations between humans or between nature and humans are determined completely by our own cultural constructions. Cultural plurality, within this picture, applies to the understanding of phenomena, and less to sensation.

Løgstrup's philosophy is thus a criticism of the philosophy that takes epistemology to be the basic discipline – a notion that again finds its historical advocates in especially Descartes and Kant – and this is exactly characteristic of the modern project; to find the certain knowledge that man can obtain without getting into any metaphysical speculation. Løgstrup tries to show that this project rests on delusions, for one thing when it comes to the existence on the edge of the universe. It is not possible to do without metaphysics or ontological considerations in our systematic thinking about the world, unless one takes as one's starting point the untenable position that everything can be explained in a causal perspective.

8. Theme II: Understandings of Representation – the Belief in Formalisation

In Theme I, certain ontological preconditions of the irrelevance position were brought forward. It was argued that the ontology of modern or what Stengers and Prigogine referred to as classical science has met its limits and other ontologies are emerging both from within science and in philosophy. In connection to these ontological issues a number of epistemological issues were also touched upon especially through Løgstrup's phenomenology. From Løgstrup we get the understanding that we have an epistemological choice whether to meet the world from the perspective of a causal system or from a phenomenological perspective. It is additionally his conviction that modernity can be characterised as putting too much emphasise on the perspective that treat the world as a causal system. In this second theme focus will be directed towards other epistemological features of modernity's conception of science. I shall try to investigate how the representation of the world applied by science has been conceived of in modernity and this leads the investigations towards the understanding of language in modernity.

At centre of this investigation is the possibility of creating an artificial scientific language that will absolutely rid scientific research from the imprecise use of natural languages. This possibility has been an articulated goal to obtain in the works of several prominent thinkers in the theory of science of the 20th century. I shall examine in closer detail what these theoreticians express as the key features of an artificial scientific language. I will subsequently try to show how the modern conception of science that leads to the search for this special language rests upon an understanding of language that has certain limitations. I will corroborate this thesis by presenting a position in the philosophy of language, which suggests that, the idea of and search for an ideal scientific language rests on a philosophical misconception. The philosophies of language that I present in my argument both stem from the work of Ludwig Wittgenstein (1889-1951) and I shall refer to his separated contributions as the former and the later Wittgenstein respectively.

As an exemplary case I will discuss the development and research in the field of artificial intelligence (AI) to reflect upon the findings in the philosophy of language. Special attention will be given to the research field referred to as machine translation. My main argument in Theme II is, hence, of a language philosophical nature and supports the idea that natural language use is a condition for the scientific enterprise which cannot be transcended.

Let me end this introduction by briefly presenting what I see as the fundamental ideas of the conception of seclusion with respect to the issue of representation. I base the conception of the seclusion of science on the assumption that a perfect representation through language of the facts of the world is possible. This representation cannot be developed only on the basis of natural language, as it is ambiguous and imprecise. Therefore an artificial language is needed which is ridden of the flaws of natural languages. Representation through this *formalised* language has several positive features. First of all it will be possible to represent any empirical fact of the world through it, and secondly, it will be possible to represent these empirical facts in a way that makes the representation consistent – that is without any logical flaws. If these claims about the perfect scientific language are principally true it would mean that the accumulation of empirical facts through scientific research could ideally be set together as pieces in a puzzle giving us a more and more detailed description of the world. In other words, the conception of seclusion claims that it is possible to create a *formal representation* of the world, which is unambiguous, logically consistent and able to depict the world. In this way the conception of seclusion supports the idea of a unified scientific approach across not just the disciplines of science but also across the facular borders. Scientific research that does not comply to the formal representation will lack the objectivity guaranteed by this language in their descriptions of the world.

In order to counter this conception, I start out by connecting the outlined idea of a formalised representation with the conception that the ideal scientific form of rationality resembles a calculus.

8.1 Leibniz’s Project

The axiomatic system of Euclid is a milestone in the history of science. It was discussed in different ways in Chapter 7. In modernity another influential idea saw the light of day, namely the idea of the calculus. Whereas the axiomatic system has its origin in the mathematical discipline of geometry calculus has its origin in algebra. von Wright who has made several contributions in the field of logic emphasises the importance of the emerging conception of a calculus in the 17th century. He finds that a reasonable definition of a calculus can be expressed as follows even though he stresses that the concept is used in numerable ways.

> *By “calculus”, one may first and foremost mean an* activity *that consists in the collocation of signs to make up expressions in accordance with the form rules and the derivation of new expressions in accordance with the transformation rules.* (von Wright 1971, p.42)[38]

Form rules tell us how to combine signs – in algebra e.g. numbers and operators – and transformation rules tell us how to get from one expression to another – in algebra e.g. the expression “2+1” is transformed into the expression “3” according to the transformation rule of addition. By definition, the transformation rules guarantee the identity between expressions. Transformations from one expression to another can be achieved quite mechanically, and this is the core idea of the calculator and later the computers processing unit.

An important person in the prolongation of the idea of the calculus is Leibniz (1646-1716). First of all, he was the inventor of the calculator as well as a pioneer in the mathematical disciplines, differential- and integration calculus; but he also connected the idea of the calculus to the scientific approach in general. Leibniz had a lifelong interest in and pursuit of the idea that the principles of reasoning could be reduced to a formal symbolic system, an algebra or calculus of thought, in which controversy would be settled by calculations. This ideal scientific language he termed ‘characteristica universalis’, and herein lay a special art, ‘ars inveniendi’ – the art of discovery. To master this language, would enable one to look into the future (Kirkeby & Tambo 1992, p.22).

In this language there would have to be as many different elements in the expression as there are elements in the event the expression denotes. The rules that govern the relations between propositions in the ideal scientific language he called ‘calculus ratiocinator’ and interpreted them to be the rules of logic (von Wright 1971, p.44). In other words, Leibniz forcefully connects the idea of the calculus with language in his effort to construct the ideal scientific language that would settle all controversy in the approach to obtain knowledge. Even though Leibniz’ thoughts on these matters are sporadic, he none the less set up the framework for what would be a dominant research agenda in the 20th century.

8.1.1 Logical Structures beneath the Surface

With their contributions to the foundation of logic, Gottlob Frege and Bertrand Russell inspired leading characters in logical positivism to pursue the creation of a formal scientific language that would continue Leibniz’ project. All ambiguities of language should be laid aside once and for all, and it would then be possible to precisely communicate the empirical facts of scientific research through formal representation. Frege’s main contribution was presented in *Begriffsschrift – Eine der Sprache der Arithmetik nachgebildete formalisierte Sprache des reinen Denkens* (1879). Russell also found that the future of science was closely related to the project of developing a formal scientific language. In his introduction to Wittgenstein’s *Tractatus* (1922), Russell justifies and explains the quest for such an ideal language.

> *A logically perfect language has rules of syntax which prevent nonsense, and has single symbols which always have a definite and unique meaning. Mr. Wittgenstein is concerned with the conditions for a logically perfect language – not that any language is logically perfect, or that we believe ourselves capable, here and now, of constructing a logically perfect language, but that the whole function of language is to have meaning, and it only fulfils this function in proportion as it approaches to the ideal language which we postulate.* (Russell 1922, p.8)

A key inspiration for Russell’s reasoning is the problem that our normal assertions are imprecise, because they do not rest on such a perfect language. It is of importance that Russell argues that language only has meaning as it approaches the ideal language. Only the uniquely determined description of reality is seen as the source of a meaningful language. Additionally, we must pay notice to the notion of ‘logically perfect' used above, which is a defining component of the concept I have termed a 'formal representation'. Russell's fundamental idea here can be expressed as the search for a formal language that rests on the unchallengeable foundation of logic. Only to the degree that such a language is developed can we think of ourselves as talking meaningfully about what goes on in the world. This ultimately means that the quality of the scientific knowledge we produce depends on the degree of formalisation through which we present this knowledge. I would say that the belief in formalisation, as it has been outlined, has since had an enormous impact on university research – even outside science.

In the following, we shall look into the language theory of the early Mr. Wittgenstein in order to understand how it fits into Russell's agenda. Some important preliminary insight is, however, essential in understanding the principal work of the early Wittgenstein. It comes from Russell himself and is related to the interplay between language and logic.

Since the days of Aristotle, logic and natural language have been closely connected spheres. Logical reasoning, which uses the connectives 'and', 'or' etc. from natural language, has been understood as directly expressed in the grammar of natural language. Aristotle's syllogisms are developed on the basis of this assumption. This, however, is something that Russell questions very seriously. In what he believed to be his most important contribution to philosophy, *On Denoting* (1905), he discusses denoting phrases in prepositional logic. The sentence "The president of Denmark is bald" can help to illustrate how the grammar of a sentence and the logical structure of the same sentence are two separate things in natural languages. The denoting phrase in this sentence is "The president of Denmark". But Denmark has no president and the sentence therefore seems meaningless. If it is meaningless, how is it, then, that we understand what the sentence asserts? Russell suggests that the sentence is not without meaning but is to be considered false. If it is considered false a problem arises with respect to the sentence "The president of Denmark is not bald". This sentence would also have to be considered false, even though it seems to be the logical negation of the first sentence. Here Russell's contribution comes in play. The logical content of both sentences are not about the denoting phrase (The president of Denmark) at all. The logical structure of the sentence is to be considered a *calculus* in which we must insert the existing things of the world in the place of the variables to determine whether it is true or false. It has the form "There exists a thing that has the attribute of being president of Denmark and the attribute of being bald". The grammatical structure of the sentence had the form "A is b" whereas its logical structure in Russell's interpretation is "There exists x : (xa & xb)".

This means that the logical content of a sentence is not directly expressed through the grammar of the sentence but is hidden beneath the surface, so to speak. In this way, we come to the core of the idea of logical analysis. A logical analysis is, within this interpretation, focused on the effort to discern the logical structure beneath the grammatical structure of language. A scientific description of the world cannot rely on the deceitful grammatical structure of natural language but must be represented in a language where the logical structure is in some sense the same as the grammatical. This insight of Russell's is a huge source of influence to the arguments that Wittgenstein presented in his *Tractatus*.

8.1.2 Wittgenstein's Picture Theory

The early Wittgenstein is out to eliminate vagueness in our descriptions of the world. In *Tractatus*, he presents the conception of language known as the "Picture Theory". Wittgenstein's project is to clarify the relationship between language and world necessary for us to have a functioning language. According to *Tractatus*, language is made up of propositions which, in order to be cognitively meaningful, must be able to depict facts.

> *We make to ourselves pictures of facts.*
> *The picture is a model of reality.* (Wittgenstein 1922, p.39 [2.1, 2.1.2])

Language consists of propositions, which are pictures of facts, and they are used to model reality. Understanding a proposition is equivalent to knowing the fact that must be present in order for the proposition to be true. This means that a proposition gains its meaning from its ability to depict a fact. What are, then, the conditions that enable the proposition to depict the fact? The fact can be depicted uniquely by a proposition, only if there exists a one-to-one correspondence between the elements of the proposition and the elements of the fact, and, additionally, language and reality must share a likeness in structure or 'form of representation', as Wittgenstein puts it (Wittgenstein 1922, p.41 [2.1.7]). Mathematics and logic are part of this shared structure. They show us the structure shared by reality and language. Wittgenstein, however, departs from Russell and Whitehead's attempt to reduce mathematics to logic in the philosophy of mathematics called logicism.

> *The logic of the world which the propositions of logic show in tautologies, mathematics shows in equations.* (Wittgenstein 1922, p.169 [6.22])

Even though Wittgenstein calls mathematics 'a logical method' (Wittgenstein 1922, p.169 [6.2]), there are indications that mathematics is not interpreted as reducible to logic in the logicist sense. Logic and mathematics are seen as two forms of representation that show us the logic of the world, but mathematics is not necessarily reducible to logic.

According to Wittgenstein, the world is not the totality of things, but of 'facts' (Wittgenstein 1922, p.31 [1.1]). 'Facts' consist of what he calls 'atomic facts'. It is not possible to directly define the concept of an 'atomic fact', but to explain the concept, we can follow Russell's outline of the concept by examining the sentence "Socrates was an Athenian" as such. Here 'Socrates' and 'Athenian' are the constituent 'objects' of the atomic fact (Russell 1922, p.12). In Wittgenstein's analysis, atomic facts are relations between objects (Gegenstände), and our most elementary propositions consist of relations between names. Propositions that assert atomic facts are called 'elementary propositions' (Wittgenstein 1922, p.89 [4.2.1]). It is from this elementary level of depicting atomic facts that language gains its meaning.

The conditions for a functioning language as stated above mean, therefore, that we must be able to attach a name from the elementary proposition to each of the objects in the atomic fact, and that the elementary proposition must have the same logical structure as the atomic fact.

Wittgenstein argues that propositions can be constructed from the basis of elementary propositions. In this manner, the totality of propositions is defined, and if all atomic facts are known, we can infer all possible true propositions about the world (Russell

1922, p.12). *Tractatus* therefore presents us with a compositional account of the meaning of a sentence. Only empirical observations can determine which propositions are true and which are false. Philosophical speculations can give us no clue about which propositions are true. They are considered meaningless, as they are in conflict with the conditions for true propositions, because they do not rest on the foundation which gives our words meaning (Adolphsen & Nørreklit, 1994, p.13). But how about the propositions asserted by *Tractatus*? Are they not also to be regarded as conflicting with their own conclusions about what are the meaningful propositions in language? Wittgenstein actually claims that, strictly speaking, they are nonsense and should be seen as a means to avoid misconceptions of language. He compares the reading of *Tractatus* with climbing up a ladder which is thrown away afterwards (Wittgenstein 1922, p.189 [6.5.4]). Anyone who reads *Tractatus* will ultimately understand its lack of meaning!

Wittgenstein's ideas in *Tractatus* can only be described as being highly important to the development of computer technology in the 20th century. His conception of language gave support to the perception that our meaningful thinking can be structured in a compositional language and in the coming section, we shall look into this influence.

8.1.3 Developments in AI

I shall now try to sketch some developments in the history of AI research. My focus within this field of research will mainly be on the efforts made to make an intelligent translation machine that would be able to translate any given text from one language to another. This field of research is considered a part of the Natural Language Processing-wing of AI-research, and I shall refer to it as machine translation in what follows. I will start out by presenting some of the basic discussions in AI and narrow down my field of interest to the topic of machine translation as I go along. My starting point will be the interest attributed by AI enthusiasts to the theory of language presented by Wittgenstein in *Tractatus*.

Ray Kurzweil (b. 1948) is one of the most enigmatic figures in AI today. He has contributed to the field with significant research, e.g. inventions in the field of speech recognition and reading machines. In addition to this, he has written several books concerning artificial intelligence, and among these is *The Age of Spiritual Machines – When Computers Exceed Human Intelligence* (1999), which describes how AI will eventually surpass human intelligence. His ideas and impressive skills have enabled him to turn his interest in AI in a commercial direction, starting several successful companies in the AI-industry, and he tries to push the development of AI ahead through debates and information on the web-portal www.kurzweilai.net. On this site it is suggested that "Artificial Intelligence" is replaced by the concept of "Accelerating Intelligence" and the site covers news on a range of sciences connected in one way or another to the research field of AI. All in all, this site is the Holy Grail if one considers "Accelerating Intelligence" to be the unavoidable future on this planet.

Kurzweil describes, among other sources, the principal work of the early Wittgenstein as the intellectual roots of the study of and belief in AI. As Kurzweil sees it, Wittgenstein's *Tractatus* presents two points of vital importance.

> *Wittgenstein makes two major points that have a direct bearing on the intellectual roots of artificial intelligence. He makes a direct link between human thought and a formal process that can be described only as computation. To reorder Wittgenstein's statements, we cannot think what we cannot say; we cannot say, or at least we ought not say, what is meaningless in the language we are speaking; statements in any language are indeed meaningless unless they can be derived from a formal (and therefore computation like) sequence of transformations on a data base of elementary propositions. […]*
>
> *The other point made in the* Tractatus *that would have significance later to computational theorists is that thought is embedded in language.*[…] *It is also interesting to note that language as conceived in the* Tractatus *has more of the quality of the programming language LISP or even PROLOG than it does of Wittgenstein's native German.* (Web kurzweil)

In brief, the basic ideas incorporated into AI-research are these, that language has a compositional structure and that human thought is embedded and limited by language. Kurzweil makes the remark that *Tractatus* itself, with its compositional structure, would be seen as an excellent programming style even today. The concept of meaning is also central to Kurzweil's understanding of Wittgenstein's importance. Only formal transformations on the basis of elementary propositions can give meaning to language. This reminds us of the Russell quotation presented earlier, and shows that the idea of language being reducible to a calculus is widespread in AI-research.

The general idea that supports Kurzweil's claims that artificial intelligence will go beyond human intelligence is the link between the conception of language we have seen and the approach in developing AI. It links a compositional understanding of language relying on the ability of formal languages to depict the world, with a special interpretation of intelligence, which asserts that human intelligence is totally embedded in a language that can be broken down into a logical hierarchy of propositions. Because computer power will eventually overcome the calculation capabilities of human brain processing, artificial intelligence will eventually become superior in all respects to human intelligence.

We should notice the connection between this research approach and those discussed in Theme I. The approach to AI described here relies on an enormous amount of reducibility in the systematic structure of language. Also, it ties together this belief in reducibility with the belief in the formalisation of representing phenomena in the world – in this case the phenomena of language and intelligence. The critiques in Theme I and II respectively are therefore closely connected and reflect that how we interpret the ontological structure of the world not surprisingly affects the way we seek to represent it.

Having considered the influence stemming from the early Wittgenstein's work on the development of computational approaches to AI, let us now consider the particular discussion of the possibility of AI within the research sub-field of machine translation. In the 1940's, the idea came about that machines could undertake language translation. The idea was that computers were more reliable than humans in performing this task (they make no mistakes) and that they would be able to translate much faster than a human, fallible translator. Efforts were made to make possible the creation of a machine that could translate a general purpose text, that is a text from a novel, a scientific article etc.

Among the theoreticians within the field of AI, Warren Weaver (1898-1978) was one of the most dominant. In what is referred to as the “Weaver Memorandum”, *Translation* (1949) and his famous cooperation with Claude Shannon (1916-2001) in *The mathematical theory of communication* (1949), he proposed several approaches to machine translation. A common trade of these were his conviction that written language is an expression of logical character, making the problem of translation formally solvable. His background in mathematical statistics and its concerns with computing logical proofs seems to have been an inspiration behind his suggestions. Weaver first felt that machine translation could be interpreted as a form of decryption. In a letter to Norbert Wiener March 4, 1947, Weaver wrote about his idea, and many consider this day to be the beginning of machine translation as a field of study.

> *One naturally wonders if the problem of translation could conceivably be treated as a problem in cryptography. When I look at an article in Russian, I say: ‘This is really written in English, but it has been coded in some strange symbols. I will now proceed to decode.’* (Weaver in Hutchins 1997)

This idea was inspired by the decryption that had been a successful technique during the 2nd world war against the Germans. However, Weaver came up with another idea to crack the machine translation problem that became much more influential. He draws the picture of what happens when two people try to talk to each other in different languages. They stand in each their tower and can hardly hear what the other person is saying. The way to make a translation of what is being said is for both of them to go to the bottom of their towers and meet at the base. Down there the language is the same – in other words, there exists a universal language which any language can be translated into, then to be translated into any other language.

> *… it may be true that the way to translate from Chinese to Arabic, or from Russian to Portuguese, is not to attempt the direct route, shouting from tower to tower. Perhaps the way is to descend, from each language, down to the common base of human communication – the real but as yet undiscovered universal language – and – then re-emerge by whatever particular route is convenient.* (Weaver 1955)

The picture that Weaver is drawing holds the idea of a universal language. This thought is still strong within the field of machine translation, and big money is being spent on Interlingua projects that try to find what we might as well refer to as a descendent of Leibniz’ ‘characteristica universalis’.

Weaver's research programme, however, did not progress as expected, even though large sums of money were put into the research field of machine translation. Because of the stagnation in useful machine translations 10 years after the emergence of the field, a US-report under the National Research Council – the infamous ALPAC-report (ALPAC 1966) – significantly stalled the governmental funding for decades to come (Hutchins 2003). Hence, machine translation faced serious problems in the wake of the optimistic ideas that people like Shannon and Weaver proposed in the late 40's. It has been argued that the ALPAC-report was, in different respects, unjust to the prospects of machine translation, but none the less it brought to light the difficulties experienced within the field.

I will leave the debate on AI and the specific research field of machine translation for now and return to it later. Instead attention will be directed towards a breakthrough in the philosophy of language that I find sheds light on the agenda in machine translation and many other areas of AI-research. With the critique presented in Theme I on the reducibility of systems in mind, one might suspect that language is a much more complicated matter than what has been presented hitherto.

8.2 The later Wittgenstein

The later Wittgenstein turned against the logical positivism of the early century and his own earlier writings that have been outlined in Subsection 8.1.2. His fundamental assertion is that his former conception of the nature of language in *Tractatus* is wrong. The meaning of a sentence is not derived from the conditions under which it is true (that is, from its statements' correspondence with facts of reality), but from the conditions under which it is properly used. The meaning of words is determined by the use of the words, not the other way around. To understand why Wittgenstein made these suggestions, we have to consider the underlying arguments of his later thinking. This section is therefore meant to elaborate on the philosophy that Wittgenstein came to hold during his last years. More precisely, this is the period from 1929, when he started to be sceptic about the conception of language in *Tractatus*, and until his death in 1951 (Gefwert 1998, pp.7-8). The arguments applied in this work stem mainly from the principal work *Philosophical Investigations* (1936) and *On Certainty* (1949-51).

Whereas *Tractatus* expressed a formal theory with its system of propositions, *Philosophical Investigations* is deliberately written in an informal style. The aim is no longer to give a formal theory of the way in which we can uniquely express ourselves through language, but rather to emphasise the complexity of ways in which our language functions. Therefore, *Philosophical Investigations* consists of small paragraphs in what seems at first sight to be no strictly determined order. It is formed as a discussion between Wittgenstein and his (imaginary) opponent, who often expresses the line of thought known from *Tractatus*. This style emphasises the later Wittgenstein's thesis that everyday-language is the foundation of meaningful use of language – a point that is quite in contrast to the thought and style in *Tractatus*, which reflected that language was to be understood as a formal compositional system whose terms are in need of strict references.

8.2.1 Refutation of the Picture Theory

The first passages of *Philosophical Investigations* open the discussion on the conception of language. First, the classical interpretation of language is presented through a quotation of Augustine (354-430).

> *When they (my elders) named some object, and accordingly moved towards something, I saw this and I grasped that the thing was called by the sound they uttered when they meant to point it out […] Thus, as I heard words repeatedly used in their proper places in various sentences, I gradually learnt to understand what objects they signified; and after I had trained my mouth to form these signs, I used them to express my own desires.* (Wittgenstein 1997, p.2e [1])

The understanding of language that Augustine presents here is essentially the same as the one earlier asserted by Wittgenstein. Language supposedly works as a medium to depict relations between objects, and words gain their meaning through this reference to objects. Wittgenstein's following remark clearly points out what he finds himself up against.

> *These words, it seems to me, give us a particular picture of the essence of human language. It is this: the individual words in language name objects – sentences*

> *are combinations of such names. – In this picture of language we find the roots of the following idea: Every word has a meaning. This meaning is correlated with the word. It is the object for which the word stands.* (Wittgenstein 1997, p.2e [1])

In questioning this understanding of correlation between words and objects, Wittgenstein sets the agenda for a rejection of theories like the Picture Theory, and the problem with this theory is its false way of explaining how we can use words to express meaning.

It was the project of the Logical Positivist movement to reduce all meaningful propositions to one fundamental type, but Wittgenstein repudiates the feasibility of such a reduction. Instead, he tries to show the variety of different types of sentences.

> *But how many kinds of sentence are there? Say assertion, question, and command? – There are* countless *kinds: countless different kinds of use of what we call "symbols", "words", "sentences".* (Wittgenstein 1997 p.11e [23])

Wittgenstein shows that a picture theory cannot account for the meaning of words in general. In the Picture Theory, names are the building blocks of meaning, in that they refer to objects of reality through elementary propositions, the fundamental type of sentence. Wittgenstein now claims that there are many types of sentences that have meaning, even if they have no compositional structure, as for example interjections such as "Help!" and "Water!". Because there is a broad variety of types of sentences which have a clear meaning to us, meaning cannot be diminished to stem only from the name-object relation (Wittgenstein 1997, p.13e [27]). Wittgenstein's point is that the naming of objects does not determine our use of the words. The naming of an object does not merely enable us to depict facts about the object. Instead, words and sentences gain their meaning from the surroundings in which we make use of them. An example of this is the sentence "Can she walk?". Uttered by someone's uncle, it could mean whether or not his niece has taken her first steps, but asked of a doctor, the meaning could be one of concern for a victim of an accident. Whereas in *Tractatus*, Wittgenstein claims that a sentence has a fixed meaning in the composition of its constituent parts, he now holds that there is no single, fixed meaning of a sentence. The circumstances under which a sentence is uttered – the use made of the sentence – is what fixes its meaning.

According to Wittgenstein, people have traditionally thought of the activity of learning language as it is depicted in the Augustine quotation above: The teacher points at the cup and says to the pupil "This is a cup". But this traditional view of language overlooks the fact that the pupil has no way of knowing whether the teacher refers to the form or the colour of the cup, or if 'cup' refers to the teacher's hand or his finger etc. (Wittgenstein 1997, p.14e-16e [30-32]). In other words, the pupil has to be aware of the kind of 'game' he is playing in order to make sense of these ostensive definitions. This argument shows that a more profound source of meaning is primary to ostentatious definitions of words. In Wittgenstein's terminology, the pupil must already be able to use the 'language-game' needed; a term I shall explain in the following subsection.

8.2.2 Language-Games

To clarify his point of view, Wittgenstein introduces the notion of 'language-games'. The concept 'language-game' is meant to underline the fact that speaking a language is part of an activity or life form (Wittgenstein 1997, p.11e [23]). Language in its totality is also called 'the language-game' from time to time. Examples of language-games are to command and to act accordingly, to describe something, to talk about an event, to make jokes, to solve equations and so on. Language works as a number of tools, with which we can perform a vast variety of different actions. Wittgenstein shows this variety of forms in which we use language meaningfully and maintains that this is in grave contrast to the traditional interpretation of meaning and language of which *Tractatus* is an example.

> *It is interesting to compare the multiplicity of the tools in language and of the ways they are used, the multiplicity of kinds of word and sentence, with what logicians have said about the structure of language. (Including the author of the* Tractatus Logico-Philosophicus.*)* (Wittgenstein 1997, p.12e [23])

To Wittgenstein, the traditional understanding of language is no more than a language-game in itself, and should not be considered authoritative. This is not to say that language does not have important descriptive properties, but these are not the foundation of language. Wittgenstein does not try to give an explanation capturing the "essence" of language as he did earlier in *Tractatus*. On the contrary, he refutes any notion that there exists a common characteristic for the class of activities we call language. The phenomenon we call language consists of a multiplicity of uses and there is no essential common characteristic between these uses (Wittgenstein 1997, p.31e [65]). Instead Wittgenstein proposes that the meaning of words and sentences flow from their use in human practice, i.e. in our language-games, and hence he maintains that the meaning of a word does not have any real existence as a physical, mental or ideal object (Lübcke 1982, p.185). The adequate approach to finding the meaning of a word is an analysis of the use of the word in the appropriate language-games. Therefore the main theme of Wittgenstein's later writings has been expressed as follows: The meaning of a word is its use.

The relation between different language-games is indicated by the term 'games'. The variety of activities we call games have no obligatory common characteristics. Some games include the use of a round ball; others include a board, and so on. The partial similarities that might be between two or more language-games are what Wittgenstein calls 'family resemblances' (Wittgenstein 1997, p.31e-32e [66-67]).

> *I cannot characterise these resemblances better than by the word "family resemblances"; for the various resemblances which are between different members of a family: height, facial features, eye colour, walk, temper, etc. etc., overlap and cross each other in exactly this way. – And I would say: the 'games' make up a family.* (Wittgenstein 1994, p.67 [67])

This concept reflects the lack of essence or a unique common feature in the activities we call games. All there is, is a complicated net of familiarities overlapping each other. We have seen how Wittgenstein has changed his mind about the source from which words get their meaning. But with the concept of family resemblance, he also refutes the idea of commonness among things that we categorise together (e.g. games) and the idea that exact definitions of words are necessary in order for them to have meaning (e.g. of the word 'game').

In Plato's argumentation, we see the opposite point of view; that there must be some ideal object summarising the essence of the particulars we perceive. All the different kinds of birds we know of must be mere copies of the idea 'bird'. This line of thought implies the view that to use a word correctly, one must understand the idea or essence of the word, regardless that one might not be able to define it. Basically, what

Socrates did in ancient Athens was to question that, for example, the mathematician can define the essence of mathematics, and in Plato's dialogues, we see how Socrates successfully proves himself right. With his Theory of Ideas, Plato saw it as his task to explain how we could still have understanding in spite of our inability to define the essence of our words.

On Wittgenstein's account, the quest for definitions of essences is in vain. To understand a word of our language is simply to be able to use the word according to certain 'rules' attached to the language-games in which the word is embedded. The extension of a word has no exact limits. Wittgenstein does not reject that we can to a certain degree specify limits to the extension of a word, but his point is that a word's lack of such limits has never worried us when we have used it in practice (Wittgenstein 1997, p.32e-33e [68]).

To explain this point, Wittgenstein compares the use of a word to a tennis game. How tennis should be played is not regulated down to every detail. For example, there are no specific limitations as to how high into the air one may toss the ball, but that does not stop us playing the game with every confidence that we are doing it right. We might decide on a certain limit for the action mentioned, but such a rule has not yet proved necessary for the game to make sense. Likewise, the meaning of a word is not restricted in every direction, but this does not keep us from using and understanding it.

8.2.3 Rule-following

The foregoing considerations will become clearer when we analyse the important notion of following a rule. Wittgenstein's considerations on rule-following are meant as an elaboration of the meaning-is-use conception of language. With these considerations, the aim is to explain that to use a language is to follow rules. With his remarks on rule-following, Wittgenstein tries to show us that the idea we normally attach to following a rule is basically wrong. This is the idea of there being "bodies of meaning" underlying and determining the use and extension of a word or a rule (Shanker 1987, p.16). Along with this idea goes the thought that when someone has grasped the rule, it must be followed mechanically in a certain way. When we speak of following a rule, we think of some guidance, which we are to follow precisely in order to do things the right way. In other words, a rule is something we can calculate how to apply. Wittgenstein rejects this idea, as he maintains that rules in themselves cannot explain to us how to follow them. No matter whether a rule is presented to us through a formula, a signpost or something else, it is always possible to interpret these signs differently from that which we call the correct way to follow them (Malcolm 1986, p.158). We simply apply them as we do as a consequence of practice. With extensive practice through exemplars in the use of equations, we finally become very certain of how to manipulate them as we do. What logically compels us to follow the rule 'add 2' in the way we do is that this following the common rule is the criteria for understanding the rule. It is we who, through our practice, determine what is to count as the correct way to follow the rule.

A most important aspect of Wittgenstein's comments on rule-following is the inability for a single individual to 'fix the meaning of a rule' (Malcolm 1986, p.156). For there to be a difference between following a rule and believing one is following the rule, there has to be some external criteria by which this difference can be established. If a single individual were to try and fix the meaning of a rule, what he believed to be the correct application of the rule would never be challenged, and nothing he could possibly do would ever count as a wrong application of the rule. There would be no difference between believing one followed the rule and actually following the rule. This ultimately leads to the rule loosing its meaning, as there are no criteria for what are the wrong and the right applications (Malcolm 1986, p.156). Therefore the activity of rule-following requires a community in relation to which it can be determined whether the rule in question is followed according to normal practice. Practice is seen as the necessary background to establish meaning and rules, where a practice is understood as a community of rule-followers who have had the same kind of training and therefore agree on the implications of certain rules.

According to Wittgenstein, we can be absolutely certain of how to use a rule, but still not be able to give ultimate reasons for following the rules as we do (Wittgenstein 1979, p.39e [307]). This is the point in the following passage.

