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This dissertation presents a combined approach to the study of discourse and technology. The approach is applied on two different cases involving the precautionary principle and chemicals; namely an in-depth analysis of a short-lived prohibition against a specific class of pesticides based on conflicting sciences, and a broader analysis of the development of chemicals regulation and the interrelation to the precautionary principle.

It is concluded that the precautionary principle in practise requires a vivid debate at all levels including scientific approaches and public deliberation.

The Precautionary Principle and Regulation of Chemicals

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Preface

This report is the result of my PhD research that I started autumn 1999.

What is it I am analysing in this project? My entrance to the concept "the precautionary principle" has been a curiosity towards the application of scientific knowledge in the creation of environmental regulation. I used the concept writing my master thesis in the late 1990s, but did so without any deeper understanding of it. My master thesis subject was the realisation of endocrine disrupting chemicals as a problem and the social response. At that time, it seemed natural that the precautionary principle ought be invoked, considering the possible impacts and the number of possible hazardous substances. And my investigations indicated that political forces in Denmark employed the public attention towards this issue to enforce the implementation of the precautionary principle in Denmark.

When I made the preliminary investigations for this PhD project in 98/99 was my primary idea to investigate the nature of risk assessments and its lagging capability of providing a frame for the discussion of uncertain or absent knowledge. At the outset I believed – and still believe – that policymaking also must take uncertainty to account. This widens the task of applying expert knowledge because this standpoint implies that expert knowledge not necessarily is enough, and that the framing of the problem at hand might be equally important for the policy process as the very specific expert knowledge. I gained my momentum for this focus, during my master thesis, working with the testing- and regulation-strategies relating to endocrine disrupters.

During the preliminary process of defining this PhD project I had an aha-experience that connected my idea of a critical approach to risk assessments, my insight into chemicals regulation and issues, and the precautionary principle. At those days I lived in Aarhus, I was just about to finish a six months contract with a consulting engineering company, and where working on my PhD proposal and application to Aalborg University. From my earlier work at the Danish Board of Technology, I had contact with Michael Skou Andersen at the centre for social science research on the environment. Michael suggested that I should look at the precautionary principle in Denmark, because, as he put it, even though there were much literature about the principle internationally, had it not got any particular attention in Denmark. To me that indeed gave sense. First of all, I perceived the principle as a challenge to the existing paradigm of risk assessment, and by centring my investigation on this concept - it seemed to me - I would obtain an important advantage. My critique of the risk assessment paradigm could get a frame with political relevance, and thereby it could become more constructive and usable.

Concurrently, I was investigating the latest trends in the field of chemicals regulation. I was especially interested in the problematic of the huge number of non-assessed chemicals, and through an employee in the Danish Environmental Protection Agency, I obtained insight into the ongoing transformation processes of the European Chemicals Policy. At an informal meeting April 1998 in the Environment Council, the EU approach to chemicals management had been discussed (UK Presidency, 1998).

The initiative to this discussion came from Austria, Denmark, Finland, The Netherlands, and Sweden, and it consisted of an critique of the existing Chemicals Policy within the European Union, and a suggestion for the development of a framework directive for the overall chemicals regulation (KEMI, 1998). What thrilled me about these papers was that both in the minutes of the pro-environment EU member countries and in the Presidency conclusions, the precautionary principle definitely had a role. The minutes on the chemical policy laid down both a call for the application of the precautionary principle, and a call for an elaboration of how this application of principle were to come about in the EU. The Council conclusions show a kind of acceptance of the new principle, and they show the tensions between different views on what should be taken into account assessing and managing the risks of chemicals. Three aspects was emphasised, and there were differing views on the relative importance of these: 1) a soundly based scientific assessment of the risks to health and the environment; 2) an analysis of the socio-economic consequences of the decision; and 3) the Precautionary Principle.

To me, the case was clear: I would work with the precautionary principle, viewed as a critique or a correction to established practise, with its application in the chemicals regulation, and with its relation to conventional risk assessments. But, of course, this project could very fast grow immensely big, so I had to delimit the scope. The intuitive cut was to limit the scope to Denmark, and that became my choice. But, in the same breath, I have to state that to talk about chemicals regulation a sole national perspective focus is to limited. Chemicals regulation is an international issue, and no government in the world can set up its own regulation independent of international co-operation, be it OECD, or WTO. There are basically two reasons for this interdependency; chemicals are valuable commodities and therefore 'protected' by free-trade rules, and chemical pollutants all too often travel world-wide, crossing all national boarders, overruling all local regulations. Therefore, the delimitation to Denmark must be delimitation to a Danish *angle* on the chemicals regulation. Political theorists often talk about a 'two-level-game', and this seems to be quite adequate in the case of chemicals regulation in Denmark and the EU. Understanding the processes at the EU level isolated from processes at the national arenas, and visa versa, can be quite troublesome, because these arenas both are connected and very different.

The upcoming revision of the European chemicals policy constituted an overall political frame giving relevance to my project, and that was the first or prime 'event' that I inspired my project. The process gained seemingly its momentum in the late 1990's EU-policymaking, but I assessed that to understand the process would require insights that I could not gain through an exclusive international focus. Therefore, I intended to bring together both the history of the chemicals regulation at both an international European and national Danish levels.

At the Danish level, the 'core-events' are less obvious than at the European level. However, there are links between the two levels. Denmark was one of the promoting countries, taking initiative to the revision of the established practice of chemicals regulation. How can we interpret the national background for the Danish promotion of a precautionary principle at the European level? How did it come about to speak about pp in Denmark? The overall questions are as follows. What is the history of the

outspoken precautionary principle in Denmark? Was the precautionary principle manifest in early environmental regulation and especially in chemicals regulation? What events and processes in Denmark could I point to as important for the appropriation of the precautionary principle?

At the outset of my research, I had some preliminary ideas of answers to some if these questions. Interviewing a political secretary of one of the political parties in parliament, I had the sense that the issue of endocrine disrupting chemicals had been used strategically to enhance the meaning and use of the precautionary principle in the parliamentary debates on chemicals regulation in the mid 1990s. In the early 1990s Environmental Minister Lone Dybkjær was seemingly one of the first to invoke the precautionary principle in a specific case on plant growth retardants. This case involves different and conflicting testing rationales, institutionalised in separate organisations.

That was my point of departure. What comes next is what the thoughts became.

During the years of study, I have had a crucial support from my two supervisors at Aalborg University, Professor Andrew Jamison and Professor Per Christensen, in shape of inspiring discussions, profound criticism, and acknowledgement of my ideas, which all are indispensable necessities when working on this type of long solo-projects.

I am indebted to numerous people, but most of all to my wife who have given me more space than I could possibly expect, our two daughters who was with us in the UK during my 'PhD-sabbatical' in Sussex, and our little son who was born just about the date I formally should have finished the job.

Summary

The precautionary principle is a concept that has taken a central place as one of the guiding principles for the European environmental policy. The shaping of this concept is examined in relation to the development of chemicals regulation in Denmark and Europe. The report documents my journey into the world of precaution in five parts. The first part introduces my approach and my problem definition.

In the second part, I have outlined and synthesised the theoretical basis for my study. I have based the study on a theoretical approach that combines a discourse theoretic understanding of policy processes and a social constructivist approach to the shaping of technology. These two theoretical approaches is synthesised into an analytical approach that is sensitive to the combined effect of discourse and technology for the shaping of policies and actual practises. The first central concept in this approach is *discourse coalitions* that are combined of a *storyline* or a set of *storylines*, of *actors* and *actor-groups* who refer to these storylines, and the *practises* through which the actors constitutes their affiliation to the discourse coalition. The second central concept is *knowledge frame* that characterises the communalities within a certain approach to a specific technological problem.

In the third part, I start exploring the precautionary principle, which I do in two steps and without specific hindsight to chemicals or regulation of chemicals. First, I draw a general picture of the genesis of the principle as a policy concept from a basic common meaning, and I analyse the use of the principle in scientific writing. Secondly, I analyse the explicit references to the principle in Danish written media debate. I do this to establish an overview of the issues linked to the precautionary principle in public debate and to outline the diversity of these issues. The issues are divided up in six different categories ranging from chemicals and chemicals regulation, over food-related issues to discrete uses such as September 11th. The changing use of the precautionary principle is also identified and is contextualised with changes in the political settings. It is a general characteristic of the issues' affiliation to the spoken precautionary principle are like the relation between the iceberg and the visible iceberg. The precautionary principle is most often used as a 'tag' that characterises the case; and the specific cases may therefore very well be discussed in length without the mentioning of the precautionary principle. However, the analysis do also indicate that the precautionary principle, as concept, enhance the discussion of uncertainties in contrast of certainties. I use the analysis to qualify the case choice of the first in depth-analysis of the precautionary principle in the following fourth part. The chosen case, straw-shortening chemicals, demarcates the first explicit use of the precautionary principle in Denmark, which also intersected with the international negotiations over the principle in relation to the preparations of the Rio Declaration.

The fourth part is devoted the analysis of chemicals regulation, which I do in two steps. In this section, I leave the explorative approach followed in the previous section in favour for the analytical framework outlined in section two. The first step, an in-depth analysis of the case, show that the practises of a wide range of involved actors

of a precautionary character long before the Minister for the Environment in 1990 referred explicitly to the principle. The case is particularly interesting for me as it involves a (sometimes heated) debate over what types of tests are valid. The case has the advantage of being nationally isolated, which results in a rather intense and deep debate that eases the analyst's task. The case shows the multi-layered nature of both the precautionary principle and that of environmental policy-making, and how both institutions and rules are put into use to re-establish the order that was threatened. Specifically, the case gives a hint to the interrelation between national and international regulation of chemicals, which is taken up in the second half of part four where I focus at the international and especially European development of a regime for chemicals regulation. My second step analysing chemicals regulation builds on three themes that reaches back to my initial interest for the ongoing revision of the European chemicals regulation and which makes out the last of the themes. The two first themes are the development of both national and international regulatory responses to chemicals perceived as problems and the development of a chemicals critique. It is demonstrated that the worries and problems that eventually lead to the initiation of European revision of the chemicals regulation in the late 1990s was present in the Danish discussions in the 1970s, and that the revision is at risk of enclosing much of the uncertainties connected to the assessment and management of Chemicals.

The fifth part concludes the project, and points to the need for vivid debate at all levels including scientific approaches and public deliberation as a necessary precondition for a real application of the precautionary principle.

Resume

Dette projekt analyserer forsigtighedsprincippet i fem dele. I den første del gennemgår jeg det analyserede problem og tilgangen til problemløsningen. I den anden del udarbejder jeg mit teoretiske udgangspunkt for analysen med afsæt i diskursanalyse og teknologianalyse. I tredje del analyserer jeg forsigtighedsprincippet på et generelt niveau, dels på et begrebsniveau, dels i den konkrete anvendelse i danske aviser. I den tredje del analyseres dels den første anvendelse af forsigtighedsprincippet i dansk sammenhæng, dels opbygningen af det eksisterende regime for kemikalieregulering samt dets pågående revision i Europæisk regi. I den femte del konkluderes og det understreges at der er behov for åben og aktiv debat på alle niveauer som en forudsætning for en reel anvendelse af forsigtighedsprincippet.

PART ONE: INTRODUCTION

1 Project Description

1.1 Introduction: roots and contemporary modes of the precautionary principle

Fundamentally, the precautionary principle is a political principle that has been introduced as the antithesis of the, in many ways dominating, principle of scientific burden of proof (Weale, 1992: 81). In the policy context, the principle of precaution argues that policy makers will sometimes have to decide on action even if there is no scientific evidence of causation.

The precautionary principle takes seemingly its point of departure from the changing social conceptions about the appropriate roles of science, economics, ethics, politics, and the law in pro-active environmental protection and management (O'Riordan & Cameron, 1994: 12).

The principle of precaution raises important questions about the relation between science and policy formation, and it has relation to the dilemma between pursuing strategies of growth, competition, and strategies of sufficiency and fairness.

Paradoxically, the threat the principle poses against what might be termed "technocracy" is probably also the characteristic that makes it attractive or necessary for the 'technocracy'. In this sense, the precautionary principle is useful as the guarantor that may serve to regain the lost confidence in the political and scientific governance in society, a confidence that has been lost e.g. in cases such as the BSE and the dioxin-food scandals.

The roots of the precautionary principle are connected to the emergence of the environmentalist discourse that emerged during the 1960s and 1970s. Central texts are Silent Spring, The Closing Circle, and The Limits to Growth (Carson, 1962; Commoner, 1971; Meadows, 1973). All are references that in their specific ways are related to specific discussions: Carson to the critique of man's destruction of nature through unnecessary employment of chemical technologies, Commoner links between the environmental crisis and the social systems, and Meadows by mediating a concern from the business segment i.e. the Club of Rome.

From being a minor argument of a critical movement, the concept today has been taken up by policy elites in most industrial countries, is now an integral part of the language in the EU-bureaucracy, and has become a central argument of the environmental NGOs.

This process of internalising the principle of precaution coincides with the narrative of the so-called ecological modernisation. According to Maarten Hajer, the principle is a key "story-line", structuring the discourse of ecological modernisation (Hajer, 1995: 67). A major component in ecological modernisation is the attempt to merge the antagonistic relation between environmental protection and economic development;

the trade off between economic growth and environmental protection was abolished – at least at the conceptual level (Weale, 1992: 31-2). The major milestones in this process were the Brundtland report in 1987, the Rio conference in 1992, and the Kyoto protocol in 1997.

1.2 Motivation: Why Precautionary Principle and Chemicals Policy?

Firstly, chemicals are an old focal point for the use of so-called technical fix's – pests needs pesticides, unclean drinking water needs chlorine, burning plastics needs brominated flame retardants – all examples of highly reactive chemicals with powerful innate capabilities that have both desirable function and destructive side effects.

Chemicals are also a traditional focal point for the environmental critique that with Rachel Carson became a contributing factor in institutional reform, legislation, and regulation, and for the basis for social activism (Carson, 1962: 35-42, Jamison & Eyerman, 1994: 101).

Thirdly, there are many symptoms of crisis in the existing regimes for chemical regulation. A clear indicator of this is the fact that the European chemicals policies are undergoing a profound revision, leading to a proposal to be presented by the beginning of the year 2001 (EC Commission, 1998; EC Council, 1999). Explanations to this crisis may be both new understandings of 'toxicity' triggered by the problem posed by industrial chemicals with endocrine disrupting properties, the apparent shortcomings of the current chemicals legislation, and to receding public confidence in the authorities handling of technological risks.

1.3 Problem definition

Within the extensive revision process of the EU chemicals policy, the precautionary principle plays a central role. It is therefore my thesis that the chemical area probably will have a conclusive importance for the realisation of the precautionary principle. In addition, the ongoing process can be viewed as a test as to whether society is capable to manage what the German Sociologist Ulrich Beck has called the transition from industrial society to risk society.

Thus, the main questions of this study are:

- How has the critique of the societal use of chemicals - and the societal acceptance of this critique - lead to policy changes?

- What role does the precautionary principle play in these policy changes and negotiations?

Conceptualising the precautionary principle:

- What are the intellectual and conceptual roots of the precautionary principle?

- How are the precautionary principle reflected in public debate?

Looking at the chemicals policy:

- What is the history of the chemical regulation in Denmark?
- What issues, other than chemicals, connect at the Danish agenda to the precautionary principle?
- How does the precautionary principle connect to chemicals regulation in Denmark?
- What role does the precautionary principle play in the ongoing discussions about how to regulate chemcials?

Looking at the chemicals policy "from below":

- How are the perceived problems tackled, concerning 'scientificallity', testing strategies, and employment of 'new' actors?

1.4 Precautionary Principle and Chemicals Regulation

The academic discussions on the precautionary principle have flourished mainly since the inscription of the principle in the Rio declaration. A number of books and articles discussing the principle from various points of views have been published. The discussion of the precautionary principle may be divided in two main themes. The first theme is the principle as a legal principle, and the second is the principle as a directive on how to implement environmental policy, which especially relates to the idea of risk assessments.

Furthermore, it is important to notice that there does not exist a definitive definition of the precautionary principle, and that the perceptions of the concept has been changed and are changing. What today may be ment by the precautionary principle might have been indicated differently in other times or at other places. This leads to some differences in the opinions about where the concept first was used and implemented. In the US for instance, the Precautionary Principle has been applied in various ways in decisions about health, safety, and the environment for about 25 years, according to US observers (Ashford, 1999: 198; Bodansky, 1994), even though the principle has not been used in the literal sense. Recently, Sandin analysed 19 different formulations of the precautionary principle, pointing at critical differences in how the principle is interpreted (Sandin, 1999: 902-5).

Most research on chemicals policy has been made in the U.S. or in the comparison between U.S. an Europe (see Bosso, 1987; Brickman, Jasanoff, & Ilgen, 1985), and has had a very empirical focus. This may very well be due to the major differences between US and European policy-cultures. In the U.S. the conflicts are very open and characterised by clashes, where the European style is much more characterised by

close connections between the state and strong interest groups (Brickman, Jasanoff, & Ilgen, 1985: 23, 300, 307).

1.5 Approaching the Analytical Framework

What kind of analytical tools do I need? I must establish that I have no intention to apply a specific theoretical understanding. For me, theory is the tool that should be adapted to the empirical case, and not vice versa. At that point, the theory should give a deeper and nuanced insight into the case, its implications, and the world (!).

The first and most important question is the following: for what do I need my tools? In this project, I am studying the application of the precautionary principle in chemicals regulation in Denmark and to some extent in the European Union. It is not the entire European chemicals regulation that I put under scrutiny, but rather the interplay between the Danish and the European level. Therefore, it is the European chemicals regulation, as I see it in the Danish perspective that is part of my investigation. This is immensely important: Danish chemical regulation is most of all about international and especially European chemical regulation. In the following, I give an account of my approach to the subject.

In the following three chapters, I develop my analytical framework. At the outset I have two basic requirements the framework should fulfil and these relates to each other as two Chinese boxes. The outer box is the concept and its interpretations, and inner the box is the appropriation, diffusion, transformation, translation and mutations of the concept. Already with this metaphor, it seems if the two requirements are intertwined, as the outer box is empty without the concrete contents of the inner box.

I use a discourse analytical approach as inspiration to the outer box, and a modified version of the SCOT approach is the inner box. In the following two chapters are these theoretical inspirations discussed, and in a concluding theoretical chapter do I outline my theoretical and analytical framework.

The overall frame of the study can be termed with the idea of processes of ecological transformations (see Hajer, 1998: 35, Jamison, 2000), and the developments of the chemicals policy and the actualisation of the precautionary principle are followed within this frame.

The precautionary principle is conceptualised as a boundary object (or concept) that enables transfer, transformation, and mutation of values, ideas, and objectives crossing realms of quite different discourses. Policy principles – or rather: policy doctrines – whether "substitutions principle", "polluter pays principle", or "precautionary principle", need institutions to operationalise them. I interpret institutions in an open way, i.e. as building blocks of society, e.g. as participation, scientific research, or monitoring and assessment.

The analytical framework of this project draws on two different albeit somewhat intersecting types of theories; namely discourse theories, and social theories of

technology. In the following, I briefly describe the two fields and their application in the present project.

Central for my study is Maarten Hajer's Foucault inspired work (1995) – *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*. This work bridges the analysis of policy processes with a discourse approach. Further, the discursive approaches are important for the conceptualisation of the intellectual roots of the precautionary principle, where the recent work by Dryzek and Darier (Dryzek, 1997; Darier, 1999) gives a good point of departure. The precautionary principle really gets interesting, when the black box of technology is opened, because the principle should open up for alternative technological trajectories, and social futures (Schwarz, 1992: 18-19; Stirling, 1999: 29-30). Therefore, a deeper understanding of technology and technological development is important for the analysis of the use, interpretation, and consequences of the precautionary principle.

Furthermore, the discussion of the precautionary principle is linked with discussions about revising the conceptual understanding of risk assessments, as well as the techniques and technologies involved in the appraisal of risks posed by technologies.

The theoretical framework of SCOT (social construction of technology) developed by Bijker (e.g. Bijker, 1987; Bijker, 1995), and ANT (actor-network theory) developed by Callon, Latour, and colleagues (e.g. Callon, 1987; Latour, 1987; Latour, 1987) are, together with theories of technological systems (e.g. Hughes, 1986; Hughes, Bijker, & Pinch, 1987) the sources that I draw on in the analysis of the specific practises that constitutes .

The research may be characterised as action-oriented planning research. This approach has a characteristic 'engineering' quality by being problem-driven, rather than disciplinary-driven. Intervention in the ongoing processes is an important part of the research. The intervention comes partly by communicating with central actors and by performing participatory observation, partly by submitting analysis to actors, reflecting actual strategies and events. Doing this requires intellectual and technical engagement in the field of study.

PART TWO: THEORETICAL BASIS

2 Discourse analysis and the making of environmental policy

To me, discourse is two things. First, it defines an abstract model of society with the central thesis that speech and linguistic constructions has to be regarded as a condition for social actions as well as for the effects of social actions. The discourse marks out a set of rules that *for the time being* excludes other rules of the game. The model also postulates that linguistic actions are co-determining for how social reality is taking form, and how social reality change. Thus, social stability and social change has a linguistic 'condition' d'être. Not *raison* d'être, as it is enough to state the linguistic as a *condition* for the social – the social cannot be explained without (great) attention to text or rather how phenomenon are codified (see Neumann, 2001: 23), but either can the social be solely derived from text[1].

Secondly, discourse is an analytical tool; with which one identifies different discourses in the historical reality. The discourse concept can be used very different levels of abstraction, different locus, and crossing different institutional borders; and discourse analysis may be targeted at both the micro and the macro level. Nevertheless, how a concrete discourse is to be identified, discourse analysis (in the sense Laclau and Mouffe has given it) does not give any detailed directions to. It is here that I try turning to Hajer.

2.1 Hajer's discourse-analytical approach to the study of environmental politics

One of my sources of inspiration for the analysis of environmental policy discourse is Marten Hajer's book 'The Politics of environmental discourse', and the concepts of story lines, discourse coalitions, and the related understanding of 'discourse' as a strategic possibility. In the book, he presents an analytical approach – a discourse-analytical framework – that are based upon the assumption that environmental discourse is fragmented and contradictory, and that we yet somehow distil seemingly coherent problems out of this. Hajer argues that to investigate this, a discourse approach is very useful, not just to examine the discussions of the ecological crisis, but all those factors that influence the way in which we conceive the environmental problematique (Hajer, 1995: 1-2). He further argues, "that the developments in

[1] I follow Laclau and Mouffe that maintain what could be called a guarded or precautious realism. In *Hegemony and Socialist Strategy*, they discuss the relation between discurse analysis and relism: "The fact that every object is constituted as an object of discourse has nothing to do with whether there is a world external to thought, or with the realism/idealism opposition. An erthquake or the falling of a brick is an event that certainly extists, in the sense that it occurs here and now, independently of my will. But wheater their specificity as objects is constituted in terms of 'natural phenomena' or 'expressions of the wrath of God', depends upon the structuring of a discursive field. What is denied is not that they could constitute themselves as objects outside any discursive condition of emergence" (Laclau & Mouffe, 2001: 108)

environmental politics critically depend on the specific social construction of environmental problems".

Hajer takes the discourse approach of Michel Foucault as a point of departure, and modifies, especially with inspiration from Davies (Billig) and Harré, to add a greater sensitivity towards social interaction, and ease the possibility of less pinioned actors, capable of some kind of action.

Hajer understands discourse as a specific ensemble of ideas, concepts, and categorisations that are produced, reproduced, and transformed in a particular set of practices through which meaning is given to physical and social realities (Hajer, 1995: 60). In the following, I unfold Hajer's approach and some of its qualifications in more detail, and return in the end of the second subsection to his idea of discourses and its relation to institutions. In the succeeding third subsection, I elaborate the two middle range concepts, story lines and discourse coalitions, which take centre stage in Hajer's approach to discourses and institutions in the analysis of environmental politics

2.1.1 Levels of discourse analysis

In his framework, Hajer distinguishes between two levels or understandings of what discourse means, and in the same movement, he underlines the importance of combining them. The first level relates to a social science understanding, where discourse analysis primarily aims to analyse why a particular understanding of a problem at some point gains dominance and is seen as authoritative, while other understandings are marginalised. The second level draws on the common-sense understanding of discourse as 'discussion', or the actual mode of talking, but elaborates this understanding from a social scientific point of view. Hajer points at the context and content of speech as important; the discourse as internally related to social context, which gives regularities and variations in speech or 'text' to examine, and on the other hand, discourse as content, which gives ensembles of ideas, concepts, and categorizations to analyse.

By combining these approaches to a rather broad concept, he defines discourse as a "specific ensemble of ideas, concepts, and categorizations that are produced, reproduced, and transformed in a particular set of practices and through which meaning is given to physical and social realities" (Hajer, 1995: 44). In this way, the discourse concept comes to embrace both scientific paradigms in the Kuhnian understanding as a specific matrix of practices, inclusive professional terminology and other kinds of sub-cultural languages, such as that of radical environmentalists, as well as the more abstract meta-level discourse concept that Michel Foucault developed, and which is more out of reach of the actors.

2.1.2 Introducing the approach; the notion of story lines

An important issue is how discourses work. It is the 'small' and less conscious practises, techniques, and mechanisms that to a certain degree determine how the larger institutional systems actually work. This idea about the importance of 'micro-powers' originates from Foucault that criticised the traditional political theory for giving too much attention to the institutions, and too little to these smaller practises. Foucault would instead break down the large discourse down into a multiplicity of

component discourses that were produced and reproduced through a whole array of practices in various institutional contexts (Hajer, 1995: 47). A consequence of this worldview is that it becomes problematic to see and understand history and institutional developments as continual processes. History should rather be understood in the light of the relations and interdependencies between discourses. In my understanding, this compares to the idea of reality being contingent; things could have been different, and the future is not determined.

Hajer stresses the importance of Foucault's theoretical work for the analysis of policy discourses and their creation. The strength of doing this lies in the analysis of discursive practises and the co-evolution and fusion of discourses, notably the notions of 'tactical polyvalence of discourses'[2] and 'polymorphous interweaving of correlations'[3].

This given, Hajer presents two 'corrections' to Foucault's theory that aims at making the approach more operational for the analysis of environmental politics. Hajer's theoretical project is to bridge the abstract work of Foucault with the study of concrete political events, and the mean is to relate the interaction between discourses to the role of individual strategic action in a non-reductionistic way (Hajer 1995: 52).

The first correction gives the actor more manoeuvre space, and focuses at the *argumentative interaction* as a key moment in discourse formation. The second correction regards *social change and permanence*, and gives like the first correction; occasion to directions of what kinds of analytical strategies might be pursued in the analysis of environmental policy formation. The corrections leads to the introduction of the 'middle range concepts' story lines and discourse coalitions, which links discourse analysis with the analysis of individual strategic action. In this subsection, I introduce the first concept, story lines, and some of the basic assumptions that Hajer use to ground his argumentative discourse analytical approach.

In the argumentative interaction politics is conceived of as a struggle for discursive dominance or hegemony in which actors try to secure support for their definition of reality. Therefore is the capability of making a pursuing argument is at centre stage, and the concepts *Logos, Ethos, and Pathos* from rhetoric are important. In this game, the dynamics is shaped around three factors (Hajer, 1995: 54, 59-60):

Credibility is a necessity for the actors to believe in the subject positioning they are given in a discourse, and it is a precondition for the actor's acceptance of the implicated structuralised subject positions.

Acceptability requires the positioning to appear attractive or necessary.

Trust refers to the fact that uncertainty or insecurity can be suppressed if the speaker (institution or person) manage to establish authority or confidence, e.g. by referring to its or her impeccable record, or by the practise through which a given definition of

[2] Hajer, 1995: 50
[3] Foucault 1975, Discipline and Punish: 58 in Hajer, 1995

reality was achieved, e.g. by showing what sort of deliberations were the basis of a given claim.

Strategically used, these factors can become the ability to convince with logics, the speakers reputation, and the speakers strategy with respect to historical positioning and identification.

In the actual dialogue, the discourse analysis examines the boundaries between clean and dirty; morality and efficiency; or how specific framings leaves certain elements to appear as unquestionable or inevitable, while other elements are abandoned as problematic (Hajer, 1995: 54).

In the actual practises of communication, Hajer point to the potential of the rhetorical approach to inform the analyses of the modern bureaucratic 'discursive styles': "[...] The rhetorical approach sensitizes research to the effects of 'categorization' according to which a particular issue is processed as just another element of a general category, or of 'particularizing', where the uniqueness of a case is emphasized." (Hajer, 1995: 54). Hajer continues. "To deconstruct a policy discourse and find that it is to be understood as the unintended consequence of an interplay of actions is one thing, more interesting is to observe how seemingly technical positions conceal normative commitments, yet more interesting still is to find out which categories exactly fulfilled that role, i.e. how this effect could occur and which course of affairs is furthered in this way."

The important aspect of this correction is the extended focus at the subject's involvement in the production and transformation of discourse.

The second correction Hajer introduces to Foucault's notion of discourses considers the idea of stability and change. Hajer aims at dealing with the problem of the actor being 'caught' by the discourse as the notion of discourse is being outlined by Foucault. To do this, he takes the position that discourses are being reproduced by sequences of speech situations (which does not differ from the position of Foucault). Where Hajer probably diverts from Foucault is in the workability of discourses, and thereby the importance of speech and speech situations for the change and alterations of discourse. However, the resulting conclusion is in line with Foucault: "Rules, distinctions, or legitimate modes of expression, only have meaning to the extent that they are taken up. It implies that the rules and conventions that constitute the social order have to be constantly reproduced and reconfirmed in actual speech situations, whether in documents or debates. Consequently, the power structures of society can and should be studied directly through discourse." (55) From this Hajer draws the following consequence for research of politics and policy making:

> "Analysing interpersonal communication thus becomes much more relevant. Analysing policy papers becomes important even if they do not include 'hard' new proposals or legislation. It becomes imperative to examine the specific idea of reality or of the status quo as something that is upheld by key actors through discourse. Likewise, it becomes essential to look at the specific way in which appositional forces seek to challenge these constructs. Discourse analysis, then, is not only essential for the analysis of subject positions but also for 'structure positionings' (referring to which structural elements can

> be changed, and what institutions remain to be seen as fixed or permanent)." (Hajer, 1995: 55-56)

As with Foucault, Hajer's actors yet seem to be caught between subject and structure. The structural determination of the actor is loosened, but it has not disappeared. In the discursive processes of reproduction and transformation, the actor is not completely free, but – as holders of specific subject positions – entangled into specific nets of meaning. Hajer uses the concept of story lines to conceptualise the tension between the influence of routinised understandings, and the possibility for the specific actors the exercise an – at least theoretical – choice between the available sets of practices. A story line becomes a generic type of a story that allows actors to draw on various discursive categories that make sense to certain specific physical or social phenomena. The key function of the story line is to suggest a (simplifying) unity and clarity in the otherwise staggering variety of discursive component parts of the problem at hand. The underlying assumption is that people do not draw on complete and coherent systems of discursive elements (typically such will not even be present). Rather, it is assumed, the interpretation is formed with reference to story lines. In this way, story lines play a key role for the positioning of subjects and structures, and Hajer argues;

> "Political change may therefore well take place through the emergence of new story-lines that re-order understandings. Finding the appropriate story-line becomes an important form of agency." (Hajer, 1995: 56)

Again, it is important to stress that this approach does not imply actor voluntarism, as the action of positioning not necessary is conscious. The positioning may just be "the way one talks" on *this* sort of occasion (Hajer, 1995: 57). Therefore, the routinised forms of discourse express a form of sustained power relation that is effective exactly because it does not imply actual confrontations. On the other hand, the actor can be conscious and may succeed in breaking with the dominating discursive structures. The discursive challenge consists in withstanding the routinised categories, or – even more powerful – to create new combinations within established discursive structures or systems. This corresponds to the discoursing subjects exploitation of what Foucault has called the 'tactical polyvalence of discourse'.

This makes this approach particular interesting for the study of environmental politics. If we take environmental movements as an example, a persistently unsettled issue is the dilemma between reasoning within the terms and rationales outlined by authorities, and insisting at developing an independent form for setting up the argument. On the one hand will the arguments be heard, maybe taken into account, but will by following the rationales of the sovereign be tame and tractable, and on the other hand may the arguments be radical and critical, but will not be heard. The dilemma stands between inclusion and de-radicalization – in worst-case co-option – on the one side, and sovereignty – in worst-case exclusion and isolation – on the other. In practise, there often exists a kind of division of labour between different parts of the environmental movement, such that different groupings take different positions, and thereby ensure broadness in the critique of, and interaction with, authorities and the public.

To argue against the routinised categories is in the political reality the same as arguing against the institutions that are based on the "specific, structures, cognitive

commitments" (Hajer 1995: 57). This may cause the discursive interaction to appear as fragmented and non-intelligent with the participants in blind, fixated positions, thwarting reflexive debate, e.g. when a non-governmental actor deny the terms set by a governmental actor and emphasise the importance of the availability of alternative discourses. Hajer points to a disciplinary force of discursive practice, which often will be at work, as the implicit assumption that subsequent speakers will answer within the same discursive frame. When the speaker refuses to fall into line, the discussion becomes divided on different and perhaps incompatible discursive frames, as even challengers of the prevailing discursive frame will be expected to position their contribution in terms of known categories.

2.2 Hajer's conceptual framework

On this basis, Hajer develops an approach for the analysis of discourses in a political context, which resembles the structure-actor relationship as pointed out by Giddens (se Giddens, 1984).

> "My 'argumentative' approach focuses on the constitutive role of discourse in political processes as described above and allocates a central role to the discoursing subjects, although in the context of the idea of duality of structure. Social action originates in human agency of clever, creative human beings but in a context of social structures of various sorts that both enable and constrain their agency. The transformational model of social reality then maintains that society is reproduced in this process of interaction between agents and structures that constantly adjusts, transforms, resists, or reinvents social arrangements." (Hajer, 1995: 58).

Compared with Giddens structuration theory, Hajer's approach seems to avoid the pitfall associated with Giddens' concepts of recursiveness and rules that makes the analysis of societal stability more accessible than the analysis of change (see also Mortensen, 1991[4]). Hajer's project resembles that of Giddens in the sense that they both work with the problem of inconsistency between structure and actor. However, where Giddens abandon the traditional structure concept and redefines it with concepts such as social practice, the latter's rule-character, 'recursivity' and 'duality of structure', does Hajer instead - especially by drawing on Foucault - aim at changing the perception of actor and subject concepts. This is probably the most important reason why Hajer escapes this pitfall. The implicit and rather radical critic of the traditional actor and structure perspectives that follows with Foucault's discourse analytical approach make actors become socially constituted *social actors* who in a wide-ranging sense are enrolled in a social context. At the outset this context has to be interpreted as more encompassing than the actual face-to-face relations those actors in the immediate situation are a part of. In line with this, it is my assessment that Hajer's framework is developed along a structure concept that allows a greater degree of systems complexity, unpredictability, and creativity, than more traditional structure- and systems-concepts do. Furthermore, it may be noted, that where Giddens aims at developing a general theory for understanding structure-actor relations, does Hajer

[4] For a extensive critical discussion of Giddens, Mortensen refer to Held & Thompson (eds.) (1988). *Social theory of modern societies: Anthony Giddens and his critics*, Cambridge: Cambridge University Press.

aim at developing operational concepts for the specific analysis of environmental politics, and they may therefore not easily be compared.

Hajer's approach gives a comprehensive attention to the actual interaction. In his conceptual framework, there exists a substantial interaction between linguistic structures and the development of preferences. Language as a specific communicative practice is an inseparable part of reality that partly shapes the interpretation of interests and preferences. Interests are – in other words – seen as intersubjectively constituted through discourse. Discourse, therefore, is utterly important for processes that involve political change, argues Hajer. In the argumentative approach, politics and policy making are seen as struggles for hegemony, where the actors seek support and stability for their respective worldviews and specific interpretations of reality. The important implication of this approach is that the emergences of new policy discourses like ecological modernisation in Hajer's case, and the precautionary principle in my case, may eventually "alter the individual perception of problems and possibilities and thus create space for the formation of new, unexpected political coalitions." (Hajer 1995: 59)

Hajer does thus combine a cognitive and a social constructive approach: Arguments can convince because of some property they have – e.g. plausibility – that countervailing ideas lack, but the plausibility is the product of persuasion, which is not a purely cognitive process (Hajer, 1995: 60). The cognitive and the social are therefore intertwined and inseparable.

The point is that the processes are social and takes place in a context of existing institutional practises, and this derives certain tasks for the analyst. One must examine which institutional practices support the existing discursive dominance, and what and how certain claims are furthered. In this sense, the institutional arrangements are preconditions for the discourse formation. Reversed, the institutions cannot function without the discursive software. For research, this implies that we must unravel how institutions are made to operate through subject positions and structure positions lending closure to institutional machinery that can be put to different uses. Here, Hajer points to two important issues the discourse analysis should illuminate:

How "cognitive and social commitments routinely are being reproduced" (Hajer, 1995: 60), i.e. the stability of discource.

How "discursive 'interpellations' takes place, whereby interpellations are understood as those moments where routinised procedures are being interrupted", i.e. change through new discursive relationships and through creation of new positionings.

With other interpretations of discourse analysis, interpellation is the act of discourse giving meaning to specific subject positions (see Jørgensen & Phillips, 1999: 53-54). This use of 'interpellation' denotes a deviation from Althusser's definition of the concept. Laclau and Mouffe see the subject as fragmented; it is not positioned at one position in one discourse, but is interpellated into many different positions by different discourses. The subject will often (normally) be over-determined meaning that it is positioned (and interpellated) by conflicting discourses. If a certain subject position

does not seem to be in conflict with other positions, this will be the result of hegemonic processes. According to this is the situation with 'discursive interpellations' characterised by the person or institution in question being under interpellation from more than one discourse, whether the 'routinised commitments' is characterised by the subject being interpellated by a hegemonic discourse.

This takes us back to Hajer understanding of discourse, and to the relations and dynamics between discourse[5] and institution. Hajer speaks (60-61) of the condition of discourse structuration if the credibility of actors in a given domain requires them to draw on the ideas, concepts, and categories of a given discourse, for instance, if actor's credibility depends on the usage (in my case) of the term precaution in the domain of environmental politics, or even technology policy. Further, he speaks of discourse institutionalisation if a given discourse is translated into institutional arrangements, i.e. if the theoretical concept of the precautionary principle (in my case) is translated into concrete policies (i.e. no pesticides in drinking water) and institutional arrangements (i.e. establishment of procedures for public involvement). If these two conditions are fulfilled a discourse can be said to be hegemonic, or weaker, to be dominant in a given domain.

The approach thus focuses at the historical formation of institutions; how ideals are created, made discursive, and institutionalised, but also how some ideals and discourses are being expelled and never become institutionalised. The distinction ideal-discourse-institution should not be perceived as a sequence in time where an ideal with time will blossom as an institution, but rather as a logical and analytical distinction. It is through the analysis and unravelling of the history of institutions this logic appears, as history is sorted out to enable the visibility of t he struggles over the formulation of ideals, how certain ideals succeeds being discursive, and others becomes displaced, and of the struggles over the institutionalisation of discourses. (See also Andersen, 1995: 16-32)

2.2.1 Story lines and discourse coalitions; the framework at work

Story lines and discourse coalitions are Hajer's middle range concepts or 'concept-tools' that are established especially for the study of inter-discursive communication. I introduced the story line concept in the beginning of this chapter as a generic story outlining an otherwise complex and intractable issue. The story line concept resembles Emery Roe's (1994) concept of narratives[6], and it draws on the idea of metaphors as important common ground mediators between various discourses for policy formation (Schön, 1979). The metaphor allows the actor to create their own understanding of the problem, by subsuming the metaphor their specific worldview. Metaphors may provide connexions between otherwise distant or incompatible domains, by

[5] Discourse understood as a specific ensemble of ideas, concepts, and categorisations that are produced, reproduced, and transformed in a particular set of practices through which meaning is given to physical and social realities. See page 1.

[6] Roe though use the *policy narrative* concept more as an analytical tool, than a phenomenon to be uncovered. I.e. in the hands of Roe, the narrative is an analytical, and in the hands of Hajer, the storyline concept is both an analytical approach and a strategic resource for the actors under examination.

simplifying or sealing uncertainties and indeterminacies. This could for instance involve the relation between advice based on expert and scientific knowledge and policy making. Neumann has the point that the metaphor is a requisite part of language, also when it comes to science writing, where the metaphor may be the most important tool in breaking through an existing discourse that normalise phenomena and thereby makes in 'invisible'. As extreme examples on 'scientific' metaphors Hajer points to a single graph representing the longitudinal development of forest damage or the reduction of ten years of research in air chemistry in a discursive change from 'tall stack will dilute and disperse emissions' to a saying like 'what goes up must come down'. Other examples that could be added is the figure of 100,000 non-assessed chemicals as a driver for renewed chemicals regulation, or the graph of decreasing sperm quality since the end of WWII and the association with oestrogenic active synthetic chemicals (see e.g. Sharpe & Skakkebaek, 1993 and Giwercman et al., 1993).

This property of metaphors relate to MacKenzie's idea of the 'Certainty Trough', whereby the perceived certainty of knowledge claims of a research specialty is greatest some way from the actual site of knowledge production, as illustrated in the figure. The knowledge is to a varying degree 'black boxed'; key issues are preserved, but uncertainties and indeterminacies are – wittingly or unwittingly – underplayed or eliminated. Therefore, practitioners may attribute greater certainty to knowledge from another specialty than the practitioners in the first would attribute to it themselves. The subsequent point in the certainty trough is that the perceived uncertainty may be even higher farther away by actors alienated from research and those institutions[7].

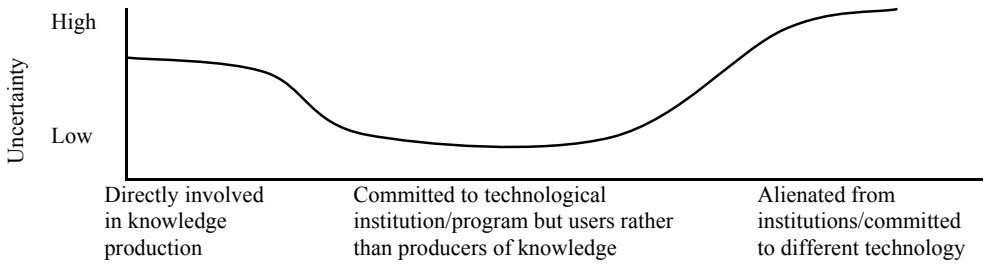


Figure 2.1 The "Certainty Through" (MacKenzie, 1990: 372).

In the hands of Hajer, the approach to story lines and the meaning of narratives as vehicles for knowledge transfer gets an extra twist, as he argues that regulation in fact depends on this loss of meaning and the multi-interpretability of text (Hajer, 1995: 62). The regulation of conflicts over the interdiscursive problems characterising complicated (i.e.) environmental problems, will be dependent on and determined by

[7] Bijker (1995: 284-285) has the point that the MacKenzie representation might be misleading, as the character of the uncertainty change along the x-axis: when the boundary of a technological frame is passed, the character of the technology in term of its obduracy changes. The uncertainty at the end of the curve is due to the obduracy of the sociotechnical ensembles in the "take it or leave it" sense, while at the beginning of the curve it is due to their high differentiation for highly included actors.

the effects of certain story lines. This partly corresponds to observations made by Shackley and Wynne (1997) in the realm of climate change and the related model building and policy making. Shackley and Wynne argue that in the case of Global Warming Potentials ambiguity in their precise meaning is a major reason why they have been developed and continue as scientific policy tools.

However, essentially working as a metaphor, story lines also encompass more than that. Story lines are problem setting stories or narratives that help cluster knowledge, position actors, and – ultimately – create new coalitions.

The workings of story lines can be sketched in three steps:

- Foremost story lines facilitate the reduction of the discursive complexity of a problem, and thereby create possibilities for problem closure.

- When a storyline is accepted and more and more actors subscribe to it, the reference to it becomes ritual, which gives certain permanence to the debate. Accordingly, the storyline has become a trope that rationalises or constructs the problem as *coherent*.

- This allows actors from different domains to expand their own understanding and discursive competence of the phenomenon, which otherwise would be beyond their reach.

It is by being a very constructed phenomena, a storyline succeeds in linking actors from very different domains or discourses (such as scientists, politicians, environmentalists, journalists), giving meaning or illustration to how his or her understanding and contributions fit into the larger jigsaw outlined by the storyline. Moreover, Hajer argues that it is the shallow and ambiguous property of the story line that allows it to become the 'cement' in the creation of communicative networks among actors that have different, or at best overlapping, perceptions and understandings. Discursive practices that come under this definition of the story line are metaphors, historical references, analogies, clichés, or even appeals to collective fears or senses of guilt (Hajer, 1995: 63).

I will propose that it is exactly this characteristic of the debate on environmental problems, which has fuelled the relative success of authors like Bjørn Lomborg representing the sceptical attitude towards the severity or even the very existence of environmental problems[8]. This paradox might have further and general implications. It is likely to assume that emergent discourses will be more fragile than established ones, exactly because the terminology and intersubjective understandings has not been stabilized. The very reason why the new understanding can emerge – the coupling by

[8] The position Lomborg takes up, place man in top of the hierarchy over everything else, and employs a mechanistic view of full the substitutability between nature, technologies, etc. (see Dryzek 1997: 43-60 for a characterisation of the promethean position cultivated by among others Julian Simon and Aaron Wildawsky, which Lomborg usually takes).

otherwise alien discourses through shallow concepts – is also the Achilles' heel of the emergent understanding.

The issue of communicative networks bring us further to the second 'middle range' concept; discourse coalitions. Discourse coalitions are the media wherein the struggles for discursive hegemony are carried out; they comprise or involve story lines in action. Discourse coalitions are formed among actors that for various (to be examined!) reasons adhere to the involved story lines, and thereby strengthen a certain understanding and rationale of the problem concerned.

A discourse coalition is distinct from the traditional notions of political coalitions and alliances. First, because the constructive approach use a linguistic understanding of social change and denies interests as the basis of actions. Instead of interests, the discourse coalition takes story lines as the basis of the coalitions, as story lines potentially can change the actors' perception of own interests. Secondly, it is possible to add the methodological argument that story lines are easier to identify and ascribe than are interests. While it is quite straightforward to know what policy actors are advocating as a policy option along with the arguments and assumptions they use to support their position, is it almost impossible to identify their interests with any reasonable intersubjective plausibility (Weale, 1992: 59, see also Neumann, 2001: 37). This said, it must be stressed that I put no claim on story lines or beliefs as being consistently more fundamental than interests, as there very well may be economic or strategic reasons behind an actor's adherence to a certain story line. I rather see beliefs, worldviews, and interests as being interwoven. In this, I believe to be in line with Hajer: " […] interests cannot be taken as given a priori but are constituted through discourse. The point here is that interests have to be constantly reproduced and will change over time […]". I perceive of the relation between interests and adherence to storylines as a chicken and egg situation. He does not explicitly address whether interest beyond perception exists, but would probably take the position that this would be an un-matched and therefore un-interesting type of interest. What is interesting to examine is how the discursive position and hence *perceived interests* is created, stabilised, and changed: "The task of the political analyst will be to explain how a given actor [person or organisation] secures the reproduction of his discursive position (or manages to alter this) in the context of a controversy." (Hajer, 1995: 51)

In line with the general characteristics of discourse analysis, the discourse coalition broadens the scope of where the actors of the coalition are to be found, especially including actors that are not founded in state apparatus or has economic relations to the problem, which normally would be the main focus in traditional systems analytical or structural Marxist approaches. Discourse coalitions therefore:

> "suggest searching for politics in new locations, looking for the activity of the actors who produce story-lines (i.e. scientists, activists, but also mediators such as journalists) and the practices within which this takes place, for instance by investigation the role of a popular scientific magazine in the construction or proliferation of a story-line, or by looking at the activities of specific organizations in bringing together previously independent operating academics or policy-makers." (Hajer, 1995: 66)

Hajer defines a discourse coalition as consisting of three elements: 1) A set of story lines, which is the 'cement' of the coalition that makes otherwise alienated actors or entities have common points of understandings. 2) The actors who utter these storylines, and therefore routinise them, by referring to them, and possibly by changing practice. 3) Finally, the coalition consists of the practices in which these discursive activities are based, and which ultimately may lead to the institutionalisation of the discursive practice.

The discourse coalition concept wraps up Hajer's approach, binding up story lines with actors and ultimately with changed practices, changed policymaking, and perhaps changed policy-outcomes.

Left is the question why a given actor adheres to specific story lines. I have already adduced that it may be strategic reasons that lead to adherence, but as Hajer states, presents this a too individualistic explanation if detached. Hajer argues that storylines do not primarily derive their discursive power from the individual strategic choice, or from the fact that the specific elements fit together in a logical way, but because they depend on what Hajer propose to call 'discursive affinities' (Hajer, 1995: 66). Hajer's inspiration to the concept comes from Weber's notion of 'elective affinities' that refers to practices that mutually favour the continuance of the other practice. This is consistent with the observation that standard operating procedures are the usual ways in which bureaucracies process issues and thereby cope by adapting existing procedures and routines of working to new problems. An explanation is that with limited time, issues compete with one another for attention and ways of coping with this information overload will have to be found if the organisation is to manage (Weale, 1992: 54). However, this example concerns a certain practice – and it is a rather mechanistic and rational choice-like explanation to affinity.

As an alternative the discourse approach suggests to take one step back, looking at the narrative that (possibly) gives meaning to a practice:

> "Separate elements might have a similar cognitive or discursive structure which suggests that they belong together. In that case, actors may not understand the detail of the argument, but will typically argue that 'it sounds right'." (Hajer 1995: 67)

In my interpretation, this account tends to omit explanations beyond 'affinity' – that something 'sounds right' means that the speaker has an affinity, but not why. Hajer continues,

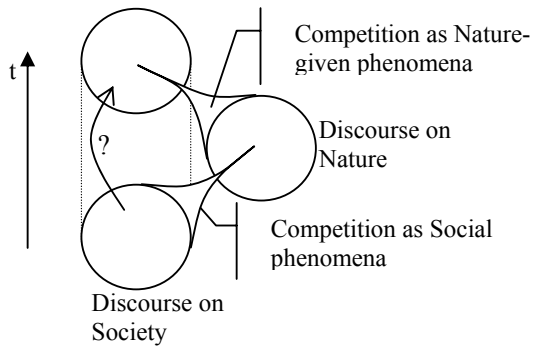
> "This element of the explanation of a discursive order thus does not primarily refer to the actors and their intention but explicitly operationalizes the influence of discursive formats on the construction of problems." (Hajer, 1995: 67).

This implies that preferences (for story lines) become an empirical issue, and that it is one of the analyst's tasks to empirically demonstrate the affinity, and its discursive explanations. Perhaps Hajer's concept of discursive affinity relate to Laclau and Mouffe's idea of interpellation, so that the discursive affinity is dependent on which interpellations that gives the actor's position, e.g. as scientist or as environmentalist.

2.3 A flawed concept and a good example

Finally Hajer operates with the concept 'discursive contamination', *which I find slightly problematic*, because the concept seems to more normative than analytical, which I explain below. I will give the concept some attention in this last section despite the fact that I do not apply it in this study. I do so because the concept gives an entrance to a distinct and a relevant example on the working of the discursive framework presented in this chapter.

'Discursive contamination' is when a discursive affinity is particularly strong, and to illustrate this he gives two examples of which the second is quite interesting in my empirical context, and I will though recount both. The first example is drawn from Donald Worster's Nature's Economy (Worster, 1994). Darwin drew on the sociological concept of 'competition' as a metaphor for the understanding of natural reality, and the 'contamination' was returned with Social Darwinists claiming competition being the natural state of society (Hajer, 1995: 67)



First, I think contamination might not be the right word as it has a negative connotation, even though it is supposed to be used in a descriptive way. A contaminant is a highly contextual concept that especially depends on the definition of what pure is; hence is 'contamination' the contaminated's concept, and the contaminated may even over time adapt to the contamination and rephrase it as 'improvement'. If a certain concept should be used for this type of situations, I would suggest simply saying that there exists a *strong influence* of a certain discourse, and thereafter seek explaining how this influence come about. I believe the conceptual framework suggested by Hajer (excluding 'discursive contamination') can cope with the crossing of discourses. In fact, the conceptual framework seems to have been tailored to this purpose. This critic becomes especially obvious, with the second example.

The example implies a sociological discourse on society contaminating a natural science discourse, which recur and contaminates the discourse on society. However, the example has the weak point that it is not the same discourse that first supplies the contamination and later receives it, as sketched (it might even be noted that also the natural science discourse changes, which actually gives a flaw to my sketch). It is important to note that what interests Hajer is the metaphorical level. Therefore may it very well be for rhetorical reasons Social Darwinists drew on the natural concept of competition, while the reason for the strong affinity for the concept might be found elsewhere.

The second example Hajer gives originates from the early days of the precautionary principle. According to Hajer is the precautionary principle one of the key story lines

that “structured the *discourse* of ecological modernization”. In the example, this story line has an impact on the “*discourse* of biological science” (67, italics added to underline Hajer’s variable use of the discourse concept). The occasion is the first of a row of interesting contributions in *Marine Pollution Bulletin* to the discussion of what precaution is, and especially how the concept relates to scientific practice. The incident takes it’s starting point in 1990 when Gray (1990), an acknowledged professor in marine biology at Oslo University, calls scientists to order: “In my opinion it should be the role of scientists to produce the objective scientific evidence on which politicians can then enact the precautionary principle”. What disturbed Gray was the tendency of scientific findings being presented with reference to the precautionary principle, and with a statistical methodology that deviates from established practice; what Gray reacts against is scientist overruling established methodologies by referring to precaution, and thereby enabling other conclusions, giving bios towards environmental protection. However, this debate eventually evolved in direction of discussing the validity of statistical methodologies, and especially the importance of type II errors (see e.g. Peterman & MGonigle, 1992, Gray & Bewers, 1996, Buhl-Mortensen, 1996, Gray & Bewers, 1996, Gray, 1996, Santillo et al., 1998), and hereby the incident gives an example of how discursive understandings may further changes in practical reality. Furthermore, the example show how the concept of discursive contamination relates to specific positions, as “contamination” would be the word of Professor Gray, defending what he perceives as pure ‘uncontaminated’ biological science.

3 Social Construction of Reality / The Study of Technology

Perhaps this chapter rather should be called the social construction of reality. That is because what I am concerned with is not the construction of certain technologies or artefacts, but the construction of effects, risks for health and the environment, caused by chemicals. Then, of cause and as many observers has noted is the construction, or more 'positivist' speaking, the perception of both the environment and of potential risks to it depends on science and technology. Lets just take the problem ozone depletion as an example; without stratospheric measuring programs, atmospheric chemistry etc, etc would it be impossible to comprehend the problems attached to CFCs, HCFCs etc, etc. It might even be difficult to establish causality when increased levels of skin cancer would start occurring. Like this, it is only in second order I am concerned with technology. Consequently, what I am interested in is the social construction of reality, the use of technology (in a broad sense) in this, and the through-going and criss-crossing rationales that co-constructs both technology and reality.

The point spelled out in social construction of technology is to go one step further into technology, and give special attention to partly how technology shapes 'reality', partly how technology is shaped socially. It says that the construction of technology is a negotiated phenomenon, and it points to the importance of 'going into' technology, to open the black box of technology. In my case it is intrinsically interesting to study how certain technologies and certain knowledge regimes supports certain regulatory regimes. To me, the social construction of technology gives the important point that tools are neither neutral nor objective, and that different tools may support different arguments and rationales. Let me give an example from a resent Dutch study evaluating controversies relating to chlorine in the Netherlands, and PVC in Sweden (Tukker, 1998: 310).

Tukker is interested in the framing of toxicity controversies, and as a part of his study he assess major tools for environmental evaluation, namely risk assessment, life cycle assessment, and substance flow analysis. He concludes, "RA and LCIA of toxic releases are frames in themselves, and thus give results that reflect a single frame. Furthermore, LCIA in particular results in data that are not robust in scientific terms. Data generated with RA and LCIA therefore cannot be presented as entirely 'value-free' or 'objective science'. Results of RA and LCIA are thus of limited use in controversies such as those about chlorine and PVC." (Tukker, 1998: 310-311). Tukker's point is that the quantitative LCIA frame has three points of departure that reflects what the risk assessment frame and contradicts what he calls the phase out frame.

The risk assessment frame assumes:

- We can obtain quite a good emission inventory.
- We are reasonably able to model fate and assess effects.
- Potential impacts of one substance regardless of e.g. its residence time in the environment can be 'exchanged' with potential impacts of another substance.

The phase out frame stress:

- The lack of knowledge about chlorinated micropollutants,
- The difficulty of modelling fate particularly for persistent substances and the fact that effect assessment may be very uncertain,
- Top priority should therefore be given to preventing irreversible contamination of the environment, implying an extra, highly critical judgement of substances with a long residence time in the environment.

Tukker argue that these two frames, for dealing with toxicity problems, are equally defensible, but that they would be performed with totally different structured indicators, and that they would lead to very different results:

> "[…] If decision making were to be supported by state-of-the art LCA it would probably be more difficult for the advocates of the alternatives to the risk-assessment frame to get their message through. One could say that LCIA has already tacitly taken side in the debate, rather than being the neutral tool it is assumed to be." (Tukker, 1998: 309)

From a social construction point of view, it is the *shaping* of the tools, that Tukker examines, which are interesting. In my case, it is the shaping, construction, or adjustment of the chemicals regulation caused by the introduction of the precautionary principle that is in focus. This includes the construction of toxicity and ecotoxicity, namely; the basis for what non-wanted effects the regulation should take into account; changing rationales for the regulation of chemicals causing these effects; and the construction of the tools to assess the chemicals.

In this chapter, I give my account of what sometimes is denoted *sociology of technology*. To me, one of the central ideas in this field is *social construction of technology*, though being aware this concept represents one approach in what is a more diverse field. I view this range of approaches as supplementary to the discurse-analytical approach that I have presented. In my understanding do the approaches largely draw on the same 'language-turn' of the social sciences, but what I am going to outline in the following is more taylored to the study and discussion of technology, and particularly do the approaches in my interpretation underline the importance of the materiality of the discourse.

My purpose with this paper is twofold. Firstly, I want to conceptualise what technology is and how technology are formed, changed, and stabilised, that is, to

dissolve the idea of technology as independent artifacts. To me this involves a (social) constructive approach to what technology is and hereby the result is partly a deconstruction of technology in the sense of technology as single-valued (unequivocal) and essential artifacts. My overarching metaphor for this first purpose is the *seamless web*, wich I will elaborate shortly. Doing this I have inspiration from the literature of sociology of technology with prominent exponents such as Wiebe Bijker, Bruno Latour, and Thomas P. Hughes.

Secondly, I need reconstructing some of that which I take apart. The seamless web metaphor point to the fading of boarders, between science and policy, between technology and science, between the natural and the social. But for analysing purpose I do need to categorise, and very important: to awoid being contradictory to my own epistemology, my approach to categorising must be non-essentialist. A central metaphor for this part is inspired by Thomas F. Gieryn's idea of boundary work, which I unfold and relate to boundary objects that Bijker has employed (1995: 282-285), and boundary concept that I suggest as useful for the understanding of the precautionary principle.

I conceive of the Precautionary Principle as a boundary concept that relates science, technology, and policy. In the following, I will elaborate on some of the theoretical inspirations that make out the basis of my de- and reconstruction of the precautionary principle. A basic ratio decidendi for my study of this rather 'fluffy' policy concept is that I need a materialised practise that relates to the concept – precaution without action is not of my interest. To me, this is enough reason to embark and draw on the field of STS.

3.1 Stepping from Discourse to the study of Technology

The central points in the following is that setting up sharp boundaries between nature and culture is artificial and misguiding, and that a networks approach is to be preferred for a systems approach, as the boundaries between inside and outside is determined empirically and depending on context and analytical purpose.

3.1.1 The ethical impetus of STS; concepts of power

A basic feature of the field of science-technology-society that has attracted me is the idea of technology and science as important factors shaping society. In fact, when I began my education as environmental engineer, my vision was to use knowledge of technology to make the society better, and to integrate knowledge of science and technology with knowledge of society in this quest. Of cause, I did not have the faintest idea of what this would be in practise, but I was quite sure environmental problems was not just a question of finding the right (technical) solutions.

Perhaps it is for this reason that I have an affinity to the following lengthy quote. It comes from an essay by Bruno Latour, where he explores how Machiavelli's The Prince can be expanded to redefine democracy, and how it can be expanded to relevance of contemporary society. Where Machiavelli wants us to understand the duplicity of Princes and Popes who break their word, is the desideratum of Latour to show how the Princes of our time appeal to both human and non-human allies, i.e.

society *and* technology: "to the age-old passions, treacheries and stupidity of men and woman, we have to add the obstinacy, the cunning, the strength of electrons, microbes, atoms, computers, missiles." (Latour, 1988b: 21). The message that I take is Latour's argument against a traditionalist perception of technology and technological development as deterministic, and the argument for a strategic use of / and non-naïve approach to / technology:

> "[…] The two most common clichés about technology, its inertia that would be too strong for anyone to resist, and its inner complexity that would be too much for any one to fathom, are real enough, not as the *cause* of the Prince's moves, but as the *effects* that the Prince strives to achieve.
>
> The first principle of technical democracy is thus never to offer this achievement to the prince on a golden plate. Alas though, this capitulation is very frequent among well-intentioned analysts of technology who accept that there are trajectories, inertia and inner complexities – in brief, that technology exists. Another capitulation occurs when analysts of society, no less well-intentioned than the former, insists that there is something like an overarching society, knowable, at least in principle, that should control and check the development of technology. These two symmetrical capitulations paralyse democracy because the only way to envisage a modification of the technocracy is then by appealing to an *alternative* technology and society. If there is a Technology and if there is a Society and if the only way to conceive of possible changes is by imagining an alternative Society, then the Prince is perfectly free in his palace, unhindered, weaving at leisure human and non-human actors, redefining locally, as much as pleases him, what ties all of us together. Observers outside will see nothing but technologies moving, thanks to their own autonomous thrust, and a society moving in parallel according to its own autonomous laws. Instead of the harsh constrains of democracy, the Prince will only hear moralists' remonstrances and a little empty talk about the 'participation of the public in technical decisions' – once everything has been decided upon. If science and technology are politics pursued by other means, then the only way to pursue democracy is to get inside science and technology, that is, to penetrate where society and science are simultaneously defined through the same stratagems. This is where the new Princes stand. This is where we should stand if the Prince is to be more than a few individuals, if it is to be called 'the People'." (Latour, 1988b: 38-39).

And this is where my overreaching ambition is: to enable and enhance an open-eyed approach to technology, and in this stance, to chemicals technology.

Of course, this quote might be eligible to a critic that would say that in the attempt to avoid naïveté, the text take a turn in the direction of conspiracy theory. With outset in discourse theory, it would be quite reasonable to assume, that it is not the cynical industrialists who the 'virtuous democrat' faces, but that the Prince himself has become more complex and integral than Machiavelli's 'bloodthirsty tyrants' have. However, do Latour's Machiavellian picture of technology, society, and power fall apart, if the Prince does not have a specific locus and a recognisable face? I would say no, as this does not influence how technology and society are being co-constructed, and hence does it not influence the need for opening up technology and enhancing debate on what futures we do and do not want. Besides – I will not rule out that such Princes with face and locus might be found, even though the face and locus may surprise!

Without using the word, this quotation is so laden with power that I need to elaborate. That power is present and though not spelled out is not is a coincidence. It is the wish to enable political debate, political aspects of technology and science, and specific perception of power that leads to this peculiar situation. If we take Latour, then on the one hand he draws heavily on the 'father of power' Machiavelli, and on the other hand he refuses to talk about power: "No, we need to get rid of all categories like those of power, knowledge, profit or capital, because they divide up a cloth that we want seamless in order to study as we choose. " (Latour, 1987: 223).

The key issue in the power concept is not to view power as an essence; it does not exist 'an sich', but is relational. As such power is not something that is possessed, but characterises the specific relation. I agree with Bijker (1995: 261) when he terms power as an overall label or a characteristic of social processes: "At the best the term 'power' can be a practical shorthand for more detailed and rich descriptions of situations, outcomes, relations, etc". This conception of power lies in the tradition that Giddens represents when he defines power *as the transformative capacity to harness the agency of others to comply with one's ends*. What is being added to this perception of power is who is being harnessed; with Latour, Bijker, with others, it is not just the agency of humans but also the agency of non-humans that is being included. Furthermore it is important to have attention to both an action and a structure perspective of the power concept. For my purpose I adapt Bijker's two concepts "semiotic power" and "micropolitics of power" (1995: 263-266), respectively representing the structure side, referring to the fixity of meaning, and the action side, referring to the. The structural end of the power concept, the semiotic power can be conceptualised as the things we take for granted. Laclau talks about objectivity as deposited power; the traces of power has vanished and we – the people – has forgotten that what we perceive as 'objective' once was politically constructed (see Jørgensen & Phillips, 1999: 49 and Torfing, 1999: chap. 8), this be facts, artefacts, agents, practices or relations (Bijker, 1995: 263). The micropolitics of power labels how a variety of practises transforms and structures the actions of actors, and thereby constitutes a particular form of power.

The two types of power are closely connected: "micropolitics result in a specific semiotic structure, while the semiotic power in turn influence the micropolitics structures." (Ibid). I find Bijker's choice of words somehow unlucky, and would prefer 'the possibilities for performing micropolitics of power' instead of the used "the micropolitics structures", as to conserve the idea of agency with the notion of *micropolitics of power*.

For me, to attain attention to power, is to attain attention to what is political, and this is what I am interested in: I want to study the politics of technology, and especially how things could have been or can be different. Secondly, my ambition is to affect and democratise technology policy, not as a 'technical' issue, but as a societal one.

Elzinga and Jamison's (1995) distinction between *science policy* and *politics of science* coins this:

> "[T]he latter has to do with the interaction between science and power, that is, the mobilization of science as a resource in international relations, the use of science by interest groups or social classes to increase their power and influence in society, and the exercise of social control over knowledge."

Contrary Elzinga and Jamison see science policy as the

> "collective measures taken by a government in order, on the one hand, to encourage the development of scientific and technical research, and, on the other, to exploit the results of this research for general political objectives" (Salomon 1977, quoted in Elzinga & Jamison, 1995).

In this relation, my prime interest is the reflexivity from politics of science and technology, but to draw near the science and technology policy approach adds what I perceive as an important action dimension.

The picture of society not being superior to technology and technology not superior to society, or what we can call the mutual co-construction of technology and society, opens the door for a research strategy that Bijker (1995: 280) calls *politics of technology*: "The politics of technology […] will not yield the concrete policy instruments that [science policy] promises to produce. It will be emancipationist rather than instrumental, it politicize technological choices rather than pacify them, and it will problematize rather than absolve."

A very important implication that comes with the Machiavellian power concept is that power is morally neutral, and so must the social construction approach to the study of power relations and technology also be. This has led Bijker to describe what he calls the Paradox of Sociotechnical Politics:

> "[…] [W]e can no longer imagine that constructivist STS studies will principally or primarily benefit any specific social group, such as the less privileged or less powerful. One might attempt to argue that the sorts of STS studies I have discussed, by highlighting the constructed nature of facts, artifacts, social orders, and sociotechnical ensembles, will allow those who are kept hostage by the semiotic powerstructures involved – nonscientist citizens, consumers, patients, women, workers, neighbors to a chemical or nuclear plant, environmentalists – to sever these bonds and free themselves. Although this may happen, there is no guarantee that it will always work out this way. First, science and technology may also be fruitfully employed by the less privileged. Environmentalists, for example, frequently use scientific data to argue their case, and the last thing they would want is to see those findings and arguments deconstructed. And second, there is no reason why the powerful may not draw on the insights of the STS community or even hire constructivists to strengthen their micropolitical strategies. The relativizing force of constructivist STS studies thus prevents it from attaining a neat and political correctness." (Bijker, 1995: 289)

So, it may be naïve to talk about an ethical impetus of STS, as nothing a priori can be taken to be good or bad. Hence, the impetus must end up with the researcher and not the theoretical or methodological standpoint. And indeed, as Bijker point it out, the ones that I actually find to have common cause with, may in fact not be interested in what I find, looking at the practices of assessing impacts and risks.

3.1.2 From essentialism to the seamless web

In a note in Social Studies of Science (1986) Hughes suggests The Seamless Web as an overarching concept for the study of science and technology. At the outset he opposes notions of technology as embedded in science, or technology as applied science, and thereafter he explores the shifting approaches and changing assumptions that has emerged in the study of technology, and that he had experienced through own work.

As an alternative to the Internalist technology-as-applied-science has been the introduction of an interactive relationship between science and technology, the so-called contextual approach. This then raised questions whether the relationship between technology/science and other contextual factors, such as the political and the social, also should be redefined as interactive. But Hughes points to the weakness that comes with the contextual approach, exemplifying with his own drift from a contextual to a systems approach to history (Hughes, 1986: 283). Hughes found that the focus of internalist analysis – more efficient and more diverse generators, motors, and so on – did not sufficiently explain growth. To do this he had to involve what conventionally is called science, politics, economics, social, and so on. But, at a later stage in his case study, the contextual approach either gave satisfying explanation, as it "In my own work I began to move away from the contextual to the systems approach when I found that system builders were no respecters of knowledge categories or professional boundaries. In his notebooks, Thomas Edison so thoroughly mixed matters commonly labelled 'economic', 'technical' and scientific' that his thoughts composed a seamless web." (Hughes, 1986: 285). Context and text tends to be not just interrelated but inseparable.

Therefore, together with Callon, Latour, Bijker and others (see e.g. Hughes, Bijker, & Pinch, 1987), suggests Hughes 'networks' and systems' as the preferred version of the interactive approach, because interaction do not simply take place between science and technology, or between technology and contexts, but among a host of actors and institutions in a 'seamless web'. Contrary to Hughes distinguishes Callon between system and actor network. Callon points to that the systems concept presupposes a distinction between the system itself and its environment, which resembles the problem with text/context. Callon prefer the actor-network concept as it avoids boundary definitions of inside-outside, and the many difficulties of methodology it raises. However, in practise the approaches of Hughes and Callon seem very similar: "By stressing continually all the connections linking the 'inside' and outside' of the system, he (Hughes) comes close to the actor-network concept". (Callon, 1987: 100-101). The important step is the dissolving of the traditional categories such as technology and science, economics and politics, content and context, foreground and background, and the resort to neologisms and "the abstractions of interaction – such as component, and system, entity and network, and actor and actor world." Hughes points to "the precise language of the case history and the historical narrative" as the way to define these abstractions. Likewise, Callon asks why we categorize, or compartmentalize the elements in a system or network "when these elements are permanently interacting, being associated, and being tested by the actors who innovate?" (Quoted in Hughes, 1986).

A sketch of Hughes account of changing approaches to the history of technology: Internalist Histories of technology ⇒ Contextual History ⇒ The Interactive Model ⇒ The Systems Approach ⇒ Networks ⇒ Seamless Web

The problem with the contextual approach is, notes Bijker, that "it is never clear a priori and independent of context whether a problem should be treated as technical or as social, and whether solutions should be sought in science, economics, or some other domain" (Bijker, 1995: 273). Bijker suggests that the seamless web not only should involve the system builders, but also the entire relevant social groups who contribute to the social construction of technology. Hence Bijker (1995: 273) suggests stressing the seamlessness between the technical and the social:

"The technical is socially constructed, and the social is technically constructed. All stable ensembles are bound together as much by the technical as by the social. Social classes, occupational groups, firms, professions, machines – all are held in place by intimate social and technical links."

In the following, I will elaborate on a number of the concepts that I have touched upon here and tie them together in the conceptual framework Bijker has suggested for the analysis of technology.

3.2 Social Construction of Technology

The type of technology that I have in mind is testing regimes that are the 'technology' used to assess possible problems with chemical substances. I will elucidate central concepts in the framework of Social Construction of Technology. The SCOT approach consists of three parts. The first part is more or less a descriptive model that combines the social constructivist insight with the study of technology and especially technological artefacts. I will return to this shortly.

The second part is analytical with the central structural concept *technological frames*, which is an explanatory frame for the descriptive analysis. It links the individual actors thinking and acting with the social dimension. Technological frames are Bijker's (1995: 126) appropriation of Kuhn's idea of the disciplinary matrix, which has similarity with Foucault's episteme concept. The latter tend though to be more encompassing, while I perceive of technological frames as well as the disciplinary matrix to be local and specific in their targets. The perhaps most significant difference to Kuhn's disciplinary matrix, is the broadened focus. The technological frame – or as Bijker prefer if it was not for the linguistic clumsiness: *frame with respect to technology* – are more heterogeneous both with respect to the emphasis on social and material elements in addition to the cognitive, and with respect to who the frame applies to. Where the disciplinary matrix is aimed at the scientist is the technological frame aimed at all relevant social groups around the technology. This gives a more widely applicable conceptual framework than the Kuhnian concept. Furthermore, the actor in Bijker's terms will typically be member of more than one frame. To make this manageable, we talk about varying degrees of inclusion in technological frames.

The third part is centred on the power conception that I already have touched upon in the beginning of this paper. In this part, no completely new concepts are being added. Rather, the processes described in terms of interactions, interpretative flexibility, stabilisation, closure, technological frames, and inclusion, are being reframed so to make more visible the strategies and redistribution of power.

3.2.1 The descriptive model

To simplify, lets take starting point in the study of an uncomplicated artefact. It should be noted, that my ambition of applying these concepts in a wider frame than the development of an artefact, does not conflict with Bijker's own idea of the flexibility of the SCOT approach, which indeed do include the analysis of the development of society and social power (Bijker, 1995: 197); these levels are just more related to the second and especially third part of the analytical framework.

The descriptive level consists of two steps; first a deconstruction of the artefact, then a reconstruction of how it came to be what it is. The three central concepts for the deconstruction are *relevant social groups, focus on problems and solutions,* and *interpretative flexibility*, and the two reconstructive concepts are *closure,* and *stabilisation.*

Below I have outlined the empirical analysis that Bijker use to develop the descriptive model to help the explanation of these concepts.

Box 3.1 Bijker's description, or rather: deconstruction-reconstruction, of bicycle technology: A compressed overview.

The central historical question Bijker (1995: 97) advance is: "How can we understand the role of the high wheeled Ordinary bicycle in relation to its low-wheeled ancestors and successors?"

The first step in his description is to line up the prehistory of the bicycle, including drawings from Leonardo da Vinci (1493), later 'running-machines' from the late 18th century to the mid 19th century, and ending with the "high-wheeled Ordinary bicycle. The Ordinary had its high time in 1860-1880.

With the Ordinary as starting point, Bijker deconstructs the technology. Finding two significant relevant social groupings, two different interpretations of the Ordinary take shape. The first is a "comfortable, classy, well-working" artefact; the second is a "dangerous, accident prone and thus non-working machine."

The description of these 'two' artefacts is made through the eyes of the relevant social groups by focussing at their perception of problems and solutions. Among the solutions that were developed to solve the Ordinary's problems was Tricycles and Safety Ordinaries.

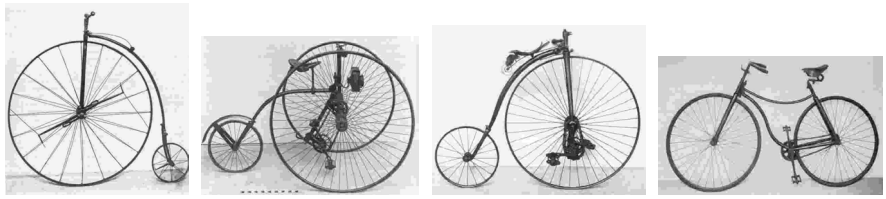


Figure 3.1 Ordinary, Tricycle, Safety Ordinary, and Safety bicycle. Reproduced from Bijker (1995: 31, 55, 63, 70).