> *"How am I able to obey a rule?" – if this is not a question about causes, then it is about the justification for my following the rule in the way I do. If I have exhausted the justifications I have reached bedrock, and my spade is turned. Then I am inclined to say: "This is simply what I do".* (Wittgenstein 1997, p.85e [217])

There is a limit to our explanations. To understand a rule is parallel to the understanding of a word discussed above. You do not *have* something when you understand a word or a rule; but rather you are able to *do* something. To understand a word or a rule is comparable to mastering a technique. You are simply able to use the rule or the word within a language-game in accordance with its established use. This agreement is the bedrock of our explanations, because it constitutes the possibility of language. Without this agreement there would be no rules. This agreement in 'doing the same' is an example of what Wittgenstein calls a 'form of life', which is what we must accept as 'the given' that escapes explanation (Wittgenstein 1997, p.226e). Wittgenstein compares this basic certainty incorporated in the language-game with an animal's need for gathering food to meet the winter or the baby's certainty of there being milk and so on (Wittgenstein 1979, p.37e [287], 47e [359], 63e [478]). According to Wittgenstein, the certainty with which we act in our different practices (e.g. not questioning that we have two hands) is the foundation of our knowledge and the foundation of our language.

8.2.4 Perspectives on AI

Several researchers and research programmes in AI machine translation have today lowered their criteria for success, in comparison to the first hopeful exploration of the capability of AI research. As a research field under informational science, AI came to life only shortly after the first simple electronic calculators were constructed. Machine translation researcher Philipp Köhn at University of Southern California summarises this development using the euphoric comments from 1958 by Herbert Simon on the early goals of AI. Simon gave AI researchers a ten-year period to achieve the following goals:

> *A digital computer would be world chess champion, unless the rules barred it from competition.*

> *A digital computer would discover and prove an important new mathematical theorem.*
>
> *Most theories in psychology would take the form of computer programs, or of qualitative statements about the characteristics of computer programs.* (Simon in Web Köhn)

Not ten, but forty years later, these goals are still far from reality, even though some might contest that Kasparov or Kramnik could beat the world's strongest chess computer. Köhn argues that the research in AI today has toned down what is seen as reasonable goals, even in the long run. Köhn suggests that the resent popularity of neural networks and fuzzy logic is a sign of the search for a more complex approach to language that takes into account the blunt definitions and ambiguities in natural language (Web köhn). Instead of a rule-based approach, he proposes a research programme in machine translation that combines the use of statistical elements with the linguistic approach based on the rules of language in building translation machines. Referring to the later Wittgenstein, perhaps the modest and appropriate term here is the subsequent rationalisation of the patterns of a language. Today the original goal of putting all translators out of work and substituting them with a super translation machine has been given up. As Köhn describes it, the research is now focused much more on commercial products that can support the translator, like the very helpful ones I am using this very moment, writing in the windows interface.

The question about the future of machine translation seems to have been reformulated in general as a result of the significant obstacles experienced in constructing artificial intelligence. The answer to why this was so could be that there are very good reasons to believe that the rule-following performed by computer programs is not able to resemble the intertwined language games of natural language we take part in every time we speak. For every sentence, machines have to take into account a possibly infinite universe of discourse that will never be completely defined as well as a huge amount of connotations, denotations, playing with words etc. etc. The highly complex task of being involved in everyday language, playing as we do (developing) with language is what it takes to speak and therefore also to translate a language properly.

Difficulties are also experienced in other areas of AI-research as the development is slower than originally imagined. The language theoretical considerations investigated in this theme suggest that the difficulties are more than practical disturbances – they may be principal in character. The research efforts in the field of AI show a significant interest in formalising our thinking through formal compositional languages – thinking or intelligence is reduced to a calculus. It is an effort in vain, from the perspective of Wittgenstein's later understanding of language. The rules that govern our thinking cannot be reduced to a mechanical calculation according to this conception of language. I find that Wittgenstein's attack on his earlier writing is of the outmost importance in our culture's understanding of the computerisation society is undergoing. If we find compelling reasons for developing artificial intelligence to ever-higher levels, we should definitely implement more reasonable conceptions of what language and intelligence is in our approach to AI-research.

Machine translation will undoubtedly get better and better in the future with a combined statistical and rule-based approach but for the development of androids or social robots – talking and physically interacting intelligence – to get even close to animal complexity…ai,ai,ai. To make a computer into anything close to what we refer to as human intelligence, I would say there is no way around socialising it into a human. For Kurzweil, among many others, to speak as though machines will become more intelligent than us, spiritually superior to us etc. is really to make a categorical mistake by treating intelligence as a formal computational process and reducing our thoughts to a simple calculus.

The argument of Theme II has shown how natural language is not something that can easily be subtracted from the practices of science. Our intelligence and the knowledge we possess are tightly connected to natural language acquisition, from the point of view I have laid out. In this sense, Theme II shows how natural language cannot be secluded from our scientific investigations. The theme thereby attacks the conception of science in modernity with regard to the efforts to provide purely formal representations of the world.

9. Theme III: Understandings of Advancement – the Belief in Progress

Theme I discussed ontological conceptions of science and their impact on scientific research. Theme II engaged in epistemological issues concerning representation from the perspective of a dominant school in the philosophy of language. The first two themes have, hence, been ontological and epistemological in their primary scope. They have discussed what the world is like and how we represent it. In my third theme, I shall pay closer attention to another aspect of science, namely the relation to society.

The interrelation between science and society has undergone dramatic changes during the 20th century. From being an authority of societal development and incorporated with great hope into the planning of public life, science became an increasingly suspicious institution to the citizen at the end of the century. Today science has, in certain respects, become discredited in our culture (Sjøberg 1998, pp.137-150). This change is easy to trace within the arts and it is e.g. displayed in numerous American mainstream movies of recent. Our relationship to science is, however, an ambiguous one. While it has become somewhat discredited, we still attribute it an enormous amount of weight in our decision processes, both in public and personal affairs.

The governments of the Western world (and, for that matter, the rest of the world also) continuously plan enlargements of science educations, large-scale research projects in science and so on. A central theme in Danish educational policy is, revealingly, the decreasing number of students at university science educations and the action needed to prevent this number from falling. In the general political agenda, a main subject is the all-important goal of supporting private industry with the technological research base that will enable Denmark to win the high-tech competition against other countries. Science plays an important role in this type of argument about competitiveness, as it is rightfully seen as highly connected to the state-of-the art advances in technology.

I find that the conception behind these political dispositions seems to be that the general progress of society basically depends upon the general advancement of science. The advancements of science and technology are often, as I see it, believed to be not only economically necessary but are also predominantly considered to automatically benefit the development of society. Why, then, are these political ideas about society's progress and science not reflected in a thoroughly positive public opinion in our culture in general when it comes to science? Why, every time we go see a film, are scientists no longer seen as decisive authorities but rather as people tampering with life? These are some of the questions that I will pursue in this theme, and they relate to the relationship between the advancement of science and the development of society.

The Exclusion of Ethical Considerations in Science

Theme III represents an attempt to formulate a critique of the conception of science in modernity, as did the two former themes. In this theme, the element of the conception subject to critique is the one which reasons that science should be secluded from the interference of ethical discussions. Ethical considerations are absolutely irrelevant with regard to the core of scientific research. According to this conception, ethics has to do with feelings and norms for the social behaviour of humans, and this is in grave contrast to the objective criteria that facilitate scientific and technological advancement. Science has to be secluded from the subjective realm of ethics in order to benefit society with its ethically neutral knowledge.

I will discern two aspects of this thought of ethical neutrality in the conception of the seclusion of science. The first one concerns the question of whether we should attribute ethical value to nature or what we might call non-human objects. The second deals with the idea of progress for society through scientific advances. The first aspect will only be briefly commented upon in the next paragraph, whereas the second aspect will be the core element of Theme III.

According to the modern point of view I will oppose in this theme, ethics has to do with interrelations between humans and is therefore irrelevant for our scientific approach to nature. Nature may be involved in ethical considerations about human actions, but always on the basis of utilitarian considerations for the benefit of human preferences – for individuals or for society in general. This is what has been called the anthropocentrical conception of ethics. We have already touched upon this topic in Theme I in relation to Løgstrup's examination of what he believed to be the misconceptions of modernity. Here it was described how an a-cosmic humanism could make us falsely believe that the boundaries of what exists are our cultural productions and that this belief rested upon a false conception of nature as our surrounding as opposed to our source. In this misconception, Løgstrup saw the mechanism behind our unrelenting exploitation of nature, and only through an alternative non-anthropocentrical worldview could nature be given its proper position in relation to human society (see Section 7.3). Being one of the pioneers in this line of thought, Løgstrup has been joined by other non-anthropocentrical theoreticians. Here one could mention the theory of deep ecology first developed by Arne Næss in the early 70's and different kinds of ethical theoreticians, e.g. Peter Singer, stressing animal rights on the basis of animals being sentient beings.

I will not explore this topic any further here but instead turn to the study of the idea of progress. It is important, however, to keep in mind in what follows, that while the idea of human progress for the sake of humans exclusively could possibly be seen as one of the most important phenomena in world history, it has, during the last decades, become increasingly contested by theories that want to attribute varying degrees of ethical value to nature and humans alike.

The conception of the seclusion of science rests on the intrinsic goodness of developing scientific knowledge to ever-higher levels. Society will prosper from this development and it ensures continued progress for society – this is the core of the *idea of progress* with regard to science. A prevalent perception in modernity is that the more scientific knowledge we gain about nature, the more control we shall have over our own future through technological innovations – there is a slant towards the liberation of humanity from the threats of nature in this historically very strong narrative. Implicit in a point of view like this is the understanding that what science brings about of knowledge is determined in advance and can only be postponed temporarily by the varying amount of investments into scientific research by society. Technology is then subsequently applying scientific knowledge for the benefit of society. The steam engine, TV, mobile phones, internet, gene manipulated crops, AI, human cloning etc. etc. are, within this picture, all thought to be predetermined stages in the progress of mankind as a result of the facts that nature has gradually revealed to science. Ethical issues, therefore, are only thought to enter the scene where clearly questionable technologies are implemented, like the nuclear bomb – they have no bearing in the formulation of scientific research agendas, as science will only uncover what is already given.

New developments in the relationship between science and technology make this line of thought within the conception of science in modernity dubious. Science and technology are becoming more and more difficult to separate and this necessitates asking questions about the role that ethical considerations should play within science.

There is an important difference between the concepts of 'science' and 'technology' as, at least from the outset, they reflect two different human activities. Science could be described as focusing on understanding nature through passive observation. The goal is to find out "what there is" and build theories about it. 'Theory' stems from the Greek word 'theôria', which in one setting means, "being an observer at a theatre", and can also be used to express something like "to go abroad and see the world", emphasising that it refers to viewing the world at a distance in contemplation (Web perseus). Technology, on the other hand, is concerned with building or controlling through technological artefacts. It is not concerned with what there is but rather "what we would like".

The parallel word for science's 'theory' could be thought of as technology's concern with 'design'. In producing designs to reach "what we would like", technology presupposes science. The two enterprises are linked in this way, but the influence or use cannot be thought of as one-directional. What we would like influences scientific research, just as the advancements of science influence the designs of technology.

However, the relationship between the two enterprises is today significantly more complex than what was outlined above as modernity's conception. Firstly, basic science research is increasingly being performed and economically supported by technological developers and, secondly, some of the newest scientific fields of research (e.g. biotechnology, nanoscience and computer science) could equally be claimed to belong to the area of technology. Science and technology are becoming more and more entangled enterprises, and our concepts of nature and culture are consequently becoming increasingly intertwined. "What there is" (in nature) and "what we would like" (in our culture) are becoming obsolete categories for interpreting the relations between science, technology and society. It is no longer a viable option to consider science as only describing nature, because science today has the power to substantially change what we refer to as nature.

Approach – Theme III

I shall now try to examine what this development means for the idea of progress as our interpretative tool for understanding the role played by science in society. I aim to illustrate why the idea of progress is a key player in the reasoning of modernity on the relation between science and society, and the task of Theme III will be to investigate what this idea consists in and what significance it plays today and has played in earlier periods of Western society.

To accomplish this, it will be crucial to clarify what characterises the role of science in contemporary society as compared to earlier periods, when the idea of progress through science seems to have peaked. In order to do so, I will start out by providing a sociological framework for understanding the role of science in the past as well as the present. I will focus on the systems-theoretical ideas presented by Lars Qvortrup, who takes his offset in Luhmann's concept of 'hyper-complexity'. The idea behind this concept is that society currently undergoes a fundamental change which demands new concepts for its description and which takes us beyond the prevalent ideas of modernity. Qvortrup concerns himself a lot with the way subsystems of society interact with each other, and I will turn Qvortrup's analysis towards the system of science through Foucault's studies on different historical epochs' conception of nature and science.

The sociological study will be followed by a historical outline of the influence of the idea of progress on Western culture, mainly inspired by the works of Nisbet and Bury on this issue. I will try to connect and incorporate the idea of progress in the sociological framework that has already been developed and relate it to the conception of science in modernity. The problems of maintaining the idea of progress in present-day society will be exemplified by von Wright's writings. In *The Myth of Progress* he sharply distances himself from the standpoint that advances in science and technology will ensure a better society.

9.1 Science and Society

It is now my aim to develop a sociological perspective on the role played by science in society. I will draw upon the work of Lars Qvortrup, whose recent books have, in different ways, continued the sociological approach of system theory developed by Niklas Luhmann (1927-1998). This theory sees the role of science as undergoing important changes, and the goal of this section is to outline and create an understanding of these changes. However, my intention is not to give a detailed introduction to system theory and its highly differentiated vocabulary. Rather, I am out to describe what Qvortrup calls the self-description optics of society and concatenate this with what Foucault calls an 'episteme' of different historical periods of time and the impact of these on the interpretation and characteristics of science. Qvortrup and Foucault's work will be used as inspiration to outline three such optics or epistemes.

9.1.1 Society under change

As a follow-up on the book, *Det hyperkomplekse samfund* (1998) [The Hyper-complex Society], Lars Qvortrup offers a description of what characterises contemporary society in *Det lærende samfund* (2001) [The Learning Society]. Much of the recent sociological discussion has been about whether today's society reflects a perfectly new epoch in comparison to the industrial society of earlier times. This alleged new epoch has, among other things, been called the knowledge society, the risk society and the information society, and there is admittedly much controversy over the interpretation of contemporary society within sociology. For instance, Anthony Giddens has argued that present society is not qualitatively different from the industrial society of modernity, but rather a radicalisation thereof (Giddens 1990). In many of Giddens' works, the argument to support this position relies on showing that the concepts of modernity encompass the development that society has undergone throughout the past few decades. Qvortrup is exemplary of a theoretician who, on the contrary, reckons that the past few decades of societal development have seen an extraordinary, fundamental change of institutions and structures.

> *The assumption in this part [the analysis of contemporary society] is that the development from industrial society to that which is randomly called information society, network society, knowledge society etc. is not only a quantitative development in which the existing society has become a "little" (or maybe a lot) more complex, a "little" more globalised, a "little" more characterised by information- and communication technology, but that we are witnesses to and participants in a qualitative change, a paradigm shift, that calls for totally new theoretical and methodological tools for society's self-description. We must get used to the fact that the basic category is not material reproduction but managing complexity. That it is pointless to look for "the power" in the singular, because society can no longer be described as monocentric, but is polycentric.* (Qvortrup 2001, p.11)[39]

System theory is Qvortrup's instrument for showing how society is undergoing a paradigm shift, and we shall later take a closer look at the results of this work, for one thing by uncovering the meaning of the concept of 'polycentrism'. Before that, however, I shall consider what sociology's system theory regards as the basic factors in accordance with which society develops, namely 'complexity pressure' and 'complexity management'.

Within Luhmann's system theory, communication is the central concept. The condition of communication between the different subsystems of society is what indicates how the system works. Many earlier sociological theories have structured and described society from a work value relation between nature and society. For example, Marxism takes this as its starting point for theorising about society, just as it is the premise of the old liberalist economical theories. Contrary to such focusing on man's struggle with nature as the structuring factor for society, system theory views communication between differentiated subsystems, arisen as a result of the division of labour, as the key characteristics of the structure of a society.

> *…in my book about "the hyper-complex society" I suggest, strongly inspired by Luhmann, that society can be viewed as a social system, the basic condition of which is communication, the main challenge is complexity and the goal is complexity management. Central to the understanding of complexity management is, however, that the challenge of complexity is not a struggle that can be won once and for all.* (Qvortrup 2001, p.25)[40]

On the basis of system theory's starting point in the communication between the systems of society, the central goal for any system (be it the political system, the scientific or the entire society system) is to reduce the complexity that meets the system from its surroundings. As Qvortrup explains in the quote above, it is nonetheless never a process that can be finished off, since complexity from the outer world (outer complexity) is handled by the system by way of increasing its inner complexity. Problematics of globalisation have, for example, been a source of outer complexity pressure in many of society's function systems. In many of these systems, the Internet has become a tool for handling this complexity, but this has, at the same time, amplified the inner complexity of the systems themselves. The same could be said for the emergence of universities in relation to medieval society as a system, or about the emergence of television in relation to the media as a function system. In this way, we can say that system theory operates with a form of societal evolution. Not an evolution that moves towards more freedom of trade, democracy or a just distribution of material goods, but one that sees a still more intense complexity pressure from the surrounding world.

9.1.2 From the Pre-Modern Era to Modernity

In order to shed light upon how contemporary society is organised – how communication between society's subsystems takes place here and now – a historical account of different types of society and the characteristic self-observation belonging to each of them will bring matters in perspective. Following Qvortrup and his general scheme of the pre-modern, modern and high-modern societies, the historical Western societies can be divided into three significant types of society epochs with each their optics for self-description. The optics in these epochs is firstly, deocentrism, then anthropocentrism and finally polycentrism, which I shall claim is becoming the dominant form of self-description in today's society. In what follows I shall pursue the task of giving these three optics a formulation that entails a special role for science in each of them.

Pre-Modern Deocentrism

Deocentrism was the self-description optics to dominate in Europe until the rationalistic worldview gained influence after the Renaissance. In the self-description of this epoch, the deity and, immanent therein, tradition was at the centre of man's interpretation of his surrounding world. For this reason, the subsystems of society were hierarchically ordered. The religious system was to be found at the top of the hierarchy and from here motivated the other systems in society (the economical, the artistic, the secular system in its entirety with kingdoms etc.).

The self-description of the individual societal systems was therefore defined largely by the church. Thus, for example, art dealt predominantly with depictions of God's creation and deeds. It is interesting to note that not only was it conventional to depict the deity, but also to make this depiction from a god's perspective and not from a human perspective. Perspective painting as we know it from Da Vinci's "The Last Supper" only came about during the Renaissance, and was since then used more and more, even though it actually met with some resistance from the deocentrically inclined, as we shall see.

Another example of this dependency upon a general deocentric self-description in society was the university, which was subjected to the administration of the church in a similar fashion. As we saw in Part I, it took the Pope's approval for a sovereign to be authorised to found a university. At the same time, the international organisational structure that the university had in the Middle Ages highlights the fact that this was an institution governed by the church, and as such, it was also, at the end of the day, an institution with a divine purpose.

One can relate the deocentric self-description treated above to Foucault's knowledge-archaeological studies of the episteme of science in the late Renaissance – the period immediately before the start of the modern project around the time of Descartes – as presented in *Les Mots et les choses – Une archéologie des sciences humaines* (1966), later published in English as *The Order of Things – An Archaeology of the Human Sciences* (1970). The original title, Les Mots et les Choses, translates directly to "the words and the things". Words and things were inseparable elements in the deocentric episteme that dominated before thinkers like Descartes and Newton helped set up a new scientific episteme during the 17th century. The deocentric episteme operated from the fundamental assumption that words were originally, in an absolute way and completely transparently, the signs of the things. Only after the Tower of Babel did the absolute connection between language and things become hidden to men as a punishment from God, and the work of the scientists, hence, was to re-establish the cohesion in the original Creation (Foucault 1999, p.72).

In *The Order of Things*, Foucault describes how this conception of the veiled Creation shows itself in the methods and the view of nature in the sciences. Both the study of language and the study of nature is based on the shared understanding that language, like animals and plants, is a thing of nature, and their respective areas are treated in the same way – as traces after the original divine state. Hence the interest in ancient Greek writings, where Aristotle's world picture in particular dominated in medieval times. Foucault gives specific examples in order to illustrate how much the way of thinking among scientists then differed from what one would find today, as they focused on discovering "likenesses" between things in the world. For example, they uncovered so-called "accordances". They found accordances between the number of animals in the sea and on land, and that the sum of these corresponded to the number of animals in the air. Space was thus not only an abstract, empty bow, as Descartes and Newton would later construe it, but something that tied the things in the world together, and the uncovering of "neighbour relations" (e.g. between species of moss and shellfish) therefore also became important. The knowledge paradigm was no stranger to what we would typically refer to as magic, either. Along with the perception that language and things were originally tied inextricably together by the Creator's hand, one could find scientific testimony about snakes that were afraid of certain words, etc. (Foucault 1999, pp.68-69).

In medieval and Renaissance European society, with its deocentric self-observation, the objective scientific wish to explain the world was based on totally different premises than those we know of today. Their ontological presumptions differed from ours, as well as their methods for uncovering the true nature of the world. But I think it is still fair to call their efforts science as they engaged in a thorough explanation of the world. They had not yet substituted the number for the word as Løgstrup put it (Section 9.3) and their whole approach differs from ours, first and foremost because of this.

Modernity's Anthropocentrism

With the Renaissance, Qvortrup has it, began a significant reinterpretation of society's and man's self-observation. It was now no longer only the deity but also the human that became the standard by which things were measured. The deocentric perspective was gradually replaced by the anthropocentric. In this new epoch of society, the subsystems of society became more and more independent of each other, thereby parting with the deocentric self-observation that built on a hierarchical structure between the individual systems of society. Science, the economy, the political system, etc. gradually detached themselves from church rule and became, to some extent, self-motivating function systems in society. In the vocabulary of this thesis, the increasing detachment of science from its bonds to the rest of society is the starting point of modernity's conception of science – the conception of seclusion.

According to Qvortrup, the development of the anthropocentric self-observation reaches its pinnacle with Kant (Qvortrup 2001, p.21). Through Kant's critiques, that which is common to man becomes the axis of society's self-observation. Kant's transcendental subject is the exclusive source of understanding, and the right organisation of society can also be determined on the basis of a universally human perspective. The introduction of the universally human rationality in all of life's areas gradually becomes the characteristic of Western European culture. After the Renaissance from the 17th century onwards, tradition and original divine planning plays a decreasing part to the self-observation of society.

We have already touched upon the conception of language and nature in the deocentric self-description of science. This conception is radically changed in early modernity. As the anthropocentric perspective made its entry from the end of the Renaissance, a development took place in the view of nature and the working of the sciences. As Foucault describes it, this happened when, around the middle of the 17th century, the word was separated from the thing. Man no longer viewed language as God's, but as his own. Knowledge was no longer about approaching things to each other by finding likenesses; rather it was about differentiating and piecing out as prescribed in Descartes' analytical method. Signs are, from then on, not considered part of the natural order, and the 'artificial' sign takes precedence when it comes to finding true knowledge in science.

> *From the 17th century on, the entire area of the sign is distributed between the certain and the probable, that is, the unknown sign is no longer acknowledged, there is no silent mark. This does not mean that man has possession of all possible signs. But that there will be no sign until the moment when the possibility of a replacement relation between two already* known *elements has been* understood*. The sign does not quietly await the arrival of the person that can comprehend it; it is formed solely through an act of understanding.* (Foucault 1999, p.96)[41]

Thus, the task in the modern project is the endeavour to unfold the elements of nature and their connections using artificial signs. Descartes' analytical approach instigated the fall of knowledge developed on the basis of history and tradition. Instead, a universally human method of reason was established as the scientific practice, but it is worth noticing that Descartes was still also influenced by a deocentric self-observation. Even though his method meant that man was now able to comprehend the world through his own signs, Descartes was nonetheless still of the opinion that it was God's creation that could be uncovered using this method. In this way, he exemplifies how different optics of self-observation exist side by side in the same person and in the same period of time.

To science, this shift from deocentrism to anthropocentrism was naturally of great significance. From a natural science that took as its starting point the divine plan of Creation, people like Newton and Descartes reinterpreted the perception of space and of the scientific method. Newton's abstract space and his conception of time in a three-dimensional Cartesian coordinate system reflects the focus on a human perspective on the world, which had already emerged in the perspective painting within the art scene. One of the great scientists of the 17th century, Blaise Pascal

(1623-1662), who was an advocate for the deocentric self-observation argued against perspective painting on the basis that it might lead us to forget that the most important perspective in the world was God’s and not humans’ (Qvortrup 2001, p.57).

In the modern society that assesses itself on the basis of anthropocentrism, the sciences are assigned a special role as the pure cultivation of reason in the struggle against superstition and tradition-based knowledge. With the positivism of the 1800’s (especially clear-cut in the works of Auguste Comte and John Stuart Mill), there was a definite break-away from tradition and religiousness in man’s self-understanding, and at the same time, history is seen as progressively moving from the era of religious world-interpretation over the era of metaphysical speculation to the empirical era of the sciences, where only that which can be sensed can be a building stone of knowledge. I would say that logical positivism (treated above in Subsection 4.2.1), can be viewed as a further development of this modern project, and is the right place to look for the extensional climax of anthropological self-observation, since in many ways, this movement is a radicalisation of the universally human project of the age of Enlightenment. The logical positivists tried to free human knowledge from the metaphysical thinking they believed that even Kant, among others, made use of, but also to free it from psychologistic descriptions of knowledge, which is what many early positivists committed themselves to (see Section 4.1 on Høffding’s philosophy). In science’s approach to knowledge, the logical positivists found what they perceived of as a method so objective that no sensible person would doubt it. In this way, I find that the logical positivist movement can be viewed as the height of European cultures’ search for a condition-less, universally human knowledge.

9.1.3 Polycentrism

One of Qvortrup’s central points about anthropocentrism is that it is characterised by having one single governing principle for the self-observation in society, as was the case with deocentrism. This means that it was possible to make unchangeable observations on an absolutely firm foundation within both these types of self-description, whether the starting point of these observations was God or Man. It was not until the 20th century, when doubt slowly began emerging as to whether the universally human principle was adequate to comprehend our surrounding world, that the anthropocentric observation was pushed aside by a new perspective on the world. This doubt emerged in many of society's subsystems.

The art world saw the emergence of impressionist and surrealist paintings that opened the way for the question of multiplicity of reality representation. Within science, Qvortrup points to the change in the view of nature that Stengers and Prigogine show in *Order Out of Chaos: Man's New Dialogue With Nature* (see Section 7.2). Furthermore, the belief in the implicit goodness of the universally human rationality and the societal advances following from that became questionable. This belief was crucially challenged with the invention of the atomic bomb (see. e.g. Joseph Rotblat's Nobel speech (Web Pugwash)) and the use of engineering in extirpation of Jews in the Second World War (see e.g. Horkheimer and Adorno's *The Dialectic of Enlightenment* (1944) or Bauman's *Modernity and the Holocaust* (1989).

Hence in more than one area, European culture started to doubt whether human rationality would automatically drive society towards better conditions. Also, doubts were raised about the adequacy of the universality of the human starting point. Qvortrup highlights the 200-year-old discoveries of other cultures by anthropologists, and that these, given the 20th century's revision on human rationality, could no longer be considered second-rate to our own. Up until then, the Western European culture had been considered *the* culture (consider the time of imperialism), which contrasted with the inferior nature and its primitive peoples. Now, contrasted with other cultures, today's Western society is characterised by having, to an increasing extent, observed and criticised this its own blind spot, which earlier allowed us to believe unreservedly that we had found the one rational and universally human way towards a sound organisation of society and understanding of the world around us. It is the self-awareness of this blind spot that has been the crucial step towards a contemporary society that is, in Qvortrup's opinion, radically different from the societies of earlier times, and today we are in the middle of a process of changing our self-description, same as we were at the time of the late Renaissance.

What, then, characterises the self-description of the systems of society in this new epoch that we are allegedly facing? It is the way in which the subsystems of society (the political system, the ethical, the economical, the religious etc.) observe and communicate with one another. These systems are each of them complex systems with their own method of observation. But while in earlier societies, this observation was based on eternal measures and principles (that of the deity or of the universally human), the observing subsystems and the society system as a whole now observe and change their own observation criteria while observing the complexity around them (Qvortrup 2001, p.20). Therefore, a whole new kind of societal self-observation has emerged, that is not only complex (with a lot to overview) but what Qvortrup suggest we call hyper-complex – that is, it has a lot to overview and simultaneously, it is always uncertain which principles to use for creating an overview.

This uncertainty characterises today's society and sets it apart from the two earlier examined epochs of societies. The observation of that which is unfamiliar now includes self-observation – observation has begun to observe its own conditions, and this optics of self-description is what Qvortrup calls polycentrism. Polycentrism thus refers to a self-observing system that not only observes surrounding systems but also its own criteria for observation, on the basis that there are a multitude of centres for observation.

9.1.4 Science under Complexity Pressure?

The sciences are not and cannot be independent of the general self-description optics of society. According to what has been outlined above based on the works of Qvortrup and Foucault, there are strong arguments that science has historically been subject to changes that have to do with circumstances outside science itself. The way in which the scientific system observes itself and the way in which it observes and relates to other social systems seems to be crucial for the results reached, the methods used etc. Admitting that doing science has very different meanings at different periods of history does not change this conclusion. It only adds to the idea that a dominant episteme of society to a large extent determines the shape of its constituent parts.

We have investigated the characteristics of science in the traditional society and the modern society above, and now the central question is what the characteristics of an authentic science in a hyper-complex society are? Within the framework set up so far, one could try and shed some light on this question by focusing on the ability of science to manage the complexity pressure from its surrounding world. As described, when it comes to the complexity challenge, the system does not create a simpler system but rather a more and more complex one in order to balance out the complexity pressure from the system's surroundings. This perspective is, in many ways, interesting with regard to the mode of operation of science. First of all, we have seen in Theme I how Stengers and Prigogine examine the way in which the complexity pressure imposed on science by nature is showing, and the vocabulary developed by, among others, Stengers, Prigogine and Deleuze of systems-theoretical concepts therefore offers a way in which we can observe and understand this circumstance. At the same time, science has, throughout the 20th century, been subjected to increasing complexity pressure by other subsystems of society, such as the economical system (knowledge production should be geared towards the needs of the business world), the ethical (knowledge production must be in accordance with our norms for what is good) or the ecological (knowledge production should be focused on the preservation of the environment).

There can be no doubt that, during the last decades of the 20th century, science has been exposed to this increased complexity pressure on its function from without. The question is how this can be handled, and within systems theory, the answer is clear: it must be handled by way of increasing inner complexity correspondingly. We must endeavour to build up the inner complexity of science so that it will be able to handle the interpretation of its objects of knowledge as more than just passive automata, and also to relate actively and competently to the needs of the surrounding society.

In this section, I have given a brief account of a development in Western societies from the Renaissance till today. It is important to keep in mind that systems theory is one among many competing theories within sociology. I find that we should not, and cannot, completely disregard the importance of earlier forms of descriptions of society either. If we limit our conception of the development of society to a matter of communication between systems, we are in my mind bound to overemphasise the ontological status of these. Focusing on the systems-theoretical approach makes us see certain issues clearer, but it also pushes important issues in the background. However, the features on which I have focused are of a very general scope and will serve to illustrate that almost all scholars in sociology infer that a fundamental change is at hand in our daily lives and for the institutions of society and that this change is intimately linked with the role of science in society.

I will return to this conclusion later in Theme III as I aim to connect the foregoing sociological account with an analysis of the concept of 'progress'. In order to do so, we shall now trace the origins of progress thinking in order to examine its position in contemporary society.

9.2 The Idea of Progress

In my investigation of the idea of progress I turn to one of the most elaborate works on this topic – Robert Nisbet's *History of the Idea of Progress* from 1980. In this work on one of the fundamental ideas of Western civilisation he offers an outline of what 'progress' basically consists in.

> …the idea of progress holds that mankind has advanced in the past – from aboriginal condition of primitiveness, barbarism, or even nullity – is now advancing, and will continue to advance through the foreseeable future. *In J. B. Bury's apt phrase, the idea of progress is a synthesis of the past and a prophecy of the future. It is inseparable from a sense of time flowing in unilinear fashion.* (Nisbet 1980, pp.4-5)

The concept of progress in this formulation, which I shall adopt here, therefore rests on a specific conception of time, namely that mankind will advance in the future and has advanced from past to present. Nisbet captures two strands in this thought about humanity's progress. The first one has to do with the gradually increasing acquisition of knowledge – especially scientific and technological knowledge. The second one has to do with the moral progress of man – or more specifically the advancement in mans spiritual life, freedom from suppression, the powers of nature or society leading towards his serenity and tranquillity (Nisbet 1980, p.5).

The vast complexity of the idea of progress stems from the relationship between these two major strands. Many thinkers in Western history have claimed that the pursuit of knowledge inevitably brings with it the fall into sin. This is the myth of Pandora's box as the ancient Greek, Hesiod, told it but also the Fall in Christian and Jewish religion shows how this relationship between acquisition of knowledge and the fall into sin is deeply rooted in Western culture. Through his detailed work, Nisbet, however, argues that an even stronger current regarding the idea of progress has claimed the inherent positive relationship between pursuing and gaining knowledge and the salvation and happiness of man and mankind (Nisbet 1980, p.6). In this section, I shall pursue this last and stronger standpoint with respect to the connection between the above-mentioned influential components of the idea of progress. It is important for the general argument of Theme III that the idea of progress can be proved to be one of the strongest ideas in the history of Western thought, and I will therefore elaborate this claim at considerable length.

9.2.1 The Heritage of the Idea of Progress

It is a common belief of today's Western culture that the ancient Greeks had a cyclical understanding of time and were unfamiliar with the concept of progress. In connection to this belief, it is also said that the Greeks often described time as degeneration from a golden age in the past. The underlying thesis is – both from progress-thinkers of the 20th century and in critiques of modernity – that progress is an idea created by modernity and has its roots in the 17th century.

Several factors indicate that this is not a true picture of history. One can argue that the ancient Greeks had plenty of room for the idea of progress. Plato and Aristotle in Nisbet's argument show clear indications of mankind possessing a potential for positive development. Especially Aristotle has been referred to by the Founding Fathers in America, and a European thinker such as Locke saw Aristotle as a justifier of progressive and even revolutionary changes in the constitution of society (Nisbet 1980, p.34). Plato clearly believed in an eternal realm of truth and justice, but this is still no clear sign that time and changes in his view are to be considered enemies, as it is often suggested. To Plato, the philosopher has an obligation to enforce progress in the earthly realm after gaining insight in the most perfect of worlds. This is evident from the allegory of the cave, but also in *The Laws* where Plato's description of mankind's development from the beginning of times entails a dominant role of the idea of progress (Nisbet 1980, p.28). The idea of mankind having developed from a more primitive state into the Athenian way of life in the period of 400-300 BC is present in the writings of the period and, hence, anything but unfamiliar to the Greek culture at that time.

Not only the Greeks, but also the Roman thinkers were largely keen on the idea that, step by step, mankind have and will continue to better human conditions and also themselves. Lucretius (app. 99-55 BC) is perhaps the most outstanding philosopher and poet of the Roman era. His principal work, *On the Nature of Things*, is a naturalistic encounter of nature and human life written at a time when Rome was enduring political instability and moral decay in the last century before Christ. In this work, Lucretius does not, as it was common in the classical era, let the gods and faith determine the development of things but pays tribute to the technological progress made by man (Lucretius 1998).

It is therefore possible to find the roots of the idea of progress deep within the classical world. In two different respects, Nisbet's examination of the idea of progress therefore has a somewhat surprising element. First of all, he claims that the idea of progress in our culture is older than normally acknowledged, and secondly, he tries to show that it has been a constantly present and very influential current of thought with the exception of two periods in time – the Renaissance and the society of today. I shall come back to discussing the special role of the Renaissance later on in this section in relation to our present day situation and here only point to the important position that the Renaissance was given in the previous Section 9.1. I leave the discussion of progress thinking prior to the Enlightenment period with two brief comments.

A widespread idea – though on the retreat – is that the medieval period was one of decay or at least standstill, but Nisbet decisively shows that this is not a just picture of life in this period. The idea of progress held a strong position in medieval times, as did inventions and cultural development in general. Another point I would like to mention relates itself to the opinion of some positivist thinkers that progress would only be suppressed as long as religious beliefs were dominant in the thinking of humans. Nisbet, as well as Robert K. Merton, has shown that the Puritans of the 17th century were in many respects the driving force behind the modern era's confidence in science and its impact on human progress (Merton 2002; Nisbet 1980 pp.124-125). Rather than being the suppressor of progress, the belief in Providence was the vehicle for bringing science in close connection to the idea of progress.

9.2.2 Modernity and the Idea of Progress

I will now turn attention to some of the clearest formulations of the idea of progress from the Enlightenment period and onwards into the 19th century. Here the important connection to science is made an intrinsic part of the idea of progress – in other words, the interpretation of progress in the modern project incorporated the importance of science into its core.

The emphasis on science is not the only connection made to the idea of progress during the Enlightenment. Rousseau connects it to the advancement of equality, and in the following century, especially Hegel and Comte give it their special interpretations but none of these manifestations of the idea will be followed here. Instead I shall follow Nisbet's account of the thoughts of two other prominent thinkers, Condorcet from the Age of Enlightenment and Marx from the 19th century. Science is a present force in the works of the aforementioned writers – especially in Comte's works – but perhaps it was never formulated clearer than exactly in Condorcet and Marx' affirmative assignment of the progress of mankind to the state of scientific progress.

Condorcet (1743-1794) is one of several important French philosophers of progress thinking among which also Turgot (1727-1781), Saint-Simon (1760-1825) and as above Comte (1798-1857) should be mentioned. In *Sketch for a Historical Picture of the Progress of the Human Mind* (1795), Condorcet establishes his thesis that the "law of progress" is one of the fundamental laws in the study of mankind. His study in the *Sketch* is the story about ten stages of humanity's progress from a barbarian state all the way up to the ninth stage, in which Condorcet believed himself to be living. This stage was dominated by the great scientists, which would eventually pave the way for the tenth and possibly final stage. Condorcet was of the opinion that the French Revolution would bring about the stage where humanity could become intellectually free, rid of superstition and near itself to perfection (Nisbet 1980, p.207).

The ninth stage of humanity's progress is, as described, dominated by the progress of science. Descartes and Leibniz, among others, are acknowledged for their contributions to the future society of the tenth stage. As Nisbet explains, Condorcet is intensely infiltrated in the politics of his time (a fact that in the end cost him his life), but science none the less holds the pedestal with respect to humanity's progress.

> *But for all his pride in the political acts which formed the substance of the French Revolution, Condorcet is far more concerned with setting forth the great contributions of the sciences during the ninth stage. Science, for Condorcet, is the golden avenue to the future and to the final perfection and egalitarian spirit of the future. Until superstitions, especially those of all religions, are erased everywhere, the attainment of future happiness must be delayed.* (Nisbet 1980, pp.208-9)

This strong emphasis of Condorcet's on scientific rationality in opposition to superstition and religion was connected to another strong idea – the belief in the prediction of the future. His belief in the predicative power of science concerning the laws of movement made him suggest that the historical – that is political, economic etc. – development of humanity would be equally predictable.

> *If man can, with almost complete assurance, predict phenomena when he knows their laws…why, then, should it be regarded as a fantastic undertaking to sketch, with some pretense to truth, the future destiny of man on the basis of his history?* (Condorcet in Nisbet 1980, p.209)

On the basis of these points of view, Condorcet logically thought about the possibility – as would later Saint-Simon and Comte and as resembled Francis Bacon's *New Atlantis* (1626) – of making a utopian state where scientists would constitute a ruling class to ensure that the universal human rationality would dominate the tenth stage. But at the same time, the idea of individual freedom is strong in Condorcet's writings. Therefore he continuously endorses the education of scientific laws and discoveries to every single human being and there is no question in his mind that the future freedom of the individual will coincide with a scientifically governed state.

Condorcet is often considered the main philosopher of progress in modernity. How common and strong the idea of progress is in our culture's past and how influential it was on many of the greatest thinkers in the 19th century may be less clear. I will bring this into light by considering the idea of progress in the work of Karl Marx (1818-1883).

According to Nisbet, one of the most peculiar aspects of 20th century thinking is its efforts to rid Marx from his attachment to the "evolutionary-progressivist tradition" of the 19th century. This has been a dubious task since none of the great thinkers of the 19th century were uninfluenced by the ideas of progress through the new understanding of evolution. In Marx' case, this point of view can be corroborated by his admiration for Darwin's *On the Origin of Species* (1859) and his account that this book gave his own work "a basis in natural science for class struggle in history" (Nisbet 1980, pp.258-9). A strong case can be made claiming that Marx saw his work as a parallel contribution to that of Darwin, in the sense that he sets out in *Capital* (1867) to scientifically explain and discover the fundamental process of the evolution of society. It is by no means a less fundamental law than Darwin's mechanism of selection of the strongest individual, Marx aims for. In the preface to the first edition of *Capital* he makes clear that what will be outlined in his principal work is "de te fabula narrator" – it is a tale told for you in the sense: a tale applying to all societies.

> *Intrinsically it is not a question of higher or lower degree of development of social antagonisms that result from the laws of capitalist production. It is a question of these laws themselves, or these tendencies working with iron necessity towards inevitable results. The country that is more developed industrially only shows, to the less developed, the image of its own future.* (Marx in Nisbet 1980, p.260)

Through the iron necessity of these laws, which Marx also refers to as "the economic law of motion of modern society", humanity will inevitably advance through several stages of development and finally arrive at the stage of communism. Recalling Condorcet's belief that predictions about economic and historical matters would seem to be very possible in the future as a consequence of the nature of science, Marx' writings could almost be seen as a forceful answer to Condorcet's conjecture.

Hence, the idea of a predictive science is thorough in Marx' work. But history is not only predictable – it is, in addition, a history of progress. History is believed to be the story of progress through stages that will result in a golden future for humanity. The engine behind this history of progress is the dialectics used by Hegel, only turned up-side-down; not focusing on the "the Idea" but instead the material state of society. In Marx' own words, he has de-mystified Hegel's dialectics but in no way softens the necessity Hegel attributed to the historical process.

I have argued that the idea of progress has been a dominant figure in Western culture for thousands of years and that a strong connection can be found between the conception of science in modernity and progress thinking. Earlier on I mentioned that the Renaissance holds a special place in the history of the idea of progress and also that many scholars of the 20th century have considered the idea of progress to belong exclusively to modernity. We shall now take a brief look at one of the promoters of this thought, in order to further develop the relation between the conception of science in modernity and the idea of progress.

In J. B. Bury's *The Idea of Progress* (1932) Nisbet's point about the status of the Renaissance with regard to its lack of progress thinking is to some extent corroborated. Bury's book interestingly enough takes as its starting point the Renaissance and the work of the French historian Jean Bodin (1520-1596) especially in *Methodus ad facilem historiarum cognitionem* (1566). Bodin is portrayed as the first producer of a comprehensive account of universal history. Bury finds that Bodin is on the threshold of developing the concept of progress but does not quite get there as he is still mingled into the thinking of medieval times (Bury 1955, p.42). In Bodin's case, he did reject the astral influence on human events but instead put his trust into the Pythagorean and Platonist interest for natural numbers. For example, he calculated that the Roman republic lasted 729 years from its foundation to the Battle of Actium, which is equal to 9 to the 8th power. In this way, he corroborated his conception of a universal history with magical numbers that made the events of history fit into the divine plan of the world. This feature fits Bury's general view of the Renaissance thinkers. They generally lack the scope of a golden future, but as is the case with Bodin, reject the theory of degeneration and claims the Renaissance to be the equal of antiquity with respect to the sciences and arts. In addition to this, Bodin has a strong belief in the common interest of the different peoples of the world and an idea of solidarity between them (Bury 1955, pp.43-44). And within these thoughts of the Renaissance, Bury finds the prerequisites of the idea of progress – an idea that belongs exclusively to the modern era. In the epilogue of *The Idea of Progress*, he claims that "the illusion of finality" has stalled humanity in bringing the idea of progress forward and this illusion has, in previous times, been the idea of providence. Science, however, is what made progress thinking possible, as Bury sees it.

> *It is science, perhaps, more than anything else – the wonderful history of science in the last hundred years – that has helped us to transcend this illusion.* (Bury 1955, p.351)

The refrain of Condorcet's *Sketch*, that science will ensure the progress of humankind for all future, is not easy to miss. What interests us here is Bury's affirmation of the very strong position that the idea of progress could be given in 1932. It is clear that Bury concluded it to be as great a part of modern civilisation as the idea of providence had been of medieval times. This is in grave contrast to Nisbet's conclusion on the state of the idea of progress only 50 years later, as he decisively connects the ideas of providence and progress, as we shall see later on.

But even though science has made the idea of progress possible by, in Bury's interpretation, subverting the idea of providence, he keeps open the possibility of still other concepts to conquer the throne of human thought.

> *Will not that process of change, for which Progress is the optimistic name, compel "Progress" too to fall from the commanding position in which it is now, with apparent security, enthroned?* (Bury 1955, p.352)

Several thinkers of the 20th century believe that the time for this conceptual transition is overdue, as they hold the idea of progress to be a myth.

9.2.3 The Myth of Progress

I shall pay attention to G. H. von Wright's work in the following. In 1948, von Wright succeeded Wittgenstein as professor at Cambridge University. Here I shall concentrate on his later work, which is concerned with what he describes as the myth of progress in Western culture.

Why would one like to describe the pervasive thought of progress in our culture as being a myth? On this point, von Wright claims that not only historically has the understanding of the relation between advancements in science and changes in society been asserted but also today there seems to be an unquestioned link between these two seemingly different spheres of development. In von Wright's view, it is the concept of rationality pervading Western thought that connects the two types of development. In *Myten om framsteget* (1993) [The Myth of Progress] he finds the clearest formulations of the link in the Enlightenment period. We have already been acquainted with Condorcet and his understanding of social progress through science. In British philosophy, the Enlightenment movement was supported by the strong line of thought often referred to as empiricism. As humankind is continuously guided by facts about the world – what is positively given – instead of resting upon authorities of tradition and superstition, the life of humans in society will gradually become better. This line of thought is clear in the works of John Stuart Mill and continues in British philosophy in what von Wright refers to as the neo-modernity of logical positivism – what I have referred to as the high point of modernity (von Wright 1994, p.30).

In German philosophy, other aspects of a philosophy of progress found its speakers. Kant developed the main characteristics of Enlightenment. He produced a critique of the faculties of theoretical reason and practical reason as well as a critique of what he called Urteilskraft – the faculty of judgement. The main feature in this immense work was to show how the three faculties were independent of each other and independent of their individual exteriors. Kantian thought thereby produced separate spheres of life that should not be disturbed by pressure from outside them – one concerning knowledge or the truth, one concerning moral or the good and one concerning aesthetics or the beautiful. Knowledge was set free from the authority of the religious or traditional writings, the human subject was morally freed from external authorities and the production of art was no longer to be bound to the opinions of government or church (von Wright 1994, p.26). In this way, Kant made it clear for humans that the time of reliance in authorities of any kind external to the human subjects own reasoning was over – "Der Ausgang des Menschen aus seiner selbstverschuldeten Unmündigkeit" (Kant 1969, p.1). It was, in other words, time to think for oneself, and this is the essence of modernity's anthropocentrism as described in Subsection 9.1.2.

The proliferation of the freed human rationality is thereby embedded in modernity's idea of progress.

A common feature of all the three nationally rooted trains of thought emerging from the Enlightenment period is the anthropocentric idea of the independence and liberty of the rational human subject. The human subject must be given conditions under which it can develop its own rationally supported view of reality. Both Condorcet and Kant hold the view that a rational approach to life will inevitably better the life of mankind not only in their close relationships but finally also between the countries of the world.

von Wright describes the basic features of the resulting idea of progress in the following passage, which refrains the two major strands Nisbet found to be dominating the idea.

> *The modern idea of progress thus shows two main tendencies. One is the conception of progress through gathering more and more knowledge and through advances in science and technology. The other connects progress with the perfection of Man and the system of society.* (von Wright 1994, p.47)[42]

Hence, the concept of progress in modernity links itself to humanity's welfare through the rationality applied by science and technology. The concept of progress is clearly not a value-neutral term as can be the case with 'development', 'advancement' or 'change'. On the contrary, it is used to explain the exclusively positive developments that society will undergo as a result of science and technology. Science has provided the foundation for the technological mastery over nature. This mastery has established economical growth and higher standards of living, but von Wright questions the reliability of calculating the progress of society through such instrumental standards. Progress is often equalled to economical growth and this is a dangerous mix-up.

> *I view this mix-up as a reification, a quantification of progress. Progress measured in this way is no longer a value concept. It becomes a factualised, value-neutral concept, what philosophers call a value reification.* (von Wright 1994, p.48)[43]

The fact that the term progress inscribes value must be found elsewhere and revolve around a measure of how humans thrive under given circumstances. The framework, in which our life world consists, depends in von Wright's analysis, on two systems – the techno-system and the political system. The techno-system is defined as the alliance between science, technology and industry (von Wright 1994, p.47). It is now von Wright's claim that there is a strong tendency to identify progress in both these systems that sets up the borders for the human life world with measures that are based on facts and not evaluations.

> *Just as there is a tendency to identify progress created through accumulation of knowledge with economical growth, there is a parallel tendency to identify progress through social reforms with the outer forms of rational administration, with bureaucracy and legislation in the name of the people. I call it a formalisation of democracy. It is another example of the reification of the value-concept of progress.* (von Wright 1994, pp.48-49)[44]

According to von Wright, these systems have their distant origin in the division of science and understanding from external authorities and the liberation of the human subject from moral restraints (von Wright 1994, p.50). In other words, von Wright finds that it is the implementation of Kant's critiques that has determined the content of the concept of progress today and traces its influence in the techno-system and the political system that shape our life world in different respects.

In Theme I, we observed how Løgstrup in his critique of modernity tried to problematise what he described as life lived on the edge of nature or universe. Western culture's failure to recognise the importance of a phenomenological perspective and the connected, false interpretation of the sphere of significance of science were central topics. The ethical field of problematics was drawn into the educational setting, in Løgstrup's argumentation. Not with regard to the scientific method of reducing phenomena to treat them causally, but rather when it comes to the interpretation of the scientific results, society takes over. To Løgstrup, only the strengthening of the technicians' cultural inheritance could secure a realistic thinking about the relation between nature, science and society. I interpret this realistic thinking as the thinking that transcends pure instrumental thinking. It resembles von Wright's thought that in order to obtain true progress in society, we cannot shrink our thinking into believing that the techno-system will automatically ensure progress for humankind. I think it is reasonable to suggest that there is a very close bond between Løgstrup's conception of irrealistic thinking and the critical stance von Wright takes on the conception of progress. They both ask us to re-evaluate the role we attribute to the advancement of science and technology for the progress of society.

9.2.4 The Decline of the Idea of Progress

The critique raised by both Løgstrup and von Wright regarding the idea of progress gives the impression that it is still a very dominant idea today. I believe it is still one of the most deep-rooted traits of our culture. However, a lot can be said in favour of the conception that the idea of progress has reached its peak of influence already. Let me turn to Nisbet's perception now and his contention that the idea of progress is declining.

What was the state of the idea of progress according to Nisbet, when he wrote his book on the topic in 1980? It was that progress no longer held the glorified position he himself had shown it to hold since the ancient Greeks – with the notable exception of the Renaissance. The reason for this he finds in the corrosion of the basic beliefs that has supported the idea of progress and he finds that there are five such founding beliefs:

- the belief in the value of the past
- the belief in the superiority of Western civilisation
- the belief in the worth of economic and technological growth
- the belief in the scientific knowledge that comes from reason
- the belief in the ineffaceable worth of life on earth

As Nisbet puts it, no complex idea can survive its loss of crucial premises and he finds that the five beliefs outlined above are all under serious attack during the 20th century (Nisbet 1980, p.317). The beliefs in the value of the past and the superiority of Western civilisation have faced tremendous obstacles, especially due to World War II, but also as a result of the more recent and media covered Vietnam War. Western civilisation has been examining its imperialistic past in the wake of these disasters and has, to a large extent, turned against the idea that Western culture is a superior culture. The recent development in US foreign affairs showed how this discredit has been far more subverted in the world's only superpower, thereby making the relation with Europe problematic in the encounters with other cultures. When the past is no longer seen as a time of gradual progress towards the present, it goes against the fundamental characteristics of the idea as a synthesis of the past and a prophecy of the future. Let us turn to the consequences of the alleged decline.

Nisbet locates what has kept the idea of progress alive during Western history to a basic belief in something sacred.

> *It was belief in the sacred and the mythological that in the beginning of Western history made possible belief in and assimilation of ideas of time, history, development, and either progress or regress. Only on the basis of confidence in the existence of a divine power was confidence possible with respect to design or pattern in the world and in the history of the world. In the beginning all knowledge was sacred by virtue of its content – the divine, the mythological. It was persistence of this sense of the sacredness of knowledge that accorded the arts and sciences high status in Western civilisation long after they had ceased to be concerned solely with the gods. […] The aura of the sacred remained with the arts and sciences until well into the twentieth century.* (Nisbet 1980, p.355)

In this way, Nisbet brings the aspect of secularisation in modern thought into light. Our culture has lost the sense of sacredness and there is no knowing whether we can regain it in the future. But it is none the less the prerequisite for the possibility of beliefs in progress and regress for Western culture, as Nisbet sees it. Within this picture modernity tried to release the scientific enterprise from its historically religious roots and has only recently discovered what a treacherous belief the, at times almost sacred, belief in secularisation can be.

The most important difference between Nisbet and Bury's conceptions of the idea of progress is perhaps that Nisbet argues that the thought of providence is and has been the driving force behind the modern project, whereas Bury believes himself to be firmly rooted in an age guided by rational reasoning of humans finally rid of deocentric guidance. They agree on the point of view that the Renaissance is a turning point in history, where no clear conception of the relationship between past, present and future existed. In my opinion, we should seriously consider the possibility that we are living in a period of fundamental transition of society like the one that took place 500 years ago. In other words, the possibility of standing in the midst of a second Renaissance of the Western world. This is a thought that was also corroborated in Section 9.1 in the search for different self-description optics of Western culture, and I have now tried to link it to the idea of progress. Progress thinking is breaking down as a viable concept in our culture, but with no clear path to follow instead and no clear sense of the value of the past. We must engage in formulating new understandings in this vacuum, as did the first Renaissance, even though we – like Bodin – are unable to free our thoughts completely from the ideas of past eras.

If we admit Nisbet's claim that the idea of progress is one of the most influential in Western culture with a history that goes well beyond modernity to our deepest cultural heritage, we come to see the radical influence a rethinking of this idea will have and perhaps already has on our lives. Modernity's conception of progress, in this view, shows itself to be merely a radicalisation and secularisation of the idea of providence, incorporating the advancement of science into its core. Progress has been the key interpretative tool in understanding and valuating science and its relation to society. If critics like von Wright are right, the understanding of the relationship between the advances of science and the improvement of human and social life must be re-evaluated. In other words, the concept of progress as the central idea regarding our understanding of advancements in science may have to be substituted with something else. I will try to suggest some directions for this substitution in Part III.

10. Perspectives on the Critique

Let me now capture the essence of what has been done through the thematic, critical approach carried out in this part of the thesis. I wish to relate it to other approaches in literature that it resembles and also comment upon my position in the theoretical landscape of today's philosophy of science and science studies.

In Scott Lash's *Another Modernity, A Different Rationality* (1999), we see one of the most comprehensive works on analysing the concept of modernity in recent years. It is a book that deals with topics in the field between sociology, culture theory and philosophy. In brief, it tries to show how modernity has been perceived as being ultimately subject to a high-modern state where no truth, including those produced by science, is kept untouched by deconstruction. This Lash refers to as the high modernist abstraction and accompanying deconstruction of the first modernity. He claims, however, that there is another or second modernity that searches for a ground beneath the first modernity.

> *In our explorations in space, society, experience and judgement, our explorations into the structure and agency of the second, the other modernity, we are engaged in a search for the ground, the ground that challenges the groundlessness of both high modernist abstraction and deconstruction. […] This ground does involve 'tradition'. But it is not traditional in the orthodox sense of Gemeinschaft, nor is it constructed. It is already built, already given.* (Lash 1999, p.9)

This ground is pursued throughout Lash's book in the different fields of study mentioned in the quote of space, society, experience, judgement and objects. It is his conviction that the role of this other and second aspect of modernity has not been brought far enough forward even though it has been a current alongside the first modernity since the period of Romanticism.

As I see Lash's suggestions for a reasonable vocabulary connected with the term modernity, they serve well to illustrate the ambiguous standpoints we take in Western culture towards science. On the one hand, we pursue a deeper illogical (not irrational) source of meaning in high modernity than what can be expressed through formal abstractions. On the other hand, our lives and many of our decisions and pursuits are influenced by what science informs us. I therefore find it reasonable to think that we have to conceive of the story of the impact of modernity as Lash argues – as consisting of two simultaneous aspects. One being the abstractions and grand systems raised in modernity only to be deconstructed; the other being the search for a ground that was always already there. This means that high modernity consists of two different kinds of rationality – one that is reflected in the occupation with abstractions in modernity and one that is concerned with the search for a ground beneath these abstractions. I have tried to argue a similar ground beneath science in modernity's abstraction and postmodernity's deconstruction in the three preceding themes: abstraction understood as reducible system, as mechanical calculus, as techno-progress. I have tried to keep away from postmodern deconstructions by focusing on the contributions made by philosophers and others that talk about ideas on forms of life, sensation, sociality, culture, nature as source, episteme etc.

10.1 The Irrelevance Position Revisited

The irrelevance position was presented as resting on modernity's conception of science understood as the conception of seclusion in Chapter 6. This conception was described as consisting of at least three central components, being a particular ontological understanding, the search for a particular scientific methodology and, finally, a firm conviction that the results obtained from science unrestrictedly assures progress for society. What I have aimed for in the critical approach is to show how this conception breaks down facing the insight that there is another modernity in play to use Lash's expression. I think he is right to suggest that there has been an undercurrent of thought throughout modernity that does not end up in a post-modern deconstruction, disillusion and nihilism, but instead starts to reconsider the pervasive subject-object, human-nature dichotomies of modernity.

The second modernity is, in my interpretation, engaged in ontological issues and with reinterpreting the role of objects as having existential qualities (as was investigated through the work of Løgstrup, Section 7.3) and as having an ontological structure that differs greatly from the prevalent conception in modernity (as was investigated through the work of Deleuze, Stengers and Prigogine in Sections 7.1 and 7.2). The second modernity is also focusing on the importance of other forms of rationality than those reached through formalisation and logic. We have witnessed an important theoretical deconstruction of the idea that science can represent nature absolutely through an artificial language in Wittgenstein's work in Section 8.2. The later Wittgenstein is often interpreted as belonging to the deconstructionist wing of high modernity – as an early post-modern critic – but I hope that my outline of his principal arguments has shown that he is instead to be considered a dominant figure in the second modernity. I see him as an important promoter of the idea that (scientific) rationality is not to be understood as exclusively logical in its judgements, but also as analogical. Finally, the second modernity is not exclusively about the promises of future progress by way of technological and scientific advances. It is just as much about promises of the value of the past – the necessity of a mythological dimension of life and the importance of historical settings and cultural heritage. It includes the idea that science has an important and non-neutral role to play in the shaping of the future.

What does this mean for the argument against the irrelevance position within the field of reflections in science educations? It means that I find it impossible to claim that science is nothing but an abstract endeavour of modernity's that is uninfluenced by the culture and history it is part of. And just as importantly, it means that science has a say in the forming of culture and history. My critical approach has tried to dissolve the idea that we will be best off by keeping science as secluded from our other doings as possible. On top of this, science and technology have already colonised almost every aspect of our culture – politics, health, the arts etc. etc. If we still act as though science is something exterior to culture, we cling on to an unfounded belief in the abstractions of modernity. Therefore we also cling on to the idea that scientists, in their capacities as scientists, are outside culture and therefore do not significantly form it. Therefore, in my best judgement, the irrelevance position cannot be maintained without distorting the picture of what it means to be doing science.

The preceding critique thereby makes it problematic to adhere to an ideal of keeping science secluded educationally. It is, as I see it, not possible to hold a position that isolates the scientific enterprise from the work produced by other parts of the universities or the remainder of society's doings. Ontological, epistemological, sociological and cultural presumptions are put into action every day through the work of the scientist. These presumptions are not malfunctions – they are the basis for doing science and they are always already there. But they are, on the other hand, in constant movement as part of the general scientific engagement with reality. It is an imperative for the science student to be aware that such presumptions rest at the core of engaging in the scientific practice at any given time. Without this knowledge, the risk of falling into absolutist reductions or methodological closures is too great.

10.2 Tensions

The critique of modernity's conception of science that I have presented above is not a unified approach, as several of the theories presented would find themselves alienated from other sources that I have used. Perhaps one of the most important tensions in my approach is that between the Wittgensteinian understanding of philosophy compared to that of Deleuze. To Wittgenstein, the task of philosophy is to clarify how we misunderstand language in numerous ways. Deleuze, on the other hand, tries to formulate a positive metaphysics and expressively claims that the philosopher's job is to think in ways that makes us see reality in new ways. I have not tried to bridge the gap between the positions presented, as the main objective in the critical approach has just as much been to demonstrate the multiplicity of critiques that can be aimed against the conception of science in modernity. And that is exactly what binds the theories that I have used together despite their differences; the search for better understandings of science than those of modernity.

However, I find that what both Wittgenstein and Deleuze aim for in their writings is to lead scientists, among others, in the clear of transcendental explanations of what they are doing. The anti-transcendental current in Wittgenstein's thinking rests on his understanding that there is a limit to the reasons we can give for what we are doing. Abstractions are always to be explained on the background of our practices as opposed to foundational or transcendental modes of explanation. Deleuze, for his part, is preoccupied with the ills of transcendental thought and wants to rid our thinking about the world from reference to the transcendent object, transcendent subject and the transcendence of communication. The transcendence of communication is interesting here, as some would claim that Wittgenstein is basing his philosophy on exactly this presumption. I see Deleuze's concept of communicative transcendence as an attack on most social constructivist theories and, for this exact reason, not the Wittgensteinian. In my understanding, Wittgenstein and Deleuze are both searching for the groundless ground of the second modernity – to use Lash's phrase – even though, in this case, the search has been performed by perhaps the most cautious philosopher and the most provocative philosopher of the last century.

Today, one of the most interesting differences in the conception of science seems to be strongly connected to the aforementioned tension between Wittgenstein and Deleuze, as they are continuously being used to back the arguments of each side in one of the dominating debates. I am thinking here of the disputes between the Strong programme in the sociology of science (including David Bloor and Barry Barnes among many others) and on the other hand Bruno Latour's actor-network theory. In his arguments, David Bloor repeatedly uses a Wittgensteinian conception of language games to support his position, and Latour is in his position strongly influenced by the writings of Deleuze (Bloor 1999a, 1999b; Latour 1999). Latour actually emphasises his connection with Deleuzean thinking and at the same time distances himself from what he sees as the French postmodernists like Lyotard and Foucault. Asked in an interview by T.H. Crawford, Latour explicitly connects his actor-network theory to Deleuze's concept of rhizome (Latour 1993)

The debate shows reminiscence of the classical debates in philosophy, like the realist/idealist debate and its newer transformation into realist/anti-realist debates. The important thing is, though, that these two different understandings of science are both critical of the modern conception of science that has been the main target in this part of the thesis.

Part III

POSITIONAL APPROACH
BEYOND THE SECLUSION OF SCIENCE

11. Introduction

I now aim to turn my study in a positional direction. I shall try to formulate a position on reflections in university science educations on the basis of Part I and Part II. The task is one of combining the ideas and positions that have been developed during the historical approach with the ideas arisen from the critical approach.

In the historical Part I, it was shown that the ascribed role of philosophy in relation to science gradually diminished in university science curricula. In Part II of the thesis, I have tried to show that this decrease in the role played by philosophy is connected to a particular conception of science, namely that of modernity. Science has been considered and celebrated as an enclosure throughout modernity. I have presented a thematic critique of the conception of seclusion, and through this work I have sought to undermine the educational irrelevance position. These efforts bring me in place to develop a positive educational position in the field of study. I shall call this position the 'borderland' position. The formulation of the reasoning behind this position will be the main task of Part III. It is my hope to develop the position in a way that brings with it some inspirational directions for the new courses to be implemented in university science educations – Fagets videnskabsteori (FV).

Contemporary positions in the field will be used as inspirational sources for the positional approach. The development ahead will, however, take as its outset a more detailed study of the recent political initiative to implement a new Filosofikum. The FV-agreement between the Minister of Education and the Danish Conference of Rectors gave us, as explained in Chapter 1, a number of guide lines with respect to the formalities of these courses (see Appendix I). To a large extent, the content of FV-courses is to be developed by the board of study in charge of a particular educational programme. Certain ideas can, however, be found in the report from the task group appointed by the Danish Conference of Rectors to clarify the official initiative for implementing a new Filosofikum. I will investigate these in Excurse II below in order to elucidate the political initiative for implementing reflections.