The next step is to understand the development of the safety bicycle. To accumulate and operationalise the insight acquired so far – mainly that the technology is differently constituted by from different relevant social groups – introduce Bijker the concept interpretative flexibility. Using this concept, he deconstructs the air tyre into two artefacts: an anti-vibration device and a speed enhancing devise. Finally, the concepts Stabilisation and Closure are introduced to help the analytical reconstruction of the safety bicycle, by explaining the decreasing interpretative flexibility of both the bicycle and the air tyre devise.

Deconstructing technology

The central point here is that an artefact, for example a hammer or a stone, gives meaning when it is contextualised. If I need a hammer but do not have one, then a stone might be appropriate – the stone becomes a hammer. Likewise, the hammer may – with the right snatch – well serve as a bottle opener. This is very much commonsense and quite unproblematic; the carpenter do not mind you using your hammer for opening a beer (he might do it himself), and the producer are not alarmed by users applying stones as hammers. Examples of *relevant social groups* to these artefacts have been presented: the carpenter, the hammer manufacturer, the DIY'er, and the scout. We can call the for interpreting the same material thing in different ways for the *interpretative flexibility* of the artefact.

The very unproblematic nature of this small example leads to the next element of the descriptive model: the focus at problems and solutions. Firstly, the focus on problems leads us away from the unproblematic. Secondly, together with the focus on relevant social groups, this does attach the specific grip on the seamless web that is characteristic of the SCOT approach. It is in the relevant social groups the technology finds it social shaping. The SCOT approach is a part of the development away from the Internalist technology-as-applied-science, that e.g. constitute the linear model of the innovation process:

Box 3.2 Technology as applied science; linear innovation model.

Research => Development => Pilot Plant => Scale up => Production => Product Development

The problem with this model could be summarised as the problem of false linearity. What has become the final product at the end of the line seems as the result of a rational and determined development. An important point that comes with the SCOT approach is the focus on problems and solutions. With the seamless approach to

technology, the locus of technology becomes more diffuse, as it is not the sole technical gadget that we are interested in. Instead the development of technology could be interpreted as the development of solutions to problems. Now it is not the mere gadget but the gadget perceived as a solution to a perceived problem, which we are interested in. The focus on problems and solutions gives thereby the possibility to shake up the deterministic understanding of technology and technological development. Further more, this conception gives a very useful handle that taps into the discourse terminology, as we study not one world, but the many representations that different discourses give, which is comparable with the varying perceptions relevant social groups has of the same artefact.

In this social constructive account, technology exists in the interplay between the artefact, the relevant social groups, their respective understandings, and respective perceived problems. The social constructive argument falls in two steps. First, how a group interprets an artefact is socially and contextually dependent. In turn, the meaning given to the artefact by the relevant social groups shapes the future conditions and possibilities for modifications and changes of the technology. This could be outlined as an alternative version of the innovation process:

Box 3.3 Technology as translated knowledge;towards a network model of innovation.

Artefact => percieved differently by different *Relevant Social Groups* => *Solutions* to *problems* => Modified *Artefacts*

But, when we open for all the development tracks that eventually did not lead to the existing understanding of the technology in question, the analysis becomes more complex. Lets take a look at the following diagrams. The artefact has different meaning depending on the social group in question. Each of these social groups will with reference to their perception of the artefact see different problems and point to different possible solutions.

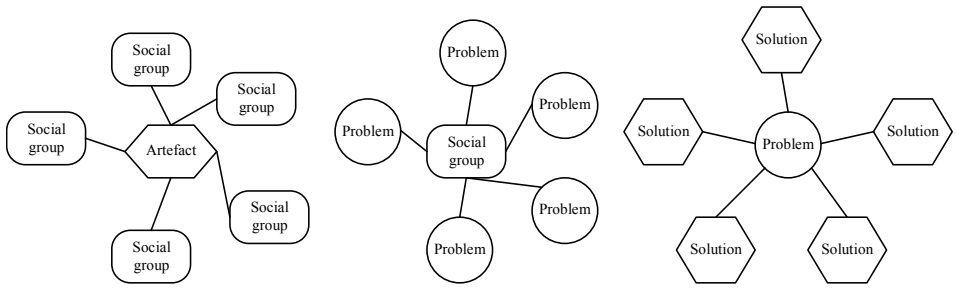


Figure 3.2 Artefact, Relevant Social Groups, Problems, and Solutions
After Bijker 1995: 47, 51, 52.

If we combine these diagrams, it becomes obvious that this analysis may be very complicated. Two comments should be tied to this. Firstly, the focus on relevant social groups seems to safeguard against the implicit linearity of traditionalists accounts of technological development, and instead stress the importance of visions of social futures (see e.g. Schwarz, 1992 for a discussion of the social viability of technologies

and of visions of social futures). Secondly, the model takes an evolutionary character when the three layers of problems, solutions, and resulting artefacts are combined, and this evolutionary character do pose a risk. The evolutionary terms make it tempting to perceive of the artefact as a fixed entity, which is generated through the selection processes.

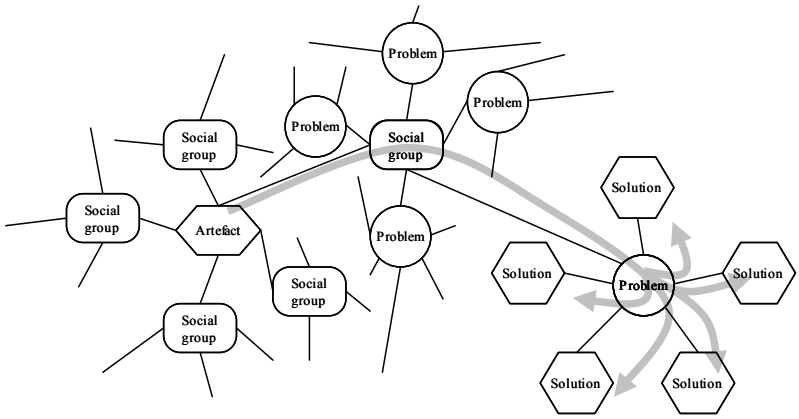


Figure 3.3 Evolutionary networks of artefacts, social groups, problems, and solutions, leading to modified artefacts
(Combination of the elements in Figure 3.2) It is exemplified how the diagrams in Figure 3.2 can be combined by linking one social group and one of its perceived problems. The higher the number of social groups and related problems, the more complex the picture becomes. The diagram is an example, and should be used as a heuristic – in practice it may be impossible and even misguiding to set it up.

Therefore, these diagrams should mainly be used as heuristics for the analysis, and not as a main structure to build the case study around (see Bijker, 1995: 50-52). I will shortly discuss the difference between diffusion, which is the pitfall the evolutionary model could lead to, and the notion of translations in more detail in the next chapter that also sums up my analytical-theoretical approach.

A fulcrum of this approach is how the relevant social group are found and defined. 'Relevant' refers to two levels. Firstly it refers to what the actors themselves find relevant, and here Bijker has found inspiration from contemporary sociological research in the 'snow-balling' method. Basically the idea is to ask identified actors who else might be relevant to interview to get a fully picture of the issue. At some point it should be likely that the analyst do not get any new names, and the resulting list is a complete set of the actors involved in the controversy. An obvious problem is the possibility of social groups that are not being referred to, "missing groups". This problem could for example be important when looking at side effects of a technology; some groups may not be aware of their (negative) interest, or some groups may simply not have the ability to speak up and are therefore not found by the analyst.

Secondly, and to resolve the problem of missing groups, 'relevant' refer to the analyst. As there is no mechanistic way of including missing groups e.g. through snowballing, is it the analysts' task to identify these, and therefore the analysts' categories may deviate from that of the actors. The point to be spelled out here is that within this

approach, much stress is put to the actor's own definitions of categories, but also that the analyst have to take responsibility to dig out and delineate categories that enlighten weak or marginalized positions.

Finally, the idea of interpretative flexibility gives the stepping-stone to the reconstructive part of the descriptive model. In the introduction I explained this concept as the possibility of interpreting the same thing in different ways. A very important issue that follows this is the criteria that are laid down for assessing the working of the artefact, which may be e.g. a bicycle, a hammer, or a regulatory regime for chemicals, may vary with the social group.

Bijker demonstrates the interpretative flexibility of the high-wheeled 74-75). For the social group of nonusers this bicycle was difficult to mount, risky to ride and not easy to dismount, all summarised to an *Unsafe Bicycle*. For the social group of users of the Ordinary, the machine was also considered risky, but for these young and often upper-class men the bicycle was an opportunity to display their athletic skills and daring in the London Parks, and at eye level with the horse riders. 'Their' bicycle was a *Macho Bicycle*, which met quite different criteria than the unsafe bicycle did. Hence the Macho Bicycle was a working machine, and the Unsafe Bicycle was a non-working.

The point is that relevant social groups not only see different aspects of the single artefact, the meanings given to the artefact also *constitutes* the artefact in this specific meaning: Bijker put it this way: "There are as many artefacts as there are relevant social groups; there is no artefact not constituted by a relevant social group".

This deconstruction may leave the analyst with a high number of artefacts. The next step in the descriptive model helps understanding the construction of the 'winning' artefact; it gives an insight into how the linear model of the innovation process was constructed

Reconstructing technology

The two reconstructive concepts are stabilisation and closure, which Bijker use to "clean up the sociologist's desk, littered with artefacts after the sociological demonstration of an artefact's interpretative flexibility Ordinary (1995: 84). Stabilisation is related to inter group processes and closure to extra group processes. The separation of these two levels is, of cause, analytical. How a group internally develop it's understanding will never be independent of how other groups try to perceive and define the same artefact, and the there will probably never exist a sequential relation between stabilisation and closure.

The inter-group stabilisation concept is about the invention process, cleared from extra group conflicts and dynamics. It is not the level of conflicting interests but the semiotic perspective to the analysis of technology, which is on the agenda, and central point is to prevent the idea of technological change as "the result of a momentous act of the heroic inventor" (Bijker, 1995: 86). Bijker exemplify with uses the invention of the Safety Bicycle as an eighteen-year long process (1879-1897), rather than as an isolated event occurring in 1884 (1995: 270). The key methodology is to trace the increasing degree of stabilisations is to examine the dropping number of modalities in

contemporary writings about the artefact. These modalities can be the number of definitions, specifications, or explaining comments (see also Latour & Woolgar, 1986: 75-88). If we look at Figure 3.3, the stabilisation increases at the end of the grey arrow, as the different possible solutions get better defined. Stabilisation is the stabilisation of the meanings attributed to the artefact by the different social groups, and the concept is therefore connected to the delineation of the groups.

It is the process of closure that links up with the interpretative flexibility. Closure leads to the diminishing of interpretative flexibility, and hence to the dominance of one stabilised understanding with advantage over the other. Compared to the process of stabilisation, closure is more related to conflicting interests or worldviews. An analogue to the closure of an artefact can be found in studies of scientific knowledge. Closure belongs in the final part of the Kuhnian 'scientific-revolution-cycle':

Box 3.4 Kuhn's scientific revolution cycle.

Normal science ⇒ unresolved problems or the like posing a threat the 'paradigm' ⇒ extra ordinary science ⇒ competing paradigms with different understandings ⇒ 'winning paradigm' ⇒ Normal Science

The situations that Kuhn describes as *normal science* are disjointed by *scientific revolutions*. It is a *closure*-like process that leads to the ending of the 'revolution'. Within normal science the practice is described as working with jigsaw puzzle; the paradigm delineate how the total puzzle is expected to look like, how the pieces is to be identified etc., and the task is to find the pieces and put them together according to the expected larger picture. But it happens that unresolved problems, or the like, emerge to pose a threat to the paradigm, and thereby threatens the foundation for the normal scientific practice. The result is that normal science pass into *extra ordinary science*. New approaches and more creative attempts to problem solving leads to a situation with coexisting paradigms that defines how to understand the world and how to go about the unresolved problem. Ultimately one of the paradigms eventually succeeds, and the scientific practise turns to a new mode of normal science. During the period with 'extra ordinary science' the interpretative flexibility is high, but through closure-processes the interpretative flexibility decreases. With the establishment of a winning paradigm, the related actors worldview becomes restructured. History is rewritten, and it becomes difficult to recapture the flexibility as it was before closure was reached.

A number of closure mechanisms have been described (see Bijker, 1995: 86, Pinch & Bijker, 1987: 44-46). A "crucial experiment" or a "knock-down argument" are of the rhetorical type that may close a controversy without necessarily being convincing to the core set of scientists or experts, but by the appeal the argument has on a wider audience. Another important type is the "redefinition of problem" mechanism. The redefinition type is probably the more stable of the two types. Though, I have to point to the circular character of the redefinition of problem as closure mechanism, as the redefinition exactly may be the result of a successful closure. Where the rhetorical type is likely to leave behind logical and in principle known inconsistencies, the redefinition type is characterised by setting up consensus around new sets of criteria, for which there may not be any established resistance in terms of such a critic. Lets

have a look at the example Pinch and Bijker (1987: 45) gives. A very important step in the construction of the safety bike, that is more or less the bicycle we know today, was the air tyre. The air tyre was introduced as a solution to the vibration problem associated with the reduced size of the wheels. But in the general public the tyre was regarded as an unsavoury solution, compared to the traditional elegant, slim and solid tyres, and for the high-wheeler's was vibration simply not a problem. But when the air tyres was mounted on a low-wheeler for a race, it proved to significantly increase the speed; in the same process, the air tyre was redefined as a speed-devise (instead of an anti-vibration-devise) and the art of bicycling turned from aesthetics to speed.

3.2.2 The explanatory scheme

The next step in the SCOT approach is to frame the descriptive model. Let me introduce the empirical case Bijker support the development of the explanatory scheme with, before we take a closer look at the two central concepts *technological frame* and *inclusion*.

Box 3.5 The narrative of the first 'modern' synthetic and commercial plastic and the relevance of technological frames for the analysis: A compressed overview.

Bijker has three points on the agenda with this case. The case is taken as a critical case, to show the applicability of the social constructivist framework, even in the case of "an individual inventor". Secondly the case is used to introduce the concepts of "technological frame" and "inclusion", which relate the interactions of the individual actors to the social processes that form the relevant social groups Thirdly, he wants to make a "comprehensive historical study of the first commercial plastic". (Bijker, 1995: 102).

What the core idea in this case can be boiled down to is that even though it is one person that is at centre stage throughout the invention of Bakelite, is the invention built on the mixing of a number of technological frames. Hence, the art of inventing becomes extended also to be the art of combining frames.

As in the case of bicycles, the prehistory of plastics is outlined, explaining the major aspirations in the search for substitutions to the natural plastics, and to ivory. This prehistory serve to present the understanding of what these plastics were – the cultural background – and it serve to present the social groups that's on the stage. The predominant technological frame for this period was the frame of Celluloid chemists. Here the main focus in technical respect was on solvents, and this proved to be a blind spot in the search for synthetic plastics. This frame is summarised below.

Elements of the technological frame:	Technological frame of Celluloid engineers:
Goals:	Production of fancy articles
Key Problems:	Price of solvent camphor, the flammability and moulding characteristics of Celluloid
Problem solving strategies:	Modification of the solvent in the reaction
Requirements to be met by problem solutions:	Set by the standards of the natural plastics: Colour, lack of shrinkage and distortion, price, aptness for being moulded.
Current theories:	No chemical theory
Tacit knowledge:	Application of heat and pressure without specific maxima
Perceived substitution function:	Natural plastics
Exemplary artefacts:	Celluloid; production machinery such as presses, preheaters.

'The inventor' of Bakelite – Baekeland – enters the stage of Bijker's narrative as a chemist working in the field of photographic paper, moving into the field of electrochemical engineers. It is only at a later stage he encounters the problem of synthesising plastics, but at that point he had gained mastery of practises and research methods that had not yet been draw in to that quest. Among the new aspects that Baekeland's inclusion in these technological frames provided him with was scientific method, and the idea of flow production of chemicals from the technological frame of electrochemical engineers, see below.

Elements of the technological frame:	Technological frame of electrochemical engineers
Goals:	Flow production of chemicals
Key Problems:	Corrosion, reaction efficiency, volume of production output
Problem solving strategies:	Specific design of diaphragms; careful examination of all variables; stepwise scaling up from laboratory to pilot to production scale
Requirements to be met by problem solutions:	
Current theories:	Basic inorganic chemistry; electrochemistry; fluid dynamics
Tacit knowledge:	Industrial flow processing
Perceived substitution function:	
Exemplary artefacts:	

Baekeland's inclusion in the technological frame of electrochemical engineers did not add any elements that were contradictory to elements from his inclusion in photographic chemistry, and the repertoires therefore continued to exist together. If the elements do not fit together, the ones of the older frame will be moved to the background, replaced by the new elements.

When the basic form of 'Bakelite' and the first patents were in place, the last stages of social construction of Bakelite could begin. Bijker follows the stabilisation in the processes of 1) patent litigations, 2) collaboration with industrial social groups, 3) influence of World War I, 4) importance of industrial designers, and 5) Bakelite's construction by the relevant social group of consumers.

Let's give Bijker the last word in this case:

"As I have traced the social construction of Bakelite it has become clear, I hope, that my social-constructivist analysis does not diminish the greatness of Baekeland as an inventor. It does, however, provide a different slant on his individual abilities. To describe Baekeland, […] as a heterogeneous engineer (Law 1987) or system builder (Hughes, 1983) does not reduce the development of Bakelite to the genius of this "grand duke, wizard, an bohemian." Rather, this characterization serves as the summary of all the social processes in which Baekeland participated; his status as an inventing genius is the result of the social construction of Bakelite, not the cause." (Bijker, 1995: 197-198).

In my research, the individual have a less central position, but that is more founded on choice of case than differences in theoretical perspective.

The technological frame is the frame of the relevant social group; as an analytical concept it can be defined by what keeps the group together. In this sense it share many properties with Kuhn's idea of a paradigm and even more equivalent, with the disciplinary matrix that Kuhn corrected the paradigm concept with.

How does the technological frame 'glue' the descriptive model together with the individual actors interactions and dispositions? Bijker stress that even though the concept involves the creative innovation process, does it not do this in 'psycho-logistic terms'. The frame is not a characteristic of the individual nor of institutions or systems; the technological frame is located between actors: "If existing interactions move members of an emerging relevant social group in the same direction, a technological frame will be build up; if not, there will be no frame, no relevant social group, no future interaction" (1995: 123).

Technological frame and inclusion do together give the possibility of both stability and change. In analogy with the Kuhnian paradigm or disciplinary matrix do the technological frames explain stability and enhance productivity within the paradigmatic understanding – Kuhn's corresponding term is "Normal science". But the inclusion concept introduces a relaxation to the Kuhnian approach, because the single actor may draw on more than one technological frame. Baekeland provides us with an example: by partly working within the celluloid frame, but also partly in the frame of electrochemistry, Baekeland became an agent of change (Bijker 1995: 192). Therefore is this approach more dynamic than the Kuhnian, as change not necessary comes as a revolution, even though it might be rationalized as such afterwards. The inclusion in the frame consist in adherence to the elements of the frame

The eight elements that were introduced in the examples above do not comprise the definite number of possible elements that can be present in the technological frame. Beyond the mentioned elements, adds Bijker *Testing procedures*, *Design methods and criteria*, and *User's practice* to a tentative list of elements, which the analyst may take as starting point (see also the box). In the end it will be a task for the analyst to establish and identify elements that are meaningful in the specific study, which I return to in the following chapter where I contextualise the concepts with the study of the precautionary principle. The inclusion in technological frames via adherence to the specific elements has both a structural and an agency side, both unconscious and conscious aspects. On the one hand the possibility for the agent to take specific elements of the frame gives the manoeuvre room that corresponds to the understanding of 'discourse' as a strategic possibility that was presented in the previous chapter. On the other hand, the affiliation to a technological frame is likely to involve enculturation and discursive closure. Finally, access to a specific technological frame may be protected by professional pedigrees and validity tests that set the members of the frame apart from other social actors or groups. Here, it is very important to distinguish between such 'member-groups' and the technological frame; as I stressed before is the frame located between actors and between actors and artefacts, and there should therefore not be equalised between a technological frame and the social group e.g. what Haas and others has conceptualised as a epistemic community. But this do not hinder that certain groupings may protect or attempt to monopolise the right to use a certain technological frame. A brief example could be engineers protecting the engineering class through educative standards and title protection. This corresponds to the maintenance- and defensive mechanisms of a paradigm that Kuhn and other describes (see e.g. Kuhn, 1970: 43-51 or Haas, 1992: 17), with the explicitation that Kuhn would say that the determination of normal science *could* come about without the intervention of discoverable rules.

Figure 3.4: A tentative list of elements of a technological frame (Bijker, 1995: 125).

- Goals,
- Key problems,
- Problem solving strategies,
- Requirements to be met by problems solutions,
- Current theories,
- Tacit knowledge,
- Testing procedures,
- Design methods and criteria,
- User's practice,
- Perceived substitution function,
- Exemplary artefacts

The last deviation from the Kuhnian disciplinary matrix prototype that I shortly will give attention here is the inclusion of other groups than scientists, and the inclusion of other elements than the purely cognitive. Technically speaking this 'extension' comes with the inclusion of the 'non-expert' elements in the technological frame that has a social and materialistic character (contrast e.g. with Kuhn, 1970 182-187).

3.2.3 Notes on my appropriation of the SCOT terminology

The SCOT framework has been developed for historical studies of the social construction of artefacts. I my work I expand this scope to ongoing processes. These do of cause have history, and for that part my work may not deviate much from Bijker's. But in addition to the historical perspective, which I find very important and not least interesting, am I also keen to study the dynamics and perspective for the processes of inclusion, stabilisation, and closure in the field of chemicals regulation.

The field I am concerned with do therefore not possess the simplicity and clarity that history tends the give reality in hindsight. But do this involve any consequences for my study in the sense of theory and methodology? I have, of cause, to direct my analysis more towards interviews and participatory observation than to historical documents.

Secondly, I do not close up on the individual construction and the process of invention as Bijker does. My focus lies at a slightly more aggregated level, where the construction of the single artefacts plays a role for the construction of reality.

How does technological frame and story lines fit together? Where the storyline comes from the rhetorical and linguistic angle, comes the technological frame from the material. However, they share the character of being a possibility for the actor, and I would rather describe them as complimentary than contradictory. In my study, the frame with respect to technology therefore becomes a part of a knowledge frame with respect to environmental regulation and environmental policy.

I elaborate on the relation between the two theoretical approaches in the following chapter.

4 Theoretical and Analytical Framework

4.1 Reconciliation of SCOT and discourse theory

The two theoretical stepping stones that I have chosen have many similarities. They share the view of 'reality' as a social construct; the reality that matters is the reality we perceive. This imply for the discourse analysis that it is interesting how we talk about and understand 'reality' and thereby constructs it. In the SCOT perspective is the basic premises the same, but the focus is concerned with the construction of artefacts. The discourse theoretical approach that I apply[9] do not rule out the discursive role of matter; structures and artefacts, and the social construction of technology approach do not rule out the role of the social.

I use the discourse theory to examine the political and discursive processes that relate to the precautionary principle, and the SCOT-terminology to examine the practises that constitute the regulation of chemicals and the precautionary principle in this regulation.

My study-object is the precautionary principle in the regulation of chemicals, and I combine the two approaches to perform this task. No doubt; the 'high-styled Precautionary Principle' of the abstract international negotiations is merely a political principle; it is not an artefact and certainly not a technical artefact. The 'high-styled Precautionary Principle' is best described in general terms; (from the Rio declaration) "[…] Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." (Rio Declaration on Environment and Development, (Annex I) 1992/6/14: principle 15)

But when the precautionary principle comes into action is it not with the general terms that it strikes, but in changed practises. We can follow the dissemination of the precautionary principle, but we may oversee what change the principle makes if we attach too much attention to the word and the political processes where the word is explicit. Therefore, I combine discourse theory with the approach developed by Bijker and others to enhance my analysis' sensitivity towards the construction of the practises that are used for the assessment of chemicals. It is exactly these practises that are so important for the constitution of the concept '*valid', 'safe'* and *'toxic'*, which take centre stage in the debate over the regulation of chemical substances.

It is reasonable to say that the precautionary principle until very recently at the most has had a distant effect on the regulation of chemicals. The precautionary principle played therefore a role as a challenge to the existing practises, when it emerged during the 1990s. The key artefact for the regulation of chemicals; the creation of the testing regimes took its beginning in the early 1970s in the UN and the OECD that took the lead in the 1980s (Nichols & Crawford, 1983: 34pp and Jasanoff, 1986: 75), and is therefore beyond the scope of the present study. But I stress the constructedness of this

[9] With inspiration from Laclau & Mouffe, 2001, Hajer, 1995 and Neumann, 2001.

testing regime by using the SCOT-terminology, and I use it to conceptualise how this construction is threatened with re-opening.

We can say that the two theoretical approaches are used to follow two plots. The discourse-analytical concept form the backbone in my analysis of the precautionary principle as a political concept, and the SCOT-terminology form the backbone in my analysis of the construction and discussion of testing-practises, that constitutes *valid knowledge*, *safe*, and *toxic* in the prevalent discourse on chemical-technological risk.

In practise will the two terminologies often have relevance at the same time; when a given testing practise is threatened by *opening* will this most likely also mean that the risk-discourse is being opened, and certain issues will logically be relevant at both places, e.g. discussions of what safe means and what toxic means. The *closure* of the conceptualisation of 'toxicity' will likewise have influence on the risk-discourse. These are concepts that have relevance for both political debate and expert discourse. The interweaving of the concepts is depicted in the table below.

	Concepts from Hajer discourse theory	<- relation ->	Concepts from SCOT
Structural / general	Discourse; Discourse institutionalisation	No directly corresponding concept	Absent; The way a *knowledge frame* works correspond much to the functioning of a discourse, as it specify the way in which members of a relevant social group interact, and the way in which they think and act. Furthermore the *semiotic power* concept has similarities with the *discourse* concept
	Discourse Coalition; Storyline Actors Practises	Same level but DC is broader and shallower than KF	Knowledge Frame; Relevant Social Group(s) Goals, Key Problems, Practises, Theories, etc.
	Opening of Discourse Closure of Discourse	Different level but corresponding concepts	Opening of artefact Closure and stabilisation of artefact
	Discourse representations discourse hegemony / domination (see Neumann, 2001pp50)	Concepts contained in opening / closure; → Outset in discourse vs. outset in artefact ←	Interpretative flexibility Fixity of meaning
process / Specific	Micro-powers; power can be understood as what produce the social. Power *produces* meaning and power *excludes* meaning.	Corresponding concepts	Semiotic power; structure-side of power (see discourse) Micropolitics of power; actor part of power

Table 4.1: Reconciliation of the Discourse approach and the SCOT approach.
Parts to the framework of analytical concepts. For a more elaborate discussion of the concepts, please see the exploration of the two approaches in the previous two chapters.

The two approaches' different focus becomes clear when one look at the two approaches' central and operational concepts. The *knowledge frame* (appropriated from the original notion of *technological frame*) resembles the Kuhnian notion of a

disciplinary matrix. It is therefore centred on some kind of practise. Bijker's example is e.g. celluloid chemistry, and in my study is the frame that constitutes the OECD testing regime an example. A *Discourse Coalition* could very well refer to a knowledge frame, and in my study is the attention towards this situation particular strong. But a discourse coalition may refer to other things, and the members of a discourse coalition may not be members of a knowledge frame, even though reference is made to the frame.

A knowledge frame may be more persistent than the discourse coalition as the practices of knowledge frame is institutionalised in laboratory practise and often will consist partly of written rules and directions, whereas the practises of the discourse coalition have the character of communicative interaction, which may or may not be translated into institutional arrangements.

Both the two approaches are reluctant to use the power concept as power is perceived as a relational phenomenon, and not anything in itself; there are no essential power, but the existence of very powerful constructions and relations is incontestable. The type of power that primarily has the attention in the discourse analytical approach corresponds to what others has termed consciousness controlling power and institutional power (see e.g. Christensen & Daugaard Jensen, 2001).

Discourse (or institutional power) is both working 'behind the back' of the actors, and it may be employed strategically. The actor may in the same moment be subject to the discourse in which they move and draw on a variety of discourses (see e.g. Dryzek, 1997: 20). In the argumentative interaction, which is an important process for change, may arguments be shaped strategically so as to make them valid in a specific discourse, or reference to a specific discourse may be used to control the other's perception of problem and interest. But the functioning of the discourse may also do the same without a conscious actor 'pulling the wires'.

4.2 Putting the concepts to use

4.2.1 Translations (not Diffusion) between sites and arenas

A central process category, which is latent in framework as it is constructed now, is 'translation'. It is a basic feature of a story-line that it has the capability of translating concepts between different frames of understanding – discourses – that otherwise would have been mutually incompatible or distant.

Likewise is it important to stress that the translation-notion has the same implications at the practise level; different actors or relevant social groups 'see' different artefacts; they translate it to fit into their specific frame of understanding, or stress certain parts of its capabilities.

When we follow the precautionary principle around could it be intriguing to talk about the diffusion of the principle but I will conceptualise the dissemination of the principle with the terms translations and transformations. I will argue that the principle is context dependent, and that this makes the translation-concept important. There is general support to the precautionary principle in Denmark and in the rest of the

European Union, even among the industrial organisations including the chemical industry. But it would be far fetched to say that this lead or will lead to a common perception of what the principle will imply in practise. The actual forms the principle has or may take is therefore negotiated and formed in the specific case. The notion of translation is therefore important for my conceptualisation of the dissemination of the Precautionary Principle as a policy concept.

The concrete struggles over the precautionary principle are performed in the specific practises where the principle challenges the dominant risk-discourse. We can talk about the struggles as performed at a number of sites or arenas. These arenas may be the laboratory where certain test designs are employed, and steering groups discussing and legitimising experiments; or it could be intergovernmental bodies working on the creation and harmonisation of test guidelines; councils counselling authorities or interest groups on what is safe and what is unsafe. It may be the public media where debates relate to experiments, new knowledge, or political processes and outcomes.

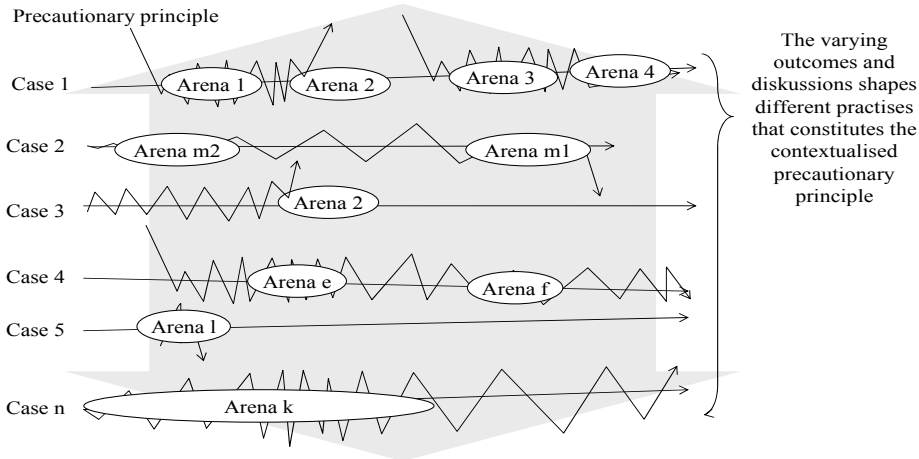


Figure 4.1: The precautionary principle is shaped in the totality of single cases.
The zigzagged lines symbolise reference to the precautionary principle. The marked arenas should be perceived as those arenas that are devoted special attention by the analyst; with the wide definition that is applied of the arena concept here will the accentuation of the precautionary principle always take place at some kind of arena. Furthermore, the principle may be at the agenda at different arenas at the same time in the same case, and the individual cases may not be as individual as the figure indicates, but may rather be intertwined and mutually interdependent, which is indicated with the grey arrow.

The important point is that the struggle to define the precautionary principle is not a grand universal one, but is discretely distributed over various issues and arenas. I investigate debates in Danish written Medias that involve explicit reference to the precautionary principle. This gives a picture of the fragmented and diverse character of the struggles to define and use the principle that characterises the examinations of the concept in the following chapters .The cases, which are of very varying character and nature, follow each a specific course of events that crosses a number of arenas and sites such as those exemplified above. Furthermore is the precautionary principle not

necessarily a part of the active rhetoric at al stages of the individual cases; often will the principle be rejected as relevant, or simply omitted, shortly after being introduced, or the principle may simply not become explicit at the early stages or at all. We can say that the cases function as media for the principle.

4.2.2 Obligatory Point of Passage and Power

I add the notion 'obligatory point of passage' to my study of the processes of openings and closures of the concepts 'valid', 'safe' and 'toxic' in the specific cases. Obligatory point of passage has been adapted by Bijker, Latour, Callon and others for the study of science from military-strategic language (see e.g. Bijker, 1995, Law & Callon, 1992, Latour, 1988a, and Callon, 1986). The key idea in the mother concept is to use the landscape; topography, infrastructures etc, in such a way that attackers can approach only via a limited number of routes (which means the attacker more easily can be crushed). The notion mean in the adapted form to arrange an argument in such a way that it uses existing discursive and institutional arrangements in such a way that only specific types of arguments are valid as critic (especially Callon). Bijker adds that also an artefact such as a certification scheme can play the role as an obligatory point of passage, and in my study are harmonised test guidelines examples on an obligatory point of passage to validity.

Test guidelines and good laboratory practise guidelines are a particular type of routines. They have been developed to secure the uniformity of testing across time and space, and to secure against both sloppiness and technical import-restrictions (see e.g. Nichols & Crawford, 1983: 61 on need to the need to improve industry's testing procedures in the 1970s and pp38 on economic and trade aspects). In my analysis of the precautionary principle these guidelines have at least two functions. Firstly, as semiotic power they represents the routines that reproduce important parts of the testing regime and the risk assessment discourse. Secondly, they may function as micropolitical devises in the negotiations of what 'valid', 'safe' and 'toxic' means.

In the specific struggles at the specific arenas may also more simple types of power come to play. We may instead use the term *force* to differ between the institutional / discursive types of power which has been discussed above. When the power-concept refers to the principal exemption of specific possibilities, then does the force-concept refer to suppression of concrete (existing) possibilities (Jørgensen & Phillips, 1999: 60). Christensen and Daugaard (2001) has demonstrated four analytical types of power, of which the two corresponds to what I here term force. The first is direct force which is performed in the decision-situation. The employment of force is here the parties' relative positions of strength, which will depend on e.g. money, position, or knowledge (Christensen & Daugaard Jensen, 2001: pp32). 'A' may use economic resources to buy 'B', or the position of 'B' may be threatened if 'A' is a superior to 'B' in the same hierarchy, or if 'A' posses a more extensive knowledge about the problem and its solution. However, the decision-situation may in practise also be dominated by discursive structures (hegemonic discourses) that provide support for specific positions, so that the force is supplemented with or intertwined by power.

The second type is indirect force which comes into play as filters that 1) limits the accessibility of the arena so that not all problem can gain access, and 2) limits the

implementation of decisions so that even though there may have been reached a decision, is the decision not put into practical politics (Christensen & Daugaard Jensen, 2001: pp50). Filter one could e.g. be definitions of which problems are relevant, or it could be narrowed time-limits for complaining. Filter two could consist of delegation of competence to execute the decision, or it could be unclear or widely interpretable decisions or non-decisions such as 'more investigations needed'. Again will the concrete situation arguable also depend on discursive structures, and the employment of filters will probably not be solely interest based.

The filter-notions do have some similarity to the obligatory point of passage, as both concepts describe a limited access to something. The most important difference is the site or arena dependency of the filter-notion and the idea of its rational employment, which probably is related to the positivist tradition that the filter concept comes from (Christensen & Daugaard Jensen, 2001: 61). In contrast do the obligatory point of passage-notion - it seems to me - catch both the structure and the actor-side of power, and it may function over time and space. We can therefore think of an obligatory point of passage as something that may function as a filter controlling the access to specific arenas.

The following figure sum up the relation between discourses, discourse coalitions, and knowledge frame in the analytical frame. I have so far been relatively muted about what the discourses may be, but I will catch up on that in the following subsection.

The actors draw on discourses in the creation of storylines. The creations of these narratives on social and physical reality build on elements from different domains and discourses. Concurrently is the discourses also influenced by the creation of storylines and discourse coalitions. A special attention is devoted to knowledge frames that constitute different versions of 'valid knowledge', 'safe' and 'toxic'. The actors and practises of these frames will often also take part in the discourse coalition, or be used as a constituting part of the discourse coalition.

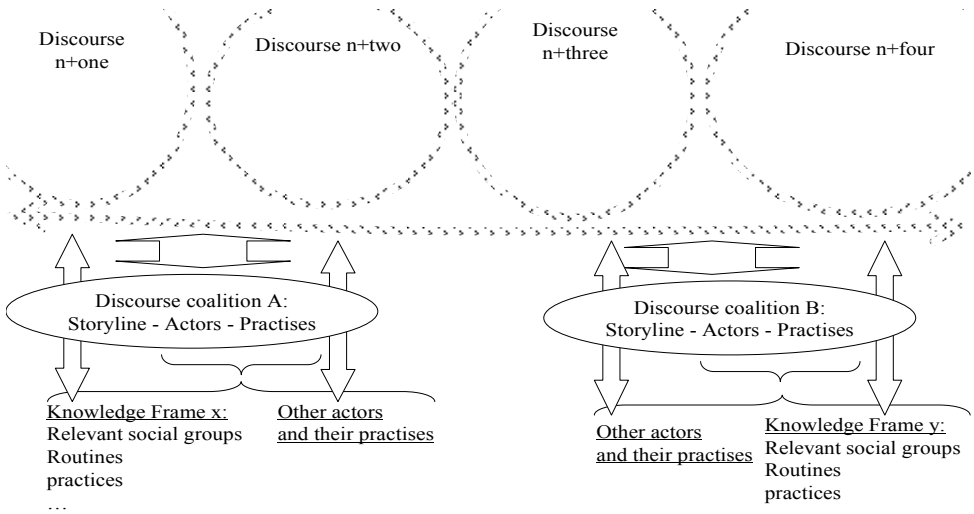
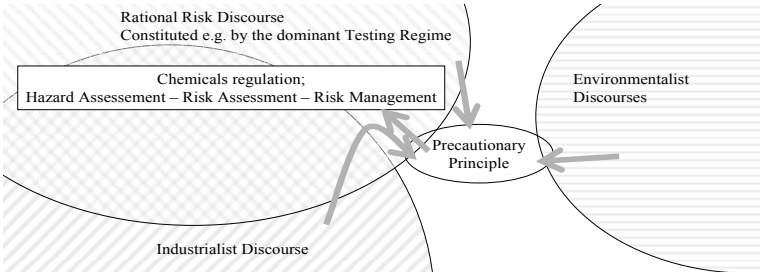


Figure 4.2: Relations between Discourse, Discourse Coalition, and Knowledge Frame. *In principle will all practise be related to discourse, but to simplify the figure has the representation of discourses been placed in the upper part of the figure.*

Knowledge frames is perhaps best conceived of as frozen discourse or institutionalised discourse, as they definitely support and constitute certain discursive structures.

4.3 Discursive struggles to define the precautionary principle and the regulation of chemicals

My general research interest in this study is whether the precautionary principle takes part in a change of the performed chemicals regulation. This interest and a general hypothesis for the relations between these two are outlined below.



The precautionary principle act itself as a storyline or a boundary concept between the rational risk discourse and environmentalist discourses. The primary target for the precautionary principle (in terms of the location of practises that should be changed) is the actual regulation of chemicals. In this struggle to redefine the premises of the chemicals regulation do the precautionary principle itself involved in a discursive struggle as it both influence and become co-opted by the rational risk discourse.

It is the discursive construction of the precautionary principle, as an idea and a specific type of knowledge in a dialectical interrelation with the social construction of the technologies and artefacts that enacts and materialises the principle, which is at the agenda in these processes.

The types of translations at the discursive level that I am especially interested could be framed as what Andrew Jamison call the translation of green knowledge into the field of chemicals regulation (Jamison, 2001). Jamison use appropriation as related to translation, meaning the act of acquiring something that is translated and thereby made meaningful and useful in the same move.

In SCOT terminology, the closure processes of the precautionary principle – or in discourse terminology, the creation of a hegemonic or dominant version of what the precautionary principle is and how it should be interpreted – will depend on processes of stabilisation and closure of the smaller practises such as methods for collecting legitimate data and relevant knowledge. In return, these smaller practises will depend on processes of hegemony and dominance at the discursive level. Therefore, the translation processes will involve both a discursive and a practise level.

PART THREE: ROOTS OF THE PRECAUTIONARY PRINCIPLE

5 Conceptual considerations on the precautionary principle

In the outset, I will give some introductory ideas to how we may understand the precautionary principle, and do that with reference to theoretical considerations in the previous chapter, with weight to the discursive level. Then I will present the historical background for the Precautionary Principle in environmental policy, and sketch out how the concept has moved into the realm of chemicals regulation.

5.1 History of the precautionary principle

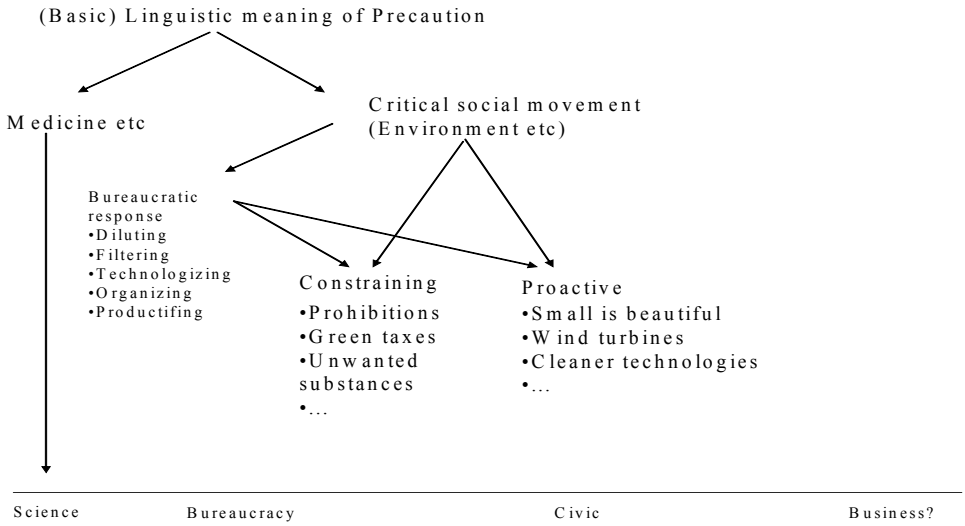


Figure 5.1 Sketch of the development of the precautionary principle from a basic linguistic to policy-forms of the principle, which is discussed in the present chapter.

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5.1.1 Common language

If we comprehend of the precautionary principle as the idea of taking into account the body of knowledge that we do not have, has the principle probably been around as long as humanity has existed. When we turn to the dictionary, *precaution* is defined as

"[…] 1. a measure taken in advance to avert possible evil or to secure good results. **2.** caution employed beforehand; prudent foresight. **–** *v.t.* **3.** to forewarn; put on guard." (The Random House College Dictionary: 1042),

and *precautionary* is defined as

"[…] **1.** of, pertaining to, or characterised by precaution. **2.** expressing or advising precaution." (ibid)

At this basic linguistic level, there is nothing 'special' about *precaution*; it is not specifically attached to environmental problems, health issues, or the application of technology. *Precaution* is simply attached to the common sense knowledge that man does not know everything, and it may be favourable to act before absolute knowledge is established. As such, precaution can be seen as an extension of prevention. Where *prevention* is about preventing known an outcome is *precaution* about preventing a possible evil or about securing a possible good. Therefore, it is easy to find numerous of historical references to situations where precaution has been applied. Precaution is a part of human language, and to take precautions must be a part of human nature.

In this definition, the difference between precaution and prevention seems be what is known, and hence the boarder line seems to be a gradient. If a problem, with the current knowledge, poses an uncertain threat is it precaution to attempt to prevent possible harm. If there did exist the knowledge that the same problem did pose a specific threat, would it be prevention to prevent the possible harm. However, a slight difference does linger in the background. Prevention is targeted at hindering something (bad) to happen, but precaution may as well secure something (good). Precaution therefore has both a positive, and a negative meaning. This will in the following show to be a quite important detail about the word precaution that can be re-established at the level of the policy-concept of precaution. The English policy-concept of precaution has tendentiously only captured the negative connotation of the linguistic term precaution, and this is most likely due to the *anti* character that has been characteristic for much of the discourse on environment. Meanwhile, a number of smaller practices, ranging from grassroots' bottom-up activities in line with 'small is beautiful' (Schumacher, 1973), to governments support to cleaner technology-programmes as it has been seen in Denmark and Europe, has expressed the positive and progressive dimension of precaution. We will return to this.

In the following, I will study how precaution has moved from being a 'normal word' to become a policy concept.

5.1.2 'Precaution' in scientific writing – pre-precautionary principle

As a logical result of the word 'precaution's common meaning, is the word to be found in scientific writing long before it starts to constitute a political programme. Based on a search in ISI web of science® is it revealed that 'precaution' has occurred regularly in scientific writing (at least) since WWII. In the figure below is the number of articles per year with 'precaution*' in the title since 1945 depicted. On the figure, a second series show the total number of articles in the database in the same period, indexed with the 1970 count of articles with 'precaution' in the title.

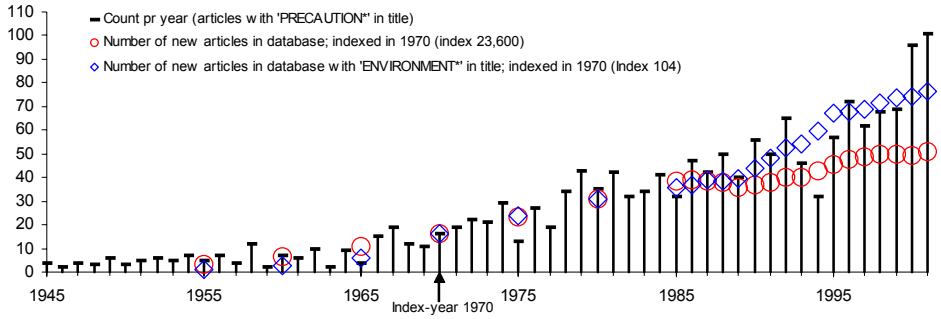


Figure 5.2 Number of articles pr year with 'precaution*' in the title, 1945-2000.

The figure show that the number of articles that refers to precaution in the title takes a more or less constant share of the total number of articles registered in the database, which is in line with what could be expected when precaution is a 'normal' word. The next interesting issue is which subjects precaution has been used in conjunction with. The absolute majority of journals that bring the articles are of the medical type. The issues are precautions in relation to health, infections, epidemics, laboratory practises, and occupational health in industries. This picture is relatively steady up to the 1970s where fire precautions as a safety issue in construction and architecture also become a much-debated topic. In the 1980s Environmental journals start to bring articles using the concept, most notably Marine Pollution Bulletin, and from the 1990s emerges a number of journals concerned with environmental issues that use the term 'Precaution'. However, in the whole period from 1945 to now, predominantly the medical journals bring articles referring to 'precaution' in the title. In scientific writing is precaution chiefly a concept used in medical language, and hence where humans and secondary livestock may be at risk. Only in the 1980s and ahead the idea of applying precaution to nature and environment becomes explicit, and this happens, as we shall see in more detail shortly, in the same move as the precautionary principle emerge as a concept. At this stage, I will say that the relation between the medical and environmental 'types' of precaution are distant, and goes back to the linguistic meaning of precaution.

Most of the environment-related use of 'precaution' in the articles reflected in the figure is more related to the 'environmental precautionary principle' than to the 'medical precaution-concept', and thus becomes a distant relative to the medical dominated precaution-concept. The main route of translation to the precautionary principle does therefore not come from medicine but rather from the critical social movement as depicted in figure 5.1.

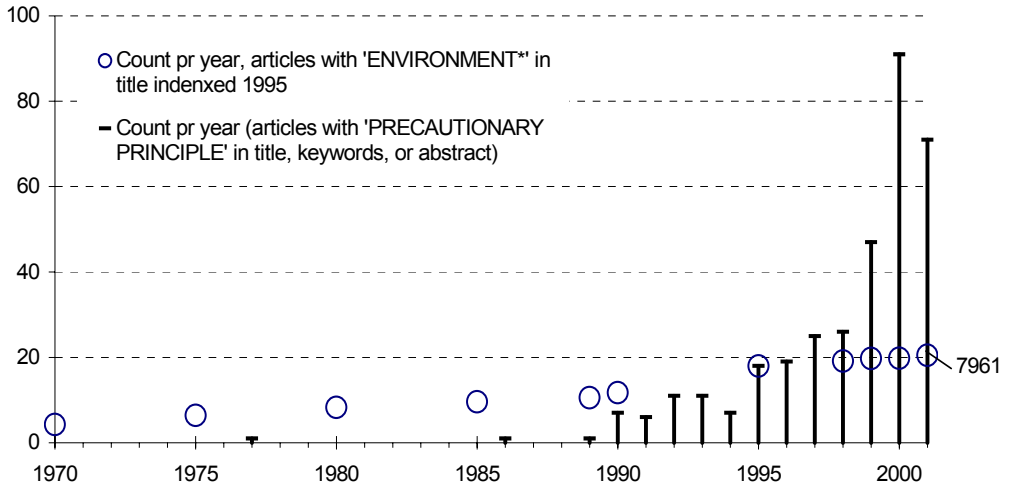


Figure 5.3 The Precautionary Principle in scientific writing.
The figure is based on a search for 'precautionary principle' in title, keywords, and abstract. The consulted database does not have abstracts and keywords in entries before 1991. This does however only introduce a minor fault, as most of the hits comes after this date.

5.1.3 The German roots of the policy-concept

There seem to be an overarching agreement among all authors writing about the precautionary principle that the concept emerged in the former West Germany as the 'Vorsorgeprinzip', and the pedigree of the precautionary principle is often assumed to start there. Beyond this, the German history of the principle is quite interesting, because the precautionary principle in Germany shape part of a larger political programme, of which parts has been visible in the Danish national environmental strategy.

The German Vorsorgeprinzip was developed in a specific social, economic, and political context, during an era of strong social democratic planning. In 1969 won Willy Brandt and the Social Democratic party the election with a highly ambitious environmental programme and the promise of *Vorsorge*, and in the 1970s and 1980s became the Vorsorgeprinzip part of a much broader effort to initiate and justify what has been called a period of 'industrial restructuring and modernisation' (Boehmer-Christiansen, 1994: 43, 32). For Hajer (1995) and Weale (1992, 1993) this political programme was framed by an 'ideology' they label 'ecological modernisation', and which had, and still have, the idea of convergence of environmental and economic goals as its hallmark.

Boehmer-Christiansen identify *Vorsorge* as state influenced planning, and trace the German application of *Vorsorge* to environmental policy to the 1970 first draft of the clean air legislation, which stated the intention *dem Enstehen Schädlicher Umwelteinwirkungen vorzubeugen* – to prevent the environmental effects. *Vorzubeugen* literally mean to bend beforehand and thereby reduce the risk of being broken, and the verb is commonly used in medicine. The same idea was expressed in

the 1971 *Umweltprogramm* (environmental programme) as *Umweltplanung auf lange Sicht*, i.e. long term planning for the environment (Boehmer-Christiansen, 1994: 35).

In the German policy context *Vorsorge* emerged s a counter concept to the free market doctrines and narrow economic feasibility criteria, which constrained any policy prescriptions that demanded more than the repair of damage already done (Wey 1993: 204 in Boehmer-Christiansen, 1994:36). The concept was, according to Boehmer-Christiansen, particularly attractive to the new Social Democrat Administration for furthering environmental policy as to create a fairer society, and the *Vorsorgeprinzip* gave an important impetus to put environmental protection inside the Interior Ministry and Foreign affairs (Boehmer-Christiansen, 1994: 36). Vorsorge was seemingly a quite general translation of the new concern for the environment, which had its rise with the counter cultural movements in the 1960s:

> "The views and ideals of the North American environmental protest movement had struck a deep chord in German society. This allowed the state […] to assert themselves in a new policy area, often by appealing to the Germanic fondness for future catastrophes" (Boehmer-Christiansen, 1994: 43)
>
> Environmental protection was moved from the Health Ministry to the much more powerful Federal Interior Ministry (BMI), that with Vorsorge among its weaponry faced the Federal Economic Affairs Ministry (BMWi). The basic assumptions of the BMI were that technical progress, economic growth, and environmental protection could be achieved without 'trade-off', and in fact would advance together (Boehmer-Christiansen, 1994: 44).

In 1976 did the Vorsorgeprinzip appear in German Legislation:

"Environmental policy is not fully accomplished by warning off imminent hazards and the elimination of damage that occurred. Precautionary environmental policy requires furthermore that natural resources are protected and demands on them are made with care" (von Moltke, 1988: 58).

As recession struck in the late 1970s the SPD lost power and was replaced in 1981 by a right-wing coalition. Even though recession alone was a threat to the Vorsorge strategy, as it becomes harder to argue for a preventive strategy based on investment in technology that may or may not abate unknown future environmental degrading when financial shortness is lurking, did the Vorsorgeprinzip not fade out with the new CDU/CSU/FDP coalition. In fact, the opposite happened, most likely because Die Grünen – the Green Party – entered parliament, and the political need to be active in the environmental arena therefore did not diminish. That the Greens entered parliament was of course itself a result of a broad popular concern about the environment, which especially had its fulcrum around the Waldsterben. Possibly with this motivation, did Helmut Kohl and the rightwing coalition in the 1980s emphasize the Vorsorgeprinzip because it was taken as a market-orientated alternative to the Verursacherprinzip – the polluter-pays-principle – which had been the central principle in the social-liberal SPD-directed government's traditional command and control policy (Zimmermann 1990: 3-4).

The strategy of furthering economic growth and environmental protection has probably been an attractive way to meet the onrushing green party. This reveals interestingly a distinctive openness of the German version of the precautionary principle. The Vorsorgeprinzip was introduced under the SPD government to counterbalance the economic feasibility criteria, and later when the CDU leaded government came to power was the principle stressed as an alternative to the polluter pay principle! Most likely, this special twist has lead to the situation as it has been from the 90s where Germany more or less has been detached from the formulation of European environmental policy. Germany certainly has high scientific-technical standards reflected in limit values and orders regarding minimisation and optimisation – in other words instruments to the modernisation of technology – but the implementation is totally based on volunteer programmes in the industry, and with very limited possibilities for public control (Pehle, 1997: 203). Examples is the very hesitant German implementation of the directives on public access to official environmental files and information, and the directive on environmental impact assessment (Pehle, 1997: 202).

Environmental protection in Germany has therefore in general been a combination of Vorsorge and the development and promotion of cleaner technologies; i.e. the German strategy is technology driven, with Vorsorge as the legitimising and driving argument. The key policy concept was *Stand der Technik*, and *Beste Stand der Technik*, which was supposed to encourage investments and promote technological change, as well as to stimulate applied research. However, the succes of this strategy, i.e. the convergence of environmental protection and economic competitiveness, is depending on the availability of investment funds and political motivation, and here did the Vorsorgeprinzip play a crucial role as metaphor for this strategy of converging environmental and economic goels (Boehmer-Christiansen, 1994: 50-51).

Boehmer-Christiansen (50-52) points to three specific factors that in the German context helped creating the linkage between metaphor and action:

Ambitious rhetoric and programme development are encouraged by the federal nature of the German state, the dominance of coalition governments and the almost continuous assessment of politicians through elections.

The engineering profession and not natural scientists dominate the advisory process. Decision criteria additional to natural scientific and economic ones are promoted, especially those that relate to innovation and application of new technology.

The courts play a major role in interpretation and implementation of environmental regulation, deciding disputes over *Stand der Technik*, and whether Vorsorge has been satisfied. Expert advise to the courts are provided i.e. by the German Association of Engineers (VDI). Because there exist two legal definitions of *Stand der Technik* is this advise very important.

This specific constellation of institutional and cultural factors, which has lead to the technology-driven environmental policy that stress applied rather than pure research, has an important consequence. The hitherto most dominating policy model for

environmental regulation – and especially for regulation of chemicals – is a reactive model, based on 'purer' science to prove harm before action is taken, and this model has a basic problem. It is based on traditional economics and natural science, which both require fully understood causality, or known probabilities of the problem to be regulated, and this lead to highly complex decision rules, i.e. as it is known from the European Chemicals Risk Assessment programme. Moreover, this is not altered if the onus of proof is moved from victim to polluter. It is commonly accepted that for major environmental problems is the causality between cause and effect hard to establish and prove in scientific terms. The transition from the 'academic' approach to policy is problematic because it is stuck in the diagnostics of the problem. The alternative policy model for environmental regulation, based on *Vorsorge* and *Stand der Technik*, bypass this problem by legitimising technical change with reference to environmental threats. (Boehmer-Christiansen, 1994: 56).

Boehmer-Christiansen ironically remarks that, because of the priority given to technical possibilities over proof of causality, American lawyers may have a political bias against the precautionary principle. This is because the US process of environmental policy making apparently places the legal profession at the centre of controversy, thereby limiting the powers of the bureaucracy to make 'complex judgements and to rely on inexplicit criteria'. In Germany, Boehmer-Christiansen writes, "this power relationship appears to be reversed, precaution giving discretionary powers to the bureaucracy rather than to lawyers, a development the American legal procession is not likely to welcome."

In the 1980s the strong environmental policies was in place in Germany, and as a logical consequence it was crucial for the German industry that the stricter requirements like Stand der Technik was extended to the European Union, so that the increased requirements could be turned into competitive advantages at the export markets. (See e.g. Weale, 1993: 214, Jordan, 2001: 146, and von Moltke, 1988: 57-58). Furthermore, Jordan (op cit) has argued that this specific German configuration has had a conclusive importance for the shaping of European Environmental regulation and the emphasis on cleaner technologies.

The German move towards using the principle internationally were especially accomplished with the proposals at the North Sea negotiations in 1984 (Bremen Declaration), and the first explicit international formulation of the precautionary concept was contained in the Declaration of the Second International North Sea Conference on the Protection of the North Sea (London Declaration) (Freestone & Hey, 1996: 4-5). This was probably also the reason why the English Royal Commission on Environmental Pollution ordered the report on the Vorsorgeprinzip in West German environmental policy in 1987 (see von Moltke, 1988), which is regarded as presenting one of the first formal English translations of the principle (see Haigh, 1994: 230, and Boehmer-Christiansen, 1994: 31).

6 The Precautionary Principle in Denmark

This chapter presents an overview of the precautionary principle I Denmark and serves as basis for the selection of the empirical study presented in the following chapter. The aim is to analyse changes in the Danish policy language and policy style with respect to the policy concept "the precautionary principle" as well as with respect to what can be described as precautionary practice.

6.1 The Precautionary Principle in the Danish Media

In this section the entrance of the precautionary principle as an explicit concept is analysed. This part gives broad picture of how the precautionary principle has been reflected in Denmark; types of constituencies, rhetoric's, and alliances which the concept has been involved with. The character of the Danish debates involving the precautionary principle is discussed, and it is concluded that the concept 'tap' into existing practices and cases, which indicated the some kind of precaution was present before the precautionary principle became an established concept. This broad picture is the basis from which the three core cases have been taken, and the section is concluded with an introductory discussion of the three cases and their relevance for the study of the precautionary principle.

The section examines the development and appropriation of the concept "the precautionary principle" in Denmark, with a focus on chemicals policy. In Danish is the precautionary principle, "forsigtighedsprincippet", which is a direct translation from the English version of the concept. This indicates the Danish concept refers back to the 'international' concept of precaution, and not its German predecessor "der Vorsorgeprinzip".

With a point of departure in Danish Newspapers I give an overview of the use of the precautionary principle in popular debate in Denmark. After that I examine the first line of events that made the precautionary principle a Danish concept, that is, a concept with specific Danish meaning that somehow leads to deviation from "practice as usual". Even though the precautionary principle in strict terms was new in Denmark in the beginning of 1990, was it the perception of Danish authorities that the principle had a non-spoken antecedent. In a hearing on the precautionary principle, Danish EPA Director General Erik Lindegaard points to the principle's presence in a number of acts:

"At first glance, the legislation does not include the precautionary principle in a way that jumps out and grabs you. The principle is not mentioned by name, but it is there. For example it states that 'consideration must be given to the likely impact of pollution'. Or, as is stated in the Chemical Substances and Products Act 'it shall be possible to intervene where there is a suspicion that a chemical substance is hazardous for health and the environment', and so on." (DEPA, 1998b: 6).

I will therefore talk about both an explicit and a 'non-spoken' type of the precautionary principle.

The major constituencies that are involved in this process are politicians, officials from the Danish Environmental Protection Agency, research professionals, e.g. in the National Environmental Research Institute, and the National Agricultural Research Centre Foulum, Danish and international NGOs, and organisations representing the industry.

Some of the questions I want to address are the following: Precaution is taking an increasing importance for the discussion of environmental issues, but why and how does it do that? Does precaution in Denmark make out a part of a new discourse? Or does it become a vehicle of change in environmental politics, or even in technology policy in more general?

What is the principle and what does it do? Hajer has suggested that the principle is a story line. This means that the concept unites a number of disparate and hardly compatible worldviews and discourses. More specifically may the precautionary principle be a vehicle for (possible) change.

6.2 Overview of Precaution in debates in Denmark

Throughout the media debate relating to the precautionary principle, the principle mainly plays the role as an additional argument or as a codification of certain viewpoints and positions. The principle are used in relation to a number of different issues that 'lives their lives' independently of the principle at least at the outset. Hence, the precautionary principle does not give rise to new issues (except for itself), but it do give more sense in some debates than in others. The principle was – as I will come to shortly – introduced relatively late to the Danish scene, compared to the case in other countries, e.g. Germany, United Kingdom and Sweden (se Boehmer-Christiansen, 1994, von Moltke, 1988, and Wahlström, 1999). This might explain the maturation-like character of the debates relating to the principle. In the early 90s the principle was introduced, as Danish authorities found the principle potentially useful for the Danish aims at the international agenda of environmental politics. Concurrently, the principle was 'tried out' at different cases and problems at the Danish national scene. While the use of the precautionary principle in the debates has a character of trial-and-error, the principle in some cases turn out being of minor use and in other cases the principle gain a significant role for the argumentation.

In this section my aim is to give the reader a larger picture of the precautionary principle in Danish debate. This larger picture is based on smaller and relatively loosely connected bits and pieces of stories and events. The essential information source is an analysis of round 600 articles in Danish newspapers that explicitly use the precautionary principle.

I have divided the subjects up in four broad categories, relating to environmental issues, and one remaining that collects a variety of uses that do not relate to environmental issues. The first category is chemicals and chemicals regulation, and this theme includes a range of specific 'problem-substances' such as brominated flame retardants, plasticizers, and it includes discussions relating to regulation of marine

pollution, of persistent organic pollutants (POPs) and European regulation of chemicals.

The second theme is food and consumer protection. This category covers especially cases where the precautionary principle has been used discussing risks related to technologies applied in food production, and very often, these technologies are chemical technologies. The most prominent issues are genetically modified organisms, followed by mad cow disease, pesticides in food and groundwater and growth hormones in beef. Especially GMOs and hormone beef are both subjects that are closely connected to the negotiations in WTO. These issues are combined with a number of more isolated food scandals and with consumer protection, especially in relation to the European Union.

The third theme is the institutionalisation of the principle in national and international regulation and politics, and at many levels. This range from articles reflecting negotiations relating to UNEP, the Danish environmental protection law, to personal reflections from politicians and various experts regarding environmental politics.

The last category consists of different issues where the precautionary principle has had an importance. The most important issue is the debate about climate change, but a number of disparate issues such as impoverished uranium in ammunition, electromagnetic fields, radioactive pollution, or bridge building. A comprehensive overview can be gained below.

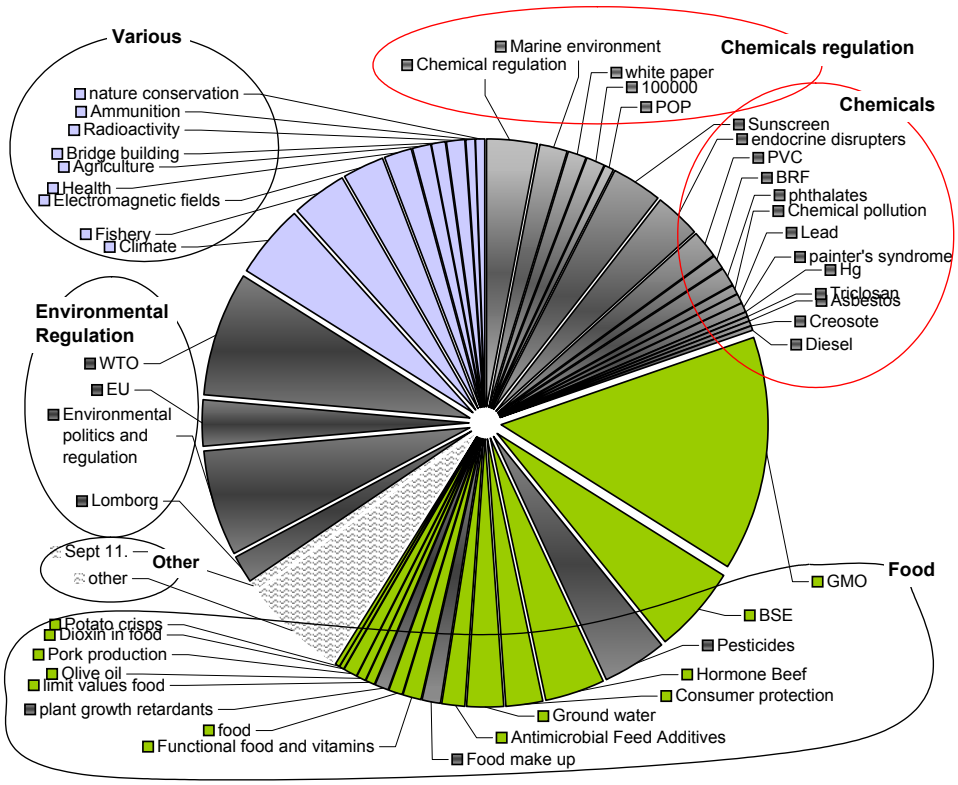


Figure 6.1 A comprehensive overview of topics related to the precautionary principle in Danish media debate.

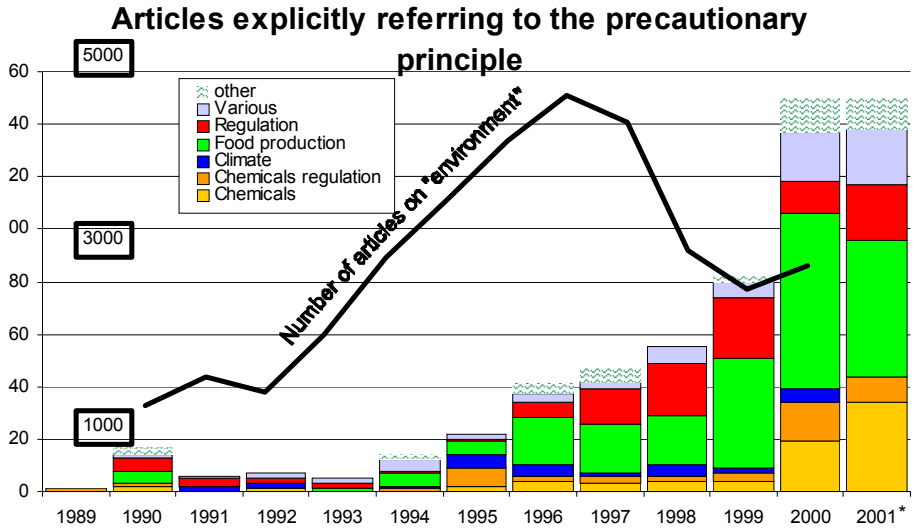
Beyond the four categories, which all relate to risks associated with technologies, the principle is used in a number of other contexts of more economic and social nature. In many of these articles, the principle is used as a rhetorical trick by referring to the technological-risk meaning of the precautionary principle, without having anything to do with it.

The figure below indicates the number of Danish national newspapers-articles using the Danish term for the precautionary principle. The newspaper debate can be divided up in three broad periods, characterised by added and accumulated subjects. The first period starts in the late 1980's and continues until 1995/1996. In this period, the debate involving the precautionary principle was dominated by distant international environmental issues, and supplemented with diffused attempts to a Danish appropriation of the principle.

In 1995/1996, a range of new issues emerges, related to food (BSE, GMO, Hormone beef, food makeup) and chemicals (endocrine disrupting chemicals, phthalates in PVC, and pesticides in food and drinking water).

Finally, in the end of 1999, the precautionary principle becomes a major concept related to the WTO negotiations especially negotiations related to GMO and Hormone beef, and *trade* emerges as a new major angle to the subjects already established as

'precaution-related'. Precaution becomes a factor that is thought to protect interests of health and environment against the possible threats of the global economy. Furthermore, the precautionary principle became a part of the rhetoric when the BSE issue gained renewed attention in Denmark with the first (registered) Danish outbreak in the beginning of year 2000.



* In 2001 the data was collected until November 20th, which was the date for the election leading to a neo-liberal Danish Government.

Figure 6.2. The Number of articles in Danish national newspapers, using the phrase "forsigtighedsprincippet" (the precautionary principle) is depicted with the total number of articles with the subject "environment".

The figure covers the following Danish newspapers: Ingeniøren from 1985, Berlingske Tidende from January 1990, Weekend Avisen from January 1991, Politiken from January 1993 (plus selected articles from 1985-1992), Ekstra Bladet and Ritzau (Danish news agency) from 1993, Aktuelt from 1996 to April 6th 2001, Jyllands Posten from September 1996, and Information from September 1997. Due to the limited data availability are the figures covering the years up to 1993, 1996, and 1997 underestimated, but except for Aktuelt and Politiken are the papers with lagging data characterised by not referring to the principle in the first periods with full text available

It is interesting that the number of articles related to environment seems to top at 1996/97, whereas the normal perception is that environmental issues topped in the late 1980's. The curve might be shaped by increased database coverage, though this should not be the case from 1996 and onwards. If the phenomenon is not a fabrication, then might the explanation be that what normally is referred to be the impact of discussions about environment, which might not be analogue to the number of articles about environment. One could assume that environment in fact becomes a 'consumer-good' in the press, and the raising curve therefore in fact reflects a combined de-politicisation and popularisation of the coverage of 'environment', and a move away from demand for fundamental actions and towards more shallow rhetoric's and symbol-politics. This reflection corresponds to some extend to Andersen and Hansen's

(1991) analysis of a transition to symbol-politics in relation the politics of eutrophication and agriculture in the late 1980s.

6.3 The Early Days of the Precautionary Principle

The figure above illustrates that the precautionary principle takes an ever-increasing importance in the Danish environmental debate. This point becomes even clearer if we look at the proportion of articles that refer explicit to the precautionary principle, compared to the number of articles that refer to 'environment'.

At the figure below, the periods that I have suggested can be found. In 1989 and 1990, the principle was introduced, and the former Environmental Minister Lone Dybkjær attempted (quite aggressively) to introduce the principle in domestic politics, but was defeated. In the following, I will give this period more attention, applying a qualitative approach. After the defeat came a political shift, as Dybkjær and the Social Liberals left the Conservative lead Government, which however did not relate directly to the conflicting views on environmental protection.

The principle now got a more humble position, and the following years were calmer regarding environmental issues; the opposition attempted and succeeded in 1991 to have the precautionary principle incorporated in the Environmental Protection Law, and the principle became an important part of the discussions of the Rio conference, and the opposition managed to introduce a CO_2 tax. But concurrently with the humble position, was the principle in general terms broadly accepted by most of the political spectrum, and all parties that recommended voting yes to the Maastricht treaty emphasized the inscription of the principle in the treaty as a big step forward, and saw this as an additional argument for joining the treaty. A very important part explanation to this consensus creation around the principle is most probably to be found in the parliamentary situation that existed in Denmark since Schlüter's Conservative government seized power in 1982. The Conservative lead minority government's main concern was economic policy as well as maintaining power after several years of Social Democratic reign, and it was depending on a close alliance with the social liberals. But the Social Liberals did not share view on environmental issues, and did often not support the government on these issues. So together with the Social Democrats and two smaller left partier, the Social Liberals formed the alternative, so-called 'green majority' (see Andersen, 1997: 265-6). In 1988 Schlüter persuaded the Social liberals to join his new minority coalition government, but in 1990 when the Social liberals left government, the green majority was re-established. As the precautionary principle wasn't a much debated, and the right wing government was weak especially on environmental issues, was precaution accepted as a policy principle.

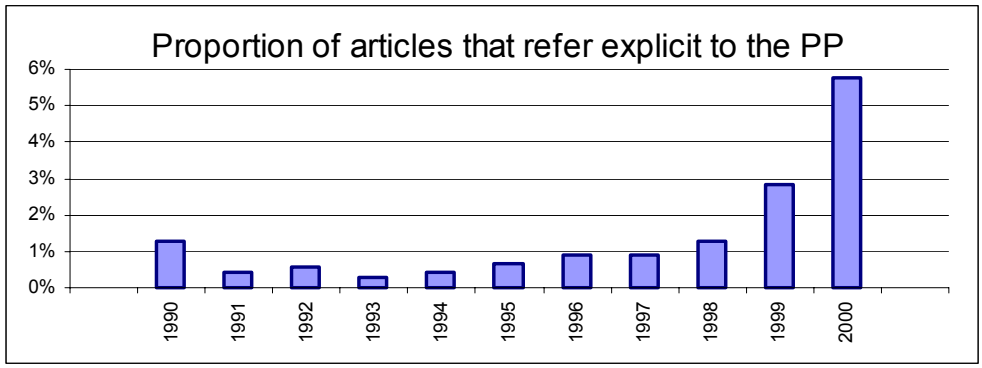


Figure 6.3. The figure depicts the proportion of articles with 'environment' as subject that explicitly refers to the precautionary principle.
The number of articles mentioning the precautionary principle before 1990 is low.

Midway in this period with low attention to the precautionary principle, in 1993, Schlüter resigned and the green majority literary came to power, with the Social Democrats in coalition with the Social Liberals, the Centre Democrats, and the Christian People's Party. The new minister of Environment and Energy Sven Auken (who remained in office until November 2001) declared, 'Green issues will be the red thread of the government's policy'. Policy integration became a common feature the following years with environmental management, volunteer agreements, labelling arrangements and green taxes, but the precautionary principle did yet not play an explicit role. The international co-operation brought the precautionary principle into the Danish environment-related discussions, and one of the most important frames was the fourth North Sea Conference where both the precautionary principle and 'the generation target' for the emission of chemical substances was included in text.

PART FOUR: EMPERICAL STUDIES

7 Plant Growth Retardants – the First Explicit Use of the Precautionary Principle

I have two aims in telling the following story, the history itself, but more importantly, the information the story conveys about how the system for controlling chemicals works. In a way this case is extreme, as it was formed by a very specific political situation; a situation that in fact as we shall see shortly also was about many other things than the precautionary principle; a situation that provoked a vivid public debate among the involved parties. It is also characterised by scientists that were accused for exceeding the boundaries that surround the normal scientific principles that are used for assessing chemicals. The extremity of the case also means that it may have limited value as a readymade paradigm in the sense of how the precautionary principle later would be applied, though it may have been paradigmatic in the sense of setting a new type of agenda and in this way shaping later practices. In turn, the extremity of the case does give an excellent opportunity to study how the system is stressed by actors not following normal procedures; this lays open a number of processes and rationales that otherwise would remain hidden.