Excurse II – A New Political Initiative

In Chapter 3 on the Filosofikum prior to the 20th century, it became clear that there has been a strong tendency throughout the years to regard the Filosofikum as educative. Also when philosophers defended philosophy and the Filosofikum in the 60's, the justification they spoke of admitted to what we might call philosophical cultivation.

A notion of general cultivation or Bildung would hardly qualify, though, as a justification for a new Filosofikum today. At least, the thought of an educative Filosofikum, if by that one means that the *purpose* of the Filosofikum should be to provide general education, has been widely rejected in the current debate as well as the one that was prevalent before 1971. Also the philosophically cultivating Filosofikum meets opposition. The usual argument is that the general education of students is the responsibility of the secondary schools. If, for example, one is of the opinion that knowledge of general philosophy is essential for a cultivated person in today's society, this subject should be made obligatory in high schools, or so the argument goes.

What then is the justification for the FV-agreement? The reason for introducing FV is not to be found in some theoretical content or, more specifically, it does not rest on a particular philosophically important content. Thus, as we shall see below, the FV agreement was reached without anyone specifying the role of philosophy in relation to the aim of the course. Rather, the course is motivated by a wish to provide students with a broader understanding of their work within the framework of their trade. With these introductory comments in mind let us take a more detailed look at the political agreement about FV-courses.

The Introduction of Fagets Videnskabsteori

The feature article treated above (see Excurse I), written by Køppe, Emmeche and Stjernfeldt was widely regarded as the starting signal for the re-opening of a pro and con discussion about Filosofikum. Gitte Lillelund Bech and Hanne Severinsen of Venstre [the Liberals] and Knud Erik Kirkegaard and Brian Mikkelsen of Konservativt Folkeparti [the Conservatives] introduced a bill 25th of February 2000 concerning the re-institution of the Filosofikum arrangement in a revised form (Web folketinget).

This bill was inspired in part by the re-opened debate, in part by the Studium generale arrangement that Aarhus University had enacted internally. The Minister of Education's traditional Sorø meeting in 2000 further placed such a re-institution on the political agenda. Under the heading "Værdier i virkeligheden" [Values in Reality], the question of the Filosofikum was discussed at this meeting.

As a consequence of the discussion at the Sorø meeting and the bill introduced by the Opposition, Minister of Education Margrethe Vestager and the Danish Conference of

Rectors agreed to appoint a task group that would discuss the possibilities of some form of re-institution of the Filosofikum. Politically, it is worth noticing that the Danish Parliament on a very broad front wishes to re-establish a Filosofikum course.

After a number of meetings, the task group under the Danish Conference of Rectors put forth a final suggestion to the Minister of Education (Appendix III), who then made arrangements with the individual universities (11 institutions of tertiary education in all) to introduce what they agreed on calling ‘Fagets videnskabsteori’. These arrangements were not passed as law, though, as this would entail changing the university law, and besides, politicians were not interested in forcing the self-governing universities into an obligatory Filosofikum arrangement that resembled the one that went under in 1971. The Minister of Education then sent letters to the university rectors about the framework for the agreement that was the result of the task group’s work. The agreement has it, among other things, that before September 1st 2004, an FV-course should be introduced at all higher educations. Hence, implementation efforts lie ahead for the individual universities in the time until then.

The making of the FV-arrangement

Below I will describe the formal structure for FV through Hans Fink’s commentary on it in an essay from the Ministry of Education periodical “Uddannelse” [Education] no.3, March 2001 (Fink 2001), and in a presentation held at the seminar “Fagets videnskabsteori – det nye Filosofikum” [FV – The New Filosofikum] on June 25th 2001 in Odense arranged by a project funded by the Centre for Educational Development in University Science.

Hans Fink, who is a senior associate professor and head of the Department of Philosophy at University of Aarhus, was invited to describe the arrangement concerning FV, and in addition, he related it to the old Filosofikum institution. Fink was a central figure in the forming of the arrangement, since he was University of Aarhus’ representative in the task group under the Danish Conference of Rectors and also chairman of the task group.

Fink considered the above-mentioned seminar an important rearmament in order to get the FV running within the three-year timeframe. He therefore called attention to the deadline September 1st 2004, when the 11 universities must be ready to provide such a course in their bachelor degrees. In his presentation, Fink then turned to the antecedents for the mentioned agreement between the universities and the Minister of Education and, later on, to differences and similarities between the new and the old Filosofikum arrangement.

When the Filosofikum was abolished in 1971, the course was replaced by others, though at University of Aarhus, there has been a development that makes the Filosofikum situation here stand out compared to the situation at the other universities, as Fink pointed out. At University of Aarhus, the Faculty of Medicine had asked the philosophy department for a new course, the design of which Uffe Juul Jensen was involved in. Fink himself was involved in the design of a similar substitute course for the social sciences. University of Aarhus thereby laid the grounds for a different development than the one taking place at other universities. As it is today, only four lines of study do not have a Filosofikum-like course at University of Aarhus. Copenhagen and Odense Universities lagged behind in comparison in the years succeeding 1971, while the newer university centres in Roskilde and Aalborg went through a different development altogether.

In 1996, University of Aarhus appointed "Udvalget vedrørende Studium generale" [The Commission concerning Studium Generale]. Studium generale was envisaged as an obligatory course. Among others, the students' council supported the idea of this broad course, as they feared that the mass university would be turned into school-like education instead of genuine academic studies. Furthermore, it was generally feared that the faculties might extricate themselves from the university structure. In the daily press, the initiative was referred to as an attempt to reinstate the Filosofikum. Fink himself was on the commission, and it was indeed discussed whether a Filosofikum could be reinstated. For example, the very ambitious Norwegian Filosofikum model inspired the commission, though it would necessitate prolonging the study period, which was not a possibility, and in Fink's opinion this model was not desirable either. In 1997, it was decided to establish a Studium generale. According to Fink, it has not been an undisputed success so far, but the quality of each of the courses is constantly improving.

Fink then proceeded to talk about the bill that finally resulted in the FV-arrangement. As mentioned, the Liberals and the Conservatives had the idea in 1999 to reinstate the Filosofikum. They were inspired by initiatives that had taken place owing to the discussion of the Studium generale in Aarhus. As illustrated above, a task group under the Danish Conference of Rectors had been appointed to investigate the possibilities of re-instituting a new Filosofikum in some shape or form – this was an indication of respect for the autonomy of the universities. 10 universities had representatives in the group, only Danmarks Lærerhøjskole [the Royal Danish School of Educational Studies] was not represented, though they later signed the agreement. The arrangement that came out of the group's work is essentially similar to the Studium generale plans from Aarhus. Minister of Education Margrethe Vestager committed it to 10 paragraphs (see Appendix I) on the basis of a statement by the task group (see Appendix III). This 10-paragraph agreement was sent to the university rectors in a letter pointing out the formal framework for the new course. It was then up to the individual universities to work out the implementation.

The Content of the FV-agreement

At the seminar, Fink went over the particulars of the new Filosofikum arrangement by way of comparing it to the one that ended in 1971. Below I will look at the most important aspects and, in this way, attempt to relate as accurately as possible the intentions in the letter from the Minister of Education to the rectors and the task group's report.

The first point on which the FV differs from the old Filosofikum arrangement is the reasons for having a course in the first place. In 1971, it was a preparatory course for university studies that was meant to be educative at the same time. The FV-courses do not have the same foundation. In the task group, there was agreement that such undertakings belonged to high schools and out-of-school education. Alternatively, the justification for the course must be to make students better qualified, i.e. to enhance their capabilities in their trades. The aspects that once motivated the Filosofikum arrangement are, in this picture, merely side benefits.

Fink found that one argument for founding the course in this way was the increasing demand to bridge between fields of study. The interdisciplinary aspect is thus a crucial one. Furthermore, a broad range of politicians back the ethical dimension that the course can be given.

In elaboration of the question of content, Fink added that the sworn anti-philosophers were welcome to teach the course, as long as it worked. In this way, there are no specific theoretical guidelines for the content of the FV in the arrangement.

The reasoning regarding what motivates the FV does, however, have other indirect effects on the content of the course. Whereas the old Filosofikum arrangement consisted of history of philosophy, logic and methodology, the knowledge of which can be considered general proficiencies preparing the student for any higher education, FV must necessarily have a content adapted specifically to the subject that the student has chosen, for it to effect a higher professional qualification.

The matter is more complicated than this, since there is also an intention in the agreement to give the student insight into and overview over his or her own role as an academic person. This argumentation has been particularly at the fore in relation to the Aarhusian Studium generale. The content of FV thus revolves around reflection on the student's own field, the relation of this to other fields and the relation between the university and the surrounding society.

What exactly this will produce, it is up to the individual specialist board of studies to decide. Thereby, the content of FV is a balance between the special content that the individual education requires in relation to these objectives and a general content that is to provide students with an insight into university conditions, internal and external. Fink's own statements pointed towards a course that focuses on university history, theory of science and ethics, and together with a group of colleagues from University of Aarhus, he has written a textbook on these themes, which can be used as teaching material in the Studium generale courses (Fink 2003).

It is a natural consequence of the above argumentation that the responsibility for the introduction and for deciding on the more specific content of FV is placed on each of the individual boards of study. For the old Filosofikum arrangement, this responsibility rested with the philosophy department of each university, and this department also managed the instruction, but Fink believed that philosophers should take a step into the background today. Philosophy is not the Queen of the sciences, as Hartnack saw it in his day, nor is it the maid of the sciences, as other 20th century philosophers have argued.

This view, and the fear that a new Filosofikum imposed from outside the university would backfire leads Fink to conclude that the optimal solution would be one in which specialist teachers are integrated in the running of the course. The specialist teachers should be part of the course in order to strengthen its status at the educational facility. Thus, by virtue of the FV-agreement, people with double qualifications are needed to handle the teaching, since they must have professional insight in the subject as well as the competence to put the subject into a broad general, philosophical and science-theoretical perspective.

It is the intention behind the agreement between the Danish Conference of Rectors and the Minister, as reflected in this argumentation, that first and foremost, the FV-course must not become an alien subject in the educations. For the same reason, the agreement states that the course should have the same kind of examination as other courses in the education so as to strengthen the student's awareness that FV is not an element coming from without the education. Therefore the agreement proposes an exam consisting of a graded paper of 8-15 pages.

As a consequence of the changed content and of the motivation for the FV-course, it should not be the first one in the education; such as it was naturally the case for the old Filosofikum arrangement. For students to benefit from their reflections on the workings of their chosen branch of learning and its connection with other specialties etc., it is natural to place the course in the second or third year, as provided by the agreement. In this way, students have an opportunity to build up a professional identity beforehand, which will make the course more relevant and more profitable for them.

Furthermore, the agreement says about the formal framework that the FV course should be the duration of ⅛ - ¼ year's credit (or 7,5-15 ECTS), where the old Filosofikum arrangement in 1971 was worth ¼ year's credit (or 15 ECTS). The Studium generale courses at University of Aarhus count for 12-15 ECTS, but Fink added that there was not agreement within the task group under the Conference of Rectors to introduce a course of this extent.

The Implementation of the Course

Besides these formal and general decisions to do with the FV-agreement, Fink commented on several other important aspects. At the seminar in Odense, where he presented the content of the agreement, there was a persistent uncertainty among the participants as to whether the course would be realised considering the decentralised administration implied in the agreement. Fink's answer to this question is that there is no doubt about the "spirit of the contract" being that the introduction of the course is obligatory for all educations, just as it was for the old Filosofikum arrangement. Fink did concede, however, that the agreement is rather loosely formulated, which could lead some boards of study to believe that providing a non-obligatory course would suffice in order to meet the requirements. In the Conference of Rectors' task group, a majority were in favour of making the course mandatory, but there was resistance, especially from the natural sciences. Moreover, Fink believed that the risk of having a decentralised administration and whatever implementation problems this might entail was a risk worth taking far more than the risk of having a central decision-making body, as this might result in distancing, something he referred to as part of the motivational problem. In that connection, Fink felt that the label "Fagets videnskabsteori" [The theory of science in the field of study] could be misleading, as it makes one imagine a course with a narrow methodological aim for the particular field of study in question, which – as is evident – is far from the purpose of the FV-agreement. Fink himself suggested the name "Studium generale" that was used at University of Aarhus, but the Conference's task group rejected this. As regards the naming of the course, the Minister of Education made it clear that she would be indifferent to the title, as long as the course in the individual department is in concordance with the decisions of the agreement (Vestager 2001).

Generally, Fink was of the opinion that this was the strongest agreement one could realistically wish for. The Minister of Education investigated whether a law could be passed on the agreement, but as it turned out, this would have necessitated a change in the university regulations. On the other hand, it was possible to change the contracts between the individual universities and the Ministry without changing regulations, and this is what was done. The situation concerning the implementation of FV-courses is, however complicated by the fact that the rectors who have signed the agreement have no direct influence on the boards of study. Rather, this is the sphere of authority of the heads of faculty, and this might intensify the implementation problems having to do with the much decentralised management of FV.

Let me briefly highlight some of the key issues that should be kept in mind from the founding ideas behind the FV-agreement and connect them to the task that I pursue in the positional approach.

It is an important task to make sure that the alienation problem posed by the task group under the Danish Conference of Rectors will be taken care of. The Filosofikum suffered from this problem and efforts should be made that this will not be the case for the FV-courses. Also, it is of importance that the task group suggests that the content of the courses might be thought of as partly similar for all university students and partly specific focusing on the discipline in question. In other words, they suggest a division between general and specific content. What I shall aim to produce in what follows is not a contribution to the general content in the sense that it would necessarily seem relevant for all university students. It is, however, content that I will claim to be important for all science students in the broad sense I have used for the term ‘science’ throughout the thesis and the proposals are meant to be shaped to fit a particular field of study within science using its particular history and current shape as a source for this further development.

Let me now finish this introduction by reflecting upon the ideas developed in the critical approach, which I bring along in the positional approach. Based on the findings of Part II, the following is a pressing question: Are reflections in university science educations necessarily to be developed with a critical aim – namely of criticising and deconstructing a modern conception of science towards a postmodern understanding? My answer to this is no, as has been hinted at in Chapter 10. It cannot be the aim of such courses to criticise science into disbelief, or into a postmodern state of understanding scientific knowledge as relative to any other knowledge production we might think of. Science is capable of making things happen that we never dreamed of, just as it is a strong and indispensable source of knowledge and resources; both to our general understanding of what human life is all about and for the shaping of our future.

The "opening up" of science that I have tried to motivate is a departure from trends that can obscure the scientific enterprise, namely those trends that lead towards simplistic views of the systems of nature, towards reductionism in scientific methodology and towards a blind faith in the progress of society through any kind of scientific advances. Science should not be deconstructed to an epistemological level close to that of an astrological foresight. Science, in the perspective presented in this thesis, is to be understood as an incredibly strong and influential force – or potency in von Wright's phrasing – of Western societies. Its triumphs and massive influence on our culture is, however, exactly why we must ensure that it is not isolated from external perspectives concerned with its status and functionality and isolated from society in its development. In Løgstrup's vocabulary, we do not only have to worry about whether or not the scientific results are correct, but also whether or not they represent realistic accounts of the world. In this sense, it is considerations on the limits and capabilities of the scientific enterprise that I find to be crucial in a science-dominated culture. Not in the sense and with the conclusion that we need science to mind its own business but the exact opposite – that science cannot mind its own business and reflect only upon the proper abstract method for producing new knowledge as in classical theory of science courses. The borders of science with respect to ethics regarding the development of society or with respect to the ontological and epistemological prerequisites of science are fluent and need to be kept in open discussion within science and are therefore especially important in university science curricula. How we deal with these issues within science will influence our culture in general, and so will not dealing with them.

12. Beyond an Educational Seclusion of Science

The thematic critique in Part II of some of modernity's fundamental pillars regarding the seclusion of science served a reconfiguration of the conception of science. My general argument is that the critique of modernity's conception of science is an adequate starting point for developing relevant reflections in science educations. This chapter searches for the educational implications of surpassing the seclusion of science.

An intermediate zone between science and its exterior arises as science as secluded has been disputed. I will call this zone the *borderland of science*. This term covers the notion of an area where science and other spheres of human activity – the political sphere, the economical, the ethical, the sphere of the humanities and social sciences, the religious sphere etc. – interact. I understand the borderland of science to be a *space of discussions involving different and conflicting conceptions of science*. We have seen some such discussions in Part II. That it is a space of discussions does not mean that it is only about the way we conceive of science. It is just as much about the way we act and use science – about the way in which conceptions of science are embodied in our activities. That the borderland of science is an intermediate zone does not mean that it is an area to itself that lies in between science and other areas. Rather, it is to be understood as an overlap between science and other spheres. Figuratively speaking, it is a fringe area where the signals from different transmitters interfere with one another and defines a field of complexity that calls for a diversity of approaches in order to be explored. Also, the borderland of science is an area of uncertainty. It is the area where our scientific approaches meet their boundaries and where there is no clear path to follow for the questions asked.

We can think of the borderland of science as having a surface as well as a deeper level. We experience the surface of the borderland in the movie theatre, at the museum, in the newspaper, the nine o'clock news and at the UN conferences on health, hunger, and sustainability and in many, many other places. We also find this surface level within science in the interpretation of results and methodology applied to a given phenomena, in the images we draw on the blackboard and so on. The borderland of science is not an area outside science but a clash between deeper-rooted conceptions of science that surface in our minds when we discuss ethical issues with regard to cloning, find ourselves trapped between an existential and a scientific explanation, or discuss competing theories within science.

At the deeper level of the borderland, one locates and becomes aware of the conceptions of science in play and is therefore reflective with regard to the existence of the borderland. This level is seldom reached, because the agents in the borderland discussions are not always aware that different and conflicting conceptions of science are at stake or are not capable of formulating these conceptions. In other words, it is possible to be in disagreement with someone about, say, the prospects of human cloning or artificial intelligence, without seeing the possible differences in conceptions of science that may be at the core of this disagreement. At the surface level, participants in a discussion can easily end up talking at cross purposes, because the differing standpoints involved go deeper.

My general argument now, with regard to science education, is that knowledge of the deeper level of this borderland and an ability to explore dimensions thereof are necessary competencies for all scientists.

In the following three sections, I elaborate on the notion of the borderland of science. Inspired by the findings of Part II, I develop three dimensions of the borderland that revolves around discussions on the complexity of objects, on the diversity of approaches and the uncertainty about progress, in confrontation with their opposite poles, simplicity, unity and certainty. These dimensions span the borderland of science, in that I believe them to be essential discussions. In other words, a standpoint in these discussions is an aspect of any conception of science. There might be other aspects that these dimensions give less focus, and the division I make here is therefore to be considered analytical, i.e. not postulating to be the concluding description of the borderland of science. It is rather an outline that involves issues which I find significant in today's discussions involving conceptions of science, and that – most importantly – will spark vivacious debate and clarify the depths of borderland discussions.

12.1 Simplicity or Complexity of Objects

The first dimension of the borderland of science that I would like to emphasise has to do with the way we conceive of the objects and phenomena under investigation in science.

Through the critical work with newer theories in sociology, philosophy and philosophy of science, several interesting observations concerning the development of the system concept and its relation to the concept of complexity have come to light. These concepts are ontological concepts in the sense that they are employed in clarifications of what exists and what does not, and they have a bearing on how science interprets its objects and how it approaches them. I find that a first aspect of the borderland of science can be traced in and exemplified through these ontological developments. This first aspect thereby consists in discussions on the interpretation of natural and cultural objects investigated by science. In what follows, I shall try to corroborate the importance of such discussions.

With regard to sociology, Luhmann and Qvortrup's systems-theoretical standpoint provides arguments for interpreting science and other subsystems in society in a way that is radically different from how they were perceived in modern society. It was pointed out that Western society of today could be described as hyper-complex in contrast to modernity's conception. Within philosophy, we witnessed how Deleuze seeks to dissolve the simple tree-structure that thinking has, in his opinion, been trapped in during modernity. Stengers and Prigogine took as their point of departure that which they call the classical science that followed in the wake of Newton's physics. They endeavour to replace the automaton-perception held by this classical science with a new ontological understanding of nature as much more complex than previously assumed. Finally, as I have interpreted his conception of language, Wittgenstein sought to undermine any simple computational or otherwise foundational approach to reduce the phenomena of language and intelligence.

All in all, there is a common concern, in the treated points of view, that modernity's conception of the objects of nature and culture investigated by science has been too simplistic and too reductionist and deterministic. In this way, the idea of science as dealing with complex as opposed to simple objects becomes central. I see the general search for a more complex understanding of our systematic thinking than that of modernity as having an educational impact. The idea is that a strengthened awareness of the complexity of objects in scientific investigations will provide better science.

Let us take a closer look into the core of the discussions on simplicity and complexity of objects. The understanding of system in modernity has, as described, been touched upon earlier in different connections, and I will elaborate on some aspects of it here. Early modernity's understanding of society often implied a view in which the actors were the free individuals that create a society together, e.g. in a contract theory. If one was is to examine something thoroughly within such a view on society, one would take the actions of the individual as one's starting point in order to realise the principle of operation for the whole system of society. This way of thinking is mirrored in a classical Newtonian approach to scientific questions, in which one seeks to find the movements in the system's smallest constituent parts in order to derive the movements on macro-level. The individual movements of molecules are understood to determine the movements of a fluid; the qualities of genes are used to determine the behaviour of a human and so on.

An analytical method turns out to be connected to the sketched reductionist ontology, since this method assumes that a reliable basis is to be found in the parts, upon which knowledge of the entirety or the system can be built. The systems examined within this framework of classical science are considered closed, determined (and therefore also reversible) and computable, which is to say that they are subject to a measurable order that it is possible for us to penetrate. Within this picture, using the term 'complexity' has to do with the immense number of calculations that must be made in order to derive the movements on macro-level from the ones on micro-level, and chaos is considered a negative term, describing lack of order in a system. In classical science, the analytical examination of nature takes place within Descartes' three-dimensional coordinate system, which Newton interprets physically as a void abstract space, in which the objects of nature are placed in a particular manner at a given time. If one knew all the information about the placement of matter at a given point in time, the progression of the world for all future and past is calculable.

In this way, there is a connection between the analytical method from which the natural sciences as we know them today have sprung and the ontological understanding they display. The analytical method implicitly incorporates a reductionism in its explanation of the world, which leaves a trace in our ontological understanding and vice versa. The method of the modern project has been extremely effective and has brought us valuable insights. But the question here is not whether or not the thinking of this classical or modern science grasps a lot about how nature behaves (which it undoubtedly does), but rather if it takes everything into account, or if it fails to recognise other approaches to gaining knowledge of reality, and more specifically put with regard to the theme I pursue here, if there are macroscopic organisations of systems that we are unable to explain using an analytical approach.

With the going through of the different theories I have presented as background, I think the answer is that modern science does not and cannot take everything into account but is much too often presented as if it did. Furthermore, there actually seems to be phenomena that an analytical approach cannot explain – even relatively simple phenomena in chemistry and biology such as the ones presented to us by Stengers and Prigogine. In opposition to modernity's ontological reductionism I have tried to corroborate the idea that we can expect no deepest ordered level from which all our knowledge can be derived. In connection to this, we have looked at Deleuze's understanding of a system, the rhizome, with its machine-relational structure in a position midway between mechanicism and vitalism. Among many other things, the rhizome makes up the frame for a new way of thinking about the concept of complexity. The mechanicist complexity of classical science, seen as calculation-heavy mechanics is not compatible with Deleuze's reality, since the mechanicist understanding of complexity obviously treats the categories of time, space, object, mass, law of nature etc. as being primary to the differences of reality. Classical science does not, if we examine the matter closely looking at Boltzmann, Descartes or Newton, have an ontology that builds on differences but rather a universal order upheld by a small number of simple laws. The departure from this ontology decisively links Deleuze to Stengers and Prigogine's new pact with the universe and the understanding of matter as creative and self-organising. Chaos – the unordered, the differences – is, in Stengers and Prigogine's project, the very source of creation of biological and chemical forms of organisation in matter, as opposed to its role in classical science as something that must be explained away as ordered but impossible to survey.

But are these new explanations of nature and the concept of system not merely an indication that we have not yet analysed and measured everything adequately and deeply enough? Will it not be possible to find order behind the chaos that can explain the macro-structures we see, whether they are Benard's cells or a cow in the field? Answering this brings us into the area of physics, since this is traditionally the last stronghold of reductionism. Here, a fervent search is currently going on for "the grand theory of everything" that will explain all movement for a given physical system in one equation. It will still be a little calculation-heavy to use the equation on a system like the universe, but the analytical goal and the implicit ontological conception is clearly enough all the same. The world of physics has, however, acknowledged another aspect of matter that throws "the grand theory of everything" in relief. Quantum mechanics shows that matter displays a lack of order which Einstein and his followers had difficulty conciliating with the ontology of classical science. Bohr's Copenhagen-interpretation of quantum mechanics describes a nethermost chaotic level of the world that is not explainable through a reductionist understanding of nature. The concept of probability had to be introduced in order to explain the quantum mechanical phenomena, and God does in fact seem to play dice. Chaos and difference is not the unlikely fundamental condition, one might say, and from it only conditionally springs order that we can measure and weigh.

Hence, the criticism of the modern project's perception of system seems to have gained a foothold in the limits to knowledge that the science of the modern project itself has found in the course of the 20th century. What, then, constitutes a plausible view of system today? Stengers and Prigogine describe nature's systems as open, i.e. systems with a constant flow to and fro of energy, matter, etc. Thereby, they differ significantly from the systems with which the modern project concerns itself, as these are primarily closed equilibrium systems – a condition seldom found under natural circumstances. Furthermore, the "new" systems are indeterminate and irreversible, their behaviour unpredictable in principle, since their organisation cannot be traced to some deeper and fundamental, ordered level. Today, we are able to study the world under these premises in complexity theory, and these studies do not gain their insight from examining micro-level behaviour. Complexity in these studies does not mean calculation-heavy, but describes a system that cannot be subjected to an analytical investigation without loss. In some respects, this non-analytical approach comprises what is necessary to bridge the cultural gap between the humanities and social sciences on the one hand and science on the other. In complexity theory, concepts like 'history', 'structure' and 'becoming' move a big step closer to the vocabulary of scientific explanations, thereby nearing themselves to the methods of the sciences of the humanities.

Let us take a look at the educational concerns that the above discussion on ontological reductionism elicits. First of all, it reveals that a new way of system thinking is gradually emerging. I have tried to show that this tendency exists in different sciences and philosophies; however, it is an important point that it is not an absolutely dominant trend within these disciplines, but a trend of new thinking. In a sense I have tried in this examination of system-thinking to draw the picture of an episteme emerging within science that counters a common conception in modernity. The principal lesson that I would like to emphasise from the ontological considerations in this thesis, therefore, is that the methods and ontological preconditions of science are not static, but rather in constant movement; and not just in connection with what Kuhn called the scientific revolutions (Kuhn 1970, p.52), but in an ongoing process that can be given higher priority to the advantage of science. The different system perceptions that have been brought forward most importantly illustrate how ontological and methodological issues in science are constantly in interaction with perspectives and developments outside the world of science.

On the basis of the ideas presented above, I advocate that an awareness of ontological issues be brought into science educations. These issues must bring our conception of nature to the fore – a task I have tackled here through my focus on the system concept. This awareness is important not only because it deals with the preconditions for doing science, but also because it can be used to clarify the characteristics of a scientific approach to a given phenomenon. What seems to me to be the most pressing issue of ontological understanding with regard to science today is the problem of reductionism in our understanding of natural and cultural phenomena. This problem shows itself as an unfounded belief that nature and culture are governed by mechanisms, which it is within our reach to formulate within formal language and to grasp with respect to simply stated principles.

To sum up, the first dimension of the borderland of science, which is inspired by the initial discussion on the dichotomy between simplicity and complexity of objects, can be defined thus:

The borderland of science involves discussions on conceptions of nature and on the characteristics of specific scientific approaches to given phenomena.

12.2 Unity or Diversity of Approach

The second dimension of the borderland of science that I want to bring forward concerns the relation between the approaches of science and the approaches outside science to gaining knowledge of a given phenomenon.

The possibility of representing the world without loss through a unique scientific language was discussed in Theme I and II of Part II. Today, this possibility is dubious on the account of several scientific results. It is highly questionable whether even the simplest mathematical system of representation could in fact be considered consistent and complete if it involves the use of natural numbers (Gödel 1992). Also, the possibility of basing our representation of the world on the most basic entities of matter at quantum level seems to be questionable. In other words, science seems to have discovered its own borders in multiple ways that makes Leibniz' idea of an absolute representation of the world through an artificial formalised language impossible. In addition to these results of science, the basic conception of language that modernity has built its hopes upon were questioned through Wittgenstein's later works. His fundamental arguments concerning language shows us how we must understand the approach to our surroundings as something that takes place through countless numbers of language games, each with specific features, and not through a uniform approach. This is the case not only in our everyday enterprises but also in the different languages that govern our scientific endeavours. This impresses upon us the idea of diversity with regard to scientific approaches when describing a certain phenomenon, as I will try to argue below. From the significantly different and metaphysical perspective of Theme I, Løgstrup inspired the idea that we are always faced with the choice of interpreting the world as a causally governed system or as a phenomenological experience. It is Løgstrup's point that if we limit ourselves to the approach of causality and its implicit formal representations, we cut ourselves off from an understanding of the universe as our source.

Let me elaborate on some of the different notions of language that were discussed in Theme II of Part II. First, one could consider the relationship between natural language and formal language. I have argued in favour of the view that natural language is the generative basis of formal language. Formal language is a derivative of natural language, which draws attention to certain aspects of natural language. In this way I believe that we should not interpret formal language as the opposite of natural language as did for instance Frege and Russell in their efforts to construct a scientific language separated and secluded from natural language. Instead we should look upon the relation between them as formal language being a subset of natural language – natural language can express what formal language can express, but in addition, it can do a whole lot more.

When we use formal language in a certain area of life, we cut off part of reality, according to the view I have sketched here. We simplify matters within this field in order to make causal judgements about it. This is what the scientific enterprise is all about and it is one very important way for us to gain knowledge about our surroundings. Another way is to maintain complexity, ambiguity and the paradoxical, as it is done in the different forms of art and, to some degree, in the works of the humanities. We must proceed in this way in science but always bear in mind that we have, in Løgstrup's phenomenological conception, cut ourselves off from some of the attributes in a given phenomenon. What I made a point of criticising in Theme II of Part II is not that we use formalisation in science – we cannot do without formalisation even though it can be done with various degrees of quality – but that the conception of science in modernity had it that the world spanned by our formalism was the uncut and entire world. Here I think it is fair to talk about a blind spot of science. This spot represents what is cut off from reality in order to perform a scientific formal representation of a phenomenon, and it is not visible from this formal framework itself. In other words, we shape the world to our scientific approach in order to talk scientifically about it. If this preliminary process is forgotten afterwards, we can be absolutely sure that we shall misinterpret the results found.

I will claim that presently, there are still – especially in the public debate on scientific issues at the surface level of borderland discussions – misunderstandings about the answers that a given formalisation of the world can bring us. I would hold this to be true of the interpretations of genetic mechanisms, for instance, and also with respect to the fundamental physical laws of nature in general. They are too often presented to the television viewer as the essential truth about what goes on in the universe. Examples were given earlier with respect to the excessive attribution of power to the DNA (Subsection 7.1.5), and with respect to a calculus in relation to intelligence (Chapter 8). Is this the fault of science and the scientists themselves in communicating their results? Yes and no. If you listen to any top scientist in the field of biotechnology, my experience is that they obviously know very well from their experimental and theoretical work that for example the DNA is only one player in the highly complex forming of a macroscopic being. The news that reaches the media and the public debate is, however, not as reflected as the researcher might have intended it to be. I think we need to strengthen the awareness of these issues to the people that work professionally with science and this of course involves both researchers and teachers at all levels. If the claim, which I shall make in Section 12.3, that there is a close relationship between science and the shaping of a 'risk society', holds true, the importance of qualified reflected scientists in the public debate becomes all the more crucial. I shall try to clarify my point, that knowledge of a diversity of approaches to a given phenomenon is essential for scientists, using a recent result of applied statistics that – to say the least – caught the attention of the media.

In 1998, Bjørn Lomborg raised considerable controversy with his book, *Verdens sande tilstand*, and it was later followed by a revised edition in English, *The Skeptical Environmentalist – Measuring the Real State of the World* (2001), that triggered international attention. The theme of the book is the global environmental discussion, which is seen by Lomborg as being dominated by what he calls the 'litany'. The picture that is spread through news media on the state of the world is, according to Lomborg, a picture without good news. We are presented with catastrophes of hunger, hurricanes, stories about cases of devastating pollution among many other horror scenarios because of, in Lomborg's view, a basically unjustified belief that the world is going to hell! It is this basic understanding Lomborg is after and wants to replace with another basic understanding which states that things actually get better all the time when we consider the global environmental situation.