My aim in telling the story is to clearly present the rationales and arguments that were put forward by the actors. In principle, I refuse the possibility of telling the one true story; the narrator will always have to make choices and exemptions; otherwise there will be no story but a massive inferno of information. On the other hand, it is important that the story I tell is in accordance with what happened. My point here will be that I tell the story with a preference for some specific aspects and facets, but in doing this I aim to be fair and balanced.

The story is multi-layered. It is comprised of a very specific national political situation, of conflicting scientific approaches, numerous constituencies with very different approaches as to what is valid knowledge for the regulation of chemicals and the criteria for validation. It shows how institutions and rules are used to re-establish order and the closure around specific substances as being safe.

The case is illustrative of the contemporary regulation of chemicals in several ways. It exemplifies how harmonised tests may be challenged by alternative testing rationales and rationalities. It exemplifies how the precautionary principle as a policy principle was translated into the Danish national context; the attempt to regulate in a traditional sense was abolished by government, but was taken over by a consumer-based boycott. The case exemplifies how diverse the interests around a regulatory controversy may be, and how the forms of alliances depart from traditional patterns in environmental controversy. Finally, the case exemplifies how political debate may support sustainable, innovative pathways.

Furthermore the case is paradigmatic because it is among the forerunners that introduce a new type of environmental debate where concerns for human health becomes a driving force, and where environmental protection, human health, and food production are firmly interconnected. The case thereby intersects a transition of the

precautionary principle that took place during the 1990s. Jordan (2001: 143) describes this as how the principle was 'transmogrified' in its topical focus: "precaution has been swept up by the politics of sustainability through which environmental protection is beginning to more forcefully intrude into previously 'non' environmental sectors." And such intrusions do of course not slip away quietly.

The case includes a number of mutually adjusted but distinct subsystems, which operate with internal codes of practices and rationales. The case would not have become a case if it had not been for an unwelcome "interloper's" attempt to apply the newly invented precautionary principle to the case; this "interloper" was the environmental minister Lone Dybkjær. She became perceived this way because she questioned some of the basic negotiations and institutions that founded the application and approval of agrochemicals, this despite agrochemicals in Denmark was the responsibility of the Minister of Environment. As I shall demonstrate later, her involvement intersected furthermore with a specific set of political circumstances that possibly influenced the minister's involvement.

In my treatment of this case I devote special attention to the experts, and their advice, involved with the case. Three systems for expert advise are especially interesting, the first targeted at agricultural advice, the second targeted at human health, and the third at environmental protection. The first system is the professional agricultural advice system, which primarily consists of the Danish Agricultural Advisory Centre (DAAC) which is owned and run by the farmers' unions, and also of the National Institute of Animal Science, that provides supportive research for Danish agribusinesses. The second system is represented by the National Food Agency of Denmark (NFA) which has responsibility for food safety and pesticide residues in food. The NFA acts as the local representative for the World Health Organisation, which operates the UN's global harmonisation of food safety testing programme. The WHO acts to institutionalise the interpretation of the existing body of acknowledged information on chemicals. The NFA also acts as the local representative for the OECD, which institutionalises the design of chemicals testing procedures. Both the WHO and the OECD are institutions that fall under what Latour calls 'centres of calculation' creating 'immutable mobiles', which are ideas and concepts that do not change properties with changes in space and the centres or institutions that creates them (Latour, 1987: pp232 & 227,236-7). The third system, the Danish EPA, mostly plays an involuntary and subsidiary role in the case. The DEPA has responsibility for approving pesticides, but takes advice from the NFA on toxicological issues.

The case became a wretched affair because information and advice transgressed the invisible boarders between the domains belonging to these two advisory systems. The agricultural advice system is, in my description, characterised by valuing local knowledge, and the case takes its beginning in the normal practice of this system, which involves practical use of the precautionary principle (tacit). The second system in the case is activated when the information and knowledge of the first system transgresses due to media and political attention.

As I described in the previous chapter technologies have persuasively been described as heterogeneous systems or networks of non-human artefacts and their human

makers, users, and regulators. Power is distributed across networks, and the components of the system must function harmoniously together in order for a technology to work. The safe use of a machine or a product does in this context not only depend on its physical chemical design and manufacture but also on the surrounding social context (Jasanoff 1998: 174). A central aspect of the technology is whether it is working or non-working. The first parameter for assessing the working or non-working of a chemical technology is naturally the intended functionality of the chemical. The obvious questions are whether the pesticide kills the pest? The straw shortener shortens the straw? The flame retardant retards flames? Etcetera. As we can see from the history of Danish chemicals regulation this type of question was among those that were first asked by the state, but it is the second type of question that I have given special attention to, which may be an even trickier question than the question of primary functionality: Is the chemical technology safe to use? It is easier to discuss the quality and quantity of an effect you expect and wish for than to discuss an effect you do not want and whose effect you in principle do not know. Safe working or non-safe working has become an important part of the working or non-working of a technology. From this perspective the course of events in the case led to a temporary non-working condition of the specific chemical technologies in question. We will in the following see how.

7.1 Short Introduction to the Case

Autumn 1989 the Danish Environment Minister refused to take action based on new knowledge concerning the results of experiments on plant growth retardants that had emerged that summer. She was strongly supported in her decisions by her advisers in the EPA, and by toxicologists from the Ministry of Health. The experiments had indicated that a commonly used plant growth retardant, namely CCC, could lead to impaired fertility among pigs and the question was whether this could also be the case among humans. The following summer the results of a new experiment using a different plant growth retardant were published. The results indicated that fertility was impaired among pigs when they were fed on grain sprayed with the plant growth retardant Cerone.

The Environment Minister chose this time to prohibit all sales of plant growth retardants with reference to the precautionary principle and the newly held Bergen Conference. The prohibition provoked uproar especially from the other parties in the government coalition as well as from the pesticide producers and importers and from the grain growing farmers, all finding support in the available toxicological advice. After an interlude, which also included a general election and change of environment minister, the prohibition was rescinded, and the status quo was seemingly re-established. But the state of affairs was not restored. Some bread producing companies had voluntarily abandoned using treated grain in their products, and in the following years consumer boycotts came to play a role for increased political attention to the problem. A storyline, nurtured by pig-breeder's and horse-breeder's continued to sustain suspicion against the plant growth retardants and has regularly kept the issue to the forefront of media headlines ever since.

7.2 Translations within the Agricultural System

- Or to anticipate (almost) all eventualities

The story of plant growth retardants within Denmark started with observations in the field and were continued with a series of experiments conducted by the National Institute of Animal Science[10] from 1984 to 1990, which were reported in the summer of 1989 (Danielsen & Larsen, 1989a & Danielsen & Larsen, 1989b) and in the spring 1990. With the release of the last results explained the following statement the experiments background:

> "Observations in some Danish pig herds have indicated that the use of grain crops treated with certain chemicals during the growing period might negatively affect feed intake and reproduction in pigs.
>
> On this background, experiments with pigs have been conducted to study the effects on their production characteristics and their reproduction and health status after they were assigned feed/straw bedding from barley crops treated with Roundup and/or Cerone during the crop's growth period." (Danielsen & Larsen, 1990: 8)

Cerone is a plant growth retardant with the active substance ethephon, and Round up is an herbicide with the active ingredient glyphosate. The previous summer the results of the experiments with the plant growth retardant CCC (active substance Chlormequat-chloride) were published.A plant growth retardant is a pesticide that regulates the growth of plants. The substance is absorbed through the plant's leaves where it affects the hormonal control system of the plant and reduces the longitudinal growth of the straw, preventing lodged corn. The two active substances in question however, chlormequat in CCC and ethephon in Cerone, act differently as they influence the plants differently and are used at different phases of the growth season.

The researchers explained the background for the experiments in the 1990-report. They described that the consumption of pesticides such as Cerone and Roundup had been increasing, and concurrently cattle and pig producers together with agricultural advisers from the influential institution the Danish Agricultural Advisory Centre had noted that some herds had seen increasing problems with, among other things, reproduction. This knowledge had come to the researchers attention through routine meetings with agricultural advisers and as questions from farmers e.g. at local meetings in the Farmers' Association. One of the questions that the researchers had encountered was whether they knew of any research concerning the effects of pesticides on the growth and reproduction of pigs. The importance of this question was obvious, as the possibility of adverse effects was alarming because the number of offspring was and is economically crucial for all animal breeding.

Therefore, The National Department of Cattle Husbandry and the National Crop Production Centre of the Danish Agricultural Advisory Centre invited the National Institute of Animal Science and the National Institute of Plant and Soil Science to

[10] The National Institute of Animal Science was a government research institute under the Ministry of Agriculture.

discuss the initiation of experiment that could elucidate the suspicion. At the first meeting were the two pesticides selected, not because of any specific suspicion, but because they were common and because they were among the pesticides that were used closest to harvest time. It was further more decided to invite the EPA as the responsible authority, and the companies that produced the pesticides, and the two companies behind the products and the Danish EPA participated at the following meetings. The invitation of these actor groups demonstrated partly a tradition for a co-operative approach to problem-solving, partly did it demonstrate the relative uncontroversial character of the case at that point.

But the researchers at the National Institute of Animal Science had actually initiated experiments with CCC in 1984. The Danish Agricultural Advisory Centre's attention was however also directed at Roundup and that is why they initiated the meetings, which ultimately led to the Roundup/Cerone experiments (per com with Danielsen 2003). The activities at this stage were meetings arranged by the Danish Agricultural Advisory Service, with participation from the corresponding departments from the National Crop and Animal Science Research institutions. At a meeting at the Danish Agricultural Advisory Centre on May 31st 1985, it was concluded that the experiments should be started.

Participants at the meeting included the Danish Agricultural Advisory Centre, the National Institute of Animal Science, the National Institute of Plant and Soil Science, the Danish Environmental Protection Agency, and the companies Monsanto and Danish Shell (later Rhône-Poulenc Agro Norden)[11]. The two companies entered into a contract with the organisers of the experiments that gave them hearing rights during the experiments and a 90-day period for examination of the results in relation to their publication, and a duty to participate in the financing of the experiments.

It was decided that the experiments should cover separate experiments with pigs and young bulls, and later experiments with poultry and mink were to be added. (Danielsen & Larsen, 1990: 10, Landsudvalget for kvæg / Jeppesen, 1985)

Danielsen and Larsen (1990: 10) would later note, in the report on the results, that the two pesticides were tested and approved for dedicated use by the authorities. However, the authors would also stress that this testing primarily was based on experimental animals, and only to a limited extent on larger domestic animals. This was a basic reason why they found it important to initiate the experiments. In the following it will be clear, that this clause was very important –reading between the lines it could read: *we know that these substances have been tested according to internationally approved test guide lines and in accordance with good laboratory practice, but we do question whether these experiments are adequate for pig breeding*. This could have been seen as a challenge to the existing testing of pesticides, but was constructed not to appear so back in 1985. In this phase, the activities did not lead to

[11] It seems that there were some reservations from the EPA and especially from the toxicologists from the companies. The problem was whether the tests should apply to normal procedure for toxicological experiments, or the suggested feeding experiments.

any breaks with normal practice, but followed the lines of what I term the knowledge frame of the agricultural advisory system. We will return to this issue later in the case.

When the information on the adverse effects of CCC reached the Danish Agricultural Advisory Centre in Århus in august 1989 the adviser on duty was in no doubt as to the seriousness of the results (per com, Per Tybirk 2003). He received approval to issue warnings to the pig-breeding farmers from the National Danish Committee on Pigs, an elected and political forum watching over pig-breeder's interests, and wrote a note in which the conclusion was assessed and compared with previous investigations. The note was aimed at farmers and recommended that CCC treated wheat and barley should comprise a maximum of only 30% of the feed for sows, and a maximum of 50% for piglets and fatteners. The recommendation was delivered in a serious but relaxed tone: "One must remember that CCC treated wheat cannot be expected to result in large effects in livestock this year compared to last year just because an experiment relating to the effects of the CCC treatment has now been published" (Tybirk 1989: 5). Following this the recommendation was repeated in the guidelines for feed composition, where it can also be found today.

So far, the practice followed what can be termed normal practice. As it is sketched below the advice was given in a closed loop system with a political control point in the elected National Danish Committee on Pigs that approved the precautionary advice. The researchers had succeeded in assuring the actors that the investigation was not a threat to plant grower's possibilities for optimising growth, neither was it a threat to the earning power of pesticide producers; and it was not a threat to the authority of the existing schemes for testing and approving pesticides.

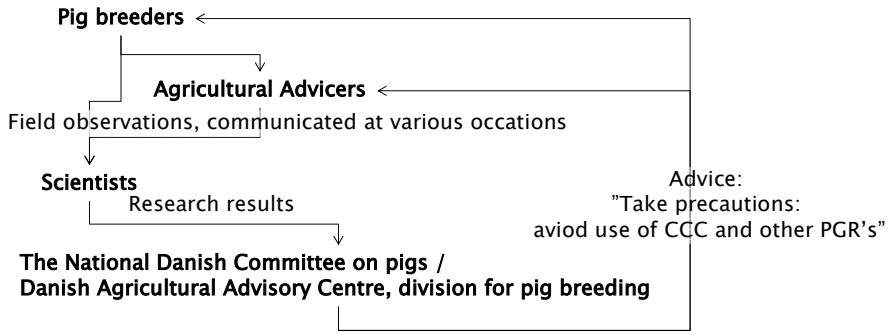


Figure 7.1: Schematic diagram of the Agricultural Advisory System.
The Figure shows the route of information and advice, starting with the pig-breeders. Through this system the informal knowledge becomes formalised. The system is sensitive to local knowledge and combines this with expert knowledge. It is important that the system is 'closed'; the advice goes specifically to the pig breeders.

The scene was now complete and the case was to explode on the 27th July 1990, the day when the environmental minister Lone Dybkjær would issue a general prohibition against the marketing of all plant growth retardants.

However, as a prelude to the prohibition, the CCC-research results and the advice to the pig-breeders gained public attention, which was hushed up – events that was very informative to those following the case!

Now I will leave the scientists at the National Institute of Animal Science, because their project, to advice pig-breeders, was partly overtaken, expanded and redirected by new actors - environmentalists approaching the experiments from the angle of concern for the general health of the public, which they did acting in alliance with public opinion.

7.3 The First and Defeated Transboundary Translation: A prelude

In the previous section we looked at the case from the rationale of the agricultural advisory system. The researchers succeeded within this rationale to anticipate possible open enmity from actors that constituted or relied upon the established procedures behind approvals of pesticides. However, the transboundary translations of the experiment did result in disorder. The Danish EPA as the pesticide authorising authority and its advisers in the internationally constituted health system- the Institute of Toxicology - eventually brought this disorder back into balance.

The transformation of the research into advice to farmers gave rise to debate. The two reports from the researchers and the advice that was given to farmers and agricultural advisers were also received outside of agricultural circles. The first reactions in the wider media were moderate. The story emerged with a notice from a news agency "did grain from treated crops pose a risk in human food?"

The first reactions from the EPA and the NFA were cautious. The EPA reaction stressed that they had not seen the results - as stated by Inge Kraul from the pesticide office to the news agency RB:

> "If the experiments at the National Institute of Animal Science complied with the rule of a three month spraying respite, and if they have found anything unacceptable then there are grounds for us to take up the matter. […] We have not seen the study from Foulum, but we will order it straight away. Then we can come to a decision on whether action should be taken immediately, or we can wait until the planned reassessment of the substance." (RB, July 28 1989)

The substance, CCC, was to be reassessed in 1992 and the central question that arose for the EPA was whether the reassessment should be hastened.

The Foulum experiments and the ensuing public attention did seemingly also take authorities with responsibility for health related knowledge with surprise.In its response the head of department in the Central Laboratory[12] of the National Food Agency, K. Voldum-Clausen, stated that it was important that the residue concentration in grain for bread was low enough to ensure no adverse effects in

[12] The Central Laboratory is synonymous with the National Food Institute.

humans. However, to assess this it was necessary to measure the residues of CCC in the grain with an analytic method, and this was not available at that time.

At this point, the problem began to fade from the public's attention. The newspapers continued to write about the case, typically under heading such as "Risk associated to white bread"[13] but, lacking the possibility of establishing causality between the actual residues of the pesticide and its adverse effects, further development of the story was halted.

The arguments put forward by the National Food Institute had affinity to cause-and-effect, and was framed in the language of traditional toxicology. The effects must be linked to a chemical concentration; this was the focal point, and the argument would remain central for the actors that criticised the wish to take action alone on the knowledge obtained from the feeding experiments.

The Consumer Council embraced the case during the summer 1989 despite the fading public attention and thereby took part in the creation of the story line that became the connecting thread for the actor groups who criticised the widespread use of straw shortening chemicals: - *If CCC-treated grain isn't good enough for pigs, should humans then eat it?*

Carried to its logical conclusion the question raised by the Consumer Council would break with the negotiated conditions of the research. The probably most important condition was the idea of the research as being intended for advice to animal-breeding farmers; this prevented the research from being a critique of the general approval of the pesticides, an approval that actually had placed the substances in the lowest of the possible hazard classifications, and the most common PGR-products were and are still not classified as being injurious to health.

Two years earlier the Consumer Council had called attention to plant growth retardants in the Pesticide Council. The reason was due to the same type of information received from farmers and veterinarians that in 1985 hinted the researchers to initiate the feeding experiments. Moreover, the Consumer Councils representative, Jette Juul Jensen, argued that the Pesticide Council had to take up problems that were discussed in society. But the request was rejected with reference to the lack of documentation (Miljøstyrelsen, 1987: 8-9). But in late summer 1989 the Consumer Council again attempted to make the responsible authorities look critically at the substance on the grounds that: *doubt should come to the benefit of the consumer!*

Questions were once again directed to the Pesticide Council, and to the environment minister[14], but none of these found cause for concern. The two answers that the Consumer Council received were mutually interdependent, as they in practice originated from the same source, namely the Institute for toxicology.

[13] Politiken 29. juli 1989, 3. sektion side 5: *Risiko ved franskbrød*
[14] Information 21/11 1989: Striden om CCC: Hvem får det korte strå? (Col1)

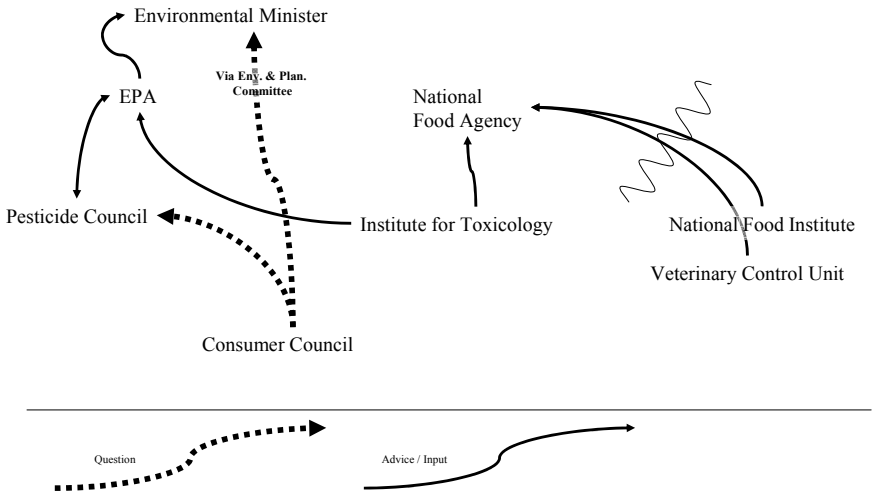


Figure 7.2 Overview of the questions asked to the minister and advise given.

Let us now look at the answers and their authors and institutions. It is the environment minister who was formally responsible for the regulation of pesticides. However, to ask the minister involves a chain of actors. The minister takes advice from the Environmental Protection Agency. However, the agency was at that time specialised in environmental issues and took advice from the Institute for Toxicology. The Institute for Toxicology was under the Environment Ministry from 1973 to 1987 as part of the National Food Agency, with the task of advising and investigating health aspects of chemicals in foodstuffs. The institute was also given the responsibility of providing research-based toxicological advice to the EPA in connection with the 1979 adoption of the Law of Chemicals. When the National Food Agency was moved to the Ministry of Health in 1987, and later to the Ministry of Foodstuffs, the Institute for Toxicology, without changes, kept its tasks for the Environment Ministry (Fødevaredirektoratet, 2003b). Therefore, the Institute for Toxicology provided advice both to the EPA and the NFA.

The Pesticide Council advises the EPA on establishing the criteria for the authorisation of and banning of pesticides. The Council had been established in 1980, following the adoption of the law of chemicals where the regulation of pesticides had been included; whereby approval also had to be based on an environmental assessment. The Pesticide Council replaced the Poisons Board.

The environment minister designates the members of the council on the recommendation of the agricultural organizations: the Danish Agrochemical

Association[15], Consumer Council, the General Workers' Union in Denmark (SID), and The Danish Society for the Conservation of Nature. In addition, authorities and organizations involved within the process can recommend members to the council: in this case the National Institute of Plant and Soil Science[16], the National Pest Control Laboratory, the Danish Working Environment Service, the National Food Agency, and the Environmental Protection Agency.

On September 4th 1989 Jette Juul Jensen asked the Pesticide Council to put plant growth retardants (straw shortening agents) on the agenda. Jette Juul Jensen was then head of section in the Consumer Council, and a member of the Pesticide Council. Her question was:

> "I will request the question of straw shortening agents to be put on the agenda for September 20th in the Pesticide Council, in relation to previous discussions in the Pesticide Council and in relation to the information that has appeared in the press on the basis of communication no. 748 and no. 749 from the National Institute of Animal Science." (Jensen, 1989).

We will return to the meeting later, meanwhile the Consumer Council also succeeded in their lobbying of the Environment and Planning Committee of the Danish Parliament, which was in a privileged position to ask questions of the Minister. Questions are always made from the Committee as a whole, but it was the member from the Socialist Peoples Party who adopted the issue. On September 13th Lone Dybkjær the Environment Minster was presented with the following question from the Environment and Planning Committee:

> "What steps does the Minister intend to take on the basis of the communications from the National Institute of Animal Science (Foulum) on feed experiments with CCC- grain and -straw (straw shortening agents). Please, answer the question with respect to:
>
> 1) human health,
>
> 2) occupational health in relation to use of CCC- preparations, and
>
> 3) the general impact on the environment"
>
> (Folketingets miljø- og planlægningsudvalg, 1989, September 13)

The Minister's reply was sent from the Ministry of the Environment to the Parliament's Environment and Planning Committee on September 20th, the same day as the Pesticide Council addressed the issue. The chair of the Pesticide Council was also the pesticides section chief in the EPA. Therefore he knew the minister's answer when the Pesticide Council held the discussion, and therefore we will start by looking at the Minister's reply.

The reply started by quoting the EPA's two-page review of the situation, which was followed by the Minister's own comments. The review concluded that there existed no

[15] Danish Agrochemical Association changed name to the Danish Crop Protection Association in **** (Dansk Planteværn).

[16] The National Institute of Plant and Soil Science was in ***1994 merged with the National Institute of Animal Science to form The Danish Institute for Agricultural Sciences.

reason for concern, and this remains the Minister's conclusion, even though she made some modifications in the reply, as we shall see shortly:

> "The Environmental Protection Agency has performed an assessment of the investigations and has, after discussion of the results with the Health Ministry's Commissioner in toxicology, Emil Poulsen and the Institute for Toxicology and the National Food Agency concluded that there exists still no support for the assumption that animal and human health could be affected as a result of regular use of the straw shortening agent CCC." (Dybkjær, 1989:2)

The EPA review developed the conclusion further by explaining that the EPA in consultation with toxicologists from the NFA and the Institute for Toxicology could not agree with the conclusion made by the researchers at the National Institute for Animal Science: "The experiments have not proved a decline in the capacity for reproduction among the pigs used". Three arguments were put forward; two specific and one general. Firstly, the EPA claimed that the symptoms of spurred fertility i.e. increased frequency of absent heat and need for re-covering, are normal in pig farming and that the results were not statistically reliable, and therefore did not fulfil the minimum requirements for evidence for toxicological effects. Secondly the review points out that the exposure of CCC to the pigs was unknown and it hints that the concentration of CCC in the harvested grain was likely to be very low, exactly because the feed had been grown according to the rules. Finally it was noted that the experiments carried out at the National Institute for Animal Science were production experiments, and that these as such ought not to be used for proving toxicological effects.

Further to the above, the EPA's review recapitulated the research that formed the basis of existing authorization of the plant growth retardant CCC. This research was made by the manufacturer BASF back in 1968, who as importer to the Danish market was obliged to supply the Danish authorities with information concerning the product.

The EPA concluded that neither those investigations, nor "a special study" of the effect of CCC on the sperm quality and quantity among boars showed any toxicity to reproduction. Further, it was noted that CCC was planned to be reassessed in 1992, implicitly meaning that this would give an opportunity to strengthen the regulation of the substance if necessary. The EPA review ends with the following remark:

> "As regarding the most used CCC-preparations these are outside the classification for health dangers, because the toxicological data has shown neither acute nor chronic effects. CCC is hardly absorbed through the skin and toxicity by inhalation is very low. Therefore, only the lowest level of protection equipment required by The Danish Working Environment Service when working with pesticides is prescribed. The new examinations do not give grounds for the modification of these requirements." (Dybkjær, 1989)

The meaning is clear, it is the EPA's opinion that the original authorization was given on grounds of fact, and that the new research results would not change that position.

A very specific word is used throughout the answer to stress the difference between the feeding experiments and the experiments behind the authorization. This word is

"regelret" meaning "regular" or "according to the rules". The methodology behind the crop growing is described as "regelret", meaning that only insignificant amounts of spray should remain in the grain used for the feeding experiments. Also, the experiments behind the original authorization are described as "regelret", and likewise were the additional "special experiments" on boars described as "regelret" (Dybkjær, 1989: 3).

In contrast, the feeding experiments are described as not being "regelret", and because of this the Minster's addition to the review included that she had taken steps to have the researchers' experiments repeated in a "regelret" way:

> "[…] I have approached the Minster for Agriculture concerning a replication of the investigation according to the rules, and with involvement of the necessary analysis. Further, I have approached the Minister of Health to secure that the health aspects will be examined thoroughly in future research." (Dybkjær, 1989: 3).

However, the research would not be repeated. Preliminary moves were taken in the coming course of the case, but for a number of reasons this track was eventually abandoned.

This reply created the link for the continued public interest in the repeated research process. However, before continuing with these, we will take a look at the meeting of the Pesticide Council. Most of the directly interested parties participated in this forum, and the minutes from the meeting gave voice to both the questioning parties, the Consumer Council, and to the defending parties, namely the head of department in the pesticide office, the crop growing agricultural interests, the pesticide-producing industry, and some of the advising authorities.

The Consumer Council's position was identical with the one they had adapted two years earlier. This coincided with the publication of the investigations from Foulum, and on this basis the council moved to have the issue debated.

The standpoint of the head of department was obviously in line with the recommendation made to the Environmental Minister. It was the agency's opinion that the conclusions made by the Foulum researchers were too rigid, and that the available facts did not give any foundation to claims that CCC had any toxicity towards reproduction in living organisms.

The only support to be found came from the representative nominated by the green NGO's, who asked whether it was possible to require further research from the importing companies. The head of department confirmed that the legislation did give this option if grounds for concern for the existence of a risk had been established. But he maintained that such suspicion did not exist; on the contrary three independent experiments had shown no such effects, and the Foulum experiments could only be used as the basis for new experiments, designed to identify toxicological effects.

Most of the participants disassociated themselves and the institutions they represented from the feeding experiments. The manager from the pesticide-producing industry was especially harsh in his response and the minutes of the meeting recount:

> "[The manager] articulated satisfaction with the [the head of department's] pronouncement, because he found it unacceptable that a state institution can accomplish such investigations without following internationally accepted guidelines. The branch (the Agrochemical Association) had been shocked by the fact that experiments could be carried out in this way and then be published. He found that the Ministry of Agriculture should be informed that it was unacceptable that a state institution followed such a line, and pointed out the danger associated with decisions taken on the wrong basis." (Miljøstyrelsen, 1989: 13)

Also the chief adviser on plant production found the investigations to be 'very bad', and a representative from another advising state institution on plant protection could inform that the case had been discussed, and that it was taken as a lesson that one had to step carefully and that one should be careful to discuss the problems already at the stage of experimental design. Finally, the representative from the National Food Agency said that his agency had over a three year period performed examinations of residue concentrations of straw shortening agents.

The closure around the use of CCC as a safe plant growth retardant was maintained, and the institutions had demarcated themselves from the research, which came to be perceived as problematic. The issue of residue concentrations did, as in the Ministers answer to the environment and planning committee, remain the only opening offered for further discussions. The concentration of pesticide residues was thereby maintained as the obligatory point of passage, which in this case seems to have been quite convenient as the necessary methodologies for making this assessment had not yet been developed.

Again, just as it happened two years earlier, the representative from the Consumer Council had to accept the rejection that "the scientific documentation is not adequate", and await the new investigations from Foulum, which could possibly give more acceptable evidence.

Back in the public debate the Minister's answer was received as an outright rejection of the assumed negative effects of CCC; with relief among farmers, and with anger among environmentalists.

In October 1989 the Danish Agricultural Advisory Centre published a "plant-growing communiqué" (Kristensen & Elbek-Pedersen, 1989) that, with weight on the EPA's review resumed the answer the Minister had given. The communications are a normal mode of spreading information to farmers and this one did not differ in this sense, but it seems to have been important for the authors to reassure the plant growing farmers that the use of CCC was safe. The same type of information but with a twist of malice can be found in the agricultural media under the heading:

> "The Environmental Protection Agency acquits straw shortening agents – reprimand to the National Institute for Animal Science" (Effektivt Landbrug, nr.18, 16. October 1989: Miljøstyrelsen frikender stråforkortningsmidlerne).

The message under the headline was the same as the plant-growing communiqué; it refers to the Ministers answer, and does not substantiate the reprimand-assertion. One of the researchers replied in the following issue:

> "Nobody has received 'reprimands' from the Minister" (Effektivt Landbrug, nr.19, 30. October 1989: Ingen har modtaget »næser« fra ministeren).

He explained that the experiment was not designed to evaluate toxicological properties of the substance, but "to study its influence on the productivity properties of pigs alone which were offered respectively untreated and CCC-treated wheat". He further explained that the experiments revealed significantly increased reproduction problems among the sows offered CCC-treated wheat. To stress the validity of the conclusions he referred to a specific scientific statement that stood up to the criticism from the EPA:

> "The statistical test was carried out according to the rules [regelret] as a $(CHI)^2$-test. The Environmental Protection Agency's claim that the registered difference between treated and non-treated wheat is not statistically certain demands therefore an explanation, with collaborating documentation." (Effektivt Landbrug, nr.19, 30. oktober 1989: Ingen har modtaget »næser« fra ministeren).

Following this the researcher pointed out that the Minister in her reply to the Environment and Planning Committee had stated that the feeding experiments indicated that follow-up experiments should be started and designed to clarify risks for human health, occupational health or the environment in general. For the researcher the difference between the two types of experiments was important:

> "[…] the experiments carried out at the National Institute for Animal Science did not aim to create certainty about CCC's influence on human health, occupational health or the environment in general. The background for the experiments was observations from praxis, where people had the interpretation that CCC-treated crops could influence production in a negative direction. The experiment was therefore clearly designed to study the production properties of pigs offered wheat sprayed with CCC in the growing season in accordance with normal guidelines.
>
> Therefore, one cannot expect an experiment as that accomplished to give answers to general questions about health and environmental-aspects associated with the use of CCC. These problems must be examined in another context, where the necessary expertise and facilities are present.
>
> Although it should be expected that this type of investigation, at least to some extent, has already been carried through before the substance was authorised. However, in the case of how CCC-treated crops influence livestock-production, there exists, to my knowledge, no such previous experiments." (Effektivt Landbrug, nr.19, 30. October 1989: Ingen har modtaget »næser« fra ministeren).

The researcher obviously sought to maintain the boundary between the approval of the substance, and the evaluation of the influence of the substance on pig production. This differentiation was one of the very important foundations that in the beginning made the research legitimate and possible. This raises the issue of locality versus universality; the researcher claims validity in a 'local' and specific context and the toxicologists seek universal validity that establishes the foundation for global trade. The problem arises when these two types of knowledge coexist and give opposing signals, and thereby tempts agents to attempt to make the local knowledge universal.

In addition, the Danish Agrochemical Society expressed relief in the society's newsletter (Sprøjten, oktober 1989). They denote the case as one of the summer's

great "sea monsters", and stress the minister's consent with rejection of the problem made by the EPA and the toxicologist of the NFA and Institute for Toxicology.

Among environmentalists, the decision was received with dissatisfaction, but the dissatisfaction did not match the great relief among the professional users. Seemingly, the case did not fit into the predominant types of environmental cases that had the attention of pro-environmentalists. The most pronounced debate followed two investigative articles in November 21st in the newspaper Information. The one article reviewed the contrast between the fact that pig-breeders as a consequence of the new knowledge in future would avoid the use of CCC-treated fodder, and the authorities' rejection of any problems to human health, and the second treated the history of the authorisation of CCC in Denmark. The former article adopted an especially critical angle on the course of the case, and brought central quotes from animal producing agricultural organisations about their recommendations to farmers, and why they sustained the recommendations after the environment ministers reply. Orla Grøn, sector chief in Danske Slagterier (the pig producer's industrial association was quoted in the newspaper article explaining the associations precautionary position:

> "We recommend that farmers reduce the use of CCC-treated fodder. We find it best to be cautious when doubts about the effects of poisonous residues exist. When we recommended the lower dose to the sows it was because of the considerable cost in reduced fertility. Therefore, we tell farmers not to go too far with CCC. Moreover, I am surprised the authorities are both able and willing to disallow the experiments." (Orla Grøn quoted in Information November 21st 1989)

The article also quoted Per Tybirk, the adviser in the Agricultural Advisory Centre involved in the case, further explaining the precautionary nature of the pig-breeders position:

> "We are in agreement with the Environmental Protection Agency when it comes to the non-decisive character of the Foulum investigations, but we do not dare ignore the results. ." (Per Tybirk quoted in Information November 21st 1989)

The article represented a nice piece of journalistic craftsmanship, but on top of this the article represented a severe criticism against the authorities' position in the case. Possibly, because of this, the Environment Minister chose to give a reply to the article, which was brought the following month, and where she repeated the arguments for sustaining the authorisation of CCC, but also balanced her position:

> "But I am also concerned that there nevertheless might be adverse effects from the use of CCC-treated grain. I have therefore approached the Minister for Health and the Minister for Agriculture and suggested that the two Ministries together with the Environmental Protection Agency organize a new research project that can demonstrate whether CCC-treated corn poses a risk. I will come to a decision on whether the use of straw shortening agents shall be prohibited when we have the answer to that investigation. Also I want to know what's in the breakfast rolls[17]." (Information December 11th)

[17] The breakfast roll is a translation of a white-bread type product that forms a core element in a highly popular and traditional type of Danish breakfast.

A group of students working with CCC in a project at Roskilde University replied to the article in the Information newspaper of the following week. They noted that the minister's position was de facto a rejection of the problem and asked what investigations and what results were needed before the minister would take action. But the Ministers reply in December had seemingly closed the discussion.

7.4 Enhanced Attention – The Conflict Intensifies

Public discussions on the subject 'plant growth retardants' began to subside after the initial interest in the subject, but resurfaced again in February of 1990. A television team had been researching the issue for a couple of months and had produced a television programme. The title of the television programme was, translated word-by-word: "Who draws the shortest straw?" In Danish the phrase "to draw the shortest straw" corresponds to the English expression 'to get the worst of it'. The title was identical to the title of the earlier article in the Information newspaper that had incited the minister's reply; also, the content and idea behind the programme was very closely linked to the article. What the programme added were first of all dramatic effects - effects that were to have such a large impact on the television media.

The core of the television drama was a presentation of evidence of damage to humans and a criticism of the traditional testing regime:

> [Voice over, pictures of pigs:] "The pig is the animal that most closely resembles humans in its biological form. Its digestive and abdominal systems function in pretty much the same way as their human equivalents. We [humans] can't tolerate what they [pigs] can't!"
>
> [Cut to statement from Sven Juul a doctor from the Institute for Social Medicine:] "There are many people who suffer from infertility, and its frequency may possibly be rising, but as yet there has not been any significant research into the problem. There is however, some research that indicates that the quality of men's semen has decreased over the last 30 to 40 years. And although this research is not considered reliable, the research results do indicate a problem with men's sperm quality and so the question is what may be causing this?" (Dreyer, 1990)

The interviewer then asked the doctor if CCC could have anything to do with human infertility to which the doctor replied:

> "Yes it could. We know of other substances contained within pesticides that are known to cause infertility, DDT for example. The action of DDT is well known [...]"?" (Dreyer, 1990)

The doctor then explained how DDT is accumulated in living organisms and biomagnified via the food chain, and is known to impair fertility within animals and that this also could be the case with other pesticides such as CCC:

> "We do not know if this is the case in humans, and there exists only one study that indicates that this could be a problem for pigs, so one has to pay attention to this research." (Dreyer, 1990)

These statements were at the best problematic, as no evidence existed for CCC having a tendency to undergo bio magnification or that it could bio accumulate, rather was the opposite indicated, plus the fact that none of these capabilities had been research-objects in the feeding experiments. However, what had been the object of the studies was the fertility of the pigs, and here the doctor had a point.

The experiments had indeed been based on a criticism against the traditional mode of testing pesticides and that criticism was inherent in the design of the feeding studies. The researchers had wished, as described above, to examine the specific effects on pigs offered fodder sprayed with the growth regulator CCC. They had paid attention to the fact that the substance had been tested and approved by the authorities, but questioned whether these tests would uncover effects as those that had been reported from the everyday use of the substance. That was the background for the experiments, which also had been discussed with both authorities and pesticide manufacturers prior to the start of the series of experiments. In the programme this rationale was turned and generalised.

A biologist was interviewed about his assessment of the available knowledge regarding possible effects in the environment. The speaker explained that the existing test guidelines focus on LD50, and on the quantity that leads to impaired fertility in animals; and that the substance is never given in the same composition and state, as when it is being used "out there in nature". In fact the biologist mainly talked about the side effects of herbicides and insecticides, and only gave a very general critique of the agent in question.

The programme concluded:

> "And this is the status of the case, with all the unanswered questions. It is striking that all the directly involved parties are in no doubt. The grain-growing farmers continue to spray, and the authorities inform us that everything is well. The pig breeders and the horse breeders are just as certain but of the contrary position. So they (sic) have backed out… But what about the rest of us? The future will show who will get the worst of it "Who will draw the shortest straw?" (Dreyer, 1990)

The programme initiated three lines of debate in the following media debate. The first two lines related to the development of an analytical method for measuring residue concentrations, and the use of CCC on fruit and grain for human food. The bread industries declined to demand non-treated grain for baking, and the National Food Agency announced that the forthcoming analytical methods for CCC would be used to analyse residues in both grain and fruit. The third line related to the experiments and was lead by a person from the agrochemical industry.

The doomsday scenario that accompanied the programme had seemingly provoked the manager of DK Petrokemi A/S; one of the companies that later that year would complain when in July 1990 the prohibition against plant growth retardants was issued. The manager produced almost identical versions of an article printed in a national newspaper (Berlingske Tidende, February 13th 1990: Misbrug med perspektiv) and a professional magazine owned by the Danish Farmers' Union (Landsbladet February of 16th 1990: Da CCC blev henrettet i TV), where he partly

criticised Radio Denmark's presentation of the case, and partly criticised the feeding experiments and the researchers.

The articles were signed with no reference to the manager's professional merit. The critique against the programme was relatively sober as it pointed to the weaknesses of the use of expert statements about possible effects towards humans and wildlife; these being the comparison between CCC and DDT, and the statements about the effects on flora and fauna. But the critique against the researchers was quite coarse and personal. I will elaborate on the criticism because that 'tune' would continue to sound throughout the case.

The manager of the CCC-producing company accused the research of being "a stitch-up" and a waste of taxpayer's money. Beyond this, he accused the National Institute for Animal Science of arranging the programme because the EPA had rejected the conclusions of the research project and in an ironic tone of voice he went on to make a caricature of the researchers:

> "For shame! One should not speak this way about, nor to, the National Institute for Animal Science. If people will not recognize the »research« [we have produced] then there must exist other ways [to make that happen]. Wonder.(to do what?) I wonder if there are some jaunty television- fellows, who are short of a »groovy« story to practise on? So that one could stir up public opinion against CCC?." (Landsbladet, February 16th 1990: Da CCC blev henrettet I TV)

The National Institute for Animal Science chose to repudiate the accusations. The researchers' superior, Henning Staun, the director of the institute, replied in a following issue of the Landsbladet magazine:

> "The CCC-experiments were carried out absolutely correctly and we did not take the initiative with the television programme." (Landsbladet, March 2nd 1990: CCC-forsøg gennemført helt korrekt)

The director explained in his reply that the institute did not address the television-team, and that the briefing about the experiments that was given to the journalists did not go beyond the communications that had been issued on July 10th 1989.

The manager replied again:

> "[…] we have a Ministry of Environment that is the decision-making authority and who decide what may be classed as hazardous or non-hazardous. I will not enter into a polemic over your CCC-experiments. I will just place it on record that the EPA is in disagreement with you and have rejected your experiments as being without scientific basis and validity." (Landsbladet March 23rd 1990: Manipulation af ikke-fagfolk)

His point of view was that if the National Institute for Animal Science did not agree with the Ministry's assessment of the experiments, then they should discuss this with the Ministry directly. He accused the National Institute for Animal Science for performing extra-parliamentary activities:

> "[…] [You] involve a population that do not have an earthly chance of seeing the manipulation behind the scenes and a population that doesn't give a damn if the TV

> addressed you or you the TV. You have under all circumstances given the TV the foundation to produce a programme, which you neither can be proud of; and you should have seen that risk. I doubt this approach appears from SH's [the National Institute for Animal Science] objects clause […]" (Landsbladet March 23rd 1990: Manipulation af ikke-fagfolk)

The Director, in his reply to this statement explained that the activities of the National Institute for Animal Science were in line with the institute's objects clause and that he found it very reasonable that the institute's research results were available to all including the television programme makers. Further, he explained and documented that the EPA did not reject the experiments on their scientific merits:

> "I shall add, for your information, that the EPA recently approached a statistical expert at the Royal Veterinary and Agricultural University, who analysed and assessed the results of the experiment. The conclusion forwarded to the EPA read as follows: - Assume that there is no effect from the addition of CCC to the fodder. And assuming that the experiments are correctly carried out (and I see no reason to question this) then the chance of achieving a result with such a marked tendency as that observed, then the accumulated effect of the three variables mentioned (heat, the need for re-covering, pregnancy) is about 1 to 2 pct." (Landsbladet April 6th 1990: Statistik og formålsparagraffer)

At this point the discussions over the television programme stopped, and the next round of media attention targeted at the problem was awaiting the publication of the results of the second series of experiments with Cerone and Roundup.

7.5 Second Round – The Precautionary Principle Enters the Agenda

In June 1990 the results of the experiments with the second straw shortening agent Cerone, and the Herbicide Roundup were published. This time public attention was limited to debate in professional journals such as "Svineproducenten" (The Pork Producer), and the pig section of Landsbladet. The frontlines were unchanged. The conclusions were in line with the conclusions drawn from the former experiments. The Danish Agrochemical Association criticized the conclusions as going too far. Per Kristensen, Manager for the association stated:

> "We find that the design of the experiments do not warrant the certainty arrived at by the conclusions. The experiments are feeding experiments, but when one wants to speak about mortality and toxicity it demands a regular toxicological investigation according to current laboratory methodologies." (Landsbladet June 22nd 1990)

The critique was moderate compared to what had earlier been issued from the DK Petrokemi Manager, and Per Kristensen stressed that it was not targeted at the National Institute for Animal Science but at the experiment's design together with the conclusions. The conductor of the experiments was interviewed in the same article. He was not surprised by the criticisms and repeated that the objective was not to perform a toxicological study, but to investigate the effects of the agents in doses determined by normal agricultural practice.

The conductor of the experiments, Viggo Danielsen published a short article in the journal Svineproducenten, also in June 1990 (mid June). Here he gave an account of the latest experiments. There were both positive and negative effects from the two pesticides tested. The positive effects were improved feed assimilation and growth among young pigs, and the negative effects were reduced offspring and reduced survival potential of piglets when treated straw was also used as bedding. The article concluded:

> "While earlier it has been shown that CCC-treated wheat among other things may give occasion to reproduction problems among pigs, the recommendations for breeding animals must be that grain treated with straw shortening agents should be used with caution". (Svineproducenten No 6 medio June 1990)

A pig breeder requested in the following number of the National Association of Pig Breeders to work for a prohibition of plant growth retardants:

> "It is hard to see any other option than a prohibition, but what consequences will that have for the pig breeder? None, except from increased certainty of getting rid of reproduction problems (reproduction is the sow's productivity).I find it important for the farmer to be able to defend what we do and also to pay attention to the unsuccessful things we have done, and then to adjust our ways, even when it actually costs us money. It seems to me stupid not to do anything and to leave it to others such as environmental groups to do something about the problem. And this inevitably leads to unfavourable publicity for our products, which in turn is detrimental to our sales." (Svineproducenten No 7 mid June 1990)

The pig breeder had earlier contacted the National Association of Pig Breeders and was of the opinion that the association, in collusion with landowners, were reluctant to react. The general secretary of the association reassured the readers in the same issue of Svineproducenten that the association would suggest that feeding grain in the future should be labelled.

The battle lines were drawn with on the one hand the researchers and the National Institute for Animal Science insisting on the validity of the research, and the National Food agency and the EPA insisting on the opposite. This was stated clearly in a newsletter from the National Food Agency in April 1990:

> This is the opinion of the National Food Agency: […] the tendencies that have been observed are not statistically certain, and are very normal in common agricultural practice. Furthermore it is uncertain what amount of CCC the pigs have consumed, because there had not been an analysis of residues of CCC in the feed.

The pesticide producers used the arguments produced by the NFA and the EPA to defend the use of the plant growth retardants. The pig breeders refused to use treated straw and grain, and they did this with support from the consulting services in the Farmer's Association.

7.6 The Lightning Prohibition

The closure around the straw-shortening agents as safe seemed to hold, even though the conflict was clear. But then, the unexpected happened on July 27th 1990. The

Environment Minister Lone Dybkjær decided to prohibit the sale of all plant growth retardants containing CCC or ethephon.

No actor on the contemporary scene had expected this move, neither the environmentalists, nor the agricultural actors. Among the agricultural actors the decision was criticised as being populist and it was postulated that the prohibition was triggered by media attention. The mood is well captured in the following quote from a contemporary leading article in the agricultural newspaper Landbrugsmagasinet, which was owned by the Danish Family Farmers' Association:

> "The lightning prohibition order came […] in connection to a planned television programme about the Foulum-straw-shortener-experiments, which the television programme makers had informed the Environment Minister [Lone Dybkjær] about, as they wanted a statement from her. But the television crew had barely turned their machines on before a call from a high ranking official in the Ministry of the Environment informed them that the minister with, immediate effect, had prohibited the sale of straw shortening agents […].
>
> Finally it must be admitted that a prohibition against straw shorteners wasn't necessarily a catastrophe. It may yet prove to be a useful means for reducing the use of nitrogenous fertilizers, and in addition help in reducing the rate of production of crops than the set-aside scheme. But the prohibition should be carried out at the EC wide level to prevent Danish farmers from being at a competitive disadvantage in relation to other crop producers within the EU, just because a short cut happened with the Environment Minister when the television camera were turned on at Foulum." (Leading article in Landbrugsmagasinet August 30th 1990: Kortslutning i stråforkortningen)

But the prohibition was also received with some surprise among pro-environmental actors. This group of actors seems to have been remarkably silent throughout the development of the case. The reason for the muted response was conceivably the unexpected character of the move; the environmentalists' position is captured in an investigative article in the Information newspaper of August 17th.

The author of the newspaper article was Jørgen Steen Nielsen, who was a very competent writer on environmental issues. The article examined the controversy – some of the quotes have been reproduced elsewhere in this chapter – but the article gives us also a clue about how the case was seen among those who felt that the environment was an important issue. The main point, which we also will be able to retrieve in Dybkjær's argumentation, is the focus on the structural level. Previously, PGRs were not considered necessary because the proportions between the ear and the straw were 'sustainable'. This proportion was then dislocated due to increased use of fertilisers and plant breeding, which was compensated for by the use of PGR's:

> "The straw shortening agents are not in harmony with the contemporary ecological [organic] message. Today they are not allowed either. Like a bolt from the blue Lone Dybkjær (The Social Liberals) announced on July 27th that CCC, Cerone and close on 40 other growth regulators were prohibited with immediate effect.
>
> The prohibition will not only remove a chemical xenobiotica from Danish agriculture, but also it will bring about a reduced use of nitrogenous fertilizers, because the use of less fertilizer is one approach to reach a reasonable balance between the bearing capacity of the straw and the weight of the ear.

> The price is reduced yield and thereby a smaller earning for the farmers, but this may be the necessary price for ecological [organic] sustainability.
>
> With the prohibition Lone Dybkjær has send a clear signal to her colleague, the Agricultural Minister Laurits Tørnæs (the Liberals), about the type of change there is needed to secure the sustainability of the agricultural reform Tørnæs is to present the coming spring. […]
>
> But this is not the actual reason for Dybkjærs prohibition against the straw shorteners. It is, as any reader of the summer newspapers will know, the suspicion that the agents may be dangerous to pig's health – and humans – that has triggered the prohibition." (Journalist Jørgen Steen Nielsen, Information August 17th 1990)

Today, thirteen years later, Lone Dybkjær explains the shift from the rejection of the problem in September 1989 to the general prohibition against plant growth retardants with three factors (Dybkjær, 2003). It was not an abrupt shift, she argues, it was not her who changed her mind, but the evidence that was altered in the summer of 1990. She stresses that her reply to the Environment and Planning Committee consisted of a replication of the EPA's review, and the following short notice where she had pronounced that the issue should be investigated further. The rejection in 1989 was therefore based on the best advice available, and the prohibition was based on additional evidence and input from professional users.

The move towards the prohibition in 1990 was motivated by contact with professional users (breeders), who were worried by the possible side-effects of the straw shortening agents. The investigation tipped the scale by adding further evidence against the agents. According to her own statement her decision was therefore thought through and not sudden:

> "It was a case that we assessed continuously, and it was discussed at great length. It was not a sudden decision. It was a type of decision where you think carefully before you take it because you know that you will stir up a hornets nest."
>
> It is one of the cases where I took a decision without consulting any of our government partner's environmental spokesmen and much less their agricultural spokesmen. There was no reason to ask them – I knew what the answer would be. I knew they would say no. […] One can discuss whether this was breaking an agreement, my own party would definitely say so, but it is sometimes necessary to break an agreement if one wants to go through with a case or wants to submit a problem for debate. […] It was a hard-nosed decision- they were against everything I proposed. It was a struggle every step of the way. It was a struggle from day one when the Social Liberals entered the coalition government: The environment was definitely not a 'favourite-subject [for the remaining coalition parties]."

Lone Dybkjær refuse to concede that it was pressure from the media that made her take the decision back in 1990:

> "Media debates always play a role in connection with political decisions. Media pressure does sometimes force through decisions and there is no doubt that media attention in those days had a very strong focus on environmental matters - the environment was a high-profile subject back then. But it is not the media that takes decisions and I was not a single-issue politician; I was definitely not the media's darling (tool)!" (Dybkjær, 2003)

Interestingly the prohibition order was not supported by new expert-statements from the Ministers advisers. Dybkjær explains this the following way:

> "I used the precautionary principle, […] and, after all, the precautionary principle is about political balancing. You use the scientific certainty as an argument if scientific certainty exists. The precautionary principle says 'you do not have scientific proof that it should not be prohibited, and consequently you prohibit it.
>
> The precautionary principle gives a term to a feeling that you are careless about nature and about our descendants. It is the experiences of the past 25 years with chemicals and nuclear power that has given a word when the precautionary principle becomes a concept. It wasn't a concept before, just as sustainable development wasn't a concept before the Brundtland report was written." (Dybkjær, 2003)

In hindsight it is likely that the prohibition order had been considered, but that the renewed media attention helped push it into reality. But let us take a look at what contemporary sources such as documents and articles can tell us about what happened during the days leading up to the issuing of the prohibition order on Friday July 27th.

The following is an extract from the Ministry's press statement:

> "**The Environment Minister stops the sale of growth regulating agents – namely CCC.**
>
> The Environmental Minister has today asked the Environmental Protection Agency to stop the sale of growth regulating agents for the agricultural sector (chlormequat chloride and ethephon), which are better know under their everyday names as CCC, Cerone, and Terpal. […]
>
> Even though the available experimental evidence still must be considered as uncertain, there are now considerable doubts concerning the products that we can no longer countenance the use of CCC, Cerone, and Terpal, as well as about 40 other similar agents. I have therefore asked the Environmental Protection Agency to stop the sale and use of these agents. I have also asked the Environmental Protection Agency to perform a thorough assessment of the case, in such a way that any doubts can be clarified. In this case, it will be up to the product manufacturers to produce additional evidence addressing the concerns raised before any decision can be made on the future use of the products in Denmark, state. Environment Minister Lone Dybkjær." (Miljøministeriet, 1990)

Simultaneously, the EPA began to send out revocation orders to all companies selling agents containing the two active substances. The revocation order cited as reason for the prohibition the accumulated scientific evidence concerning the agents. Furthermore, it was stated that any possible complaints, e.g. made by the producers or retailers, would not have a delaying effect on the imposition of the prohibition order by referring to the basis of the revocation order (Miljøstyrelsen, 1990: 3).

The decision that any complaints should not have any delaying effect will in the following be referred to as the 'appeals-leads-to-non-delay' decision. This extra twist of the prohibition was carried forward by a specific logic. The core prohibition was targeted at the sale of straw shorteners. Normal practice was that when a prohibition order was issued the pesticide producer would issue a complaint concerning the validity of the order, which would then have a delaying effect on the imposition of the prohibition order itself. Therefore the practical effect of prohibition was dependent on

the 'appeals-leads-to-non-delay' decision. The CCC agents and analogues were not to be used before the first quarter of 1991, and Cerone and analogues are often used even later in the growing season. However, the planning and choice of crops is made during the fall.

The prohibition prompted reactions marked with surprise from all parties. A veritable uproar took place in the press, led by the agricultural interests.

7.7 Prompt Responses

Before we turn to what happened on the political scene, will we pay attention to a number of responses that developed in different directions. The actors who had been active in the previous events of the case made their positions clear, which did not involve any major deviations from earlier statements. What the reader perhaps should pay special attention to in the following is the central disciplinary role played by representatives from the agrochemical industry.

The National Food Agency was still of the opinion that no problem existed:

> "The results are absolutely not alarming. Both the Swedish and the German limit values for the residues of Cerone in bread grain are way higher than the levels demonstrated in the Foulum experiments." (Knud Voldum-Clausen in Berlingske Tidende August 1st 1990)

7.7.1 The Agrochemical Industry

Also the pesticide producing industry was in opposition to the prohibition. Chairman for the Agrochemical Association in Denmark Per Kristensen, Director in Monsanto was highly irritated by what he perceived as the EPA's volte-face and asked: "What shall we do with the Environmental Protection Agency now? […]" (Per Kristensen in Effektivt landbrug August 2nd 1990: Hvad skal vi nu med Miljøstyrelsen?)

He pointed to the EPA's earlier rejection of the CCC-experiments as relevant, as he found that there was no principal difference between the experiments with CCC and Cerone, and stated on this basis that the prohibition was performed 'over the heads of the EPA'. He called for uniform standards and criticized the use of the experiments on that basis as a basis for political action:

> "If Foulum and other state experimental laboratories are to participate in the procurement of documentation for the approval or banning of pesticides then they must live up to the requirements and standards that are called for in GLP (good laboratory practice) by both Danish and international experts The state experimental laboratories should abstain from participating in the serious and important work within toxicology, if they cannot do this." (Ibid)

The agrochemical industry came to intensify the criticism especially of the Foulum experiments, as we shall see shortly.

7.7.2 The Farmers

But among the agricultural interests unity rapidly began to splinter. The axis for this divide was a disagreement between the grain-growing and the pig-producing interests.

They were not in line with the otherwise dominating tendency in Danish agriculture, where the farmers had learned to stand shoulder to shoulder, not least in relation to the very intense discussions concerning the effect of fertilizers on the aquatic environment.

At the outset the grain-growing farmers were in solidarity with the pig-producers, even though they were also very critical of the prohibition:

> "We have a very competent Chemicals Inspectorate in Denmark, and no clues have been found showing that the agents do inhibit the fertility of pigs that eat the treated grain. We are therefore very surprised by the sudden prohibition. It should have been investigated closer, and we feel that we should have been consulted prior to the prohibition. […]
>
> We stand shoulder to shoulder with our farmer-colleagues in animal production. And if there are signs that the use of plant growth retardants inhibits the fertility of pigs, then it is our opinion that their use must be stopped. But there exists no foundation to say so." (Vice-president Poul Siegumfeldt from the Association of Grain-producers in Berlingske Tidende July 27th 1990)

The Chairman of the National Danish Committee of Plant Grower's Niels Th. Ilsøe found that the prohibition was morally ambivalent as long as it is possible to import grain from treated crops. And the Chief Adviser for plant growing, Kaj Skriver, assessed that it would become very troublesome to continue growing rye, and also wheat of bread making quality.

Vice-president of the National Federation of Large Farmers Union Anders Lassen commented that if the prohibition was legitimate, then it was without practical meaning, if it was not accompanied with prohibitions in the countries that export grain to Denmark. Otherwise the prohibition would only function as a very unfair reduction of Danish farmers' competitive power. (Kristeligt Dagblad July 30th 1990)

But statements from pig-producers were much more direct. The pig breeders were in line with the prohibition. This was of course consistent with their earlier position in the case, but it also represented a rupture with earlier practice, where the different branches of agriculture – at least seen from the outside – would stand 'shoulder to shoulder', not least when the issue was environmental regulation. One has though to be aware that the issue among pig breeders was not seen primarily as an environmental issue but rather as discussion of optimizing production. The statements came promptly from the Danish Pig Breeders that represents the largest Danish pig producers:

> "When we cannot have a declaration clarifying whether forage grain is treated with plant growth retardants or not then the pig-producers must welcome Lone Dybkjær's prohibition against these agents. The experiments carried out at the National Institute for Animal Science suggests that the plant growth retardants have a negative effect on pig reproduction, even though the experiments are not too extensive." (President for Danish Pig breeders, Erik Jantzen in Berlingske Tidende July 27th 1990)

But such a lack of solidarity was not accepted, so when the chairman of The Federation of Danish Pig Producers and Slaughterhouses (Danske Slagterier) Bent Sloth was cited in Politiken for welcoming the prohibition he was asked to see reason

by the chief of public relations from the Danish Agrochemical Association, Torsten Buhl:

> "[…] If it is true that Bent Sloth has made the statements reproduced in Politiken and Landsbladet, then he must have taken a wrong turning. But, as mentioned above, I doubt that Bent Sloth has said any such thing. He is usually such a reasonable man who will know absolutely that the slaughterhouses as well as the remaining agricultural interests have a vital interest in ensuring that environment and agricultural policy is based on reasoned and objective arguments." (Torsten Buhl in Landbrugsmagasinet August 9th 1990: Misforståelser af Bent Sloth om stråforkortning)

The 'offensive' quotes had been published in Politiken and Landbrugsmagasinet:

> "It creates mistrust for the politicians when the prohibition comes this late. The straw shortening agents have been in use for years, and it is most unfortunate that the authorities have not investigated such agents before they were marketed […]" (Bent Sloth in Landbrugsmagasinet August 9th 1990: Ministeren har været alt for længe om at gribe ind)

The position was in line with the statements the researchers had presented that same spring - although the substance was approved by normal toxicological tests they had not undergone a more realistic test, such as the feeding experiments.

Bent Sloth clarified his position in the same issue that brought the contribution from the chief of public relations from the Danish Agrochemical Association. On the one hand he criticised the abrupt character of the prohibition, but on the other hand he maintained the critique:

> "I have earlier raised the problem of straw shortening agents' effect on pig fertility in the Agricultural Joint Council on Research and Experiments, but was informed that no justification of a prohibition existed. There have now been conducted new experiments. These results ought to be discussed in the Research Council for Agriculture before any political decision is made? There is plenty of time before April next year.
>
> No one in agriculture, neither grain-growing farmers nor pig producers, wants to use straw shortening agents that may influence animal fertility. We have used these agents in good faith based on the expert advice of the experimental laboratories that perform tests and give approvals.
>
> The Environmental Minister's prohibition, at a totally unnecessary moment, is a blow to our faith in the politicians and their officials" (Bent Sloth in Landbrugsmagasinet August 9th 1990: Lone Dybkjær for hurtig med sit forbud).

In the end the two branches of agriculture did make up. The chairman of the National Committee for Pig Production and the chairman of the National Committee for Plant Growing were in mutual agreement that the prohibition represented a far too strong and unwarranted interpretation of the experiments. Almost all pig producers are also plant growers and intensive use of manure increasees the need for straw shortening. They were interviewed together in the main Danish agricultural magazine, Landsbladet:

> "Bent Sloth has forgotten to think. The doubt shall of course come to the benefit of the pig producers. But I find that we have done that with our recommendation of a maximum

of 30 percent treated grain in the feed for breeding pigs" (Erik Skovgaard Kristensen, chairman of the National Committee for Pig Production in Landsbladet August 1990: Beklager forbud mod stråforkorter)

7.7.3 The Agricultural Researchers

The third strand of debates, which the agrochemical industry engaged in, was targeted at the Foulum researchers who had produced the evidence that eventually lead to the prohibition.

The prohibition came in fact also as a surprise to the researchers. The following quote shows this but also gives us an insight into the researchers' basic opinions about the solidity of the experiments, which probably may be part of the explanation as to the eagerness with which the agrochemical industry put in to the discussion against the experiments, the researchers, and their research institution.

> "One feels a little 'knocked about' in a debate like this one, and I am surprised that Lone Dybkjær made such a substantial decision. I am of the opinion that our results in the long term should give rise to a phase out of straw shortening agents. But it is debateable whether the prohibition should be that hasty. Perhaps it should have come into force over a two-year period [?]. […]
>
> One could easily get the suspicion that human fertility may be influenced by drawing an analogy from pigs to humans because both rye and wheat for bread grain is sprayed with the straw shortening agents. But it is not possible to conclude anything such as this from our experiments, and I do not know how one should manage investigating it."(Viggo Danielsen in Viborg Stiftstidende July 31st 1990, p9: Forsker overrasket over sprøjte-forbud)

Soon, the criticism against the experiments started to rise. It was the director of Rôhne-Poulenc, who later would participate in a television feature along with the minister and a number of other involved actors, who took the lead as the most active critics. The main point of the criticism was that the experiments were not in line with OECD guidelines for toxicological experiments, and the conclusion that the use of Cerone treated crops led to a decreased number of offspring was based on results from only nine sows, and that the active substance in Cerone, ethephon, was proved to have had no effects on the reproductive capability of rats, and that residues could not be detected in the grain.

The criticism gained support in statements and reports from Christian Friis KVL and Professor D.E. Noakes of the University of London, both experts in their fields, who had made reports at Rhöne-Poulenc's request:

> "Rhône-Poulenc Agro Norden's conclusion on the experiments is [in conformity with Professor Noakes'] that the experiments are so defective that *any conclusion about the effect of the investigated agents is impossible.*
>
> One must be able to request that the same strict requirements that exist for the documentation for approval of a pesticide also must apply if a substance is desired prohibited. That has not been the case in this instance." (Jan Stranges in Effektivt Landbrug August 6th 1990: Forbudet er basere på resultater fra kun 9 søer)

A leading article from the agricultural magazine, Landbrugsmagasinet, commented that:

> "The experimenter and his chiefs should have paid more attention to the fact that they were moving in a political and dangerous landscape, as already last year they were in the foreground with a couple of reports […]" (Leading Article in Landbrugsmagasinet August 9th 1990: Forbud på spinkelt grundlag)

The Association of Scientific Workers at the National Institute for Animal Science responded by stressing the right to, and importance of, free research and the freedom of speech (John E. Hermansen in Landbrugsmagasinet August 23rd 1990: Research results should not be straw shortened)

Also, the Director of the National Institute for Animal Science found it necessary to respond to the criticism. He was concerned that the institution's credibility in some instances had been questioned, and stressed that research was impartial and focused at providing solid advice to Danish farmers:

> "That results are published, which are found inconvenient in some circles, ought not to lead the agricultural press to cast doubt on the research institutions work. Nor would it serve the agricultural interest if research results were to be assessed on the basis of their usefulness as arguments in the political debate." (A. Hjortshøj Nielsen in Landbrugsmagasinet August 30th 1990)

Dansk Landbrug asked the researcher to respond to the criticism directed against the experiments. In an article on August 27th 1990 he pointed the researcher to the main critisism that came from the company selling Cerone, that in fact had participated in the planning and financing of the experiments, and he referred to the background for the experiments as he had done almost one year before when the debates had cantered around the CCC-experiments (see also p94). He responded explicitly to the criticism of the experiments as not complying with the OECD test guidelines, and the criticism against the number of animals in the experiment. Again the reply was a repetition of earlier replies. The OECD test guide-lines had not been followed because they apply to experiments with laboratory animals and because the experiments:-

> "[…] should have a tight connection to practice, were they carried through as feeding experiments according to established methodologies." (Viggo Danielsen in Dansk Landbrug August 27th 1990: Korte strå, færre grise).

Regarding the number of animals, the researcher stated that the two experiments in total had comprised 95 sows with 267 farrows, and that the conclusion regarding Cerone was based on results from 47 sows that brought forth 177 farrows with 1949 piglets.

The debate continued until the middle of September involving titles such as "Rigging experiments on short straws and pig-breeding" (Jan Stranges), "Criticism against Cerone-experiments is out of proportion" (Viggo Danielsen), and "How nine sows became 95" (Jan Stranges).

The debate continued to revolve around the same issues. Were the experiments valid with or without compliance to the OECD test guidelines? Were the experiments twisted or not? Further to this did the researchers' ask why the manager hadn't used his opportunity as a member of the steering group to comment or oppose the experiments before the report was published, and he stressed, that the criticisms ought

to differ between the experiments and the prohibition. The end of the debate coincided with the Environmental Appeals Board's decision that the complaints should have a delaying effect, meaning that the preparations could be freely sold again. We will return to this shortly.

7.8 Promoted Motive and Motivations for the Prohibition

The fierce reactions from the agricultural sector may be better understood if we turn to the EPA's and the Minister's argument for a contextualisation of the prohibition. The Deputy Director-General of the EPA stated in the middle of August that an important aspect in the valuation of the Foulum research was the fact that the research was performed by a research institution belonging to the Ministry of Agriculture:

> "No matter what one might think of the experiments, the Ministry of Agriculture's experts at Foulum are not just anybody. We cannot just ignore it when they, for the second time, present the conclusion that straw shortening agents influence pig, reproduction. We – as the Environmental Protection Agency – are the responsible authority in relation to public health.
>
> I do not know whether the results hold true when other and more profound studies have been made, but the precautionary principle prompts us to intervene."
>
> [Interviewer:] – *But the experiments must have some creditability in your opinion. Surely you don't intervene with a prohibition on the basis of anything?*
>
> "The experts of the Ministry for Agriculture have invested their good reputation in these results. If we choose to ignore them, we probably would be open to even more severe criticism. I find that we acted prudently by intervening, at least until we get more knowledge." (EPA Deputy Director-General Hans Henrik Christensen in Information August 17th 1990)

The Minister argued furthermore that the prohibition should be seen as a minor part of a larger necessary change of Danish agriculture if it is to become sustainable.

Dybkjær argued that the costs of a prohibition will be more than outweighed by saved expenses among pig breeders due to reduced fertility and also saved expenses from the purchase of fertilizers. She argued for a structural re-organisation of Danish agriculture:

> "[…]
>
> We shall in the coming years readjust and secure Danish agriculture, which is sustainable both in terms of economy, environment, and health. We shall clean up that jumble of subsidy schemes, which among other things make up the European Common Agricultural Policy. The Aim is an economically independent agriculture, which shall be secured by, among other things, a price and market policy that incorporates environmental considerations as a central element. We have to acknowledge that we can only secure sustainability if reasonable doubts about substances and methods of production are made in favour of the environment and the health of the nation.
>
> There is in fact, international agreement that we shall use such a precautionary principle. We must therefore prepare our selves for future cases a la the case about straw shortening agents, concurrently with our knowledge being enlarged.

> […] this development has started internationally, according to the National Bureau for the Cultivation of Plants. Straw-stiff winter wheat is marketed in the United Kingdom and in France, but is perhaps not yet suitable for the Danish winter. We can probably have variants of straw-stiff winter rye on the market in three to four years. I wonder if the possibilities for Danish agriculture wait around the corner. It is also in this perspective that we have to see the straw-shortener case.
>
> […] The customers for the agricultural products in industry and consumers are co-determining how Danish agriculture should develop. The customers of the agricultural products in industry and consumers should, from now on, set up claims to the agricultural methods of production and the quality of the products.
>
> But not least the farmers themselves have a fundamental interest in developing agriculture in a sustainable direction.
>
> The intensive, heavily specialised and industrialised agricultural sector results in, and this can be demonstrated, a number of 'sustainability-problems', and there is a need to halt these problems and then correct them. This is a possibility because Denmark has the natural foundations for agricultural production that are effective, profitable, and safe for health and the environment.
>
> Danish agriculture has been able to re-organize before. This can happen again, and this must happen again. Much is at stake so we must not let things slide."(Environmental Minister Lone Dybkjær in Politiken August 14th 1990: "Debat: Landbrug må forædle sig til miljø...")

In the quote the Minister combined ecological modernisation type of arguments with the prohibition, and she thereby attempted to question one of the criticism's strong arguments, namely the cost of not using the straw-shorteners. But she did also extent the case's scope to include a structural level which, anything equal, would trouble the Liberals and the Conservatives in the coalition government.

7.9 Crisis in the Government

Let us return to the political processes that followed the prohibition. We will now step two weeks back in time.

The decision started a crisis in the government. The Ministry of the Environment had only cursorily informed the Ministry of Agriculture about the coming prohibition. The agricultural spokesmen of the two other parties in the coalition government, the Liberals and the Conservatives, were furious. The two spokesmen were, as active landowners and farmers, personally affected by the prohibition, and they found that the prohibition represented a break with the governmental alliance between the Liberals and the Conservatives on the one side, and the Social Liberals on the other side:

> "»The Minister for Environment simply cannot take such a, for the agricultural sector, crucial decision without first consulting the other parties in the government. And we will under no circumstances take part in a prohibition,« says Bernt Johan Collet. The Ministers solitary approach »does not follow the rule of the game in this government, where it is customary to converse,« he adds." (Agricultural spokesman Bernt Johan Collet, the Conservatives, quoted in Berlingske Tidende July 28th 1990)

Also, the Liberals took the prohibition very seriously:

> "The agricultural spokesman of the Liberals, Peder Sønderby, will take the prohibition up with Lone Dybkjær at a spokesmen-meeting on August 9th. I am surprised that the prohibition was issued, and that she did not discuss it with us first. Peder Sønderby is a farmer and has 12 hectares growing rye. He states that without straw shortening agents the grain crop would now be lying across the fields. They [the straw shortening agents] lead to a larger yield. But it is true that there exists a fear of side effects from these agents. And the pig breeders have drawn it to our attention that we must be cautious about what we use. But it would be a catastrophe for agriculture if we had to do without the growth regulators, stated Peder Sønderby." (Agricultural spokesman Peder Sønderby, the Liberals, in Ritzau, July 28th 1990)

On Sunday, the second day after the prohibition was issued the permanent secretary of the Ministry of the Environment, Leo Bjørnskov, asserted that the Ministry of Agriculture had been informed about the coming prohibition:

> "We informed the Ministry of Agriculture on Friday that we, on the basis of the report, considered intervening. If the Ministry of Agriculture had had serous problems with this, it would have been discussed more profoundly, but that did not happen." (Politiken July 29th 1990 section 1, p8)

The Minister of Agriculture was on holiday, and refrained from giving any comments until one and a half months later in mid September. The case seems to have been politically very sensitive, as we shall see shortly. The minister explained his silence with the necessity for the mutual respect between the ministers regarding their respective spheres of competence (see e.g. Danmarks Erhversradio September 14th 1990 0730, transcript from Presseklip).

The Ministry of Agriculture selected a cautious strategy, and shortly after the emergence of the debate, in mid august, the ministry asked the Royal Veterinary and Agricultural University of Denmark to assess the research that prompted the prohibition. The Agricultural University requested a group of scientific staff with relevant specialities – mainly professors – to perform a profound assessment of the Foulum experiment (Willeberg et al., 1991: 1). This group started to work immediately, but did so in the background and without interference from the public debate. The final report was delivered eight months later: where it came to play a role for the symbolic conclusion of the case. We will return to this later.

The divide between the agricultural interests and non-agricultural interests including the members of the core government in the two parties was emerging. A contemporary political commentary in Berlingske Tidende assessed that the conflict potentially could mean the end of the coalition government, which it warned against:

> "Conservative wishes for a tightening of refugee legislation have made the Social Liberals bristle in advance. And the Liberals' desire for reductions of public expenses and interventions against transfer payments will hardly be received with Social Liberal warmth. So far the cooperation between the Liberals, the Conservatives, and the Social Liberals has been amazingly easy. And it would be incomprehensible if an affaire about straw shortening crop sprays should shorten the government's lifetime." (Berlingske Tidende August 4th 1990: Blæsevejr).

The basis for the coalition government was a common perception of economic policy as the most important issue. When Prime Minister Poul Schlüter formed his first minority government in 1982, the main concerns were economic policy and maintaining power, and this was supported by the Social Liberals (Andersen, 1997: 265).

This attitude was a moderator on the agricultural interests, who otherwise lined up for a major clash with a very harsh criticism of the Environment Minister and her prohibition:

> "The Minister's attitude does not create a durable basis for future cooperation, said Bernt Johan Collet. He will not comment on whether the Conservatives will demand Lone Dybkjær's removal as Minister of the Environment, but does state that: This mode of cooperation, where the minister from one party takes decisions without negotiating with the remaining government parties, cannot continue in the long run." (Bernt Johan Collet in Berlingske Tidende August 4th 1990)

7.10 The "Precautionary Principle" Enters the Agenda

Minster for the Environment Lone Dybkjær maintained her position at the meeting; the prohibition would be maintained until the agents were proved safe:

> "We have reached a new époque for environmental policy where it is a necessity to let reasonable doubt favour the environment […] Doubt has been created around the agents by means of the experiments from Foulum. This doubt shall benefit human beings, but certainty has not been created. And we must produce that certainty. The future of the substances on the market can be decided when we can present the renewed investigations." (Minister for the Environment Lone Dybkjær in Berlingske Tidende August 10th 1990: Lone Dybkjær står fast på forbud mod vækst-middel)

Further she maintained that the prohibition was not in conflict with EC law as the prohibition was directed towards sale and not towards use of the agents in question (Ibid). The day for the spokesmen's meeting saw the conservative/liberal newspaper Berlingske Tidende announce that the prohibition was in disagreement with EU-law (Berlingske Tidende August 9th 1990: Advokater: Forbud mod vækstmiddel i strid med EF-regler)

In Radio Denmark's six o'clock News the Environment Minister amplified her position and rejected the Liberal's and the Conservative's agricultural spokesman:

> "I told the spokesman [of the Liberals and the Conservatives] that I would maintain the prohibition against the sale of straw shortening agents, and I do so because I find there is so much doubt in this case, and that it therefore is correct to let the precautionary principle apply, that is, there should not be anything on the market that we are not sure is safe."
>
> Interviewer:" But you could with ease just have talked with the agricultural sector, as, at least, the pig producers seemingly supported you?"
>
> "Well I could have talked with the agricultural sector, but I would also have known the answer. I could anticipate the reactions that I would've received, you know, the grain-

producers disagree, and the pig-producers agree, and then it must be my decision, of course."