Lomborg analyses a number of subjects, e.g. hunger, pollution, extinction of species and waste deposit problems, and applies statistical methods to corroborate his claim that things are going better than the litany says. It is an important aspect of Lomborg's work that it is not new numbers that he is working on but the same numbers as those his opponents in the environmental debate have worked with before him, stemming from big international organisations such as the FAO and WHO under the UN

(Lomborg 2001, p.31). The fundamental argument of the book is, then, that any reasonable statistical analysis of these data shows how the litany has influenced the minds of people who have used the statistical data in the environmental debate to support their pessimistic foresights.

Lomborg's work is a meta-research study that examines the work of other researchers within the field, and we should welcome it as such. This is one point to make about *The Skeptical Environmentalist*. Another point to be made is, however, that at the same time, it commits the same mistake as the litany it opposes so strongly. Having read the book, one can only put it back on the shelf feeling that the statistical treatment of the data as presented by Lomborg is convincing. This has been seriously questioned by the UVVU (Udvalget Vedrørende Videnskabelig Uredelighed [DCSD – the Danish Committees on Scientific Dishonesty]) but I find their critique deficient, to say the least. If Lomborg's work has a serious flaw scientifically speaking, I find that it is similar to the one he opposes. Lomborg substitutes the litany with the 'praising' of future development through further technological research. However understandable this may be, if one considers the litany to be deeply rooted and always taken for granted in the media and research on these topics, Lomborg's work is not scientifically reflective on its own enterprise, in my opinion. His book does not thoroughly take up the limitations of the formal approach that has been applied through statistics. It may be that Lomborg is right about there being a decrease in the number of species that are extinguished, but the numbers hide that, for example, the Bengalian tiger is threatened. This may be an animal of special importance to the self-understanding of humans on this globe, not to mention the ecological systems of which it is part. And what ethical value is attributed to the hunted animals? These are questions of ethical values – anthropocentric or not – that statistical analyses will always hide and often overlook their engagement in. Statistical analysis is created in a way that excludes the value of particular events, and can therefore always only be part of the story about the real state of the world. Lomborg knows he has made such preliminary ethical choices, but finds that his starting point is the only reasonable option, and he presents it on one page out of the 352 of the book (Lomborg 2001, p.12). Many would disagree with him on exactly these issues, and this is where I find the real scientific debate should be focused and take place, and not exclusively with regard to statistical technicalities.

The most interesting feature about Lomborg's book is perhaps the measure of attention it received in the public debate. Lomborg is backed by a considerable public consentience, because he is not afraid to talk about what is right and what is wrong in the environmental debate. This attracts the media and influences the public opinion. It displays a feeling of lack in the public debate of science making a clear cut comment on what is right and what is wrong in for example the environmental debate. Science should present a given case to the public as complex, undecided, based on limited knowledge and so on, if this is actually the state of our knowledge in that particular field of investigation. We should be thankful to scientists when this is how they reply to our questions. But Lomborg's crusade against the litany very convincingly showed us how the production of scientific knowledge is also imbedded in power struggles – in this case about what path to proceed along in environmental issues. I think that the debate was an important illustration of the need for scientists to be reflected on the diversity of approaches that can be pursued in the study of a given phenomenon – in Lomborg's study, the state of the world!! It could have been a fruitful display of discussions on the limitations and capabilities of science.

Let me sum up two points that have been argued from the inspirational discussion on the diversity and unity of approaches to knowledge acquisition; the benefit of interdisciplinary studies and the connected issue about the capabilities and limitations of science. Interdisciplinary studies should be nurtured in order to support the idea that the university undertakes a diversity of approaches to knowledge acquisition. Improvement in understanding the capabilities and limitations of the results of science is another important and related feature of my general heading, "diversity of approaches". The problem, that may be emerging if these issues are not internalised, is scientism; with the omission of such issues, the educational setting could easily lead to an interpretation of the formalisms of science as the only source of knowledge.

A second dimension has now been added to the borderland of science, namely discussions involving conceptions of the boundaries of scientific explanations and the characteristics of other forms of knowledge acquisition.

12.3 Certainty or Uncertainty about Progress

My third exploration into the borderland of science concerns our conceptions of the impact of science on the development of society and culture.

On the basis of Theme III in Part II, the idea was set forth that the development of science can no longer be expected to obviously benefit the welfare of human life and society. Support for the idea that science and technology increases the human ability to survive in the battle against nature has reached its limits, and we therefore have to establish new understandings of how scientific advancements influence society.

The idea of progress was under critical fire in my effort to pinpoint what has been central to the conception of the relation between science and society in modernity. Two approaches to the study of the idea of progress were followed. The first was a sociological approach that focused on society's move from the one-dimensional anthropocentrism in modernity towards a polycentric view. The second approach focused on the historical influence of the idea of progress. The loss of belief in something sacred within our culture became Nisbet's prime target for understanding the deterioration of the idea of progress from the middle of the twentieth century. von Wright's thoughts on the connection between rationality and the idea of progress were also examined. Belief in human rationality as the guiding light for humanity's progress was conceived of as a myth. An important insight that I would like to draw from this study is the perception that progress is one of the fundamental ideas of Western civilisation but also that this idea to a large extent has been pressed forward by the idea of providence.

One highly important thing to notice about the different theoreticians discussed in Theme III is their common belief that the world is in a state of transgression from a dominant conception of life, namely modernity's. Their focal points are different in describing the force behind this development, but their conclusions bare resemblances. They all point towards the end of understanding science as the catalyst for progress. The loss of unambiguous and absolutely certain progress by way of the inventions of science leaves us in an altered situation. The advancement of science can no longer be interpreted as straightforwardly beneficial to society – instead we must describe it as highly complicated.

I have thus supported arguments on how we cannot think about the connection between science and society today in terms of outright progress.

How might we then think about this connection?

Excurse III – Contemporary Art

Let me take a short diversion to the contemporary cultural scene. Recent cinematic films have shown a considerable interest in the scientific enterprise – or rather the failures, limitations and uncontrollability of the scientific endeavour. This is not the same cultural reflection as Orwell carried out in 1948, as he was writing *1984*, or as Stanley Kubrick portrayed in his *2001*. The theme then was not that science was out of control but rather that it would take control. If we are not careful, Orwell instructs us, we will end up in a totalitarian society run by a technologically based Big Brother who is in complete control. The keyword for understanding *1984* was the suppression of humans through means of technology. Humans on the one hand and technology on the other are remarkably separated in early science fiction productions.

I do not aim to establish that this critique is exhausted or irrelevant today – it is anything but that. Another type of science fiction, however, has supplemented – and to a large extent substituted – Orwell's critique with movies that show us science and technology not in control but in lack of control over nature and culture. Countless American mainstream movies illustrate this, and Steven Spielberg's *Jurassic Park* is but one famous example of this. The general scheme is: the scientist tampers with nature (e.g. genetics) and causes catastrophic situations that strike back on the humans (often the scientists) who start out with a Titanic faith in the possibilities and inherent goodness of scientific and technological advances. This common type of mainstream movies could be summarised to deal with the theme of Pandora's box – a reflection, which corroborates Nisbet's argument that Pandora's box, is getting the better of the idea of progress today. One might interpret our concerns (or perhaps the worst part of our joint sub-consciousness) about the exploitation and devastation of nature for the benefit of mankind alone as being contemplated by our culture through a kind of cinematic catharsis. A chief aim of these movies could therefore be to warn against the possible effects of advanced technology and in this respect, they represent an interpretation of the conditions a 'risk society' imposes on us.

But our cultural (science fiction movie) production is able to give even more profound formulations of the current relation between science, nature and society. In my opinion, *Minority Report* (2002) and *Blade Runner* (Do Androids Dream of Electric Sheep?) (1982), both based on the science-fiction novels by Philip K. Dick (1928-1982), do just that. Let's take a look at *Minority Report*. It tells the story about a cop from a not too distant future in charge of a project called Pre-crime. Pre-crime is a high-tech-system that can foretell future murders that will occur within hours or, if premeditated, within days, making intervention before the crime possible. This has almost stopped murders from occurring as we enter the scene. The basic components of Pre-crime are the three oracles or pre-cogs – mutant human beings with extraordinary sensitive minds – and their connection to the high-tech-Pre-crime-system. The superior oracle functions as a symbol of nature from which science and technology draw their predictive power. However, at the same time she represents what is an essential part of human life – sensation, knowledge of the body and in particular: unrestricted contact with ones feelings and sensations.

The cop who is the main character, on the other hand, is a man that has lost contact with his feelings. Only by taking drugs can he reach a sensitive state that makes life bearable. He is a firm believer in the Pre-crime system and illustrates its capacity and the validity of its predictions to a colleague by rolling a ball over a table towards the edge, saying that if no one catches it, it will inevitably fall to the ground (i.e. if no one stops the would-be killer, there is no doubt that he will kill). Humans are literally reduced to mere physical-psychological machines in the Pre-crimean worldview.

The course of the film leads the cop and the Pre-cog, not in the arms of each other, but rather in connection with each other's fundamental characteristics. At a crucial moment, they are depicted in a Janus-head profile and only then – in their mutual complementation – they become human beings in the full sense of the term, where they are able to make ethical decisions and determine the course of their lives. In *Minority Report*, humans are defined as human beings not by becoming liberated from technological bureaucracy and control, but by the impossibility of being described exhaustively in scientific terms. As the movie progresses, it becomes more and more obvious that the Pre-crime technology has flaws – a "minority report" (a discrepancy in the three oracles' predictions) now and then occurs, which highlights the point that our technology-based decisions have limitations. And a "minority report" is not only an effect of the complexity of nature or society. It is portrayed as the cornerstone of our human condition between reason and feeling, mind and body and is perhaps better formulated as the condition between mind, body and technology as it is technological designs that bring the two characters together. Science fiction movies have, within recent years, moved closer to the interplay between these three concepts, which can be summarised as an interest in the cyborg.

The capability of science is limited in *Minority Report*. This can be seen in opposition to *1984*, where the possible control through science and technology was considered unconstrained and *Jurassic Park*, where science is also highly capable but its impact on society totally uncontrollable. In *Minority Report*, the effects of science are limited because the nature of nature – even in its human form – is fundamentally beyond our grasp. To complete the all-swallowing scientification and technologisation of our life world, thereby making us technologically unable to kill each other, is at the same time portrayed as killing what is most human in us. In this way, the element of suppression is also in play in *Minority Report*. But this is not all. Not only is the message that we cannot expect to benefit from letting technology colonise our life world without constraint, but also that it is impossible for science to reach certain goals – e.g. to explain away human action as determined by the scientific laws of society and nature. I find that a key idea for understanding *Minority Report* is the 'borderland of science'.

Aporism

If we give up the thought of progress as an obvious continuance of the ongoing development of science and technology, we need new concepts to speak about the situation that this development puts us in. The following description and reflections with respect to the concept of 'aporism' is one such effort to explain what our current situation consists in. My point of departure will be to draw upon the theoretical consideration behind this concept posed by Ole Skovsmose. In *Aporism: Uncertainty about Mathematics* (1998), he suggests that mathematics has a formatting role in society but that this structuring of society is anything but easy to pinpoint. What Skovsmose calls the Vico Paradox is used to express how we can conceive of this problem of uncertainty. Vico thought it blasphemous to believe that humans could conceive the creations of God – that is, God's creation of nature and universe. Only the creations of the human and therefore limited mind would it be possible to fathom. But what if the social functions of mathematics are as inconceivable to us as Vico believed God's creations to be?

Skovsmose argues that we are surrounded, not by nature, but by techno-nature, and mathematics is part of the structure of this techno-nature. It is suggested that the fundamental categories of what we must refer to as techno-nature are continuously modulated and eventually constituted by mathematics (Skovsmose 1998, p.91). To mention but a few examples, these categories emerge in credit cards, life insurances, health statistics, grading systems, stock markets etc. The mathematics present and constantly modulated in these systems is not best described as "applied" – it constitutes or formats our lives and characterises our specific culture and life form. This interpretation opens a sphere for ethical considerations in mathematics as 'aporism' represents an epistemological uncertainty about how to understand and criticise the social agency of mathematics.

Let's take a closer look at the meaning of the word 'aporia' in order to get a deeper understanding of how we can interpret Skovsmose's idea of aporism. In order to learn you must first reach an aporia! This English saying means something like the place in your understanding where you realise you do not understand. It reflects, at the same time, a point of total confusion from where you can and only can start to learn. Aporia in logic and philosophy refers to a difficulty encountered in establishing the theoretical truth of a proposition, created by the presence of evidence both for and against it (Webster's 1996, p.99).

In order to enlighten the etymology of the word aporia, I here refer to a study by Sarah Kofman. In a direct translation from Greek 'aporeo' means something like "lacking a path, a passage, a way". 'Aporia' is related to the Greek concept 'aporos'. The Greek word 'poros' can be contrasted to the likewise Greek 'odos' which can also mean "a path", but under circumstances where the road ahead is known in advance – a path between two known entities. 'Poros', on the other hand, refers to a passage across a chaotic expanse where there is no trail to be found (Kofman 1988).

In Plato's Meno, we see the classical use made of the term aporia. Socrates leads a slave boy into a state of aporia where he does not know how to go on. According to the philosophy of Plato-Socrates, this is the state from which all true learning commences, and it is a state of transition out of doubt. Subsequently, Socrates helps the slave boy to find the true knowledge through a logical path that ultimately leads to the known and predetermined result, namely of the area of the square. The point to be made here is that Socrates did bring the slave boy into a state of aporia where he was without any sense on how to proceed, but nonetheless and most importantly, the trail was already there to be found or recollected and the slave boy found the 'odos' between the two known entities. A state of aporia may thus have an 'odos' leading out of it, but this is not necessarily the case. It could just as well be that the trails were nonexistent in advance – that we will have to lay down the trail (the 'poros') for the first time.

In this sense, we are facing two different situations of transition out of doubt; one that is a path of *progress* towards a predetermined known (an odos-path), and one that reflects a journey into a territory lacking a trail (a poros-path). The excursion on this path is not one of guaranteed progress, but rather a path of *uncertainty*. We could speak of the idea of uncertainty as opposed to the idea of progress. What Skovsmose refers to as epistemological aporism becomes a philosophical foundation for the idea of uncertainty.

I propose to emphasise the idea of uncertainty as characteristic of the situation we face in our efforts to produce new scientific advances. The idea of uncertainty is meant to highlight that it is not sufficient to consider only epistemological and ontological issues in science education – one must also reflect upon the impact on society and vice versa. The idea of uncertainty inscribes the risks attached when we pursue a given research goal and thereby raises ethical considerations.

Paideia, Techne and Aporia?

I would now like to contrast the idea of uncertainty with that of progress. As used in the context of this thesis, each of them signifies a particular conception of the development of future science and technology. I will try to contrast them by using some of the insight gained through the historical approach of Part I.

Hartnack's position contained some of the most interesting concepts in the historical part. He set up the dichotomy between the Greek concepts of paideia and techne in order to reflect upon our different relations to and conceptions of knowledge. Paideia referred to the attitude towards science that because man is a creature of intellect – has an intellectual potential – he seeks to fulfil this potential through science in order to complete himself. In opposition to this, techne is the notion that science is about man controlling nature to his advantage. Hartnack considered Plato the advocate of the paideia-conception, while Bacon was considered an advocate for the techne point of view, and Hartnack further stated that these two views make up the poles in our perception of science.

On the basis of the critical approach, one might ask if these two are still the poles of the different relations to science of relevance today. I will subsequently suggest that another dimension is needed in our understanding of science, but let me first comment on the dichotomy set up by Hartnack.

It seems even more impossible than in the sixties to separate the two conceptions of science today as discussed earlier on (see the introduction of Chapter 9). Hartnack's two poles may, to some extent, be seen as representing "pure" science and "applied" science. If these aspects were once possible to abstractly keep apart from one another as science and technology, it seems today to be an abstraction falling short of the interplay between them. To further elaborate on this point, let me refer to the notion of 'risk society' that has become increasingly used in sociological theories during the last decades. Its roots are closely connected to the earlier addressed transformation of Western societies in the late twentieth century (see Section 9.1).

In his article, *Politics of Risk Society* (1998), Ulrich Beck presents the main arguments for the theory of risk society. First of all, risk society signifies a change in which anxieties concerning what nature can do to harm us are substituted by worries over problems constructed by ourselves against the good of nature. Examples of such anxieties could be the worries over effects of the nuclear power industry or the biogenetic industry. Interestingly (and perhaps even terrifyingly!), the modernisation measures taken to prevent nature from harming us are interpreted by Beck as the force that generates the risks posed on nature (Beck 1998, p.10).

Secondly, risk society distinguishes itself in being the society where tradition cannot be used to justify our ways of living. This goes for all departments of life and increases the amount of decisions and calculations we have to make about our lives and our society in general. In systems-theoretic terms, this increase in the amount of decisions to be taken has not just increased, but can also be considered a hyper-complex condition.

As a consequence of these distinguishing features, risk society denotes a conception of the world in which it is hard to distinguish nature from culture. I comply here to Skovsmose's emphasis on the term techno-nature. Beck refers to Bruno Latour's argument that risks in present society are man-made hybrids of politics, ethics, science, mass media and technology (Beck 1998, p.11). Risk society thereby becomes 'reflexive', meaning that society becomes an issue and a problem for itself.

In the traditionally based society, where nature and culture were seemingly parted, science was an authority and the solver of our problems. Now instead the sciences themselves pose serious problems for society. According to Beck, the old conception of the relation between theory and experiment has vanished. In risk society, we see the need to experiment with biotechnology, test-tube babies or nuclear technology in order to understand them. Testing these technologies cannot be done under classically closed circumstances. In other words, society becomes an experiment. Mistakes therefore become incredibly dangerous, as is or may be the case with nuclear power plants or gene-manipulated crops etc.

Therefore, Beck's sociological conception points towards the need for redefining what a scientist is and how science interplays with society. Uncertainty becomes more than an exterior term within the university curriculum when viewed through the scope of this theory. It becomes an essentially integrated part of the activity of doing science.

I would like to suggest that, in addition to the conceptions of paideia and techne, another dimension has to be added to our understanding of science, namely the dimension of science as the producer of problems and solutions to problems alike. The concept of risk was tied to the view that it is uncertain what scientific advances will bring along. 'Risk' underlines how humankind does not unambiguously change the condition of the world for the better through its scientific advances; science also produces serious problems for society, nature and the intermediate zones in-between. Besides a perception of science as an expression of human intellectual needs and as an advantageous activity in the struggle against the dangers of nature, we must add another dimension that focuses on the uncertainty that is an inherent part of the inventions of science and technology.

But is not a risk conception of science easily included in the utility notion in Hartnack's spectre of views on science? The answer to this question must be negative, because while the utility notion involves an ingrained belief that the development of science will bring progress for man in the struggle against nature, the risk conception is about both man and nature being in possible danger from man's activities. Nor can the concept of paideia encompass the uncertainty intrinsic to science. Even though Hartnack describes the difference between the Platonic and the Baconic as the difference between knowledge as understanding and knowledge as skill, with Hartnack, understanding means a deeper epistemological and ontological insight into one's knowledge – it does not entail knowledge as including risks. A new triangular conception is spanned by the concepts of understanding, skill and risk.

By introducing this more complex notion of humankind's relation to science and technology, an ethical dimension to the enterprise of doing science has consequently been introduced. It is not a number of ethical demands that must be complied to or a set of rules for the internal conduct among scientists themselves. It is instead an ethical dimension in our relation to science that makes us conscious about the impact that science has on the human life world. Science is capable of changing the way we behave, what we consider ourselves to be and how we think. Ethical considerations are therefore increasingly becoming an element in the development of science.

The real message I want to emphasise with the risk dimension in our conception of knowledge is that there is no master plan of progress that the development of science will follow in the future. To develop science is to change things with the choices and risks this involves.

Let me state this as an important aspect in my search for relevant reflections in science university curricula, namely that the understanding of science as entailing progress could be challenged by an understanding of science incorporating the idea of uncertainty. An important aspect of a turn towards an adequate understanding of science involves a focus on the shaping of societies and individuals by science and thereby a focus on the ethical discussion about what we want science to focus its force upon.

I see this topic as an important element in science reflections, as it will enable the science student to take up a discussion whose preliminary insight is that the tracks are not laid down as to what science will look like and be engaged in in the future. It could open up the possibility of discussing what we want to do with science for the benefit of society instead of assuming that science is intrinsically beneficial to the development of society no matter how it proceeds. Such discussions will produce better scientists, as they will be strengthened in the process of formulating research agendas and additionally will be reflective about the role they play in the forming of not just the future of science but also our future culture. Without such ballast, science is most likely to be interpreted as the result of a predetermined journey towards progress.

A third dimension of the borderland of science involves discussions on conceptions of the impact of science on culture.

Excurse IV – Borderland Courses

In this excurse, I bring forward two contemporary courses that, in my judgment, are exemplary of courses emphasising borderland discussions. They take place in two very different areas of science education – at the Center for the Philosophy of Nature and Science Studies under the Faculty of Science, University of Copenhagen, and at Centre for Bioethics and Risk Assessment under the Royal Veterinary and Agricultural University, Denmark. The first course is developed mainly by Claus Emmeche and the second mainly by Peter Sandøe. Emmeche's reflection course, "Philosophy of Nature", which has been offered for many years, is in a transition phase towards meeting the new FV-agreement and is therefore now called "Theory of Science – philosophy of science, foundational issues and world pictures" [Naturvidenskabsteori – naturvidenskabernes teori, grundlagsproblemer og verdensbilleder]. The version of Sandøe's course, "Introductory Philosophy Course for veterinary Students" [Veterinærmedicinsk videnskabsteori], that I will describe here stems from 2001, when it was a pilot project for the FV-agreement.

I by no means suggest that the organisers of these courses would be in agreement with regard to their conception of science, but rather that, in my interpretation, both courses and the reasoning behind them are good examples of courses dealing with the borderland of science. That is, I find that both courses incorporate the three dimensions of the borderland I have presented above, and that in their positioning, both Emmeche and Sandøe show signs of being occupied with the formulation of the borderland.

A Philosophical Course on Nature

"Theory of Science" is open to students who are wholly or partly attached to the faculty of science, but a parallel course exists for humanists, also concerning the theory of science. The course has been worked out by associate professor and head of the Center for the Philosophy of Nature and Science Studies, Claus Emmeche. I will use an article written by Emmeche called "Naturvidenskab – sand almen dannelse" [Science – true general Bildung] as well as the course homepage in an effort to present the shape of and the ideas behind the course.

As its previous name ("Philosophy of Nature") suggests, the course is a philosophical one that takes its outset in the concept of nature. An awareness of the three dimensions I have argued span the borderland of science all seem to be comprised in Emmeche's course in his own description, below.

> *The purpose of this 'filosofikum'-like course is to introduce participants to the nature-philosophical discussion of concepts of nature, views of nature and world pictures and to the modern science-theoretical debate on science, hereby contributing to participants gaining an overview of the possibilities and limitations of their field of study, its relations to other fields and to the society of which science is part.* (Web nbi)[45]

Emmeche contends with the question of justification from an understanding that technology and society have made living nature a fragile phenomenon, where science is both the messenger of information and knowledge about this fragile nature and the instrument for curing this fragility. In this situation, Emmeche suggests that a certain constructive postmodern type of science Bildung is needed in the educational system. He defends a position on Bildung that does not take the path of social constructivism – a part of general cultural relativism. Cultural relativism is explained to be the idea that each culture is special due to a specific socialisation process, which ultimately means that no general Bildung can be claimed (Emmeche 1999). Instead, an intermediate road of constructive postmodern Bildung must be pursued in a society that is becoming aware of the problems created by the advancement of technology, science and wealth. It must be midway between the classical Bildung of modernity, as developed in Humboldt's humanism, and a postmodern meta-Bildung. Emmeche addresses what this means for nature-philosophical issues in a constructive postmodern Bildung:

> *The postmodern philosophy of nature is "metaphysics light"; a light metaphysics understood as having room for a self-ironic twinkle when confronted with any limited narrative that seeks to comprise all things, e.g. "the history of nature".*

> *All narratives, science included, i.e. also narratives that honestly strive for the scientific common standards like truth, public accessibility, clarity, verifiability, observability are subject to the hermeneutical principles of context, interpretation, metaphors, subjectivity (of the narrator as well as the recipient), limited horizon and background knowledge, etc.* (Emmeche 1999)[46]

On the basis of these considerations on a general Bildung, Emmeche draws up a number of themes that should be part of the educational system and studied by all, as they are of great importance for people living in what he refers to as a risk society. These themes have to do with knowledge about nature, science and the limits of science. Four different themes are presented, namely “knowledge about nature”, including ontological considerations with regard to e.g. complex systems and determinism; “knowledge about science” which focuses on the methods, history and social aspects of science; “the limits of science” which deals with the problem that science seldom recognises its limitations itself – sociology, ethics and sociology of religion play an important role in this theme; and finally “The values of science” which considers the likenesses between democracy, human rights etc. and the values of science.

In addition to these, a certain number of themes are also mentioned that are of importance to the Bildung of those studying science at the tertiary level. Emmeche mentions the ability of cross-disciplinarity, a broad orientation in the field of study, having practical abilities in communicating science to those outside the limited circle of colleague’s and an understanding of other types of disciplines outside science. These themes are conglomerated in what Emmeche refers to as the avoidance of narrow-mindedness within the perspective of a particular discipline, or in more positive terms – a philosophical and scientific knowledge of the system one is working with, that there are several such systems, and that these systems are not necessarily reducible to one another.

These are some of the ideas of Emmeche’s that guide the content of the Theory of Science course at University of Copenhagen. But the course is, at the same time, dominated by the idea that it is a forum for all the questions and themes that might surface from the students as well.

> *It should be emphasised that the course speaks in many voices, the students’ as well as those of the many lecturers: reductionists meet anti-reductionists, atheists meet believers, humanists meet scientists. Philosophy of Nature is an area for debate and posers, not an area for doctrine and orthodoxy.* (Web nbi)[47]

I therefore see Theory of Science as based on the assumption that science has to be kept non-secluded and the course tries to develop a safe haven for students that show interest in what their metier is all about, seen from a broader perspective. Let me conclude with a reminder that the four themes that Emmeche advocated for lower level education are not implemented today. This means that many science students start out lacking in these types of knowledge at the tertiary level.

A Veterinary Medical Course

Let me now move on to another contemporary reflection course that I find exemplary of a course dealing with the borderland of science. I will use my observations of the course to illustrate how reflections in science educations can be brought into the lecture hall. Subsequently, I will show how a concern for the communication gap between science and its exterior can be argued as a fundamental reason for introducing reflections in science. As was the case for the Theory of Science course, I find the veterinarian FV-course to be dealing with all three dimensions of the borderland of science.

In the fall semester of 2001, KVL had a new course in its programme. It was a test course for the new FV-courses, for the students of veterinary medicine, developed by research professor in bioethics, Peter Sandøe. The course aimed to introduce project work to the students in addition to the general ideas of the FV-agreement, but I will leave this out in the following, focusing instead on the content of and justification for the course.

The overall aim of the course was, first and foremost, to make students reflect on ethical issues. This was done through an elucidation of the duties of a veterinarian, and the outline of objectives stated that a historical and social perspective was to bring about such reflection. The benefit that students derived from the course was measured in their ability to identify and analyse ethical issues in connection with the work tasks of the veterinarian and humans' general use of animals.

Apart from this focus on ethical issues, there were furthermore two main goals of the course. One was to provide an understanding of health- and illness concepts in connection with the veterinary field, and another was to provide a deeper understanding of the scientific ways of thinking that have influenced our relationship with animals through time. Thus, in the formal declaration of purpose, it is stated that students should have

> *…gained a certain overview of the scientific mode of thought in a historical perspective, and to have made themselves acquainted with different views on animals which are connected to different scientific traditions and other modes of thought – including the question of animals' ability to think, feel, and animals understood in ethological, ecological, genetic, molecular-biological and other scientific terms.* (Web kvl)[48]

I see the topics outlined as an example of a veterinary edition of central discussions in the borderland of science, as I have presented it so far. It focuses on the research objects of science (how they have been conceived of in history) and also how different modes of thought (approaches to knowledge about animals) have a bearing on the way we treat animals. Thus, the course can be summed up as follows: 1) ethical issues in connection with keeping animals, 2) the role of the veterinarian in this ethical problem field, 3) an understanding of different historical and current modes of scientific thinking about animals and 4) an understanding of the sickness and health concept. Of the philosophical disciplines, the ethical has priority in this course, but as can be seen, a number of different science-theoretical issues that are relevant to the veterinary field in particular are also included.

The veterinary medical FV-course is structured into three main parts. Firstly, there are lectures in which a visiting lecturer and the course teacher collaborate on lecturing on a theme. The second part of the course is practical classes where the material lectured on at the previous lecture is worked through. Finally, the third part of the course is the drawing up of a more substantial project report, which is based on group work. The project has to be on one of the themes that have been expounded in the lectures, which is why this part is placed last in the course, while the two first parts run simultaneously. There are two hours of lectures and one practice class a week.

In the following, I will describe in more detail two of the course lectures, which I attended myself. These lectures thereby work as an example of the specific content of which the course consisted. Additionally, the following descriptions of actual lectures in the course will bring us close to the educational setting in one of the first and most progressive FV-courses that took place. Afterwards I shall expand on the reasoning supporting the course through an article written in part by Peter Sandøe.

Lecture #4 October 1st, 2001: Keeping exotic/wild animals

Zoologist Bengt Holst first had 25 min. to lecture on the theme. He started out talking about what history can tell us about the keeping of exotic animals. In the 19th century, exotic animals were shown in market places, where they were personalised in various ways, which often meant that they were ridiculed. The way of presenting the animals has developed from the menageries of those days to zoos and lately to what is known as conservation centres.

The zoological garden distinguishes itself by having a predictable and simple environment, and animals' behaviour follows this environment. By contrast, nature is an unpredictable and complex environment, and therefore one of the dangers in running a zoo is that you could make the environment too simple. There ought to be some difficulty in obtaining food, and feeding the animals whole carcasses is more lifelike, though this is prohibited in many places.

Next, Holst discussed the question of animal welfare. This question is at the core of disagreements as to the best way to run a zoological garden. Should naturalness be a measure for this? Or perhaps the number of offspring produced? The lack of negative behaviour? Holst argued that we must assess conditions differently, depending whether we are talking zoo animals, domestic animals or pets, since these have different functions.

After Holst's presentation, there was time scheduled for a few questions. After this, Sandøe started his lecture. He began with a brief response to evaluations of the course as it had yet proceeded. There is an ongoing evaluation of the course by students, and some has argued that the ethical theories (such as utilitarian and deontological ethics) were unnecessary, but Sandøe explained that they were needed in order for students to be able to put words on such issues.

After the evaluation, Sandøe addressed himself to the issue of what it is that we are trying to preserve and protect. Three theories offer an answer to this question, namely a human centred theory (contract ethics), a theory centred on consciousness and a life centred theory. Sandøe then put forward different answers to the main question and related these to the three types of theories. One issue throughout was the question of what constitutes untouched nature. The dichotomy between nature and culture was problematised – areas of original nature are limited in Denmark. Another question that presents itself in this connection is whether or not domesticated animals count for as much as wildlife? As an example, Sandøe mentioned that he was curious as to whether the new elephant grounds in Copenhagen Zoological Garden will try and give visitors the impression that the recently acquired animals are wild, even though they are thoroughly domesticated animals received as a gift to the royal family when travelling in the Orient. Finally, Sandøe turned to the discussion of what the veterinarian's role in all this is.

Both lectures were presented using overheads with pictures. Very few students took notes, but the level of concentration seemed high. After Sandøe's lecture (approximately 30 min.), both lecturers went on to take questions from the students. There were a lot of questions, and quite a few specific problems were taken up, dealing directly with legal issues and the like. Sandøe concluded the lecture by pointing out the ethical discussion that a veterinarian must enter into with his surrounding world in order to come to some clarity about the questions that had been raised.

Lecture #5 October 8th 2001: Limits to treatment of family pets

Veterinarian Annemarie Kristensen first addressed this topic on the background of her own practical experience. One main question was whether or not family pets should be given chemotherapy. She brought up a number of factors that need to be taken into account in making this decision: emotions, our knowledge, the well-being of the animal, the relative prolongation of life, side effects, safety and ethics. Kristensen explained that 1 in 10 owners are interested in having their animals treated with chemotherapy.

After this introductory description of the problem that many veterinarians will face, she put the problem concerning cancer illness into perspective by relating it to other illnesses and different types of procedures on animals that we find easier to accept. Her overall conclusion was that the limits are individual in this ethical question. The veterinarian can, however, look to the law of animal protection and the council for animal ethics for guidance. Kristensen also pointed out that supplementary education is needed in the field and highlighted the importance of the new Filosofikum course in this connection.

Sandøe then began his part of the lecture. He talked about the term 'unnecessary suffering' and informed the students that a Ph.D. scholarship was being offered on this subject. In his discussion of this topic, he included a historical account which, he pointed out, is part of the new Filosofikum course and shows how, these days, the veterinarian's attention to the individual animal concerns pets, whereas earlier, this was the case for domestic animals (cattle and so forth). In the farming industry, there is no longer a financial foundation for such treatment and focus on individual animals, and so the use made of vets has changed over time. Besides the financial aspect of the owner's choice, there is a social context to be taken into account. It is probably not enough that owner and animal can live with Fido running around on three legs if they are both stared at in the street. After this outline of historical, financial and social aspects of the concept of 'unnecessary suffering', the drawing of limits between owner's needs and the animal's welfare was discussed.

The next concept to be subjected to philosophical treatment was ‘limits to treatment’. Here, Sandøe brought up the notion of autonomy as the distinguishing feature of man. He argued for the standpoint that endorses putting down some animals in order for others to thrive. As an example, he talked about putting down pups in litters of more than eight, where putting down some of them will give the others a quality of life that they will not have unless we act. Subsequently, he discussed practical destruction vs. the notion of saving animal lives. Furthermore, the problem of genetic deficiency was included in the discussion. Can or should the veterinarian intervene and prevent the spreading of such illnesses in order to avoid sick offspring?

As a passing remark and in conclusion to his own discussion of the problem, Sandøe suggested that psychology be included in the veterinary education. The psychological aspect plays an important and even decisive role in the work veterinarians do when having to decide on the appropriate treatment.

Sandøe’s presentation was followed by discussion among the class and both lecturers. Among other things, this discussion was about the differences in what is allowed, depending if one is dealing with domestic animals or pets, and about the destruction of animals suffering from rheumatism and the norms concerning the keeping of animals in flock if they are naturally gregarious.

The General Perspective in Science

In cooperation with PhD.-student Gitte Meyer, Peter Sandøe has, in the publication of the Ministry of Education *Uddannelse 7, 2001*, presented some of the reasoning he sees as vital in the formation of reflection courses in science education. The article *Det almene perspektiv i naturvidenskaberne – specialisering uden åndelig dværgvækst* [The general perspective in science – specialisation without intellectual dwarfism] will be my point of departure in describing the position behind the veterinarian reflection course described above.

The article takes as its starting point the historical perspective of the university (Sandøe & Meyer 2001). Historically, the university was bound together by a religious grounding of all topics that were considered. Modern science, according to the authors, has a strong self-understanding even today of being the critical institution that punctured this common perspective in the effort to avoid superstition and unfounded religious beliefs. In the wake of this liberation from religious beliefs, science has taken the position of supreme knowledge. This position is however problematic, as Sandøe and Meyer suggest that science is weak on general perspective and joined obligations. They argue that today, the university as a whole is rootless. It is an institution in lack of a clear purpose, and this is an especially troublesome position in science. A communication gap between the developers of scientific and technological knowledge on the one hand and the public sphere on the other has turned out to be the consequence. Often, this gap has been explained as resting on the lack of knowledge about science in the public sphere, but Sandøe and Meyer suggest that the gap is also a product of the conception of science within science. A lack of interest in the connections between science and society and a parallel lack in the understanding of other forms of knowledge than those produced through scientific methods in the laboratory, both widen the communication gap. In brief, science has attained the position of both isolating itself and its methods in the academic world of specialisation, while being the undisputed authority of knowledge in the public sphere.

The scenario presented by Sandøe and Meyer therefore points towards demanding that specialised knowledge production is brought into a general perspective. The general perspective can only become a reality if ethical, socio-economic and value-laden issues emerge within the scientific community as central topics. A rule of thumb is presented on the basis of this argument. The more specialised a scientific milieu becomes, the greater the need for implementing a broader perspective in the milieu.

Sandøe and Meyer do not expect this type of reconfiguration of science to take place on its own. A deeply rooted idea in the scientific milieu is the separation of basic research freed from external influence and applied science that deals with the relations between basic research and society. The rule of thumb is based on a competing conception of science; that the road to application is very short and that scientific research is something that has a vast impact on human beings.

What is then needed to decrease the communication gap in the future? Sandøe and Meyer point to the idea that universities should evolve into institutions where different kinds of knowledge confront each other and the surrounding society for mutual inspiration. This way, self-sufficiency can be avoided, and because universities are places where every aspect of life is contemplated, this is a possibility, however remote from the current situation. It is nonetheless what is needed and what could provide a common goal and direction for the university institution. It could be the task for universities to conscientiously, critically and open-mindedly examine the world from a plurality of perspectives and to bring to attention the many circumstances that need to be considered with respect to science.

The FV-courses are seen as a promising start towards this goal, but it is emphasised that a general change in our way of thinking is needed and must be brought through in all areas of the scientific community. Hiring a bunch of philosophers for a short course will not make the difference, but a new way of thinking must find its way into the general educational practice, research projects and the systems of acknowledged qualifications.

13. A Position on Reflections in University Science Educations

This chapter is to conclude on the thoughts presented throughout the thesis. The conclusion outlines a position in the field of study and deals firstly with the question of justification and secondly with the question of content.

13.1 The Question of Justification

During the preceding chapters, several arguments have been touched upon regarding the question: Why reflections in university science educations? I will try to discern three different strands in these arguments, namely the 'Anti-', the 'Bildung-' and the 'Scientific' arguments in order to contrast them with my own.

Disagreements on the implementation of FV-courses have been the dominant theme of the Filosofikum debates, rather than discussion on its content or practical development. The implementation of a new Filosofikum is not an unproblematic task – especially not in science educations. Thus it is clear that the Filosofikum debate involves different positions that are sharply opposed, and the Filosofikum debate is spanned by Naur and Frøkjær's position and the different views defended by Hartnack and also Emmeche, Køppe and Stjernfeldt, especially on the role of philosophical reflections in science curricula. Of the positions with which we have been acquainted, these can be said to constitute the extremes.

On the one hand, we have seen Hartnack argue that the role of philosophy is crucial in a Filosofikum education, and even to the very idea behind any university education. Philosophy is not only a source for considering what should be presented to students about the practice of doing science; students should be taught philosophy from the bottom, so to speak.

Opposite this position stand Frøkjær and Naur who argue that philosophy would be an irrelevant element in university science educations. If we are to adopt Hartnack's division into the Platonic and the Baconic I find Naur's reasoning to be part of the Baconic aspect of our relation to knowledge. The scientist best produces knowledge that is useful to society independently of any form of philosophy or ideology. All meddling from the other side, i.e. the humanistic side with its vague and dogmatic perceptions, can only harm science. Hartnack, on the other hand, seems to occupy the Platonic pole on this spectre.

'Anti' Positions

Why should we interfere with the course structure in a particular field of study in favour of topics that are basically founded on research in other disciplines? An 'anti' position states that the only way to improve the students' abilities, for example physicists' abilities, is to give them technical courses in physics. This position was a dominant feature in the Filosofikum debate at the University of Copenhagen around the time when the agreement on FV-courses were discussed. Previously, in Excurse I, we have seen a brief outline of this sort of anti position. Furthermore, in Part II, I have tried to formulate a position – the irrelevance position – which argues the irrelevance of reflections in university science educations.

My general response to positions of this type is that they all, to a great extent, seem to rely on modernity's conception of science – the idea that science can be secluded from cultural, historical, philosophical and other perspectives. In Part II, I have sought to show how ontological, epistemological and ethical issues are principally connected to the practice of doing science all the way down to the formulation of research projects and the interpretation of the results produced. I therefore back the justification argument proposed by Hartnack, namely that there are problems in science that it is of vital importance to recognise as philosophical problems. Here, however, I find that Hartnack's argument is just one dimension of a more general argument in favour of reflections that I will describe below.

‘Bildung’ Justifications

In addition to the type of position I have termed anti positions above, we have also met what I shall call the Bildung justification. In Part I, the idea that certain fundamental types of knowledge should be taught prior to the studies of a particular discipline was shown to be a historically dominant answer to the question of justification. During the first 300 years of the Filosofikum institution, the intention of this Bildung course was to prepare the students for teaching in schools, for public administration, for ministration, or for further studies. They were tutored in fields of study they would not proceed to study at the higher faculties with the purpose of familiarising them with the most common knowledge of a learned scholar.

In today’s debate, the Bildung argument in this formulation meets very little appreciation. The main argument is that it is the task of the secondary educational system to ensure that the science student is familiar, for example, with basic and general knowledge of the humanities and the social sciences. Hartnack, as well as the Köppe, Stjernfeldt and Emmeche-position, attacks the Bildung argument on this account, and I concur with this. Additionally, the official frame for implementing FV-courses very clearly points out that the notion of Bildung cannot be the justification backing the new FV-courses in tertiary educations (see Excurse II).

‘Scientific’ Justifications

Another train of arguments on the question of justification has been discussed, that I shall call the scientific justifications. These arguments focus on the improvement of the scientist in his or her field of study. This argument claims that the science student will ultimately become a better scientist if reflections are integrated in science curricula. It meets support from Høffding, Jørgensen and Hartnack. In each their way, they claim that their particular development of the Filosofikum will bring about better scientists. Their ways, however, differ quite significantly. Høffding’s argument revolves around the idea that students must be taught the importance of experimental methods in science and how especially philosophy and psychology relates to this methodology.

Jørgensen, on the other hand, justifies reflection courses through the need of making the science student aware that there is a shared method in all sciences and that they participate in an encyclopaedical enterprise that includes all sciences in their joint effort. I do not accord with the idea that there is a shared general method throughout the disciplines of the university, or even in the disciplines of science. I do, however, find it important to discuss with science students what gives validity to the knowledge produced, and how different disciplines relate to one another. This is one dimension of Jørgensen's position that I find beneficial. Another is his concern that scientists become increasingly specialised with the risk of narrow-mindedness. We recall here the rule of thumb by Sandøe and Meyer in Excurse IV. In connection to this, the Köppe, Stjernfeldt, Emmeche position held that reflection courses will benefit research across discipline borders. They see a trend in Ph.-D.-projects towards even cross-facultary research projects. The argument is, hence, that in order to benefit research, narrow-mindedness must be prevented through the support of interdisciplinary research. I find this argument of considerable importance, but not just for the quality of research at universities – just as much for the communication of science in educational settings, and for communicating science in the public debate.

Hartnack emphasises that there exist philosophical problems within science that the scientist will unavoidably encounter, whether she knows it or not. Therefore, it is necessary to include a philosophical reflection in the science curricula. As mentioned above, I agree with Hartnack that this is a very strong and even a sufficient justification for reflection courses. However, it does not seem all that obvious why philosophy – understood as a specialised method of inquiry into the meaning of concepts – should be the only discipline to produce this sort of argument. If we take, for instance, the STS-movement in the USA, it obviously has a parallel argument for implementing reflection courses, but in this case to secure a sociological understanding of and approach to what it means to do science. History of ideas, psychology of science, history of science and any other meta-science, not to mention ecological or economical perspectives, would be able to supply yet other sets of methods to deal with important issues in science. Each of these different perspectives could be used for launching an argument of justification parallel to that of Hartnack's – arguments that scientists will encounter social issues, religious issues, environmental issues etc. I am therefore of the opinion that other disciplines than philosophy should be considered valuable as producers of content for reflections in university science educations. The relevant reflections must be carefully decided upon with respect to each discipline.

An Answer to the Question of Justification: Awareness of the Borderland

The historical understanding of the need for a course with an educative or general 'Bildung' aim seems to me a problematic justification for reflections in university science educations. As it is the task of our preliminary studies at secondary educational programmes to provide this broad insight in the institutions of our culture, there seems to be no argument that the universities should deal with it as well.

Is there then any sustainable argument for implementing obligatory reflection content in science curricula? With this question in mind, I have in Part II tried to criticise a position that holds reflection content to be in vain in science education. Through a thematic critique of the conception of the seclusion of science, the irrelevance position was attacked at its foundation.

The critical approach was used as an inspiration to develop reflection competencies in Chapter 12. I supported the idea of producing better scientists on the basis of certain reflection competencies. I have argued the importance of science students being able to discuss the ontological preconditions that are inherent in a given scientific theory; the importance of science students being familiar with discussions concerning the borders of scientific representation and explanations in general; and finally I have argued the need for an ability to address the issue of differing conceptions of the relation between science and society.

The kind of reflections that are needed is not – at least in science but perhaps also in the humanities and social sciences – constituted by thoughts about the lack of ability to do something with or hold something true that comes from the enterprise of doing science. Science has proven itself so successful that we must ensure that science students are given tools that help them to reflect upon the borderland of their discipline. In other words we need to bring forward discussions about what are the capabilities and limitations of science. As described, I concur fully to the scientific justification towards producing better scientists but I consider it of the outmost importance that science students are not educated with an emphasis on the seclusion of science but rather with the opposite effort – to give them insight in the borderland of science. I find that the capability of formulating a conception of science in opposition to others must be a resource that any professional scientist should have – in order to better research as well as education and public communication. In terms of what I have presented on the borderland of science above, this means that the scientist should be able to perceive the deeper level of borderland discussions. This capability involves awareness and knowledge about certain dimensions of the borderland, as well as having the competencies to discuss and formulate ones own conception.

To briefly summarise my answer to the question of justification, let me bring forward my main conclusion. Science students will become better scientists if they are made aware of the borderland of science and are able to locate a deeper level of borderland discussions where different conceptions of science clash.

13.2 The Question of Content

The question of content is, as argued in the introduction, closely related to the question of justification. My answer to the question of justification therefore naturally bears with it an idea for a reasonable content of reflections in university science educations. Let me gradually present this idea as I revisit some of the content types that has been proposed or enacted on the basis of the positions outlined in this thesis. I will comment on three such types in my argument below, namely with regard to 'Bildung' content, 'epistemological' content, and 'philosophical' content.

Bildung Content

From the beginning of the Filosofikum institution, it was the seven free skills of the Trivium and Qvadrivium that were taught. The content inherent in these teachings was to develop the general Bildung of the student, in some cases as preparation for further studies, but in most cases as preparation for the ministry or the school system. The general Bildung of the oldest Filosofikum models was focused on bringing to the student's attention the most fundamental knowledge and the most fundamental technical study skills – often what was at a given time called philosophy, for example in the case of the seven free skills.

Later, towards the end of the 19th century, general Bildung content was, to an ever increasing extent, substituted with what we might call content of scientific Bildung. This was clear from e.g. the content presented by Sibbern (see Section 3.4). His way of introducing students to the academic world was to make them acquainted with the fundamental characteristics of the rational thinking in science. In this way, general Bildung was gradually replaced by scientific Bildung, in the sense that content became focused on the epistemology and methodology of science.

Epistemological Content

Epistemological and methodological content was at the fore in Høffding and Jørgensen's Filosofikum. They may be seen as advocating reflections compatible with a modern conception of science, since, in different ways, their courses sought to bring the science student, and even any university student, an insight with regard to the proper methodology of science. Even though psychology and philosophy were used to reflect upon this matter, I find that the goal of these Filosofikum courses was to expound on the reasons for secluding science from the remainder of human practices. They were epistemological courses in their core, and first and foremost tried to demarcate science from non-science.

Of course, Høffding and Jørgensen would never have complied with the assumptions about the conception of the seclusion of science, as I have described it in Part II, but they nonetheless enacted a seclusion of science to some extent. The issues they engaged are not generally in opposition to what I propose is reasonable content, as they were both highly concerned with the proper relation between science and other disciplines. But their philosophical standpoints made epistemological reflections swallow up other possible perspectives on science. First of all, I agree with Hartnack that there is no such thing as a single scientific method in the first place. A theory of science that outlines the basic mechanisms in the construction of theories, the relation between theory and empirical studies etc. will always be our additional construct on the basis of the actual practice of socialisation taking place within science and science education. This does not mean, however, that one could not say many things of vital importance about these issues, but I argue here that scientific methodology is learned through all courses in the science curricula that teach the specific theory in the field of study.

Philosophical Content

Hartnack's Filosofikum, as it has been interpreted here, is not a position that supports the seclusion of science, but instead it strongly emphasises the role of propaedeutic philosophy, which has a long-lived tradition as Filosofikum content. Hartnack sees philosophy as *the* discipline to lift the students' understanding of science to a higher level through clarifications and analyses of the concepts used in science. In this sense, it does recognise the necessity of competencies and understandings that reach beyond a thorough seclusion of science, but it attacks this problem only indirectly by teaching propaedeutic philosophy – that is, with no connection to a given discipline.

I suggest that we corroborate a closer connection between science and its exterior in the forming of content for future courses. The content must relate directly to the science student in order, for one thing, to be motivational, and also to be grasped. This entails an educational opening up of science, but not only towards philosophy; also towards other disciplines outside and within science, as well as several cultural perspectives (e.g. economical and futuristic perspectives). Hartnack's argument is that only philosophy can bring about a deeper (Platonic) understanding of knowledge than the strictly utilitarian (Baconian). As discussed previously, I find that a wide range of university disciplines and cultural issues can contribute to this and should not be discarded in the competition with propaedeutic philosophy.

An Answer to the Question of Content: Exploring the Borderland

The answer I have presented above to the question of justification rests upon improving the science student's awareness of the borderland of science.

Three initiating discussions were chosen in order to develop three dimensions in the borderland. These initiating discussions revolved around the simplicity or complexity of objects investigated by science; the discussion on the unity or diversity of approaches to knowledge acquisition; and the discussion on certainty or uncertainty with regard to the progress for society through scientific advancements. I developed the following three general dimensions of the borderland of science on the basis of the initiating discussions.

(1) Discussions on conceptions of nature and on the characteristics of specific scientific approaches to given phenomena.

(2) Discussions involving conceptions of the boundaries of scientific explanations and the characteristics of other forms of knowledge acquisition.

(3) Discussions on conceptions of the impact of science on culture.

I have given the three dimensions above a broad formulation in order for them to span a range of conceptions of science, including those that have been considered throughout the thesis. Based on my own conception of science, three important aspects of this borderland have been pointed out: the ability to grasp the complexity of research objects, knowledge of the diversity of approaches to a given problem and an understanding that science entails both risks and solutions to our problems. Let me further elaborate on these propositions of mine.

The first dimension deals with the conception of objects in science. In this relation, the topic of *reductionism* in science should, in my opinion, be given special attention in science educations. It is a general problem in science and many other areas of the university to regress into a simplistic understanding of the objects under consideration. The initiating reduction necessary to conduct scientific analysis should be kept in mind and emphasised in order to admit the complexity of objects under analysis. In his time, Descartes forcefully advocated a simple ontological conception of the world, but it is time to reflect upon the boundaries of this idea.

The second dimension deals with the characteristics of science in comparison with other types of knowledge acquisition. The capabilities and limitations of scientific explanations need to be reflected upon by science students. This will ensure improved communication of scientific results and also an increased awareness of what characterises scientific knowledge in contrast to other types of knowledge, inside the universities as well as outside. This could be called reflections upon the *formalisations* that characterise science. It also deals with the risk of losing sight of the broad perspective while undergoing an increasing specialisation in a specific subdivision of a scientific discipline. Leibniz's original idea that science could develop a uniform language that would enable absolute representation must be critically reflected upon today.

The third dimension deals with the relation between science and society. Science can solve and has solved many problems for humanity, but is at the same time a player in the production of new problems and risks. Even if the implementation of scientifically based technologies did not cause any problems for society, science and technology would still not be able to solve all types of humanity's problems. Because we can do a lot with science, the need increases for science to stay in close contact with the discussions of what we would like and what is acceptable to do. It could also be considered in the interest of companies to hire science students that are highly aware of the discussions on science in society. The element of content I propose here bares resemblance to the use Løgstrup makes of the concept of *realistic thinking*. It is not enough for the scientist to think correctly about the world; he or she must also think realistically. Condorcet's belief in the progress of society on the basis of scientific advances seems one-dimensional today and should also be reflected upon.

Let me finally conclude on what I have proposed as important elements of reflection content in university science educations. My suggestions are to be conceived in relation to the general justification argument that science students need to be made aware of the borderland of science. I suggest that an exploration of this borderland is the guideline for the development of reflections, and the abovementioned dimensions outline categories for developing content for the exploration.

Let me add a few comments about the shaping of the proposed content. A topic that has not been touched upon in my answer to the question of content is the issue concerning the history of a particular science. First of all, I would like to state the importance of investigating science historically. Viewing science from a historical perspective enriches and clarifies many of the content aspects I have proposed. This goes for the ontological preconditions under which science works, as is clear from a historical description of its methods as well as its continuously developing worldview.

It also applies to considerations about the benefit of science for the improvement of society and can be used to clarify the borders that science share with other institutions of university and society. Therefore I recommend that historical case studies, examples and developments be brought forward in science educations as the basis for the exploration of the borderland of science. I find that the importance of the history of science is exactly to be found in the search for conceptions of what science was, what it is and what it can become.

The way to pedagogically deal with reflection content in university science educations is in itself a question for another project, but let me nonetheless make some comments on it that seem relevant on the basis of what has been argued above. I find that a reasonable way of opening up science towards the borderland is by presenting the themes or discussions etc. in a case study setting. Only by doing so will it become possible to ensure that students do not see reflections on science as exterior to science. To exemplify what such cases could look like, I would mention the development of AI treated in Theme II of Part II as well as my discussion of the Lomborg-case. Discussions on reductionism, risk society, computational understandings of language or science-media relations could emerge from cases like these. Case studies on such themes are destined to cause debate, and I find that this must be an explicit criterion of a successful implementation of reflections in university science educations.

This is in opposition not only to some of the historical positions I have investigated in Part I, but also to the classical theory of science courses that try to explain how science works at the most general level and what separates it from anything else humans do or think about. It seems almost obvious that this will not be a fruitful strategy, as it entails an abstraction from the actual context of doing science. Theories from the particular science must come in play in order to make students immediately see and understand the importance of reflections.

13.3 The Borderland Position

I have now produced a framework of ideas for the justification and content of reflections in university science educations. The position that I defend here I have chosen to call the borderland position. It emphasises that science is an enterprise incorporated in and connected to other human enterprises. I view science as embedded in a culture where different kinds of fringe areas can be located – where the signal from science meets interference from other transmitters, so to speak. The mere existence of this borderland is an argument against an educational seclusion of science. This seclusion was the prime feature of the conception of science in modernity as I presented it in Part II. The borderland of science refers to debates on limitations and capabilities of science. It refers to the grey zones where science is on the verge of its authority – grey zones defined by science always being embedded in a particular culture. If there where no grey zones to be found with regard to science – if there was no borderland – we would have to admit the full seclusion of science. Hence the critique of modernity's conception of science. The borderland position is therefore, in its core, concerned with the boundaries for the seclusion of science as perceived in modernity.

I would like to emphasise that the position developed here is an attempt to further discussion and not dogma about the true conception of science. I do hold modernity's conception of science – as it has been developed in Part II – to be a false and of course extreme conception, but this is not to say that one should teach another conception as doctrine instead. I suggest that a presentation of the dimensions of the borderland – the space of discussions involving different conceptions of science – is the reasonable direction for reflection courses.

Another aspect of my proposal concerns philosophy. Its role in connection with reflections in university science educations has been touched upon several times. I have used philosophical reasoning to argue the justification and content of such reflections. This, however, was not done with the idea that the content presented to students should be the philosophical disciplines. My perception of philosophy has been formulated as a meeting place between the different university disciplines and as the place where one can ask the questions that do not clearly belong under any one discipline. The questions connected to the borderland of science are of this kind and can only be given depth by bringing together knowledge from the different faculties and the cultural setting in general.

I do not believe this borderland to be static; rather it varies over time depending on the culture of which science is part, the knowledge produced by science etc. Exploring the borderland of science is especially important today. From periods in time when science was under explicitly enforced control from the church, the role of science is changed, as it has gained an enormous influence. Now it has the force – perhaps even more than state, religion and art – to shape our life form, and therefore a reflected science student seems to me more important than ever before.

The textbooks that the science student meets are often taken to be the whole story about the issue. They predominantly present knowledge as though it has had no history and no competing theories. Reflection competencies in relation to scientific knowledge therefore do not automatically fall under the present science curricula, but as I have argued, such competencies would make the individual student a better scientist. I have tried to formulate a topology for the borderland of science, presented as three dimensions that I find essential. Their common trait is that they open up the enterprise of doing science towards other fields of research. The dimensions have been shaped to avoid the conception that the knowledge with which one is presented in the specialist courses is the exhaustive story about the field. Scientific research could benefit from these dimensions by making what is learned into an interpretation that can always be challenged, instead of a finished picture of the world. The borderland dimensions could improve a realistic understanding of the scope and application range of scientific theories. They could be influential in bettering interdisciplinary research, public communication of results and educational quality. The idea is that a science student will become a better scientist in a number of ways with knowledge – a map so to speak – of the borderland of science.

The most outspoken agents in the borderland of science are often politicians, philosophers, priests and artists, as they discuss the impact of science on society. These are, however, technically speaking outside science, in the sense that they have limited scientific knowledge. It seems reasonable to suggest that scientists are indispensable agents in the borderland as well. In the past, many scientists have taken on this role, and to mention just one example, Niels Bohr did this with an insight that was not obtainable from outside science. Bohr’s reflections upon the significance of his results serve as an ideal that any scientist should strive for – to always let science exist in the tension between wholeness and analysis.

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Translation Notes

[1] Frågar man, vilken av de tidigare nämnda fyra "potenserna" – staten, religionen, konsten eller vetenskapen – som djupast trycker sin prägel på det moderna livet, så kan svaret inte bli annat än at det är vetenskapen. Vi leva i en i högsta grad "vetenskaplig" tidsålder. Detta bevisas redan av de förändringar som den tillämpade vetenskapen, tekniken, åstadkommit i människans yttre levnadsvillkor under vårt sekel. Om civilisationens tre andra potenser kan man säga, att de i dag leva under intryck av vetenskapens makt. [...] Vi behöva inte här forska i frägan, om vetenskapens herravälde är mera på gott eller ont. Blotta medvetandet om detta herraväldes existens borde för varje vaken människa vara en maning att söka lära något om den filosofi, som lever så at säga med ansiktet vänt mot vetenskapen. (von Wright 1971, p.23)

[2] ...overgivet os klare kundskaber om stjernernes fart og deres op- og nedgang, og om geometri, arithmetik og sfærik og ikke mindst om musik; thi disse studier viste sig at være søstre. (Archytas i Pedersen 1979, p.20)

[3] …ingen efter denne dag maa anbetroes enten hørers eller Rectoris plads udi store eller smaa Scholer, eller tilladis at komme til Attestationen eller examen Theologicum, førend de in examine Philosophico ere kiendt dychtige at niude priman in Philosophia lauream, och ere bleffne promoti Baccalaurei. (i Ellehøj 1980, vol.X, p.15)

[4] …jeg støder nemlig på mysterier, som trods al anvendt flid til evig tid vil blive ved med at være mysterier for mig…Det ville være rart, hvis dyrkerne af det fornemste filosofiske fag ville efterligne den beskedenhed og forsigtighed, som Newton udviser i matematikken, det vil sige, at de skulle afholde sig fra demonstrtioner a priori og lade være med at definere sjælenes og åndernes natur. Gid de ville holde op med at undersøge åndernes egenskaber og spekulere over, hvordan sjæle er formet, hvordan de fungerer…Gid de ville holde sig fra disse spekulationer, som plager sindet, og som bevæger sig på områder, hvor vi famler i blinde, og ville holde sig til kendsgerninger og konkrete ting. (Holberg i Ellehøj 1980, vol.X, p.18)

[5] Efter denne Examens egentlige Hensigt, og, fordi den er almindelig, skal ved samme giøres Reede for de Kundskaber, der kan være nødvendige og nyttige for alle, hvad Hoved-Studium end een eller anden have bestemt sig til; og, da disse ere dels Philosophie og Mathematik, deels Sprogkyndighed og Historie, saa skal og de Studerende til den Philosophiske Examen prøves udi begge Deele. (i Blegvad 1977, p.13)

[6] Da H.C. Andersen var oppe til filosofikum, blev han eksamineret af Ørsted, der med et lille smil spurgte ham: "Sig mig, hvad ved De om elektromagnetismen?"

"Det ord kender jeg slet ikke!" svarede Andersen. "Husk Dem om! De har førud besvaret alt så fortræffeligt og De må vide noget om elektromagnetismmen!"

Andersen måtte gå til bekendelse og indrømme, at han havde været til alle professorens forelæsninger undtagen den, hvor dette spørgsmål var blevet behandlet.

Denne tilståelse morede Ørsted, han nikkede og sagde: "Det var skade, at De ikke vidste det, for ellers havde jeg givet Dem præ, nu får De laud - for De har svaret meget godt!" (Web assistens)

[7] For at vise, hvad den, der tragter efter ægte Erkjendelse og Videnskab, bør at have for Øje, er det det første og vigtigste at betænke, hvad Erkjendelse og Videnskab ere. Men til Grund for al Erkjenden ligger Tænkning. (Sibbern 1822, p.V)

[8] Det første i al ægte Videnskab er Ideen selv, som Videnskabens Middelpunkt og alt bestemmende Sjæl. I dennes Erkjendelse og alle Erkjendelsers Tilbageførelse dertil, viser sig det speculative og philosophiske i Videnskaben. (Sibbern 1822, p.XV)

[9] …henlede Studenternes Opmærksomhed på den filosofiske Erkendelses Opgave og Betydning i Forhold til den videnskabelige Forskning i Almindelighed, at give en foreløbig Orientering med hensyn til denne Opgaves mere specielle Fremtræden samt endelig, i formel Henseende, at styrke Tænkningen og vænne denne til en selvstændig Udfoldelse i Behandlingen af rene Begreber. (i Blegvad 1977, p.14)

[10] …den virkelig overlegne Metafysiker er den, der lader sine Ideer bevæge sig i den Retning, i hvilken allerede Erfaringserkendelsens ledende Træk pege. […] Derved kommer han ikke i Strid med den, skønt han gaar ud over den. Han søger en sidste, afsluttende Hypotese, men Grundlaget er fælles for ham og Empirikeren. (Høffding 1882, p.16)

[11] Psykologien danner det Grundlag, paa hvilket de ideale Aandsvidenskaber, Logik og Etik bygge. Hvad der er sandt og godt, kan kun bestemmes ud fra det menneskelige Stade og kan ikke forstaas uden Kendskab til den virkelige Menneskenatur. (Høffding 1882, p.34)

[12] Dersom vi altsaa vil lære Bevidsthedslivet at kende, maa vi først og fremmest studere det der, hvor det er os *umiddelbart* tilgængelig, nemlig i vor egen Bevidsthed. Af denne umiddelbare Erfaring øser ogsaa Fysiologen, naar han søger at bestemme de forskellige Hjerneorganers Betydning for Sjælelivet. Den er det faste Udgangspunkt for al vor Kundskab om den aandelige Verden; det er paa den, vi grundede de Analogislutninger, paa hvilke denne Kundskab beror. (Høffding 1925, p.12)

[13] Filosofien danner derfor et gavnligt Supplement til den fagvidenskabelige Uddannelse, som ofte maa føre til en meget stærk Specialisering. Som Modvægt mod denne er det sikkert heldigt at have et almindeligt Overblik over den hele menneskelige Viden, og et saadant Overblik kan netop Filosofien og kun Filosofien give. Det følgende propædeutiske Kursus vil derfor naturligt falde i to Hovedafsnit, hvoraf det første handler om Filosofiens Materiale, som bestaar i de foreliggende Fagvidenskaber, og det andet vil handle om den filosofiske Behandling af dette Materiale. (Jørgensen 1962, p.8)

[14] De fysiske teorier er med andre ord deduktive systemer, i spidsen for hvilke de mest generelle love og definitioner staar: men de er ikke rent formale systemer, thi de i dem indgaaende sætninger forudsættes at udtrykke sande domme om fysiske objekter, og dette søges garanteret derved, at de implicerer konsekvenser, som kan verificeres direkte ved sanseiagttagelse. (Jørgensen 1963a, p.133)

[15] Bevidsthedsfænomenerne kan ligesaalidt som de andre livsytringer forklares udfra ukendte faktorers indgriben, thi selve antagelsen af saadanne faktorer stiller blot et problem, og saalænge de ikke er paavist og deres natur nærmere klarlagt, kan de ikke forklare nogetsomhelst. De er i virkeligheden blot et udtryk for, at bevidsthedsfænomenernes fremkomst for tiden er uforklaret. (Jørgensen 1963b, p.34)

[16] Forskellen ligger imidlertid i dette: Et universitet ville ikke være et universitet hvis det ikke, foruden i større eller mindre grad at være baconisk, tillige var platonisk. De øvrige højere læreanstalter ville derimod ikke nødvendigvis miste deres karakter af at være højere læreanstalt dersom de udelukkende var baconiske – de ville formentlig være ringere læreanstalter, men ikke derfor miste deres karakter af at være en læreanstalt. (Hartnack 1966, p.13)

[17] ...at vurdere og at se i perspektiv de løsningsforsøg nutidens filosofi er nået til. Dette er, og bør være, kernen i den filosofiske skoling der siden gammel tid er kaldt for filosofisk propædeutik.