Interviewer: "Now, there are only signs of the straw shortening agents being harmful to pigs, and the pig producers themselves have worked out to how reduce the use of the agents, because they don't want these agents getting into their animals. Couldn't you just accept that business has managed the problem this way?"

"No, because pigs, so to speak, are closer to humans, and so it could be argued that what happens with pigs could also happen with humans. Except that I subsequently have received some results from the National Institute for Animal Science, who has performed experiments on other areas with these straw shortening agents. They have tested [treated] feed on young bulls, and they have tested it on mink, and in both instances there is what is called physiological change in the animals. That is to say, changes take place in the animals." (DR's Radioavisen August 9th 1990, transcript from Presseklip, 90.08.10)

The spokesmen for the Liberals and the Conservatives became even more furious. The public could after the meeting read in Berlingske Tidende that the two spokesmen seemingly were ready to let the crisis end the life of the coalition government, but also that Dybkjær kept a stiff upper lip:

"And Collet will request that Lone Dybkjær's decision is taken up at the government's top-level – the Coordination Committee – in order to order the Minister to revoke the prohibition. »Now, Collet does not have a seat in the government and it must be up to the prime minister to decide whether this is an issue for the Coordination Committee, « replied the Minister for Environment Lone Dybkjær." (Berlingske Tidende August 10th 1990: Lone Dybkjær står fast på forbud mod vækst-middel)

Even though both the Liberals and the Conservatives requested the case be treated in the Coordination Committee, this did not happen. At a meeting between the chairs of the government parties and Prime Minister Poul Schlüter (the Conservatives) on August 17th, instead it was decided to await the negotiations and investigations at EC level, and the outcome of the case at the Environmental Appeals Board (Politiken August 18th 1990 section 1 page 8: Stråforkorterne tabte). Dybkjær later wrote in a memo (festschrift) to Schlüter that Schlüter, on his own initiative, supported the prohibition and (in deviation from normal practice) informed her about this personally with a phone call. (Dybkjær, 1999:280)

The straw shortening agents had at this point clearly become a part of the intra-governmental power game, and Dybkjær had won the first battle. By deciding not to follow the recommendation from the Conservatives and the Liberals to discuss the issue in the coalition-government's Coordination Committee, the Prime Minister had chosen to avoid an open confrontation over the issue, and to wait and see if the case would be resolved from the outside. In fact the coalition government did have several problems with cooperation among the three partners, and of these this issue was probably a minor one (Bille, 1998: 74-85). In hindsight the crisis was managed in such a way that it disappeared as a major conflict for that coalition government.

During 1990, the internal tensions of the coalition government increased. The budget compromise for 1990 had been relying on votes from the extremist rightwing party 'the Progress Party' (Fremskridtspartiet, a Danish populist party with tax reduction as its platform). Until this, one of the Social Liberal's mottos had been: "Rather close to

the hurdle[18] than close to the Progress Party" (Bille, Nielsen, & Sauerberg, 1992: 15). The dependency of the Progress Party represented a disruption with the Social Liberal's strategy of creating compromises across the middle of the political spectre.

Since the Social Liberals had joined government with the Conservatives and the Liberals in 1988, the little middle party had been facing opinion polls that forecast ever decreasing electoral support, (Bille, Nielsen, & Sauerberg, 1992: 27). Furthermore, the party was provoked by the coalition partners' populist refugee policy, which among other things made the party request the Parliament's Ombudsman to examine the Conservative Minister of Justice, Hans Engell's, practise in a specific case (Polinfo September 26th 1990). When Foreign Minister Uffe Elleman (the Liberals) sent a corvette to the Iraq-Kuwait Gulf War, had it also been in the teeth of the Social Liberals.

Up to the Social Liberals' party conference, which took place on September 15th, the president of the party Thorkild Møller could inform the party that it had been engaged in rendering the party visible in the government, and that examples on this were Environment Minister Lone Dybkjær's preservation of the South West Jutland coastal mudflats, and prohibitions against straw shortening agents in agriculture. According to Møller this was a new policy – doubt must come to the benefit of the environment – part of the Social Liberal counter weight to the two coalition partners. (Thorkild Møller in Politiken September 14th 1990: Markante udspil før radikales landsmøde).

But even though the Environment Minister and her party had succeeded in maintaining the prohibition internally in the coalition government, she did foresee that it could be difficult to sustain the prohibition:

> "They [the chemical industry] will use all means available to knock down this decision. stated Lone Dybkjær at the Social Liberals summer convention yesterday. She stressed that Denmark as such is so small that as a market it is uninteresting for manufacturers. But she pointed out that they fear other countries may follow the Danish example and prohibit the straw shortening agents. The environment minister anticipated that it will turn out to be tough because the perspectives are so immense. She appealed to everybody to help back up the prohibition. The single citizen can do quite a lot. The point is really that the citizens comprehend this and seek to support it, stated Lone Dybkjær. (Environment Minister Lone Dybkjær in Politiken August 19th 1990: Forbud med problemer)

Dybkjær had been interviewed for a feature about the straw-shorteners on the very popular Sunday television news, which was broadcast on the evening of the same day, where she brought with her the precautionary principle as argument for the prohibition. The feature brought also statements from the main actors involved in the case:

[18] 'Hurdle' understood as the minimum percentage of the votes necessary for a party to be represented in parliament. The Social Liberals were relatively close…

The Scientist: "We observed that the litter sizes went down by about one piglet when we used barley treated with Cerone, compared with untreated barley"

The Pesticide producer: "[…] the results show nothing. […] What annoys us here is that this influences our ethical reputation and our scientific reputation, and we will therefore now demonstrate that there exist no negative effects to health from Cerone or Cerone treated crops - not to animals or to humans."

The Minister: "When there is doubt about the harmful effect to humans or the environment, then the precautionary principle must come into force, that is, we should not say yes to anything where doubt about the effects exists […] You may say that the precautionary principle is new, but we use it regularly when new substances enter the market; we are then very careful with testing. You can say that this is the first time we have acted this promptly on an existing substance."

The Farmer's Union: "It is a new approach the Environment Minister has taken up; that the prohibition is issued suddenly from one day to the next. We can normally discuss things like that if we are sure they are built on a scientific basis."

The Consumer's Council: "I really think that it is very pleasant that Lone Dybkjær acts to do something before it is too late. It is often necessary to have 'corpses', so to speak, before any legal intervention is performed."

The TV-feature and especially Environment Minister Lone Dybkjær's performance in the Sunday television news was given the following comment in Berlingske:

> "The Precautionary Principle [forsigtighedsprincippet]. Minister for the Environment Lone Dybkjær claimed yesterday in the Sunday Television News that this term covers a new principle, which shall apply when the slightest doubt about a substance's possible danger exists. She made her statement in connection to the prohibition against straw shortening agents, which have come under suspicion. The scene is laid for an armoured

> battle. For the time being, we have been given a new phrase - The Precautionary Principle. […] (Gert Smistrup in Berlingske Tidende August 20th 1990).

At this point it might be useful to take stock of the situation: the prohibition was issued, the actors had made their positions clear, and it had been announced that the case was to be tested at the European Union Commission and at the Environmental Appeals Board.

Lone Dybkjær had appealed to the public to support the decision. One of the two major Danish industrial bakeries (the Schülstad group) announced shortly after the appeal had been issued that they would seek to avoid growth-retarded rye for black bread. The head of research of the Schülstad group had stated to Radio Denmark's regional radio stations, Holstebro, Radio Midt and Vest that "the positive thing about the Environment Minister's prohibition is the process it has started in the agricultural sector".

7.11 The Confutation of the EPA Decision

A formal complaint had not yet been issued by September 19th, the day when the minister brought the precautionary principle with her on to the television news, and where the other parties had made their cases. The Danish Agrochemical Association had announced that it would issue a complaint, but the association was not directly afflicted and could therefore not complain on behalf of its members. The association arranged instead coordination meetings to secure that all importers and manufacturers submitted complaints to the Environmental Appeals Board.

7.11.1 Environmental Appeals Board

The first complaint arrived at the Environmental Appeals Board on August 23rd 1990 from DK Petrokemi and Shell Kemi A/S, shortly after the Sunday news. During the succeeding days additional complaints were forwarded from BASF Danmark A/S, Rôhne-Poulenc Agro Norden, Plantekemi Odense A/S, KVK Agro A/S, Danish Cooperative Farm Supply and the Danish Farmers' Union, and JBC Handel ApS (Miljøankenævnet, 1990: 3).

The appeals were targeted at both sales prohibition and the 'appeals-leads-to-non-delay' decision. Furthermore, it was stressed in most of the complaints that the decision regarding 'appeals-leads-to-non-delay' was taken before mid September. The following is reproduced from the front page of the written complaint submitted to the board from the lawyer representing the Danish Cooperative Farm Supply and the Danish Farmers' Union:

> "I would like to point out, to keep the record straight, that (among other things) there are claims laid as to attach the claim for delaying effect, and that request is made to the Environmental Appeals Board, out of consideration for the farmer's possibility for disposing and for the supply-situation, as to arrive at a decision regarding this issue before the middle of September." (Gaarden, 1990)

It was immensely important to have the EPA's iron grip loosened. If the alliance of plaintiffs could succeed in having the 'appeals-leads-to-non-delay' decision lifted,

then the pesticide industry could sell the products legally and the farmers buy supplies. Then it would be up to the individual farmer to decide whether to comply with a possible later prohibition.

The Board followed the plaintiff's request and focussed its work at a part decision which was made on September 17th 1990:

> "The Environmental Appeals Board revokes the Environmental Protection Agency's decision that the announced sales prohibitions shall be obeyed notwithstanding the complaints to the Board." (Miljøankenævnet, 1990: 21)

The decision regarding the actual sales prohibition was postponed until the board could receive the requested remarks regarding the complaints from the Environmental Protection Agency. The Board stressed that the part decision did not take the prohibition as such into consideration, but would only come to a decision on whether the EPA was entitled to deviate from the principal rule (§53 subsection one) that complaints should have a delaying effect. (Miljøankenævnet, 1990: 14)

The part decision was accompanied with an elaboration of the complaints and the EPA's dispositions.

The grounds for the Board's decision fall into three parts; the *juridical* aspects of the paragraphs the EPA decision pointed to, the *solidity of the evidence* behind the EPA's decision, and finally *the EPA's administrative procedures* in relation to the decision.

The EPA's decision was made with reference to the Law of Chemicals § 53 section two. This article says that the controlling authority may set aside the principal rule of right to complain (§ 53 subsection one); "[w]hen particular health reasons calls for it". This rule had been established to give 'the authorities' the possibility to immediately execute a prohibition in instances where serious health risks or environmental damage threatens." (Remarks to the bill L 162 sessional year of the Danish Parliament 1988-89)

The board assessed therefore that the EPA would only have been entitled to use it if it was the agency's assessment that the "use of the growth regulating agents involved a serious danger for health or the environment"; and that had not been the case. (Miljøankenævnet, 1990: 15). Central to the board's argumentation was that the prohibition was made with reference to § 38 subsection 1, which says that "an authorisation *can be* redrawn if new information pledges for this". But, the board stated that if the EPA had assessed that the use of the growth regulating agents involved a serious danger for health or the environment, then the appropriate section would be section 38 subsection 2, which says that "an authorisation *must be* redrawn provided the concerned substance or preparation involved serious danger for health or the environment" (italics added).

The board also criticized the EPA for not having made a supplementary assessment of the results of the Foulum experiments. The board stated that it was found problematic if isolated research results that raise doubts about e.g. health aspects of a substance or a preparation alone could lead to the use of the 'appeals-leads-to-non-delay' clause.

The board's opinion was that the consequences of such an interpretation of the law would be difficult to grasp.

The board did furthermore refer to earlier cases where the EPA had revoked authorizations for the sale and import of specific substances, which the EPA regarded as particularly dangerous for health and particularly harmful to the environment. The EPA had therefore decided that the right to the sale and import the substances would cease after one year. These decisions had not referred to the 'appeals-leads-to-non-delay' clause. The board found therefore that:

> " – also with reference to equality principles – that it is inadvisable to assume that isolated results – no-matter what the authors' conclusions – can form the basis of a decision as the one the agency has reached pursuant to the § 53 subsection 2 of the Act, for the board presented cases." (Miljøankenævnet, 1990: 19)

The board pointed also to the EPA's earlier rejection of the seriousness of the results of experiments with CCC, a judgement for which the EPA seemingly had not made its reassessment clear.

Finally, the board remarked that the specific course of events further weakens the EPA's case. According to the information available to the board, the results of the Cerone-Roundup experiments were given to the EPA as members of the steering group for the experiments in April. The EPA had approved Cerone on April 18th, EK Chlormequate 700 on June 29th, and CCCCC 460 on July 24th. And the prohibition was issued on the 27th, only three days after the last authorisation.

The board found that the parties should have had the possibility to produce a statement before the prohibition was issued. The board did agree that situations could occur where considerations for health and the environment would be so weighty that a decision must be take immediately and without hearing the other parties. The Board did however also find that:

> "the respective authorities' preparation of the administrative procedures should be implicated in the assessment of the legitimacy of such a course of actions". (Miljøankenævnet, 1990: 21)

The Environmental Appeals Board's part decision was a defeat for the Minister and the decision to ban the plant growth retardants. The EPA had been criticised not just for taking a decision on an uncertain basis; but also the main argument against the EPA's decision had been created by the EPA itself one year earlier. The course of events had shown a lack of consistency between the EPA's day-to-day work and the decision, and the latter seemed to be enough alone to reject the use of the 'appeals-leads-to-non-delay' clause. It was stressed in the decision that it did not involve or influence the assessment of the prohibition itself, but some of the elements of the assessment of the 'appeals-leads-to-non-delay' decision would most likely also have relevance for the main assessment.

It was furthermore specified that the rejection of the EPA's decision was "carried unanimously", which is an unusual wording compared to other decisions taken in the Environmental Appeals Board, signalling that a complete agreement was reached

among the board members. The specific wording, in Danish "enstemmigt", does not in fact, occur in other decisions made by the board.

The board members are nominated jointly by a number of branch organizations including the Confederation of Danish Industries and the Agricultural Council of Denmark, and jointly by the Environmental Protection Agency and the Danish Working Environment Service. The most pro-environment member of the committee was Professor Bro-Rasmussen. He recalls that he was used as an expert in the Environmental Appeals Board, and that he was generally contrary to the decision made by the Board. He remember the specific case as haute école legalism. He was called as an expert in the testing of chemicals, but recalls that the chairman of the committee had impressed on the committee that they only should assess the validity of the use of 'appeals-leads-to-non-delay' clause, and that he therefore was professionally sidetracked: "the legalistic manoeuvres did not need any professional insight, and the jurists could in fact have done this alone". If we look at the part decision this becomes very clear as it is stated:

> "The board has carefully considered whether the circumstance that an isolated experiment at a research institution or the like raises doubts about e.g. the health consequences of certain substances or preparations in its self may justify the Environmental Protection Agency […] decision that eventual complaints to the board will have no delaying effect. […] According to the opinion of the board is this not the case […]" (Miljøankenævnet, 1990: 18)

It was the opinion of the board that it would take more than one series of experiments to justify the use of the 'appeals-leads-to-non-delay' clause, no matter how well-performed the experiments were.

Bro Rasmussen's approach to the case was that the Institute for Toxicology had rejected relevant experiments:

> "I complained during the discussions in the board: [remembers] why Emil Poulsen [Manager of Institute for Toxicology] discarded experiments even though they looked sensible. And when he justifies why he should not take the results seriously he did so with reference to the experiments as not being regular laboratory experiments. […] It annoyed me very much that he on that basis actually discarded […] production experiments, (quotes part decision p9 which reproduced the statement made by the Institute for Toxicology to the Minister for Environment in November 1987): It must be remarked on in general that the accomplished experiments at the National Institute for Animal Science are production experiments, and that they as such should not be used as production of evidence for toxicological effects. Thus it corresponds that to discard epidemiological data in human-toxicology, and not just epidemiological data but actually experimental and controlled epidemiological data. It annoyed me but I was just brushed aside in the board's decision. […] We (the board) were not supposed to take decisions on the prohibition and its background, but only on the issue whether complaints should have a delaying effect." (Bro-Rasmussen, 2003)

Bro-Rasmussen stress that he was never invited to participate in the board's assessment of the prohibition. The simple explanation for that, as we shall see shortly, is that that assessment was never made.

In the Ministry of Environment the decision was received as unwelcome news:

> "Seen from an environmental angle it is an unfortunate decision. The decision shows that our law and legal details aren't at the foreground of the development. On the contrary […] the law blocks environmentally sound solutions" (Dybkjær 1990**)

7.11.2 Ministry of Justice and the Ministry of Health

The difficulties for the prohibition accumulated. The Ministry of Justice produced a note in which the sales prohibition was assessed with respect to EC law. The note was presented immediately before the environment board had decided the 'appeals-leads-to-non-delay' decision was invalid.

In the note it was stated that restraints on commerce could be introduced if it is substantiated by concern for human and animal health, or by concern for the environment, but based on the Treaties on the European Economic Community and the legal usage practiced by the Chambers of the Court of Justice the following assumption also existed:

> "a product that legally can be marketed in other EEC-countries is not dangerous to health. This assumption can be invalidated, but the burden of proof lies with the Danish Environmental Protection Agency. Hereby will there be attached great importance to the results of international scientific research just as it will be taken into consideration whether the research results, which the EPA rely on, have been produced on a scientifically sound basis." (Justitsministeriet, 1990: 5).

Important for the scientific soundness, stated the note, was the link between residue concentrations and limit values, a causality which had not been established in the Foulum experiments. The note concluded that the sales prohibition constituted a barrier to trade, which was in conflict with EU law as the prohibition was assessed as both disproportionate and arbitrary (Justitsministeriet, 1990: 7). The assessment of the decision as arbitrary was based on the fact that the prohibition was only targeted at the sale of straw shorteners and not the import of treated grain.

The simple explanation for the Ministry of Environment's emphasis is quite logical, as importation of treated grain belongs to the jurisdiction of the Ministry of Health. The Ministry of Environment had in fact requested the Ministry of Health to consider an intervention with regard to the import of grain. The Minister for Health, Ester Larsen (Liberals), replied to the Environment Minister Lone Dybkjær (Social Liberals) a few days after the Environmental Appeals Board had made its decision:

> "It is the opinion of the Ministry of Health that no problems are associated with humans eating products treated with straw shortening chemicals". (Ester Larsen 1990**)

The opinion was based on advice from the Institute for Toxicology, and as such did not deviate from earlier advice the institute had given.

The note from the Ministry of Justice concluded that the revocation of the authorizations for the importation and sale was assumed to be against the EEC treaty. The reaction in the Ministry of Environment was to attempt to demonstrate how the precautionary principle could be worked into the legislation. October, Lone Dybkjær stated that the precautionary principle could come to play a role for the approval of

new substances on the market and for the actualization of cleaner technology in industry (Lone Dybkjær in Politiken October 18th 1990: Tvivl skal komme miljøet til gode).

It seems as if the Minister at this point had waived the possibility to have the straw shorteners prohibited. It was quite obvious that her formal advisers, i.e. the Institute for Toxicology and the Environmental Protection Agency were, at best, sceptical towards the health effects of the straw shorteners, and the Environmental Appeals Board's part decision came as a trump on this discrepancy between the Minister and the experts. Furthermore ,a general election was in the offing, which attracted media attention and increased the focus on traditional 'strong issues' namely economic policy, and in general the years from 1990 to 1993 have been described as a calmer period regarding environmental issues (Andersen, 1997: 266).

When the sale of the straw shortening agents was permitted again many farmers purchased extra supplies, which in fact made total pesticide consumption explode in 1990 (Dansk Agrokemisk Forening Pesticid statistic)

7.12 New Government – Prohibition on Ice

The attention to the case now diminished. The coalition government faced problems with a totally different issue, namely economic policy; and the electoral campaign was primarily focused on this.

The election was a defeat for the Social Liberals and the party did not join the coming government. When the new government took over on December 12th it consisted of the Liberals and the Conservatives; and a new Minister of Environment was appointed. The new Minister was the Conservative Per Stig Møller, who was a newcomer when it came to environmental issues.

At this point the case was neutralised and contained, and did not warrant any specific political attention. Dybkjær, who had raised the issue, was not in office anymore, the 'appeals-leads-to-non-delay' decision had been lifted, and the afflicted parties had issued appeals. The straw shortening agents could be sold again, and there was no need for hasty decisions, and the actors who were in positions to take decisions could with ease await the investigation from the ad hoc committee at the Royal Veterinary and Agricultural University of Denmark.

All debate about the prohibition faded out, and did so in spite of the fact that the part decision in principle did not affect the prohibition itself. The compelling explanation for this is that the primary driver behind the very intense debate, which escalated up to the part decision, was driven by agricultural and especially agrochemical interests. After the part decision these parties were probably confident that the prohibition would fall, and did not need any further media attention. It was simply assessed that at this stage the battle was in practice won.

Also in the Ministry of Environment the attention to the case faded out; the latest document related to the prohibition was in fact dated January 30th 1991, which is

seven months before the prohibition was revoked on August 2nd 1991. Certainly, the issue had no longer any political attention.

7.13 The Prohibition is Finally Exorcised

The Environmental Protection Agency did, on August 2nd 1991, finally revoke the prohibition. The press statement justified both the prohibition and its withdrawal. It refers to the Foulum experiments and stresses the Institute's close connection to the Ministry of Agriculture, and the Danish Agricultural Advisory Centre's recommendation to pig-breeders as to the limiting of the use of straw shortened grain in fodder. The withdrawal was based on the assessment made by the expert group at the Royal Veterinary and Agricultural University, which the EPA interpreted this way:

> "It is not documented that sows fed on grain treated with straw shorteners produce fewer piglets than other sows."

The primary argument for the withdrawal was therefore the critical evaluation of the Foulum experiments.

The press statement further explained that the straw shorteners in question were to be reassessed in 1992. The reassessment would naturally be based on the internationally accepted OECD test guidelines that had been brought forward all along the development of the case by the toxicologists and the industry. The logical consequence was naturally that the pig-feeding experiments were contained as far as it concerned authorisation of the straw shorteners.

The EPA had received the report from the ad hoc committee in April, four months before the revocation was executed. The Division for Research in Pigs and Horses at the National Institute of Animal Science was not satisfied with the evaluation, and therefore produced a reply to the evaluation, which was directed at both the manager of the National Institute of Animal Science and the EPA. The reply was accompanied by a letter signed by the head of the Division for Research in Pigs and Horses. In the letter it was stated that the division maintained and supported the conclusion that the spraying agents could have a negative impact on some reproductive properties among swine, and warned against acquitting the spraying agents of this.

The EPA rejected the objections made by the researchers at the National Institute of Animal Science, based solely on the argumentation for the revocation of the prohibition on the evaluation (see e.g. Miljøstyrelsen, 1991).

7.13.1 The Evaluation and the Foulum Researchers' Response

But let us turn to the evaluation and the researchers' comments. The ad hoc committee consisted of six experts with specialisms in toxicology, statistics, reproduction, feeding, and epidemiology. The evaluation went through the background for and purpose of the experiments, the accomplishment of the experiments, and the reporting of the results. Finally the evaluation discussed and concluded on the solidity of the Foulum report.

Central for any evaluation is the basis of valuation. When the Ministry of Agriculture approached the Royal Veterinary and Agricultural University the object was an "interpretation and assessment of the raw material behind report no 677 from the National Institute of Animal Science". This can be interpreted as the evaluation of the experiments on the premises that are common for that type of experiment. The ad hoc group also maintained that this was the aim of their work. But the ad hoc group's report also reflected the aim of their evaluation in terms of practical politics, namely the critical remarks that had emerged with the public and political attention that came with the prohibition. (Willeberg et al., 1991: 1)

It had been one of the Foulum researchers' central points during the debate in 1990 that their research should not be evaluated as formal toxicological experiments, but as production experiments. Furthermore, it had been of the utmost importance for the researchers to stress that the experiments and the conclusions should not be evaluated on the basis of how they were used politically. The researchers did therefore point to this:

> "It is unreasonable if [the criticism in the press] is taken as a starting point for an '*interpretation and assessment of the raw material behind report'*. […] The report ought to be assessed on the tenability of its conclusions, and not on the basis of how the results are being used and covered publicly and politically. (Danielsen & Larsen, 1991: 1).

The key issue for the Foulum researchers was most likely to champion their legitimacy as scientists and experts. It was obvious that if the research was evaluated as experiments leading to regulation of a chemical substance then they would have to comply with the rather strict OECD test guidelines, which they did not do.

The evaluation seems to balance between these two poles: evaluation of a normal feeding experiment, and evaluation of an experiment that is used as basis for a prohibition. The ad hoc committee did on the one hand recognize that the experiments were "feeding experiments of a type, with which [the National Institute of Animal Science] has a wide experience of". (Willeberg et al., 1991: 5, 9)

On the other hand there are throughout the evaluation expressed criticisms that extend the scope of the evaluation from a feeding experiment to a more conclusive experiment that aimed at giving directions for regulation. It is stated that the type of experiments were criticized as not being useful for a conclusive assessment of the possible side effects of the straw shortening agents. It is also stated that the ad hoc group cannot fully accept that exposure to Cerone and Roundup treated grain and bedding influences the piglet's survival potential, because the reporting did not specify the cause of death -cause-effect- (Willeberg et al., 1991: 6). In the discussion it was suggested that the pigs had been exposed to different doses as to disclose dose-response effects, and that the report discussed explanations for the effects in the shape of biological mechanisms (Willeberg et al., 1991: 9).

The evaluation puts forward a differentiation between experiments that are hypothesis generating and experiments that are hypothesis confirming as a key point of criticism. It is stated that the report has a limited value for hypothesis confirmation, as the experimental plan did not explicitly indicate what variables would be central and how

they were to be analysed, and it is concluded that the experiments were of the hypothesis generating type. Furthermore it is stated that only hypothesis confirming experiments of a verified design-type should be used for the type of conclusions that are given in the Foulum report:

> "The observations made of a number of reproduction-parameters are useful in a hypothesis generating study, but do not live up to the requirements of investigations of reproductive toxicology. The investigations may on this basis lead to errors, therefore lacking detection of the effects of the crop sprays on the animals' fertility and reproduction. When it is concluded on page 54: "Among sows reproduction was characteristic including heat, remating and farrowing rates not significantly influenced by any of the chemicals", this may therefore be correct but it could also be incorrect, because the registration has been too inadequate and imprecise for such a general conclusion."

This point of the criticism can be boiled down to the experiments being as such acceptable, but that the character of the conclusion belonged to the established domain of testing of reproductive toxicity, and therefore was problematic. This was also rejected by the Foulum-researchers. In the reply it was stated that the experiments were not planned or carried out as reproductive toxicological experiments, and maintained that the conclusions were concrete and based on the observations made in the experiments.

This criticism is also remarkable because it is the one of the two concrete points given in the conclusion of the evaluation. The second concrete point of criticism, which can be related to the Foulum report's conclusion, was less precise. It regarded the central issue of whether the experiments could give a basis for the conclusion that the use of Cerone-treated grain would negatively influence litter size at birth. The ad hoc group found that this was not the case:

> "It is therefore questionable whether the demonstrated difference in experiment one is an effect of Cerone in the experimental group or is a coincidental high value in the control group, which can occur despite randomizing, not least because of the high number of parameters included in this hypothesis generating research." (Willeberg et al., 1991: 10)

The ad hoc committee fastened upon the relatively high number of live-born piglets in the control group in experiment one. The Foulum researchers also rejected this criticism. They pointed to the fact hat the ad hoc group erroneously referred to the figure of totally born piglets and not live-born pigs, which was lower. They maintained furthermore that the statistical analysis supported the conclusion.

In the end of the 10 page reply the Foulum researchers gave a general comment to the ad hoc committee's report. They found that the ad hoc committee lacked a basic understanding of the problem behind the experiments and that the evaluation therefore was based on a false premise:

> "In our opinion the report exceeded the given mandate, as it seems as if the assessment has been made under consideration of the political decisions and the public debate, which the report gave occasion to. This is manifested by, among other things, the fact that statistically, certain effects on litter size and survival rate, despite verifying tests and recognition, are attempted to be explained away." (Danielsen & Larsen, 1991: 10)

The criticism against the Foulum experiments did, all things considered, both raise questions on the experiments on the premise themselves, and discussions which touched upon how an experiment that should be used to assess the toxicity of a chemical should be designed. The Foulum researchers' reply did contain answers to most of the critique, answers that do sound reasonable for a non-expert.

Whether these replies were adequate to reject all the criticisms is beyond what I am able to assess, but I am perfectly sure the reply is so solid that it should have been taken into account when assessing the experiments. Furthermore, it is not the aim of the present study to judge who was right or wrong but rather to assess the types of arguments and framing used by the actors involved. This leads us to the level beyond the questions, whether the statistical models were correct and the litter sizes were normal or abnormal.

We can see that the researchers had answers ready for the criticism, and we can see that these answers did target both the detail level, and the design level. We can also see that the researchers were very much aware that the 'battle' could be lost at the design level. They had in fact attempted to safeguard themselves against every contingency, first in 1985 when both the EPA and the pesticide producers had been invited to discuss the experiments' design, and in the spring of 1990 when they had stressed in the report that the experiments should be seen as supplementary to the existing and required toxicity testing; and again in the summer of 1990 when one of the researchers, just after the prohibition was issued, expressed the opinion that he was surprised by the hastiness of the prohibition.

7.14 Epilogue to the Case

The two substances chlormequat-chloride and ethephon were routinely reassessed by the EPA in 1992 where they passed without any public attention. The assessments were based on the internationally recognized laboratory tests, which earlier had given authorisation to the substances. Ethephon, traded under the brand name Cerone, has not attained any attention since the case, but chlormequat-chloride, traded as CCC has. Chlormequat-chloride counted for about 90% of all straw shortening agents sold in Denmark.

The issue gained media attention again in 1998. Again it was a television documentary programme that initiated the debate. By and large it was the same evidence that was presented, and most of the programme was devoted to a thorough investigation of what happened during the heat of the case in 1990. The occasion was that the Danish authorities had now developed a reliable methodology to assess residues of CCC in cereals (Hjortshøj, 1998, Granby & Poulsen, 1997: 5), and that residues had been detected.

Another issue, that of hormone like substances, had emerged since 1994, which gave new life to the problem (Løkke, 1998: 62pp). A prominent Danish researcher Philippe Grandjean from the field of social medicine supported that, if the substances in question gives an effect on semen quality and if it is an enduring effect, then one should look differently at the uncertainties rather than the authorities had done so far,

and therefore be more responsive to the research results that had been produced at Foulum in 1985 to 1990 (Hjortshøj, 1998). Grandjean had also been very active in the debate endocrine disrupting substances One of the main features of that case was the oestrogen hypothesis, which implied that it could possibly be a wide range of chemical substances and pollutants that had led to decreased semen quality etc. (Sharpe & Skakkebaek, 1993, Løkke, 1998). There was a 'need' for the identification of these incognito substances, and hence the straw shorteners did, as a possible problem, fit nicely into the problematique of hormone-like substances.

Since 1991 two processes had been developed by 1998 relating to technology and the market, this probably furthered the responses that followed. As Lone Dybkjær had pointed out during the debate in 1990 straw-stiff crops were under development, and in connection to the abolishment of the prohibition in 1991 the succeeding Minister for the Environment Per Stig Møller (Conservative) supported this strategy.

The straw-shortening chemicals are also used in horticulture to regulate the growth of potted plants, and the development of alternative technologies to accomplish this had also started and are still running as a common research project between the Royal Veterinary and Agricultural University and the Danish Institute of Agricultural Sciences . The second strand of processes was a part of the bread industry that had started the production of bread baked with grain grown without straw shortening chemicals. The firm the Danish Bakeries, owned by COOP-Denmark[19], had made contracts with farmers to ensure a supply of non-treated rye for black-bread in 1997.

The debate evolved during 1998. COOP-Denmark could announce that the sale of black-bread without straw shortening chemicals increased. The issue received attention in the Parliament in the summer. Minister for the Environment Svend Auken replied to the Environment and Planning Committee that the substances had been reassessed and approved in 1995, and that the issue whether the use of the substances should be regulated had to await the results of the ongoing assessment of pesticide use in Denmark, the so called Bichel-Committee (Auken, 1998 and Bichel, 1998). Because of the intense public debate and the detection of residues, the Danish agricultural organisations in 1997 suggested a stop to the use of straw-shortening chemicals in crops for bread grain. (Ritzau November 6th 1998: Landbrug vil stoppe brug af stråforkortere and Aktuelt November 21st 1998: Landmænd dropper stråforkortere).

The voluntary agreement did seemingly mitigate the debate, and it returned to a 'normal' level. But repeated findings of residues in bread grain during the following years culminated in the summer of 2001 with a grass roots consumer organisation ordering an examination of 'OTA solgryn' which is the Quaker Oats' rolled oats brand in Denmark. The objective was to bring imported cereals into focus. As a result of this the public's attention to the issue grew again and the sale of the specific brand went down by 20% in the major Danish grocery conglomerate Dansk Supermarket A/S (Danmarks Aktive Forbrugere, 2001). Quaker Oats decided in February 2002 to use non-treated oats in the product:

[19] The Danish Bakeries was sold to Schülstad Bakeries A/S in 2000.

> "The unfortunate publicity for our product has caused heavy damage, even though we have complied with current legislation. The consumers' reaction has been very clear and we listen very carefully to that." (Mangaging director Hans Blomgren, Quaker Oats Scandinavia in Politiken February 27th 2002, 1. section, side 11: OTA bøjer sig for pres)

The media attention to straw shortening chemicals has not yet ended, and topics in 2003 was lacking compliance with voluntary agreements among farmers and resistance at the retail stage against the phasing out of treated grain.

It is very important to note that it is now generally accepted that plant growth retardants should be avoided. Almost no politician in the Danish Parliament would today stand up at the rostrum and announce that straw shortening chemicals should be used on grain produced for human consumption. When, in the beginning of 2003, it was again demonstrated that there were residues present in grain, which should have been grown without straw shortening chemicals, Politiken wrote:

> "[…] there exists a wide-ranging agreement in Denmark that the substance [Chlormequate-chloride] must be entirely removed from the food chain. The very fact that there exist common EU limit values means that Parliament cannot unanimously prohibit the substance.
>
> »I will urge the trades and industry to enter into a voluntary agreement that can phase out the use of straw shortening chemicals; it should be possible to accomplish this, « says food Minister Mariann Fischer Boel (Liberals). […]"
>
> (Politiken April 8th 2003: Det er umuligt at undgå stråforkorter)

There exists no new investigation in to the problem, so it is not due to scientific proof that this change has happened. The Danish Veterinary and Food Administration did in July 2003 prepare a note to the Parliament Committee for Food, Agriculture, and Fisheries in which they concluded that the use of chlormequat-chloride (which is the most frequently used straw shortening chemical) does not pose a risk to human health, and that the experiments that founded the criticisms against the substance, forthwith the Foulum-experiments, are not trustworthy (Fødevaredirektoratet, 2003a). The assessment was made on the same basis as the earlier assessments in 1989, which had been reassured by WHO examinations in 1995 and 1998, also based on the same types of tests.

Has the political culture developed to become more precautionary? Is the attention and acceptance of the problem due to long-term media and NGO-pressure? Is information such as quantities of residues important for the construction of public opinion? Might the changed attitude be explained by the attention to sex-disturbances due to hormone-like substances that, meanwhile, had developed? Possibly we have to see the case in combination with a 'meta' precautionary principle, which invokes at a cultural level, and which is developed through multiple processes and experiences.

7.15 Analysis

Let us start the analysis of the case by taking a step back. The reason we have looked at the specific case during the last fifty pages is that it represents the first explicit use of the precautionary principle and that the case posed a threat to existing established

practices. I will in the following perform the analysis partly with the terminology from discourse analysis, partly with terminology from the SCOT-framework.

As we shall see these are two sets of terminologies; both overlapping and complementary. Both frameworks are concerned with stability and change; the discourse framework would use these words, and within the SCOT-framework the terms would be closure and broken closure. The case shows us how stability is achieved in the perception of whether the straw-shortening agents are safe or not. Before the Foulum research results were disseminated in 1989 and 1990 the established truth was that the substances were safe. This was based on tests performed under a very specific test regime. The harsh debate in 1990 can be perceived as an attempt to force back the routine categories; hence the debate can be seen as a struggle between two different discourses, which are connected by the storylines.

Let us start by identifying storylines and discourse coalitions, and examine their development during the stages of the case. The suspicions that led the farmers, the agricultural advisers, and the researchers at Foulum to initiate the examination of the straw shorteners were formed as a storyline: *pesticides may have detrimental effects on pig production despite formal authorisation*. We will call the coalition of these actors the… '*Animal Production Discourse Coalition*'. This storyline was met by a counter storyline, which the EPA and the pesticide producing companies adhered to, and which is institutionalised especially in the more than 100 different OECD Test Guidelines (OECD, 2003): *Hazard evaluations must comply with internationally accepted test guide lines for toxicological tests to be valid*. The obvious conflict was reconciled as the agricultural discourse coalition could draw on the institutionalised practise for feeding experiments, and therefore was partly independent of the definitions and categorisations put forward by this '*Test Guideline Discourse Coalition*'.

At the early stage of the case, that is before the first research-results were published in 1989, the *Animal Production Coalition* succeeded in convincing the *Test Guideline Coalition* that the research was relevant and that it should be initiated as feeding experiments and not as regular toxicological experiments, but how did they do this ?