Uden en grundig filosofisk propædeutik er de nødvendige forudsætninger for en tilfredsstillende forståelse af de forskellige videnskabers filosofiske problemer og deres eventuelle løsning ikke tilstede. (Hartnack 1966, p.19)

[18] ...at være i stand til at opfatte de forskellige anskuelser og standpunkter som *filosofiske* anskuelser, d.v.s. som en anskuelse der er nået gennem filosofisk argumentation. Det har betydning at forstå og erkende at der er problemer og argumenter der er væsensforskellige fra alle andre slags problemer og at forstå at disse problemer, der er uundgåelige, er almene; thi de knytter sig til tænkningens grundlæggende begreber – begreber der derfor er fælles for al intellektuel aktivitet. (Hartnack 1966, p.32)

[19] Derfor har det i det foregående været lidt anstrengende for mig at fortælle om filosofi, som om jeg udelukkende hyllede det baconske ideal. Læseren må undskylde mig, at jeg har ment det nødvendigt for overhovedet at kunne råbe ham op. (Favrholdt 1968, p.113)

[20] Men inden det kommer så vidt, bør det gøres helt klart, hvad det er, der er ved at ske. Specielt bør det gøres klart, at påstanden om, at filosofi er af betydning for videnskabsfolk, er uden grundlag i de faktiske forhold. Det er en af den slags påstande, filosoffer gerne fremsætter, som blot er opstået i deres fantasi. (Naur & Frøkjær 2001, p.1)

[21] Som konklusion af undersøgelsen af filosofiske talemåder i videnskabelig aktivitet påviser vi, hvordan den forvirring og forvrøvling der findes i besvarelserne af vores spørgebrev rinder direkte af filosofiske misforståelser og dogmer, af filosofiske vildfarelser. Den centrale filosofiske vildfarelse er den dogmatiske tro eller ideologi, at der findes særlige personer, filosoffer, som besidder indsigt i denne verdens forhold uden af behøve empirisk belæg for den. Denne ideologi er i direkte modstrid med videnskabelig åbenhed over for at undersøge tingene og er således ødelæggende for videnskabelighed. (Naur & Frøkjær 2001, p.3)

[22] Tænkning er ikke noget, der kan foregå på forskellige måder. Ifølge klassisk psykologi er selve udgangspunktet for at beskrive tænkning dette, at tænkning foregår. Tænkning er ikke noget, nogen foretager sig på den ene eller anden måde. Hermed bortfalder talen om, at bestemte beskrivelsesformer, såsom formel logik, skulle indtage en særstilling blandt de utallige beskrivelsesformer, der anvendes videnskabeligt. (Naur & Frøkjær 2001, p.2)

[23] Spinoza, den uendelige bliven-filosof. Han har vist, optegnet, tænkt det "højeste" immanensplan, det vil sige det reneste, det plan der ikke overgiver sig til det transcendente eller giver noget transcendent fra sig, det der fremkalder de færreste illusioner, slette følelser og fejlagtige perceptioner… (Deleuze & Guattari 1996, p.84).

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[24] Begreberne afventer os ikke fuldt færdige, ligesom himmellegemer. Begreber har ingen himmel. De må opfindes, fremstilles, eller snarere skabes, og de ville ikke være noget uden deres skabers signatur. Nietzsche bestemte filosofiens opgave, da han skrev: "(Filosofferne) må ikke længere blot lade sig skænke begreber, heller ikke kun rense og opklare dem, men derimod først og fremmest *lave*, *skabe* dem, fremstille dem og lade sig overtale til dem… (Deleuze & Guattari 1996, p.23)

[25] Den foreliggende bogs hovedemne er følgende: vort udgangspunkt er en natur, der sammenlignes med en automat. Denne automat er underkastet matematisk formulerede lovmæssigheder, der koldsindigt og for bestandig determinerer fremtidige og fortidige naturprocesser. I dag er vi imidlertid kommet i en teoretisk situation, der er en helt anden, fordi vi er nået til en naturbeskrivelse, som bringer mennesket på plads i den verden, som det beskriver; og på en sådan måde, at der åbnes op for denne verden. Vi kan uden overdrivelse tale om denne forvandling som en ægte *gennemgribende forvandling* af videnskaberne. (Stengers & Prigogine 1985, p.33)

[26] Hvad videnskaben om kompleksitet angår, tøver vi ikke med i denne forstand at lade den "begynde" fra og med 1811. I dette år, hvor Laplacianerne triumferer og behersker den europæiske videnskab, hjemfører baron Jean-Joseph Fourier (1768-1830), præfekt i departementet Isère, Akademiets pris for sin teoretiske afhandling om varmens udbredelse i faste legemer. Laplace, Louis Lagrange (1736-1813) og deres elever forenede forgæves deres kræfter for at kritisere den nye teori, men var nødt til at affinde sig med den. (Stengers & Prigogine 1985, p.151)

[27] Når de én gang er dannede, kan de isoleres og opretholdes i det uendelige uden yderligere at vekselvirke med omgivelserne. Hvis vi undersøger en levende celle eller en by, er situationen en helt anden. Ikke blot er disse systemer åbne, men består kun takket være den kendsgerning, at de er åbne. De lever af den stof- og energistrøm, der kommer fra omverdenen. Det er ganske indlysende, at byer og levende celler ikke stræber mod en tilstand af gensidig udligning eller en tilstand af ligevægt mellem de indkommende og udgående strømme. Vi kan, hvis vi vil, isolere en krystal; men en by eller en levende celle, der afskæres fra deres omgivelser, dør hurtigt. (Stengers & Prigogine 1985, p.178)

[28] Benards celler danner en første type af en *dissipativ struktur*. Betegnelsen "dissipativ" for denne struktur udtrykker sammenhængen mellem ideen om orden og ideen om spild og blev valgt med henblik på at udtrykke den fundamentalt nye kendsgerning, at dissipation af energi og stof – der i almindelighed er forbundet med ideerne om tab af output og med udvikling i retning af uorden – langt fra ligevægt bliver en kilde til orden. Dissipationen er kilden til noget, som man meget vel kan kalde nye tilstande af materien. (Stengers & Prigogine 1985, p.195)

[29] …G. Deleuze og F. Guattari [stiller] to forskellige syn på organismen op som modsætninger: organismen betragtet som en strukturel enhed (mekanicisme) og organismen betragtet som en individuel og specifik enhed (vitalisme) […] De to forfattere placerer sig således i et udvidet (eller sprængt) funktionalistisk perspektiv, der ligger temmeligt tæt på det perspektiv, som de teorier, vi her gennemgår, kan give anledning til. (Stengers & Prigogine 1985, p.399)

[30] …der behersker os med en sådan selvfølgelighed, at vi end ikke tænker på at sætte spørgsmålstegn ved den – og det til trods for at det er oplagt, at den er en vrangforestilling. Vi finder, at sansningen er receptiv, men det er den ikke, den er afstandsløs. (Løgstrup 1995, p.15)

[31] …det sansede er udenfor vor eet-steds-tilstedeværende krop, men ikke udenfor vor allestedsnærværende sansning. […] Vi kan ikke nære os for at lægge vor krops afstand til det sansede og vor forståelses afstand til det forståede ind i sansningen. Det sker for fortalerne for sanse-data teorien, dem selv uafvidende. (Løgstrup 1995, p.20)

[32] En indbildning er det, at sproget skulle kunne føre os ud af vor indfældelse i universet op til en tilværelse på kanten af det. Eet er at sproget bringer os på afstand af det forståede, noget andet er at dissociere os fra universet, det sidste kan sproget ikke. Randtilværelsen er modernitetens formidable illusion. Reduktionen af universet til bare omgivelse for vor tilværelse på randen af det – og opfattelsen af sansningen som receptivitet befordrer hinanden og gør vor tænken irrealistisk. (Løgstrup 1995, p.17)

[33] Med to udskiftninger bliver naturvidenskaben moderne. Dagligsproget udskiftes med tallet. Verden i dens sansbarhed udskiftes med verden i dens målelighed. Det er den første udskiftning, som det kommer an på, sådan som det fremgår af Carnaps udredninger. Udskiftningen af sansbarheden med måleligheden følger af erstatningen af dagligsproget med tallet. (Løgstrup 1995, p.177)

[34] Men hvad der er den empiriske forsknings force er også dens fare. Med udskilningen af synspunkter udgår vigtig og væsentlig indsigt. Af den grund er den ikke sikret imod at dens tænkning bliver irrealistisk. Der er intet i vejen for, at videnskabelige resultater kan underminere vor tilværelse og alt liv på vor klode. Undermineringen og irrealismen rokker ikke ved resultaternes rigtighed. Tværtimod, fører den irrealistiske tænkning til katastrofer beviser de kun resultaternes rigtighed. Realistisk er ikke det samme som rigtigt. Irrealistisk er ikke det samme som urigtigt. (Løgstrup 1995, p.171)

[35] Det fænomen, der korrellerer med sansningen, og med hvilket mennesket bliver til et kulturelt væsen og får historie, er forståelsen. Kultur og historie får vi altså af fænomener, der er særlige for os, tilbageholdenhed og forståelse – og som korrellerer med behov og sansning, som vi er fælles med dyrene om. Kultur og historie bliver til af spændingen mellem erobring og tilbageholdenhed. Og kultur og historie får vi af samspillet mellem den afstandsløse sansning og den afstandsmægtige forståelse. (Løgstrup 1995, p.48)

[36] Humanisme er, at alt til syvende og sidst står til mennesket, for det synsæstetiskes vedkommende til kunsten. Men kunstarterne grunder i, at i sansningen står alt til universet, før det står til kunstarterne. I den allestedsnærværende sansning er universet ureduceret og umodificeret, uformidlet og æstetisk til stede. Den indsigt lukker en a-kosmisk humanisme sig ude fra. (Løgstrup 1995, p.57)

[37] Opfattelsen af, at det som udmærker mennesket er at gøre sig redskaber og efterhånden teknik, svarer til en behovspsykologisk opfattelse af den menneskelige tilværelse. To indskrumpninger følges ad, indskrumpningen af den kulturelle overlevering til teknisk fremskridt, og indskrumpningen af synet på den menneskelige tilværelse til behovspsykologi. Men intet truer vort liv som den behovspsykologiske indskrumpning af det. Det kommer af, at hvis vi anser den kulturelle reproduktion for ikke at være andet end en forlænget biologisk reproduktion, ser vi ikke andet i den kulturelle reproduktion end en udvikling i teknik. Og faren ved teknik, det er vi blevet klare over, er at den fodrer vore behov til døde ved at overfodre dem. Det kan kun hindres, hvis der er en kulturel overlevering hos teknikerne, der er stærk nok til at imødegå tendensen til at lade intelligensen ene og alene stå i tjeneste for tilfredsstillelsen af behovene. Mindre kan ikke gøre det, så stor er instinktreduktionen. Men der findes også teknikere, der i deres tekniske forskning gør op med vaneforestillinger, men de står op imod en modstand, der er sejg, fordi den har institutionerne med sig. (Løgstrup 1995, p.58)

[38] Med "kalkyl" kunde man först och främst förstå en *verksamhet*, som består I tecknens sammanställande till uttryck enligt formreglerna och nya uttrycks härledning enligt omformningsreglerna. (von Wright 1971, p.42)

[39] Antagelsen i denne del [analysen af nutidens samfund] er, at udviklingen fra industrisamfund til det der i flæng kaldes informationssamfund, netværkssamfund, vidensamfund med videre ikke blot er en kvantitativ udvikling, hvor det eksisterende samfund er blevet "lidt" (eller måske meget) mere komplekst, "lidt" mere globaliseret, "lidt" mere præget af informations- og kommunikationsteknologi, men at vi er vidner til og deltagere i en kvalitativ forandring, et paradigmeskift, der kræver helt nye teoretiske og metodiske redskaber til samfundets selvbeskrivelse. Vi må vænne os til, at grundkategorien ikke er materiel reproduktion, men kompleksitetshåndtering. At det ikke nytter at lede efter "magten" i ental, fordi samfundet ikke længere kan beskrives som monocentrisk, men er polycentrisk. (Qvortrup 2001, p.11)

[40] …i min bog om "det hyperkomplekse samfund" foreslår jeg, med stærk inspiration fra Luhmann, at samfundet kan iagttages som et socialt system, for hvilket grundvilkåret er kommunikation, hovedudfordringen er kompleksitet, og målet er kompleksitetshåndtering. Centralt for forståelsen af kompleksitetshåndtering er imidlertid, at kompleksitetsudfordringen ikke er en kamp, der én gang for alle kan vindes. (Qvortrup 2001, p.25)

[41] Fra og med det 17. århundrede fordeles hele tegnets område mellem det sikre og det sandsynlige; det vil sige, at man dér ikke længere vil kende til at have et ukendt tegn, intet tavst mærke. Det betyder ikke, at menneskene skulle være i besiddelse af alle de mulige tegn. Men at der ikke vil findes et tegn før det øjeblik, hvor muligheden for et erstatningsforhold mellem to allerede *kendte* elementer er blevet *erkendt*. Tegnet venter ikke stille på ankomsten af den, der kan erkende det; det dannes kun gennem en erkendelseshandling. (Foucault 1999, p.96)

[42] Den moderne fremskridtstanke viser altså to hovedtendenser. Den ene er forestillingen om fremskridt ved at samle mere og mere viden og gennem landvindinger for videnskab og teknik. Den anden forbinder fremskridt med fuldkommengørelse af mennesket og samfundssystemet. (von Wright 1994, p.47)

[43] Jeg betragter denne forveksling som en tingsliggørelse, en kvantificering af fremskridtet. Fremskridt målt på denne måde er ikke længere et værdibegreb. Det bliver et faktualiseret, værdineutralt begreb, det filosofferne kalder en værdireificering. (von Wright 1994, p.48)

[44] Nøjagtig som der er en tendens til at identificere fremskridt skabt gennem akkumulering af viden med økonomisk vækst, er der en tilsvarende tendens til at identificere fremskridt gennem sociale reformer med de ydre former for rationel administration, med bureaukrati og lovgivning i folkets navn. Jeg vil kalde dette formalisering af demokratiet. Det er igen et eksempel på tingsliggørelsen af værdibegrebet fremskridt. (von Wright 1994, pp.48-49)

[45] Formålet med dette 'filosofikum'-lignende kursus er at introducere deltagerne til den naturfilosofiske diskussion om naturbegreber, natursyn og verdensbilleder og til den moderne videnskabsteoretiske debat om naturvidenskaberne, og herved bidrage til at deltagerne erhverver sig et overblik over deres fags muligheder og begrænsninger, dets relationer til andre fag og til det samfund, naturvidenskaberne er en del af. (Web nbi)

[46] Den postmoderne naturfilsofi er "metaphysics light"; en let metafysik forstået som havende plads til et selvironisk glimt i øjet over for enhver begrænset fortælling, der vil sammenfatte al ting, fx "naturens historie".

Alle fortællinger, naturvidenskabens inklusive, dvs. også fortællinger, der ærligt tilstræber de videnskabelige almene normer som sandhed, offentlighed, klarhed, efterprøvbarhed, erfarbarhed, er underlagt hermeneutikkens regler om kontekst, fortolkning, metaforer, subjektivitet (hos fortælleren såvel som hos modtageren), begrænset horisont og baggrundsviden, osv. (Emmeche 1999)

[47] Det skal understreges, at kurset taler med mange stemmer, hos såvel studerende som de mange forelæsere: reduktionister møder antireduktionister, ateister møder troende, humanister møder naturvidenskabsfolk. Naturfilosofi er et felt for debat og drilske spørgsmål, ikke et felt for doktrinen og den rette lære. (Web nbi)

[48] erhvervet sig et vist overblik over videnskabelige tankesæt i et historisk perspektiv, samt at have stiftet bekendtskab med forskellige syn på dyr, som knytter sig til forskellige videnskabelige traditioner og andre tankesæt – herunder spørgsmålet om dyrs evne til at tænke, føle, og dyr forstået ud fra etologiske, økologiske, genetiske, molekylærbiologiske og andre videnskabelige tankegange. (Web kvl)

Abstract

Exploring the Borderland – A Study on Reflections in University Science Educations

My point of departure is a demarcation of what I understand by a position regarding reflections in university science educations. A position consists in an answer to the question of why there should be reflection courses in science educations and furthermore what the content of such reflections should be. Thereby I define the field of study of the thesis. A problem statement is developed that describes how I myself try to answer these questions. The approach by which I attack the problem posed falls in three parts.

Part I: Historical Approach

By September 2004 the new aspect of university science educations often referred to as the new Filosofikum –Fagets videnskabsteori – is to be implemented. This coming element in science educations has clear roots to the former obligatory course for all university students to pass, the Filosofikum. The Filosofikum was an integrated part of university educations until 1971, when it was made non-obligatory and consequently disappeared from most science curricula. I therefore make an effort to investigate what history can teach us about reflections in science educations. As its first task, the historical approach gives an account of the history of the Filosofikum in the Danish educational system in the period prior to the 20th century. A second task is to consider the development towards the revocation of the institution in 1971. Thirdly and most importantly, an analysis is given of three dominant positions on the Filosofikum in the 20th century.

Pre-20th Century Filosofikum

I examine the roots of the Filosofikum institution dating back to the first universities in Europe. Different periods of time are touched upon – scholasticism, renaissance, enlightenment and romanticism – in the investigation of the content of and justifications supporting the Filosofikum in the different eras.

20^{th} Century Positions on Filosofikum

Afterwards, three influential positions on the Filosofikum courses of the 20^{th} century are analysed with regard to their placement in the field of study. The philosophers behind these positions are Harald Høffding, Jørgen Jørgensen and Justus Hartnack.

The Filosofikum Høffding develops is a course that takes its outset in an understanding of scientific knowledge and epistemology in general to rest upon the psychological state of human beings. A fundamental understanding of this primary status of psychology is held by Høffding to be an important part of educating scientists. I argue that Høffding's position is best described as the "psychologistic" position.

Jørgensen's founding idea for having a reflection course in science educations focuses on the unity of science. His approach to science is dominated by the thought that there exists a unified scientific method, which must be taught to all scientists in a preliminary study. This idea makes Jørgensen suggest that an encyclopaedically educational approach is necessary for university students to see how the different branches of science are engaged in a homogeneous enterprise. I argue that Jørgensen's position can be described as a "science encyclopaedic" position.

In the study on Hartnack's Filosofikum it becomes clear that his position rests upon the argument that scientists cannot avoid interaction with philosophical issues and problems. This argument makes him propose that the Filosofikum should consist in a propaedeutic course in philosophy. This type of course will make it possible for students to acknowledge that problems exist that cannot be treated by scientific methodology but must instead be interpreted and dealt with as philosophical problems. Hartnack's position is interpreted as the "philosophical propaedeutic" position.

The Revocation of the Filosofikum

Subsequently, different attempts at renewal of the Filosofikum in the 20^{th} century are treated. Several reasons for the revocation are discussed, including the practical problems caused by increasing numbers of students during the 60's as well as the development in the conception of the relation between science and philosophy.

Furthermore, I discuss general developments regarding reflections in university science educations in the turbulent period of the late 60’s and early 70’s.

General Conclusions on the History of Filosofikum

The 20th century versions of the Filosofikum are shown to rest on ideas handed down to them from a 500 year long tradition. It is concluded that the institution had varying aims in different periods of time. Originally, it was used to prepare priests and school teachers and later became a preliminary study for further university studies. Its emphasis consequently developed from an educative aim towards the 20th century’s emphasis on the methodology and epistemology of science. The question of the role to be played by philosophy within science is pointed to as a factor in the revocation of the Filosofikum.

Part II: Critical Approach

The main objective of Part II is the presentation of a critique of the conception of science in modernity that undermines an educational position in the field of study claiming reflections to be irrelevant. The conception of science in modernity is determined to be a conception that supports the seclusion of science. This conception of seclusion is the philosophical support of what I call the irrelevance position and is confronted from three different directions in a thematic critique. The first theme focuses on the idea of ‘reducibility’, the second theme is concerned with ‘formalisation’ and the third with ‘progress’.

The conception of seclusion is formulated in connection to these three themes. First of all, it asserts that, through a reductionist analysis of a given phenomenon, science will always be able to determine all physical behaviour of the phenomenon described. This part of the conception is thereby concerned with how nature is structured, or what types of systems exist in the world. The first theme is thus ontological in its character. Secondly, the conception of seclusion holds that it is possible to construct a scientific formal language that is capable of excluding the ambiguities and imprecision of natural language and provide absolute representations of the world. Within this line of thought, science is the sole provider of understanding. The second theme is thus epistemological in its character. Thirdly, the conception of seclusion is defined to advocate the intrinsic goodness of scientific advancement which means that science is a source of progress for society. The third theme is thus ethical in its character.

Theme I: 'Reducibility'

In Theme I, modernity's understanding of systems in scientific thinking is criticised. This understanding is related to the Euclidean system in mathematics, as well as Descartes' and Newton's efforts to reduce complex macroscopic matters of investigation into microscopic causal relations. These scientists and philosophers function as my inspiration for constructing this particular aspect of the conception of seclusion.

My critique falls in three parts. The first one engages in a philosophical point of view on the concept of system. Deleuze and Guattari are used to show how modernity has entrapped our thinking in a too narrow system conception. Their reformulation of the system concept as a rhizome is presented and exemplified in a scientific setting.

Secondly I use Stengers and Prigogine's philosophy of science to give a critique of modernity's conception of systems in nature. They formulate a new system conception and relate modernity's ideas on the reducibility of the systems of nature to recent developments in science. Stengers and Prigogine's work is argued to show how the classical or modern conception of science has reached its limits – by inner necessity, it has been developed to a level where it breaks down as a reasonable explanation of the architecture of the world.

Thirdly I provide a phenomenological account of the reduction taking place in scientific research in general. I use Løgstrup's ideas on the characteristics of science, and thereby aim to concretise what limits the scope of what can be explained through a scientific systematic analysis.

Theme II: 'Formalisation'

My inspiration for this aspect of the conception of seclusion comes from the efforts of especially logical positivists at the beginning of the last century who strived to construct an artificial language that could be used as a flawless, unambiguous, consistent and perfectly referential language of science.

Special focus in my critique is given to the later Wittgenstein's interpretation of the scientific language. I show how Wittgenstein's rethinking of the role played by language in knowledge acquisition, reveals the positivistic interpretation of the use of formal language as a simplistic view of what goes on in scientific research. I exemplify the different conceptions of the capabilities of formal scientific language through an examination of the development of machine translation within research on artificial intelligence. I also show how these conceptions have a bearing on the scientific research agenda.

Theme III: 'Progress'

The idea of progress is examined as a third aspect of my critique. I try to criticise the idea that advances in science will automatically bring with it progress for society. I take up two perspectives on this issue, namely one that provides a sociological framework for understanding the relation between science and society today as opposed to earlier, and another perspective which directly discusses the influence of the idea of progress.

The sociological framework is developed on the basis of Qvortrup's Luhmann inspired conception of present society as having a 'polycentric' self-description. In addition, I use the work of Michel Foucault in order to focus my study on science. His ideas are used to clarify what historical and cultural patterns decided what was possible to think scientifically in different epochs of Western history.

The investigation of the idea of progress takes as its outset Nisbet's assertion that it is one of the fundamental ideas in the history of the Western world. It is shown how the idea of progress has only been absent in the Renaissance, but is also becoming disputed today. I corroborate the critique of the idea of progress using von Wright's assertion that the idea of progress is to be considered a myth of Enlightenment rationality. In conclusion, I suggest that we need new ways of interpreting the relation between the development of science and its impact on society, and secondly that, in certain respects, we may well interpret the time we live in as a second renaissance.

Part III: Positional Approach

In Part III, I present ideas that benefit from the insights of the two preceding parts. I call my standpoint the borderland position and try to put my position in perspective from, among other things, a description of contemporary courses. However, Part III starts out with an investigation into the agreement on Fagets videnskabsteori, as well as an analysis of the official reasoning for its institution.

Beyond an Educational Seclusion of Science

The effort to undermine the irrelevance position in Part II leaves room for the formulation of a positive position within the field of study. I develop three dimensions of what I call the borderland of science. The first one deals with conceptions in science of given phenomena, and I argue for strengthening students capability in discussions on the complexity of objects under investigation. The second dimension of the borderland of science deals with conceptions of scientific knowledge in comparison to other approaches to understanding. I argue that reflections in university science educations could familiarise students with the diversity of approaches to knowledge acquisition. A third dimension revolves around the relation between science and society. It is argued that science students need to be able to engage in discussions on this theme as well.

The Borderland Position

In conclusion, I formulate the borderland position and attempt to answer the questions of justification and content within the field of study. I justify the implementation of reflections on the basis that it will improve the qualifications of science students. I argue that students become better scientists if they are aware of the existence and characteristics of the borderland of science. My answer to the question of justification revolves around the idea that knowledge of the borderland of science produces better scientists that do not fall into simplification, one-dimensional thinking or lack the ability to interpret the cultural and social significance of science.

The content I propose for reflections as part of the borderland position builds upon the three dimensions outlined above. It is argued that these dimensions are essential in the acquisition of competencies in the borderland of science. The three dimensions are presented as being of an analytical character, but with the addition that I describe them as spanning the space of discussions in the borderland of science.

Resumé

På udforskning i grænselandet – en undersøgelse vedrørende refleksioner i de teknisk-naturvidenskabelige universitetsuddannelser

Mit udgangspunkt for denne afhandling er en afgrænsning af, hvad jeg forstår ved en position med hensyn til refleksioner i de teknisk-naturvidenskabelige universitetsuddannelser. En position består i et svar på spørgsmålet om, hvorvidt der bør være refleksionskurser i teknisk-naturvidenskabelige uddannelser og endvidere, hvad indholdet af disse refleksioner da bør være. Dermed afgrænser jeg afhandlingens forskningsfelt. På den baggrund udvikler jeg en problemformulering, som beskriver, hvordan jeg selv vil prøve at besvare disse spørgsmål. Den tilgang, hvormed jeg angriber det stillede problem, falder i tre dele.

Del I: Historisk tilgang

Inden september 2004 skal det nye aspekt af teknisk-naturvidenskabelige universitetsuddannelser, som ofte kaldes for det nye Filosofikum – Fagets Videnskabsteori – implementeres. Dette kommende element i de teknisk-naturvidenskabelige uddannelser har tydelige rødder til det tidligere obligatoriske kursus, Filosofikum, som alle universitetsstuderende skulle bestå. Filosofikum var en integreret del af universitetsuddannelserne indtil 1971, hvor kurset blev gjort ikke-obligatorisk og følgelig forsvandt fra de fleste studieordninger. Jeg undersøger derfor, hvad historien kan lære os om refleksioner i universitetsuddannelserne. Den historiske tilgang har som sit første formål at redegøre for Filosofikums historie i det danske uddannelsessystem i perioden indtil det 20. århundrede. For det andet bruges den til at fremføre nogle overvejelser omkring udviklingen hen mod afskaffelsen af institutionen i 1971. For det tredje, og som det vigtigste, gives der i denne tilgang en fremstilling af tre fremherskende positioner i tilknytning til Filosofikum i det 20. århundrede.

Filosofikum før det 20. århundrede

Min historiske tilgang tager udgangspunkt i Filosofikum-institutionens rødder, der går tilbage til de første universiteter i Europa. Forskellige perioder berøres – skolastikken, renæssancen, oplysningstiden og romantikken – i undersøgelsen af indholdet af og retfærdiggørelsen for Filosofikum i de forskellige perioder.

Positioner vedrørende Filosofikum i det 20. århundrede

Efter gennemgangen af den ældre Filosofikum-institution analyserer jeg tre indflydelsesrige positioner omhandlende Filosofikum-kurserne i det 20. århundrede med hensyn til deres placering i forskningsfeltet. Filosofferne bag disse positioner er Harald Høffding, Jørgen Jørgensen og Justus Hartnack.

Det Filosofikum, som Høffding udvikler, er et kursus, som tager udgangspunkt i en forståelse af videnskabelig viden og erkendelsesteori generelt som hvilende på menneskets psykologiske indretning. En grundlæggende forståelse af denne psykologiens primære status ser Høffding som en vigtig del af en videnskabspersons uddannelse. Jeg hævder, at Høffdings position bedst kan beskrives som den "psykologistiske" position.

Jørgensens begrundelse for et refleksionskursus i universitetsuddannelserne fokuserer på videnskabernes enhed. Hans tilgang til videnskab domineres af den tanke, at der findes en samlet videnskabelig metode, som alle videnskabsfolk må lære i et forberedende studie. Denne ide får Jørgensen til at foreslå, at en encyklopædisk tilgang er nødvendig for, at universitetsstuderende kan se, hvordan de forskellige grene af videnskab er involveret i et enhedspræget foretagende. Jeg hævder, at Jørgensens position kan beskrives som en "videnskabs-encyklopædisk" position.

I studiet af Hartnacks Filosofikum bliver det klart, at dennes position hviler på det argument, at videnskabsfolk ikke kan undgå berøring med filosofiske emner og problemer. Dette argument får ham til at foreslå, at Filosofikum bør bestå i et propædeutisk kursus i filosofi. Denne type kursus vil gøre det muligt for studerende at erkende, at der findes problemer, som ikke kan behandles med videnskabelig metodologi, men i stedet må tolkes og tages op til behandling som filosofiske problemer. Hartnacks position tolker jeg som en "filosofisk-propædeutisk" position.

Afskaffelsen af Filosofikum

Dernæst behandles forskellige forsøg på at forny Filosofikum i det 20. århundrede. Adskillige grunde til afskaffelsen diskuteres, herunder de praktiske problemer som forvoldtes af det stigende antal studerende i løbet af 1960'erne, så vel som udviklingen inden for opfattelsen af relationen mellem videnskab og filosofi. Jeg diskuterer endvidere nogle generelle udviklinger i forbindelse med refleksioner i teknisk-naturvidenskabelige universitetsuddannelser i den turbulente periode i de sene 60'ere og tidlige 70'ere.

Generelle konklusioner vedrørende Filosofikums historie

Det 20. århundredes versioner af Filosofikum-kurset vises at indeholde tankegods, som er gået i arv gennem en 500 år lang tradition. Det konkluderes, at institutionen har haft forskellige mål til forskellige tider. Oprindelig blev den brugt til at forberede præster og skolelærere og blev senere fortrinsvist anvendt som forberedelse til videre universitetsstudier. Følgelig har den udviklet sig fra at have vægt på almendannede mål til det 20. århundredes vægt på videnskabens metodologi og epistemologi. Spørgsmålet om filosofiens rolle i videnskaben påpeges som en central faktor i afskaffelsen af Filosofikum.

Del II: Kritisk tilgang

Hovedformålet med Del II er at fremsætte en kritik af modernitetens naturvidenskabsopfattelse, som kan underminere en uddannelsesmæssig position i forskningsfeltet, der hævder at refleksioner er irrelevante. Naturvidenskabsopfattelsen i moderniteten ser jeg som en opfattelse, der støtter en afsondring af naturvidenskaben i forhold til det resterende samfund. Denne opfattelse af afsondring er den filosofiske støtte til det, jeg definerer som irrelevans-positionen, og den angribes fra tre forskellige retninger i en tematisk kritik. Det første tema fokuserer på idéen om 'reducerbarhed', det andet tema beskæftiger sig med 'formaliserings'-tanken og det tredje med 'fremskridts'-tanken.

Inden kritikken udvikler jeg modernitetens afsondringsopfattelse i forbindelse med disse tre temaer. Opfattelsen hævder for det første, at videnskaben, gennem en reduktionistisk analyse af et givet fænomen, altid vil kunne bestemme al fysisk opførsel hos fænomenet. Denne del af opfattelsen har at gøre med, hvordan naturen er struktureret eller hvilke typer systemer, der findes i verden. Det første tema er dermed af ontologisk karakter. For det andet defineres afsondringsopfattelsen som den holdning, der efterstræber konstruktionen af et videnskabeligt formelt sprog, som er i stand til at omgå de naturlige sprogs tvetydigheder og mangel på præcision, og som kan tilvejebringe absolutte repræsentationer af verden. Inden for denne tankegang er videnskaben den eneste erkendelseskilde. Dermed er dette tema af epistemologisk karakter. For det tredje hævder afsondringsopfattelsen at de videnskabelige landvindinger har en iboende godhed, som medfører, at naturvidenskaben er en ufejlbarlig kilde til fremskridt for samfundet. Det tredje tema er dermed af etisk karakter.

Tema I: 'Reducerbarhed'

I Tema I kritiseres modernitetens forståelse af systemer i videnskabelig tænkning. Denne forståelse relateres til det Euklidiske system i matematikken, såvel som til Descartes og Newtons bestræbelser på at reducere komplekse makroskopiske undersøgelsesemner til mikroskopiske kausale relationer. Disse videnskabsfolk og filosoffer tjener som inspiration til at konstruere netop dette aspekt af afsondringsopfattelsen.

Min kritik falder i tre dele. Første del giver sig af med et filosofisk synspunkt på systemopfattelsen. Deleuze og Guattari bruges til at vise, hvordan moderniteten har indespærret vores tænkning i en for snæver opfattelse af et system. Deres omformulering af systembegrebet som et rhizome præsenteres og eksemplificeres i en videnskabelig ramme.

I anden del bruger jeg Stengers og Prigogines videnskabsfilosofi til at give en kritik af modernitetens opfattelse af systemer i naturen. De formulerer en ny videnskabelig systemopfattelse og relaterer modernitetens idéer om reducerbarheden i naturens systemer til nylige udviklinger inden for naturvidenskaben. Der argumenteres for at Stengers og Prigogines arbejde viser, hvordan den klassiske eller moderne naturvidenskabsopfattelse har nået sin grænse – af indre nødvendighed har den nået et stadie, hvor den bryder sammen som en rimelig forklaring af verdens arkitektur.

Tredje og sidste del giver en fænomenologisk redegørelse for den reduktion, der finder sted i naturvidenskabelig forskning generelt. Jeg undersøger Løgstrups tanker om naturvidenskabens kendetegn og søger derigennem at konkretisere, hvad der begrænser omfanget af det, der kan forklares med en videnskabelig systematisk analyse.

Tema II: 'Formalisering'

Min inspiration til dette aspekt af afsondrethedsopfattelsen kommer specielt fra de logiske positivister i begyndelsen af forrige århundrede, som troede på muligheden af at konstruere et kunstigt sprog, der kunne bruges som et fejlfrit, utvetydigt, konsistent og rent beskrivende videnskabssprog.

Min kritik fokuserer særligt på den senere Wittgensteins tolkning af det videnskabelige sprog. Jeg viser, hvordan Wittgensteins omtænkning af den rolle, sproget spiller i videnstilegnelse, afslører den positivistiske opfattelse af naturvidenskabelig sprogbrug som et forsimplet syn på, hvad der foregår i en forskningsproces. Jeg eksemplificerer de forskellige opfattelser af formelle videnskabelige sprogs formåen gennem en undersøgelse af maskinoversættelsens udviklingen inden for forskning i kunstig intelligens. Desuden viser jeg, hvordan disse opfattelser har indvirkning på den videnskabelige forsknings dagsorden.

Tema III: 'Fremskridt'

Fremskridtstanken undersøges som et tredje aspekt af min kritik. Jeg forsøger at kritisere den idé, at landvindinger inden for naturvidenskaben automatisk vil medføre fremskridt for samfundet. Jeg tager to perspektiver på dette emne op, nemlig ét, der giver en sociologisk forståelsesramme for relationen mellem videnskab og samfund i dag modsat tidligere samfundstyper, og et andet perspektiv, der fokuserer direkte på fremskridtstankens indflydelse.

Den sociologiske ramme er baseret på Qvortrups Luhmann-inspirerede opfattelse af det nutidige samfund som havende en 'polycentrisk' selvbeskrivelse. Derudover bruger jeg Michel Foucaults ideer for at fokusere mit studie på naturvidenskaben. Hans tanker bruges til at klargøre, hvilke historiske og kulturelle mønstre der bestemte, hvad man kunne tænke videnskabeligt i forskellige epoker af vesterlandsk historie.

Undersøgelsen af fremskridtstanken tager sit udgangspunkt i Nisbets påstand om, at denne idé er én af de grundlæggende i den vestlige verdens historie. Det vises, hvordan fremskridtstanken kun har været fraværende i renæssancen, men også bestrides mere og mere i dag. Jeg tilslutter mig kritikken af fremskridtstanken med von Wrights argument, om at den må opfattes som en myte tilhørende oplysningstidens rationalitet. Jeg foreslår konkluderende, at vi behøver nye tolkninger af relationen mellem udviklingen af naturvidenskaben og dens indvirkning på samfundet, og at vi i visse henseender kan tolke den tid, vi lever i, som en anden renæssance.

Del III: Positionerende tilgang

I Del III præsenterer jeg nogle idéer, som trækker på indsigten i de to foregående dele. Jeg kalder mit standpunkt for grænselandspositionen og forsøger at sætte den i perspektiv, blandt andet gennem en beskrivelse af nutidige kurser. Del III indledes dog med en undersøgelse af tilblivelsen af aftalen omkring Fagets videnskabsteori, såvel som en beskrivelse af den officielle begrundelse for indførelsen.

Overskridelsen af den uddannelsesmæssige afsondring af naturvidenskaben

Bestræbelserne på at underminere irrelevans-positionen i Del II giver plads til en positiv formulering af en position inden for forskningsfeltet. Jeg udvikler tre dimensioner af det, jeg kalder for naturvidenskabens grænseland. Den første har at gøre med opfattelser af givne fænomener inden for naturvidenskaben, og jeg argumenterer for at styrke de studerendes evner til at diskutere kompleksiteten af naturvidenskabelige objekter. Den anden dimension af grænselandet omhandler opfattelser af teknisk-naturvidenskabelig viden sammenlignet med andre tilgange til erkendelse. Jeg argumenterer for, at refleksioner i teknisk-naturvidenskabelige universitetsuddannelser kan gøre de studerende fortrolige med mangfoldigheden af tilgange til videnstilegnelse. Den tredje dimension drejer sig om relationen mellem naturvidenskab og samfund. Jeg hævder, at naturvidenskabsstuderende tillige har brug for at kunne deltage i diskussioner om dette emne.

Grænselandspositionen

Afsluttende formulerer jeg grænselandspositionen og forsøger at besvare spørgsmålene om begrundelse og indhold inden for forskningsfeltet. Jeg lader implementeringen af refleksioner være berettiget ved, at den vil forbedre naturvidenskabsstuderendes kvalifikationer. Jeg argumenterer for, at de studerende bliver bedre videnskabsfolk, hvis de er bevidste om grænselandets eksistens og dets væsentligste karakteristika. Mit svar til spørgsmålet om begrundelse drejer sig om den idé, at viden om naturvidenskabens grænseland giver bedre videnskabsfolk, som ikke forsimpler, tænker endimensionalt eller mangler evnen til at tolke den kulturelle og samfundsmæssige betydning af naturvidenskaben.

Det indhold i refleksionskurserne, jeg foreslår som en del af grænselandspositionen, bygger på de tre dimensioner, der er skitseret ovenfor. Der argumenteres for, at disse dimensioner er afgørende i tilegnelsen af kompetencer i naturvidenskabens grænseland. De tre dimensioner præsenteres som værende af analytisk karakter, men med den tilføjelse at jeg beskriver dem som udspændende rummet af diskussioner i grænselandet.

Appendix I

UNDERVISNINGS
MINISTERIET

Uddannelsesstyrelsen

Frederiksholms Kanal 26
1220 København K
Tlf 3392 5300
Fax 3392 5302
www.uvm.dk

Principper for filosofikum: Fagets videnskabsteori

20. december 2000
J.nr. 1999-2723-106

1. Formålet med studieelementet er, at de studerende får lejlighed til at kvalificere deres faglige specialisering ved at se den i et større, alment perspektiv.
2. Studienævnet for den enkelte uddannelse får ansvaret for udviklingen af den bedst egnede filosofikummodel for det pågældende fags studerende.
3. Undervisningen skal være forskningsbaseret, og den skal baseres i uddannelsens/fagets forskning.
4. Indholdet af studieelementet må svare til formålet, dvs. forbinde faglige spørgsmål med interessante og relevante spørgsmål af mere almen art.
5. Navnet på studieelementet er fagets videnskabsteori.
6. Placeres på bacheloruddannelsen normalt efter 1. studieår.
7. Omfanget af studieelementet er normalt minimum 1/8 årsværk.
8. Studieelementet afsluttes med eksamen, og som udgangspunkt med ekstern censur, men eksamensformen er i øvrigt studienævnets afgørelse.
9. Studieelementet indføres i de respektive uddannelser, således at det hører til det normale studieforløb.
10. Der arbejdes på at indføre studieelementet i alle universitetsuddannelser, dvs. at det søges indarbejdet i de enkelte uddannelsers studieordninger inden for en 3-årig periode. Det betyder, at studieelementet forventes at indgå i alle universitetsuddannelser senest fra 1. september 2004.

Appendix II

Nr. 74. Bilag 1.

ANORDNING OM DEN ALMINDELIGE FILOSOFISKE PRØVE VED KØBENHAVNS UNIVERSITET.

Vi Christian den Tiende, af Guds Naade Konge til Danmark og Island, de Venders og Goters, Hertug til Slesvig, Holsten, Stormarn, Ditmarsken, Lauenborg og Oldenburg,

Gøre vitterligt: Efter de Os af Vor Undervisningsminister allerunderdanigst foredragne Omstændigheder ville Vi allernaadigst have anordnet følgende Bestemmelser om den almindelige filosofiske Prøve ved Københavns Universitet.

§ 1.

Enhver studerende, der vil indstille sig til en af Universitetets Embeds-Eksaminer - herunder ogsaa den statsvidenskabelige Eksamen og Eksamen i Forsikringsvidenskab og Statistik - eller til en Magisterkonferens, skal forinden have bestaaet en filosofisk Prøve. Dog kan, hvor Studieplanen for det paagældende Fagstudium foreskriver en Prøve allerede 1 Aar efter Studiets Paabegyndelse, Aflæggelsen af den filosofiske Prøve udsættes til den første Eksamenstermin efter Fagprøven.

Islandske Studenter, der har taget den filosofiske Prøve ved Reykjavik Universitet, er fritaget for den nævnte Prøve ved Københavns Universitet.

Fritagelse for Aflæggelse af den filosofiske Prøve kan efter Indstilling af Konsistorium meddeles af Undervisningsministeriet i ganske særlige Tilfælde, navnlig hvor en andetsteds bestaaet Prøve skønnes at kunne træde i Stedet.

§ 2.

Den filosofiske Prøves Genstand er filosofisk Propædeutik, saaledes som denne i et Kursus - fordelt paa det akademiske Aars 2 Semestre med 4 ugentlige Timer i hvert - er foredraget af en af de filosofiske Professorer.

§ 3.

Prøven er mundtlig under Overværelse af en Censor. Der gives for Prøven en enkelt Karakter: Udmærket Godt, Meget Godt, Godt eller Temmelig Godt. Temmelig Godt er Betingelse for, at Prøven anses for bestaaet.

§ 4.

Prøven holdes i de to sædvanlige Eksamensterminer efter foregaaende Indtegning ved det filosofiske Fakultet. Fakultetet kan, naar særlige Omstændigheder taler derfor, give Tilladelse til, at der afholdes Prøve uden for Eksamensterminerne.

§ 5.

Ingen studerende kan uden særlig Tilladelse stedes til den filosofiske Prøve, førend der er hengaaet et Studieaar, efter at den paagældende har bestaaet Studentereksamen eller - saafremt vedkommende er immatrikuleret uden dansk Studentereksamen - efter at Immatrikulationen har fundet Sted.

Dispensation fra denne Regel kan gives af Konsistorium, dog at Fakultetet kan

1) meddele studerende, der godtgør en ved særlige Forhold begrundet Interesse i at indstille sig til Prøven før Udløbet af Aarsfristen, Tilladelse til at indstille sig tidligst et halvt Aar efter Studentereksamen (Immatrikulationen),
2) meddele Dimittender fra Niels Brocks Handelsskole Tilladelse til at indstille sig samtidig til den filosofiske Prøve og Tillægsprøven til Erhvervelse af akademisk Borgerret, dog saaledes at en eventuelt før Tillægsprøven bestaaet filosofisk Prøve kun beholder sin Gyldighed, saafremt Tillægsprøven bestaas i samme Eksamenstermin

§ 6.

Ved Indtegningen til Prøven betales et Gebyr af 6 kr.

Hvorefter alle vedkommende sig have at rette.
Givet paa Amalienborg, den 11. April 1927.
Under Vor Kongelige Haand og Segl.

Christian R.
(L.S.)

J. Byskov

ANORDNING
angaaende
Ændring i kongelig Anordning af 11. April 1927 angaaende den almindelige filosofiske Prøve ved Københavns Universitet.

Vi Christian den Tiende, af Guds Naade Konge til Danmark og Island, de Venders og Goters, Hertug til Slesvig, Holsten, Stormarn, Ditmarsken, Lauenborg og Oldenburg,

Gøre vitterligt: Efter de Os af Vor Undervisningsminister allerunderdanigst foredragne Omstændigheder ville Vi have anordnet følgende Bestemmelser angaaende Ændring i kongelig Anordning af 11. April 1927 angaaende den almindelige filosofiske Prøve ved Københavns Universitet.

Anordningens § 3 affattes saaledes:

Prøven er mundtlig under Overværelse af een Censor. Der gives for Prøven en enkelt Karakter: Udmærket godt, Meget godt eller Godt. Godt er Betingelse for, at Prøven anses for bestaaet.

Hvorefter alle vedkommende sig have at rette.

Givet paa Amalienborg, den 26. Marts 1930.
Under Vor Kongelige Haand og Segl.

Christian R.
(L.S.)

Fr. Borgbjerg

Appendix III

REKTORKOLLEGIET

The Danish Rectors' Conference

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5. oktober 2000
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PH

Til Rektorkollegiet

Statusrapport fra ad hoc-arbejdsgruppe vedr. Filosofikum

I. Indledning

Foranlediget af et forslag til folketingsbeslutning om indførelse af filosofikum på de lange videregående uddannelser har Rektorkollegiet 6. juni 2000 nedsat en ad hoc-arbejdsgruppe bestående af repræsentanter for de 10 universitetslovsinstitutioner under Forskningsministeriet. Gruppen har som kommissorium med udgangspunkt i det materiale vedrørende filosofikumrelaterede aktiviteter, der er indsamlet fra institutionerne, at

1. give en vurdering af mulighederne for og hensigtsmæssigheden af at indføre et fælles "filosofikum-modul" for alle uddannelser på kandidatniveau

2. foreslå pilotprojekter

3. komme med forslag til indhold, emner og cases, der kan inspirere til at integrere filosofikumrelaterede aktiviteter i undervisningen

4. komme med forslag til, hvordan eksisterende initiativer kan synliggøres.

Arbejdsgruppen består af:

Jes Adolphsen, AAU,
Lotte Søgaard Andersen, SDU,
Leon Brimer, KVL,
Hans Fink, AU, (formand),
Finn Frandsen, HHÅ,
Helge Elbrønd Jensen, DTU,
Ole Fogh Kirkeby, HHK,
Søren Kjørup, RUC,
Else Lemmich, DFH,
Thomas Söderqvist, KU.

Sekretær for arbejdsgruppen er Peter Holsøe, Rektorkollegiet.

Arbejdsgruppen har holdt møder i København 27. juni og 18. september og skal på den baggrund gøre status over sit arbejde.

II. Det gamle filosofikum

I 1675 blev der på Griffenfeldts initiativ indført en ny prøve på Københavns Universitet. Dens navn var "Examen Philosophicum", og den skulle afløse en tidligere mere krævende eksamen som adgangskrav til videregående universitetsstudier. Undervisningen til prøven var i filosofi i en særdeles bred forstand, der omfattede matematik, fysik, grammatik, logik og etik.

Prøvens formål var at give de studerende en vis almen dannelse som forudsætning for deres mere specialiserede fagstudier. Den gav i øvrigt også kompetence til at undervise ved de højere skoler. Indholdet og formen af prøven var ofte genstand for diskussion og blev ændret flere gange.

Ved en større reform i 1871 skabtes den form, der skulle være gældende i 100 år. Prøven skiftede officielt navn til "Den almindelige filosofiske prøve", men blev dog ofte fortsat kaldt "filosofikum". Det blev fastsat, at undervisningen til prøven skulle være "philosophisk propædeutik", dvs. en forberedende undervisning i filosofi, nu især forstået som en indledende oversigt over den europæiske filosofis historie og en elementær introduktion til logik og psykologi. I nogle tilfælde kunne en almen videnskabslære også indgå i pensum. Undervisningen havde form af forelæsninger ved professorerne i filosofi, som personligt havde ansvaret for undervisningens indhold og ofte selv havde skrevet lærebøgerne. Da beståelse af prøven var en betingelse for at tage andre

prøver på universitetet, lå undervisningen i sagens natur i første studieår og havde normalt et omfang på 4 timer om ugen i 2 semestre. Der var mundtlig eksamen med ekstern censur og mulighed for karaktererne "udmærket godt", "meget godt", "godt" og "temmelig godt", med "godt" som mindste krav for beståelse. Også på de nye universiteter i Aarhus og Odense var det fra oprettelsen et krav, at de studerende skulle tage filosofikum som den første universitetseksamen. Et tilsvarende krav har aldrig været gældende på de øvrige lange videregående uddannelser og nåede ikke at blive gældende
på universitetscentrene i Roskilde og Aalborg. Det stærkt stigende studentertal i 1960'erne førte til, at mange andre lærere end professorerne medvirkede som undervisere.

I 1971 blev der udsendt en bekendtgørelse fra Undervisningsministeriet, der ophævede reglen om, at de studerende skulle bestå Den almindelige filosofiske prøve, før de kunne aflægge nogen anden universitetseksamen. Formelt var det ikke en afskaffelse af prøven; men i praksis blev det resultatet. Det indtraf pludseligt og uden officiel begrundelse. Et længerevarende ministerielt udvalgsarbejde var udmundet i, at et stort flertal gik ind for en reform af undervisningens form og indhold; alligevel resolverede ministeren simpelthen, at reglen skulle ophæves. På nogle fakulteter og institutter - især i Aarhus - blev der indført nye obligatoriske kurser i fagrelevant filosofi og videnskabsteori; men et fælles kursus i filosofi for alle nye studerende på universiteterne var der ikke længere tale om.

Filosofikum havde fra begyndelsen været omstridt. Der var stadige pædagogiske problemer med at finde et niveau for undervisningen, der passede til alle. Hvis kravene blev for strenge, ville for mange dumpe, og hvis kravene blev for løse, ville for mange miste respekten for prøven og forsøge at klare sig med manuduktion frem for at følge undervisningen. På grund af prøvens særstatus risikerede man let, at både de studerende og de faglige miljøer oplevede den som en irrelevant forhindring, der blot skulle passeres lettest muligt, før man kunne komme til det egentlige. På grund af den manglende koordinering mellem lærerne i filosofi og de øvrige lærere var prøvens indhold ofte ude af trit med den i øvrigt meget forskelligartede faglige udvikling på de mange forskellige fag. Stigningen i studentertallet førte til stigende praktiske problemer i forbindelse med afholdelsen af undervisning og eksamen. I perioder, hvor dygtige og velrenommerede lærere forestod undervisningen, kunne der stå respekt om filosofikum, men ordningen var generelt sårbar for kritik. Blandt dem der har taget filosofikum, er der således yderst forskellige vurderinger af udbyttet af undervisningen. Der går mange vandresagn om besynderlige lærere og uforberedte eksaminander. Når der nu foreligger et forslag om indførelse af filosofikum på alle de lange videregående uddannelser, er det derfor helt nødvendigt, at man gør sig klart, hvad man vil forstå ved "filosofikum", hvad kontinuiteten til den gamle ordning skal bestå i, og hvordan man sikrer en fornyelse, der bedst muligt tager højde for de problemer, som ubetvivleligt knyttede sig til den gamle ordning.

III. Den øjeblikkelige situation

Rektorkollegiet har foranstaltet en rundspørge til de 10 berørte institutioner om hvilke filosofikumrelaterede aktiviteter, der var i gang på institutionen. En oversigt over svarene fra institutionerne er samlet i bilag 1. Det indkomne materiale er temmelig heterogent. Der er tale om kurser på mange niveauer, med mere eller mindre fagspecifikt indhold og rettet til undervisningshold af meget forskellig størrelse. Tolkningen af hvad der skal lægges i betegnelsen "filosofikumrelateret", har tydeligvis været forskellig fra uddannelse til uddannelse.

I flere af svarene fra uddannelserne fremgår det at en refleksion over fagets egenart og historie indgår i den øvrige undervisning som en integreret dimension. Vi er i vore overvejelser gået ud fra, at et "filosofikummodul" må forstås som et egentligt kursus eller undervisningsforløb med tilhørende eksamen og ikke blot en dimension eller
tematik i den øvrige undervisning. Hvis det kun drejede sig om det sidste, som burde være en selvfølgelig del af enhver akademisk undervisning, ville der ikke være nogen grund til at tage noget initiativ overhovedet.

IV. Et nyt filosofikum?

Vi har samlet vore overvejelser over mulighederne for og hensigtsmæssigheden af et fælles "filosofikummodul" for alle kandidatuddannelser i 8 punkter, der under alle omstændigheder må tages stilling til, før en beslutning kan konkretiseres og føres ud i livet:

IV. 1. Formålet med kurset
IV. 2. Ansvaret for kurset
IV. 3. Undervisernes kompetence
IV. 4. Indholdet af kurset
IV. 5. Navnet på kurset
IV. 6. Placeringen af kurset i studieforløbet

IV.1. Formålet med kurset

Når der er tale om at indføre et nyt eller fornyet "filosofikum", er det vigtigt at gøre sig klart, hvad der er den overordnede begrundelse for initiativet, som skal være styrende for beslutninger på alle niveauer. Hvad er det, der savnes i den nuværende situation, og hvad er det, man ønsker at opnå med det foreslåede kursus? Arbejdsgruppen har overvejet 3 formål, som man kunne ønske, at et filosofikummodul opfyldte.

A) At de studerende får en fælles almen dannelse bestående i et vist overblik over filosofiens og den vestlige kulturs udvikling.
B) At de studerende forberedes til deres fagstudier ved en almen introduktion til videnskabelige tænkemåder og metoder
C) At de studerende får lejlighed til at kvalificere deres faglige specialisering ved at se den i et større, alment perspektiv.

Disse hensyn udelukker ikke hinanden, men der er enighed i arbejdsgruppen om, at C), hensynet til faglig kvalificering, må være det overordnede. For os at se vil der kun være grund til at indføre et nyt filosofikum, hvis det kan udformes sådan, at det vil bidrage til at gøre de færdige kandidater bedre egnede til at varetage de funktioner, deres uddannelse skal kvalificere dem til. Et kursus ville således være velbegrundet, hvis det på en systematisk og velgennemtænkt måde kunne modvirke den stadige risiko for, at de studerendes faglige fordybelse fører til et fagligt snæversyn, der reelt gør dem mindre egnede i de ofte tværfaglige sammenhænge, de vil komme til at fungere i. Kurset måtte gerne bidrage til realistisk faglig selvforståelse og en passende faglig ydmyghed.

Hvad A), hensynet til almen dannelse, angår, kunne man altid ønske, at de studerende ved studiestart havde bedre og mere ensartede såvel almene som specielle forudsætninger, end de faktisk viser sig at have. Hvis der særligt savnes en fælles almen dannelse i form af kendskab til hovedtræk i den vestlige tænknings historie, kan dette dog efter vor mening bedst søges løst i gymnasiet, gerne ved en styrkelse af filosofifaget der.
Når det gælder B), hensynet til en indledende studieforberedelse, mener vi ikke, at et alment kursus er velegnet. En almen refleksion over videnskab og videnskabelige tænkemåder er en både nødvendig og

værdifuld ledsager til videnskabelige studier, men næppe en god introduktion til dem. Her gælder det om at komme i gang med konkrete eksempler på faglige problemstillinger så hurtigt som muligt. Der vil formentlig altid være problemer knyttet til overgangen fra gymnasium til universitet, men disse problemer bør efter vor mening søges afhjulpet målrettet og helt uafhængigt af spørgsmålet om oprettelse af et filosofikumkursus.

IV.2. Ansvaret for kurset

Hvis hensynet til at styrke den faglige kvalificering er det overordnede formål med et filosofikummodul, betyder det efter vor mening, at de faglige studienævn, der har ansvaret for de enkelte uddannelser, også bør have det primære og formelle ansvar for udviklingen af det bedst egnede filosofikummodul for det pågældende fags studerende. En integration af et nyt filosofikum i den løbende faglige udviklingsproces ser vi som afgørende for, at kurset bliver et velfungerende led, snarere end et påtvunget fremmedelement i uddannelserne.

Ved en sådan decentral placering af ansvaret for kurset er der selvfølgelig en risiko for, at den almene dimension i kurset glider i baggrunden, og at der ikke bliver det ønskelige fællespræg mellem de mange fags filosofikummoduler. For at modvirke denne risiko vil det være nødvendigt, at der fra mere centralt hold (enten ministerium eller institution) fastlægges nogle minimumskrav, som det enkelte kursus skal opfylde for overhovedet at være et filosofikummodul. Disse krav må på den ene side være rummelige nok til at tillade varianter og en stadig fornyelse, men på den anden side også præcise og operative nok til, at studienævnene kan fastholdes på deres ansvar. Dette sidste må ske gennem institutionernes godkendelse af studieordningerne. På store institutioner kunne man oprette et tværfakultært udvalg, der kunne have rådgivende og koordinerende funktioner i forhold til kurserne. Man kunne også overveje et fælles censorkorps for alle institutionerne. Spørgsmål om meritoverførsel må på sædvanlig vis være et studienævnsanliggende; men der bør lægges op til en liberal godskrivningspraksis.

IV.3. Undervisernes kompetence

Det daglige ansvar vil være undervisernes. Udvalget finder det yderst vigtigt, at undervisningen er forskningsbaseret, og at den varetages af

lærere, der kombinerer beherskelse af de overordnede filosofikumproblematikker med konkret indsigt i de fag, undervisningen skal perspektivere. Flere fakulteter og store uddannelser har allerede deres
egne institutter eller afdelinger for fagenes eller fagets filosofi, historie, videnskabsteori og/eller etik, hvor en sådan dobbeltkompetence forefindes, og disse må forudsættes udbygget. Ansatte her vil selvstændigt eller i samarbejde med andre kunne forestå kurser, der sætter faglige problemstillinger ind i almene sammenhænge. Mindre uddannelser vil kunne gå sammen om opgaven eller "udlicitere" den uden derved at afgive det overordnede ansvar. Det ville være ønskeligt, at der etablerede sig et landsdækkende fagligt forum for undervisere ved kurserne, og at der åbnes muligheder for efteruddannelse af lærere.

IV.4. Indholdet af kurset

Hvis formålet med et evt. filosofikummodul er at give de studerende lejlighed til at kvalificere deres faglige specialisering ved at se denne i et større alment perspektiv, må indholdet af kurset forbinde faglige spørgsmål med interessante og relevante spørgsmål af mere almen art. Vi foreslår, at kursets indhold skal være en undervisning, hvori det enkelte fags genstandsområde, typiske problemstillinger og aktuelle situation søges indplaceret i en almen filosofisk, videnskabsteoretisk, historisk, sociologisk og etisk sammenhæng. Til de fleste fag foreligger allerede bøger og artikelsamlinger, som vil kunne være egnede som undervisningsmateriale. Kursets direkte fagrelaterede og dets mere almene elementer kan enten behandles integreret kurset igennem eller behandles hver for sig, enten sådan at kurset starter i det fagrelaterede for derefter at udvide perspektivet, eller omvendt sådan at et alment perspektiv præsenteres først for derefter at snævres ind til det fagrelaterede.

IV.5. Navnet på kurset

I det foregående har vi blot overtaget ordet 'filosofikum' fra vort kommissorium og fra forslaget til folketingsbeslutning. Vi mener imidlertid ikke, at navnet vil være særlig velvalgt, da der næsten uundgåeligt vil være mange associationer knyttet til det, som vil være vildledende i forhold til begrundelsen og indholdet af et nyt kursus. Vi er enige om i stedet at anbefale betegnelsen "Studium Generale", som allerede bruges på Aarhus Universitet.

IV.6. Placeringen af kurset i studieforløbet

Det ligger i vor opfattelse af formålet med kurset, at dette ikke egner sig til at være studieforberedende eller studieintroducerende. Kurset ligger formentlig bedst på bacheloruddannelsen, men efter 1. studieår. Det kunne gøres til en regel, at prøven skal være aflagt inden specialet påbegyndes.

IV.7. Omfanget af kurset

Jo større kursus, man forestiller sig, des vanskeligere vil det blive at finde plads til det og især på de uddannelser, hvor der ikke er tradition for videnskabsteoretisk refleksion. På den anden side må kurset have et vist omfang, for at det skal give mening at indføre det, og for at det skal have en mulighed for at opfylde sit formål. 1/8 årsv. eller 7,5 ECTS-point må være et absolut minimum.

IV.8. Eksamensform

Hvis kurset skal tages alvorligt af de studerende og af de faglige miljøer, bør det i videst muligt omfang ligestilles med alle andre kurser og under alle omstændigheder være forbundet med eksamen og ikke blot afløsning ved aktiv deltagelse eller lignende. Vi vil anbefale skriftlig eksamen (gerne hjemmeopgave) med ekstern censur og karakter efter 13-skalaen; men mener i øvrigt, at det må være op til det enkelte studienævn at vælge eksamensform ud fra en samlet vurdering af prøvens placering i uddannelsen.

IV.9. Pligten til at oprette og til at tage kurset

Hvis der virkeligt skal være tale om et fælles kursus for alle kandidatuddannelser, må det selvfølgelig være en pligt for alle studienævn for disse uddannelser at oprette et kursus og gøre det til et obligatorisk element i fagets studieordning. Vi er i arbejdsgruppen enige om, at der må være en pligt til at et kursus oprettes, mens vi ikke er enige om, hvorvidt kurset skal være frivilligt eller obligatorisk for de studerende.

Det vil under alle omstændigheder være forbundet med næsten uoverstigelige praktiske problemer at få udviklet et kursus og få ændret alle
studieordninger i løbet af et år. Det forekommer ganske urealistisk at forestille sig, at dette skulle kunne ske med virkning for studieåret 2001-02. Man kunne anbefale en overgangsperiode på 5 år, hvor studienævnene fik lejlighed til at eksperimentere med frivillige kurser, som evt. kunne gøres obligatoriske, når studieordningerne alligevel skulle revideres. Man kunne også overveje, om ikke indførelsen af filosofikummoduler på uddannelserne, når det kommer til stykket, snarere burde gøres til et tema for de enkelte institutioners udviklingskontrakter, end til et bekendtgørelsesanliggende.

V. Afslutning

Udvalget håber med ovenstående at have besvaret kommissoriets pkt. 1. Besvarelsen vil selvfølgelig kunne uddybes, hvis det ønskes. Hvad pkt. 2 angår, har grundlaget for at foreslå egentlige pilotprojekter ikke været til stede; men på nogle af institutionerne er man allerede på udvalgsmedlemmers initiativ gået i gang med at overveje nye kurser, som evt. vil kunne gøres til pilotprojekter.

Ud over at give vort forslag til en indholdsbestemmelse af et kursus, venter vi indtil videre med at komme med mere detaljerede forslag til indhold, emner og cases (pkt. 3). Indsamlingen af oplysninger fra uddannelserne (bilag 1) har givet en første, ret ufuldkommen, synliggørelse af allerede igangværende aktiviteter. Såfremt en ny, fælles ordning for Studium Generale-kurser indføres, anbefaler vi, at institutionerne udarbejder samlede oversigter over kurserne til gensidig inspiration mellem uddannelserne både internt og eksternt (pkt. 4). Udvalget medvirker gerne som koordineringsorgan for institutionernes videre arbejde med udviklingen af sådanne kurser.

På arbejdsgruppens vegne

Hans Fink