We can perceive the development of the case as various translations that transform the issue. The first translations are distant and muted in my case description. These are the farmers interpreting the pigs and the other animals and their production properties, and it is the agricultural consultants interpreting the clusters of local and, probably, partly tacit knowledge among the farmers.

We enter the scene; or rather we gain access to the case through written accounts when the Animal Production Coalition encounters the Test Guideline Coalition. We could say the Animal Production Coalition succeeded in creating an obligatory point of passage when they proceeded with the feeding experiments with support from the pesticide producers and the EPA.

We can see from the contemporary sources that the Foulum-researchers did not only focus on the key question - whether the pesticides were likely to cause impaired

reproduction and growth among pigs; they simultaneously worked on the social networks that surround the reduced problem. The very idea of the research was in fact created in the network of farmers, advisers, and scientists from the agricultural research sector.

During these early stages of the case there occurred a number of very important translations. In the problematization of the problem and in the determination of the set of actors and their identities the research and the feeding experiments were established as an obligatory point of passage for the question of whether the pesticides in question were problematic for pig-breeding and production. That means that *in the situation* it was acknowledged that if one wanted to gain knowledge about the uncertainty that was raised through the concern of the pig-farmers' and their consultants, *then* the suggested experiments were the only possible way to proceed. This is illustrated below.

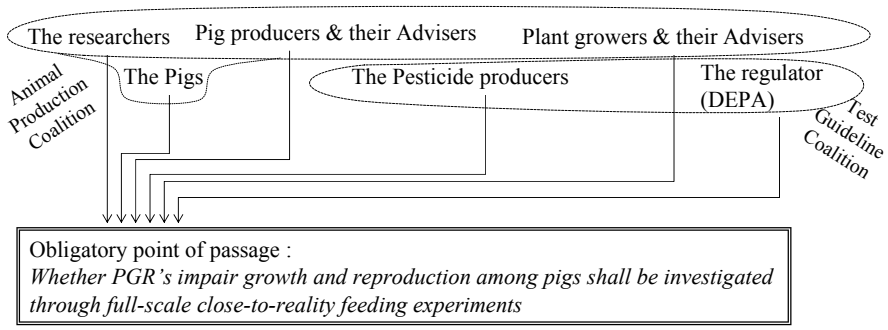


Figure 7.3: The feeding experiments were established as an obligator y point of passage in the early stages of the case.
The two discourse coalitions are marked with dotted lines, and it is shown that the pigs were captured by the animal growth coalition.

We can say that these two coalitions of the interpretation of the pesticides refers to two different knowledge frame, a concept that finds inspiration in Bijker's technological frame concept and Kuhn's disciplinary matrix (see section 3.2.2 above on page 51 for a discussion of these concepts). The two discourse coalitions agreed that the experiments were carried out with respect to the knowledge frame of applied agricultural research, and that the interpretation with respect to the knowledge frame of internationally harmonised regimes for toxicity-tests was independent of this. The two knowledge frames are sketched out below:

Elements of the knowledge frame	Knowledge frame of applied agricultural research
Goals:	Support of agricultural production / Agribusiness
Key Problems:	Relevance for farming context; complex reality
Problem solving strategies:	Tests in systems as close to reality as possible (in situ type). Ad hoc and problem oriented
Requirements to be met by problem solutions:	Reliability towards farmers and the farmers' organisation. Some level of scientific rigor
Current theories:	The usual stuff (design and analysis of experiments - statistics), knowledge of farm-system, Sensitive to tacit knowledge among farmers + … Investigate composite effects
Testing procedures	Avoid animal models – test directly on species in question
Design methods and criteria	

Figure 7.4: Knowledge frame of applied agricultural research
The knowledge frame is constructed on the basis of the empirical presentation of the case. It is the Animal Production Coalition that has a high inclusion in this frame.

Elements of the knowledge frame:	Knowledge frame of internationally harmonised (toxicity-)test regimes
Goals:	Harmonisation of chemicals regulation, sharing knowledge
Key Problems:	Enabling free trade, reproducibility, animal models relevant for human health, prioritising chemicals under concern. (chemical universe)
Problem solving strategies:	Tests in simplified systems, Easing replication of tests. (in vitro type)
Requirements to be met by problem solutions:	Scientific rigor, reproducibility, reliability towards OECD test guidelines etc.
Current theories:	Cause and effect, dose-response, toxicology, The usual stuff (design and analysis of experiments - statistics)
Testing procedures	Animal models
Design methods and criteria	

Table 7.1: Knowledge frame of internationally harmonised toxicity-tests regimes
The knowledge frame is constructed on the basis of the empirical presentation of the case. It is the Test Guideline Coalition that has high inclusion in this frame.

It is likely that the two members of the Test Guideline Coalition had a common adherence to the toxicity-test regime as it prevents non-resolvable discussions. Several studies have shown that the existence of different expert communities and hence different approaches to assess the same problem can render the role of expert advice ineffective in a controversy. The development of harmonised international standards can be seen as a countermove to this (Halffman, 2003: 112-113, Jasanoff, 1986: 75). The standardised tests and laboratory practise guarantee a basis that is necessary for the functioning of the regulator and it guarantees the producers clear unambiguous rules, which is important for the stability of the sale of the products. In this sense the regulator and the regulated are tied together in a contractual relationship with the internationally accepted test guidelines and standards for good laboratory practise as a fulcrum.

We could ask why the test guideline coalition after all did accept the obligatory point of passage presented by the animal production coalition. In short the explanation is

probably that even though the obligatory point of passage did concur with issues normally treated in accordance to the established toxicological knowledge frame, then it could be argued that the investigation design would not threaten the established test procedures as the tests was targeted at animal *production*.

Firstly the animal production coalition acknowledged the formal testing that had given approval to the use of the substances, and it was therefore possible to keep these two issues apart. Secondly, were the established test procedures and the tests performed with the pesticides in question, targeted at detecting problems related to residues in human food? The suggested test-design was targeted at pigs, which is in fact a target organism that has been investigated in relation to neither ethephon nor chlormequat (see e.g. WHO, 1994 and JMPR & WHO Core Assessment Group, 1999).

We can develop the analysis presented in Figure 7.3 further to explain why the actors accepted the feeding experiments as an obligatory point of passage. The actors perceived all that we can call different obstacle problems with the possibility of non-intended side effects of the plant growth retardants.

Within the Animal Production Coalition the obstacles were problems related directly to the possible effect of the chemicals. The pigs were lined up as the central but muted actor by the coalition[20], and the coalition was built up around the problem of possibly negatively affected growth and reproduction. For the pig producer these are two of the most important production properties, which are tightly connected to the profitability of being a pig-producer, and which is an enduring subject within pig-production (see e.g. Udesen & Thorup, 2003).

The general problem of maximising profit was therefore legitimately translated into the specific question of the specific pesticides, so as to render it possible to avoid pesticides with damaging effects. Also the plant-growers belonged to this coalition in the early stages of the case, when the conflicting interests between plant growing and pig production had not yet materialized.

Within the Test Guideline Coalition the picture was quite different. The coalition consisted of two members at this stage of the case; the pesticide producers and the Environmental Protection Agency who were responsible for the regulation of the substances in question.

It is obvious that the pesticide producer's prime goal was to sell the pesticides that are the primary product of their business. Two properties are important when a pesticide is marketed. To make the pesticide sell the farmer must believe that it will help him increase his earnings, it must increase the work yields or decrease the needed input of work, and in this sense the pesticide producer becomes an ally to the farmer.

[20] Pigs was just one among the four different species that was selected as central actors, which possibly was negatively affected by the use of the straw shortening chemicals, but I delimit the attention to the pigs.

But the possible side effects of the pesticides are important also. This is both a question of formal regulation – it must be demonstrated to the regulator that the substances pose no threat to health or the environment – and it is a question of informal regulation as the farmer and downstream users should believe in the safety of the product. This was the issues that were at stake for the pesticide producers. The agricultural actors' suspicion of the specific pesticides added uncertainty to the functionality of the pesticides.

Also, the EPA was faced with increasing uncertainty. The EPA had authorised the use of the pesticides, and as such guaranteed their safe use. It is furthermore important to see that the experiments were supposed to be carried out within the agricultural realm, with very specific production-related questions, and by a research organisation belonging to the Ministry of Agriculture. It is therefore likely that the EPA saw the need for the clearing up of whatever substances that were considered suspicious in the pesticides in question and concurrently perceived the problem as being isolated as an agricultural one.

These considerations are sketched out below in

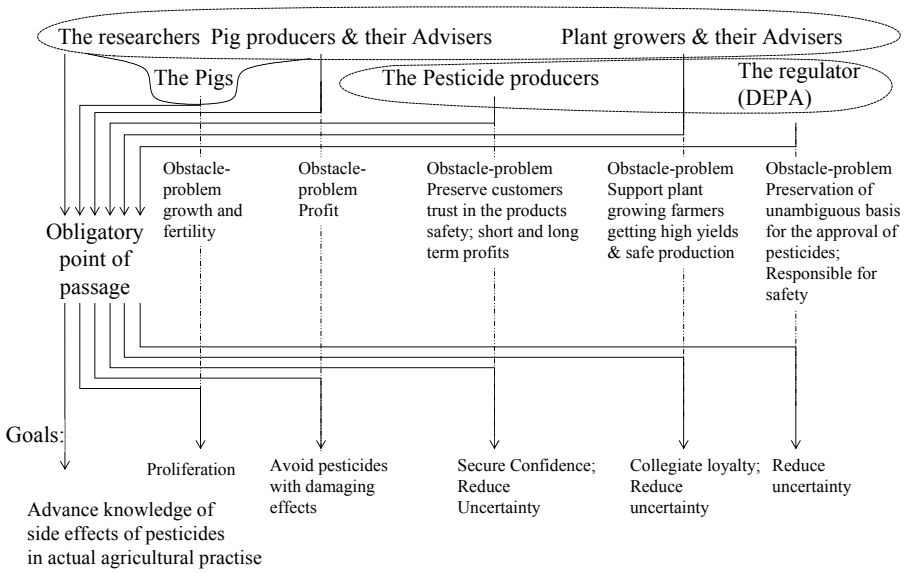


Figure 7.5. This constellation would remain stable until the case developed into its next stage, here coined by the expert who represented Rôhne-Poulenc in the task group that followed the experiments:

> "We did touch on that discussion, but people were not very concerned. The problem did not arise before Viggo Danielsen started deriving conclusions for which there was no support according to our toxicologists' opinion – and of other toxicologists. As a production study – that was our opinion all along –it was a very good idea, which we would support, we knew that Foulum was very experienced, inclusive of Viggo Danielsen, so that was ok, and that was why we agreed to [take part in the financing] (Arne Agger, 2003)

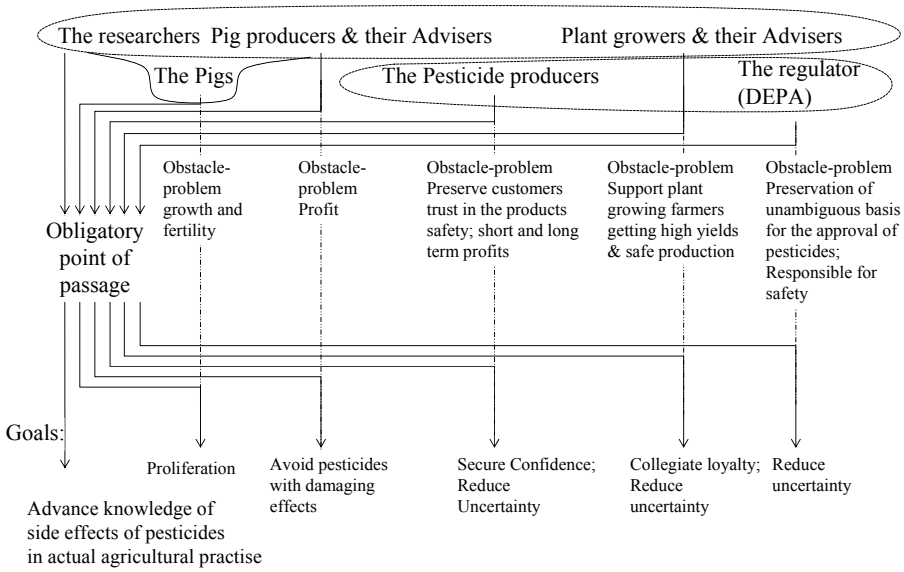


Figure 7.5: Translations of the Active Actors' Obstacle-Problems.

The next stage of the case started when the first experiments were published. It is important here to understand that the experiments were divided up into two separate experiments. The first concerning CCC (chlormequat-chloride) had no task group, and the second concerning Cerone (Ethephon) and Roundup (Glyphosate) had a task group.

The publicity to the two experiments can be seen as two different and separate courses of events. They both follow the same scheme. First, the closure of the pesticide as safe is attempted to be reopened. This happens as a result of a specific storyline that connects otherwise separate discourses, and the effect is a rupture in the reproduction of the routine categories that constitute the closure, namely the formalised criteria for valid testing of chemicals and pesticides. Then starts a debate which aims to reinstate and maintain the routine categories. And in the end the closure is around the specific substances as safe and secure and maintained.

The perception of straw shortening agents, e.g. CCC, as being safe were and are based on the voluminous piles of documentation made by the producers in confirmation with the prevailing test guide lines. We can perceive this as a double closure. The first closure concerns the test guide lines, and the second closure is the closure around the specific pesticides as being safe. It is the second closure that is threatened directly, whereas the first closure is only threatened indirectly.

The pig-industry reacted promptly when the CCC-experiments were published by advising the pig producers to limit the use of CCC treated grain. The storyline for the Animal Production Coalition was confirmed: *pesticides may have detrimental effects on pig production despite formal authorisation - CCC should be avoided*. This was picked up by the Consumer Council which had experienced the pesticides earlier. The result was the core storyline that has politicised the case ever since it was constructed:

“If CCC-treated grain isn’t good enough for pigs, should humans eat it?”

This storyline connects the hitherto isolated agricultural discourse on the possible adverse effects of CCC to a public discourse on safety. The story line resounded in the Parliamentary Environment and Planning Committee that raised questions about the safe use of the pesticides to the Minister of Environment. We can dig out the micro-politics of power relationship that reproduced and stabilised the closure firstly from the Minister’s answer, which was constructed by the Environmental Protection Agency, secondly from the discussions in the EPA’s Pesticide Council, and thirdly from the first reactions from the EPA and the Food Agency.

In this process the scope under which the Foulum investigations were established as an obligatory point of passage for the investigation of the adverse effects of the specific pesticides, transgressed. Suddenly, the investigations appeared not as a specific business related production-study but as a study used to argue that the permission perhaps was given on an inadequate basis, and hence that the testing procedures used were possibly inadequate. A new situation did therefore supersede the situation outlined in

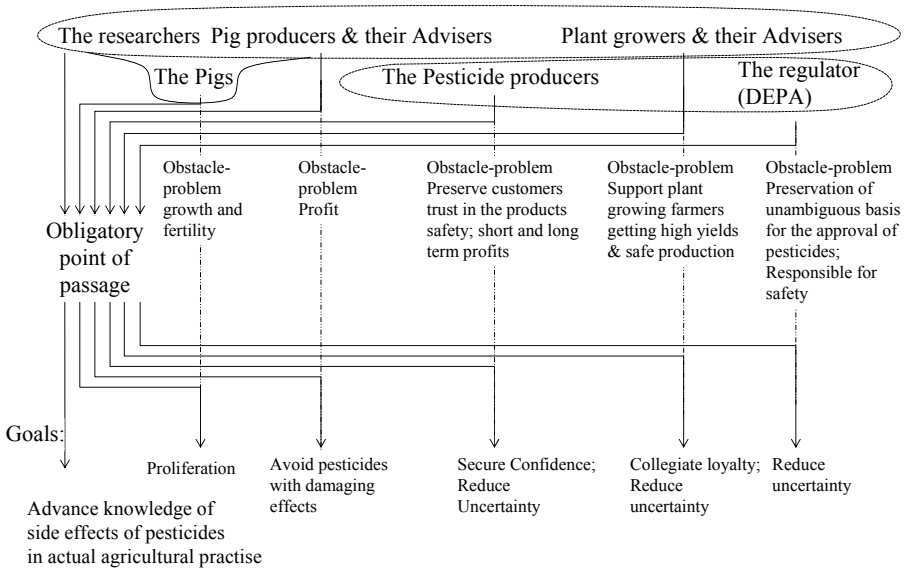


Figure 7.5. The two discourse coalitions did now enter an antagonistic relationship as outlined below:

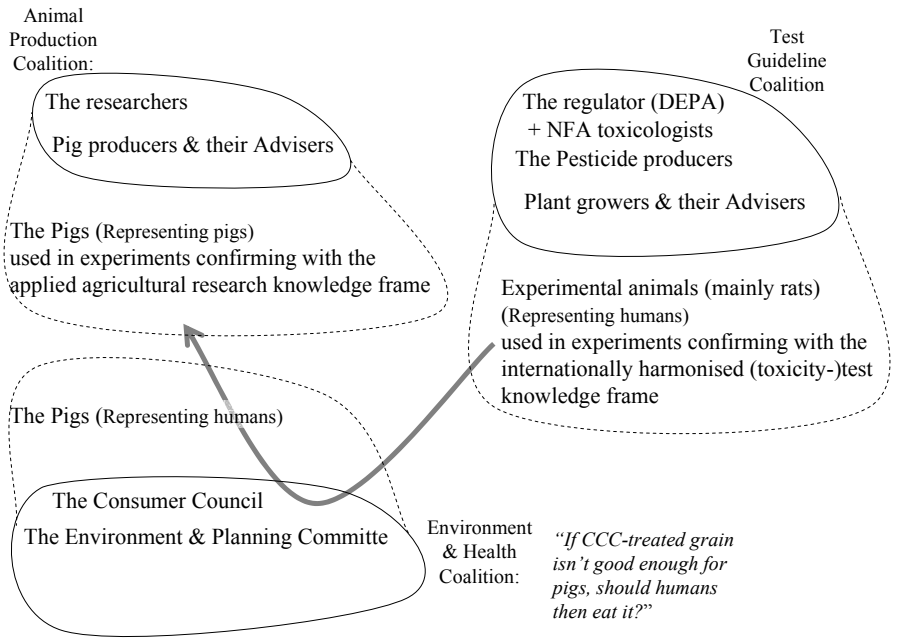


Figure 7.6: New Constellation of Discourse Coalitions
The appearance of the third discourse coalition changed the relationship between the Animal Production Coalition and the Test Guideline Coalition. Suddenly the relationship was redefined by the third coalition so that the obligatory point of passage earlier defined now was of minor interest.

The Environment and Health Discourse Coalition was at this point sparsely populated by the Consumer Council and the Parliament's Environment and Planning Committee. In the interpretation of the plant growth retardant CCC there were grounds between the two discourses with respect to the interpretation of the experiments, and the basic idea that the possibility of a detrimental effect should lead to action; that is a common affinity for a precautionary principle-type of argument. But the Environment and Health Discourse Coalition transformed the experimental results from being specific production related, to universal and therefore the Test Guideline Coalition started interpreting the experiments according to the knowledge frame of internationally harmonised (toxicity) tests.

The key issue was validity. The conclusions made by the Foulum researchers did not comply with the conclusions obtained in the experiments by which the substance was approved. The dividing line between valid and non-valid was defined by the Danish word 'regelret' (English: regular, according to the rules), which referred to the international harmonisation of toxicological investigations.

The key sub-issues to validity were dose-response and cause-and-effect-relationships. The Foulum experiments had not involved variation of dosage, in fact the doses were likely to be very low compared to the doses used in traditional testing; no method for detecting residue-concentrations was available at that time so no concentrations were

known. Neither did the experiments include any theories to explain how the measured effects came about.

As the Foulum experiments did not follow these rules, the results were perceived as invalid and rejected. We can follow the actors that were represented in the Pesticide Council, and observe how they supported the reproduction of the valid/invalid dividing line. We can furthermore see how the consultant from the crop growing agricultural sector in the Pesticide Council marks a shift from the Animal Production Discourse Coalition to the Test Guideline Discourse Coalition by dissociating themselves from the experiments.

The investigation was rejected as irrelevant by the EPA and the Minister, and it was also rejected by the Pesticide Council. The challengers from the Environment and Health Discourse Coalition accepted the rejection. Therefore, the closure around CCC as being safe was sustained.

But the new storyline continued to linger. A representative for the Animal Production Coalition, Orla Grøn, maintained the relevance of avoiding the straw shortening chemical in feed for pigs, but he did furthermore also question the fact that the EPA rejected the experiments (see above, page 95). He therefore approached the Environment and Health Discourse Coalition, and this position was also reproduced later.

The Foulum researchers worked at maintaining the validity of the experiments, and the central issue was to retain the obligatory point of passage that had been developed and respected up until the Health and Environment Coalition precipitated its breakdown; the boundary between production studies and toxicological studies was important for the validity of the studies, as the researchers stated:

> "Therefore, one cannot expect an experiment as that accomplished to give answers to general questions about health and environmental-aspects associated with the use of CCC. These problems must be examined in another context, where the necessary expertise and facilities are present.
>
> " (Effektivt Landbrug, nr.19, 30. October 1989: Ingen har modtaget »næser« fra ministeren, also quoted at page 94)

Radio Denmark took up the case and made a feature that balanced the two storylines and combined it with comparisons to DDT, and with a critique of the standard toxicological investigation. A major vendor of the specific pesticide reacted vigorously and attacked both Radio Denmark and the researchers, without differing between the two storylines. The boundary between the two storylines of the Animal Production Discourse Coalition and the Environment and Health Discourse Coalition became less clear through these processes, and seen from the outside the two discourses could seem to be amalgamating. The researchers' attempts to mark the difference did not bear fruit.

We can see how the Minister for the Environment was torn between the Test Guideline Discourse Coalition and the Environment and Health Discourse Coalition both in terms of interpellation and attraction. She toned down the outright rejection

made by the EPA of the Foulum experiments and the Environment and Planning Committee's questions both in the reply and subsequently in the press. She had given her assurance that she was also concerned with the possible prospects, and that she had asked the Minister for Health and the Minister for Agriculture to further investigate possible risks associated with CCC treated grain.

We can use the notion of interpretative flexibility to grasp the quite different perceptions of CCC. The traditional environmentalists saw the substance as an unnecessary technology that enabled the farmer top dressing the crops and thereby pollute the aquatic environment with fertilisers. The pig producers saw the substance as a fertility damaging pesticide that reduced the profitability of production. The crop growing farmers saw the substance as a necessary technology for the production of bread grain. The pesticide producer and the EPA saw the substance as a very safe growth regulator. The possibility for increased interpretative flexibility was tightly connected to a weakening of the closure around CCC as safe. But the openings that had been looming had not succeeded. Thus far the closure around CCC had been seen as safe and stable

These different groups also saw different solutions to the problems. Compared to the analysis performed by Wiebe Bijker of bicycles the present analysis contains an even more outspoken mixture of technical and social solutions. The actors present both social and technical solutions to the perceived problem.

The case would have been over and done with if the Minister for Environment had not shifted position to the Environment and Health Discourse Coalition during 1990. We can only point at possible explanations for this shift, which has been covered in the previous section. She had announced that she would act if new evidence made that reasonable, but the criteria for 'reasonable' had seemingly changed. In 1989 her statement said that the new evidence should be based on 'regelrette' (according to the rules, meaning OECD test guidelines and GLP), but the experiments publicised in 1990, which prompted the new position, were based on the same design experiments publicised in 1989.

Secondly, the Minister and the Social Liberals had in 1990 chosen an offensive strategy on environmental issues to make the party more visible in the coalition government and counteract its decreasing electoral support. Thirdly, Denmark was involved in the global negotiations to prepare the 1992 UN Conference on Environment and Development in Rio, which was a follow-up on the Brundtland Report. The precautionary principle was one of the three contested issues that divided the US from other participating actors, especially the European negotiators at the Bergen ECE Conference in Norway 8th to 16th of May 1990 "Action for a Common Future".

The Minister referred to the international obligation to use the precautionary principle and proposed that this principle would come to play an increasing role in future. The fourth and more speculative factor was the specific settings of the development of the case that made it 'comfortable' for the Minister to use. The basic research and the conclusions that indicated the problem was performed under the Ministry of

Agriculture and the Ministry of Environment could therefore not be accused of bias in the research; the ministry would not have been able to make, initiate or finance similar experiments – this is clearly indicated by the EPA's first response to the CCC-experiments. Furthermore, the pig producers had made a breach in the normally very strong alliance among Danish farmers, which potentially could make the prohibition more politically viable.

Whatever the reason, the Minister changed to the Environment and Health Discourse Alliance with support from the Animal Production Discourse Coalition, and dictated that the EPA should prohibit products containing the two substances.

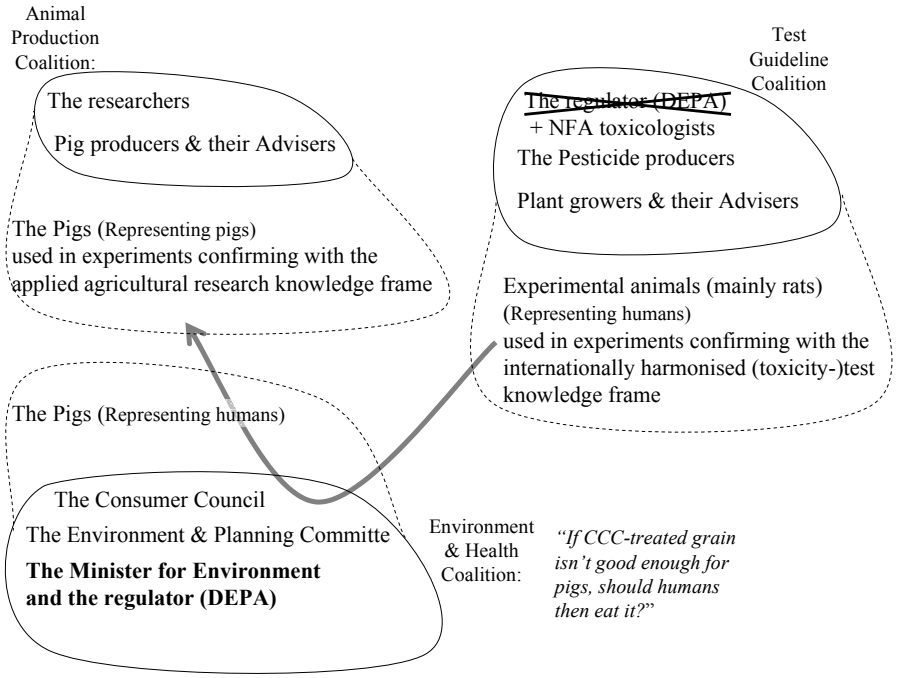


Figure 7.7: Changed Configuration of Discourse Coalitions

UP until this point it was the EPA and the Minister who had taken the lead in the rejection of both the Animal Production Discourse Coalition and the Environment and Health Discourse Coalition. We see that the Test Guideline Discourse Coalitions' rejection of the questions raised by the Environment and Health Discourse coalition followed a strategy which involved the centre of the testing regime.

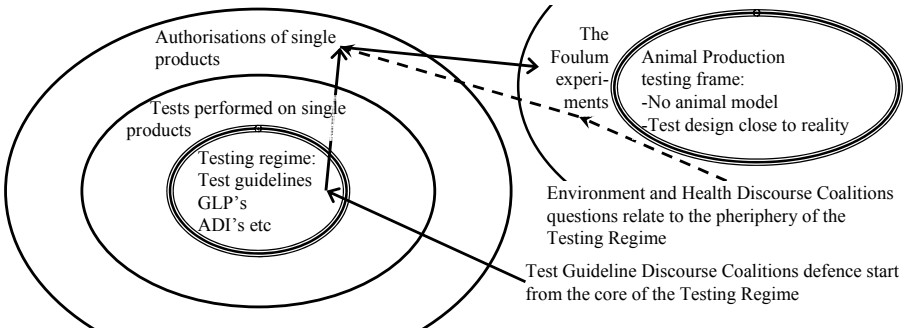


Figure 7.8: Centre and periphery in the testing regime.
The Minister's changed position was seen as a threat to the centre of the regime.

When the minister shifted to the Environment and Health Discourse Coalition the core of the Testing Regime was therefore left open to attack. The toxicologists in the National Food Agency who had supported the EPA's rejection of the questions raised against the authorisation of the substances were suspended (dismissed), as their advice was not needed anymore. The shift created a distinctive opening of both the closure around straw shortening agents as safe, and indirectly an opening of the closure around the testing regime's monopoly as a guide for the regulation of pesticides.

The Pesticide Producers were now left as the most active actors in the Test Guideline Coalition even though they found increased support from the crop producing farmers. The agrochemical industry started to work on three fronts. The breaches between the agricultural branches had to be overhauled, and the pig farming interests needed to be reminded that they also were dependant on the general interests of farmers. The second front was the Ministry of Environment, which had to return to normal practise in the assessment of pesticides. The third front was the Foulum experiments and especially the conclusions that gave nourishment to the criticism of the Environment and Health Discourse coalition.

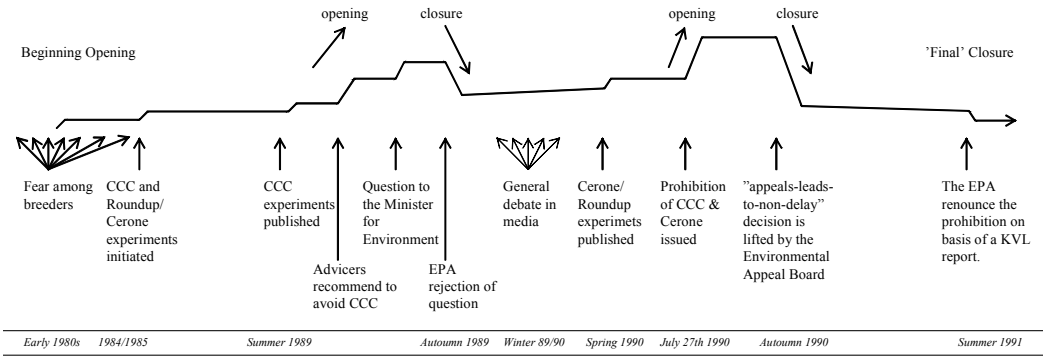


Figure 7.9: Openings and (re-)closures of straw shortening agents as safe.

But the processes that led to the final closure of the straw shortening agents was not dependant on the eagerness of the agrochemical industry alone and its attempts to train the erring branches of the agribusiness and particularly the Foulum researchers.

We can see that the decision on whether the prohibition was legitimate or not was displaced to a number of arenas. As an internal issue in the coalition government, agricultural interests in the Conservatives and the Liberals attempted to have the prohibition reversed in the government's Coordination Committee; this however did not succeed. The argument for not treating the case in the Coordination Committee was that the case was to be tested at the Environmental Appeal's Board and against EU-law. Jurists dominated both these two arenas.

The Minister for Environment had furthermore asked the Minister for Health to investigate the health aspects of the straw shortening agents and the possibilities for prohibiting the importation of straw shortened grain. And the Minister for Agriculture asked the Royal Veterinary and Agricultural University to assess the solidity of the Foulum experiments.

These four arenas played the most important role for the final closure of straw shortening agents as being safe, and showed how different types of power came in to play. The decision made at the Environmental Appeal's Board is particularly interesting.

The decision can be seen as a major defeat for the prohibition against the straw shortening chemicals; this was the Minister for Environment's contemporary perception, and the decision put an end to the agrochemical industry's continuous attacks on the Foulum researchers.

The board can be seen as an institutionalised filter that retrospectively deactivated the EPA decision. In fact one of the members of the board committee did have an affinity for the Environment and Health Discourse Coalition, but he was not able to express support for the openness of the warnings provided by the Foulum experiments. The reason for this was that the board was asked by the agrochemical industry (the plaintiffs) to assess the validity of the 'appeals-leads-to-non-delay' decision only, which the board had accepted. The Board's decision was therefore based on an assessment of the EPA's decision. The assessment was based on compound evidence pointing to failures in the EPA's administration of the case, but the board's decision was based mostly on minor judicial faults in the combination of the grounds for the 'appeals-leads-to-non-delay' decision.

The assessment made by the Ministry of Justice shows a very strong affinity for the Test Guideline Discourse Coalition, which is very logical. The Ministry's assessment took its starting point in the EEC free-trade regulations, which is an integrated part of the philosophy behind the test regime; tests are harmonised to ensure the same product is assessed the same way in all countries. As a logical consequence it was concluded that the assessment of the prohibition was in conflict with EEC free-trade regulations.

The third arena was the Ministry of Health that again launched action from the Institute for Toxicology for an assessment of the substances. The Institute for Toxicology gave advice in concordance with earlier advice; the substances do not pose any risk to health.

The fourth arena was the scientific assessment of the Foulum experiments made by the Royal Veterinary and Agricultural University. There was a paradigmatic difference between the Foulum researchers and the evaluators. The request for mechanisms etc is an issue which is easy to fulfil with 'traditional' types of toxicity evaluations. But the Foulum researchers did not limit their research to established techniques and known mechanisms.

The 'traditional' types of toxicity evaluation tests test the effect of the chemical under test conditions where the chemical is given directly, either orally or by injection. In the Foulum experiments the interest was more explorative, and the reply to the evaluation implied that the second step could be more comprehensive and – in the language of the KVL report – of a hypothesis confirming character.

One of the conflicts was the difference between 'traditional' science (mode 1 science) and regulatory science (mode 2 science) (Gibbons et al., 1994, Jasanoff, 1994). Regulatory science is characterised by its contextuality. The Foulum researchers' context was Danish pig production. The toxicologists' context was the free market in terms of the OECD and EU regulations for good laboratory practice. We can talk about a type of stiffened mode 2 sciences. The KVL-scientists' context was a combination of the norms of the toxicological expert's international norms, and disciplinary science in a more traditional sense. The KVL-researchers suggested modifications to the experiment that would increase the statistical power but also multiply the size and costs. They were not bound by the functional rationality of the two other groups of researchers.

On this basis the EPA decided in the summer of 1991 to abolish the prohibition, which in fact had only been active during 21 days in 1990 and in a period where no farmer would consider purchasing straw shorteners. The EPA's position was and still is well captured in the following quote from Leif Mortensen, head of EPA pesticide department. Leif Mortensen explained why the straw shortening agents were approved (early spring 1990):

> "The investigations that have been made are the standard investigations we demand to be able to review the effects of substances before they are approved. We take decision on whether there are any negative effects. That is the procedure with all applications and if we find any [negative effects] then the [substance] is prohibited, [but] we did not find anything here, so we cannot see any basis for an intervention." (Leif Mortensen, head of EPA pesticide department, in Dreyer, 1990)

This position has – with the temporary exemption in 1990-1991 – stayed unchanged in the Environmental Protection Agency and the National Food Agency; today the straw shortening case is seen as a periodically returning issue, which does not have any environmental or health-related relevance (se e.g. Fødevaredirektoratet, 2003a, discussed briefly above at p127).

All in all, the case can be seen as an analogy corresponding to the US EPA experiences with taking action on the basis of preliminary or questionable scientific results, resulting in intensive political fire and sometimes the overruling of decisions in courts. US examples are saccharin, nitrites, Love Canal and formaldehyde, where

scientific findings were cautiously incorporated into decision-making (Brickman, Jasanoff, & Ilgen, 1985: 154).

7.16 Discussion

The case contains the first explicit Danish use of the precautionary principle. We have seen how institutional arrangements together with industrial interests were able to dismiss the new evidence. We have thereby seen the difficulties an actor or a discourse coalition will be met with if it wants to question the evidence by which existing practices are approved and authorised.

We can also see the case as an instant in the transition from an industrial society to a risk society. By way of example we can use the note made by the Ministry of Justice in 1990. The note did not relate to the risks which the Foulum experiments indicated. By contrast, the note focused on reproducing the reasoning that originally had made the substances legal; without acknowledging that the substances naturally would be assessed as ok anything else would imply that the experiments behind the original approval were flawed, which nothing indicates! In a reflexive approach it would be accepted that our perception of a risk is constructed through the assessment; hence a substance may be constructed as harmless in one investigation/design, and less harmless in another investigation/design. By the sole focus on the one test-design as revealing the one truth, the Ministry of Justice is represented as being part of the 'old' industrial society.

The elements of transition came with the Environment and Health Discourse Coalition, and found clear expression with the Minster of Environment who interpreted the situation in a terminology which is best described as being of the ecological modernisation type. Most noteworthy was a chronicle (quoted above) where she attempted to abolish the anachronistic relationship between ecological considerations and economic/industrial interests, and where she linked this to the precautionary principle. Here the prohibition was seen just as one minor part of a larger necessary reorganisation of Danish Agriculture.

The Minister herself was nevertheless entrapped by parts of the rationality that governed the Test Guideline Discourse Coalition. She followed the advice from the EPA and the NFA to reject the Foulum experiments as irrelevant when the first questions were raised to the Minister in 1989. Later when the prohibition was issued the argumentation was still subordinated to the toxicological rationality with a strong focus on the single substances, even though she also argued with a multiplicity of reasons why the substances were problematic, and why alternative technologies could be advantageous.

We can therefore see the prohibition as a policy-reaction which reaches back to traditional command and control measures, but which is also furthered by a discourse coalition that draws on a terminology that indicates transition to a risk society, which has many resemblances with the ecological modernisation discourse which were developed in Europe at that time.

We can observe alterations in the applied strategies used to cope with the partisan knowledge from the Foulum experiments, when we look at the wider development of the case. The immediate reaction was to apply a prohibition, and to stress the possibility to develop alternative technologies. When that failed, due to the judicial and, especially, the institutional settings, the new strategy was to work around juridical barriers and attempts to have the precautionary principle incorporated in the Environmental Protection Law. This was however an irrelevance for the regulation of pesticides, as these are not regulated by that law.

We can perceive the EPA's abolition of the Foulum experiments as a realisation of the experiments' incompatibillity with the international conventions and European regulations on pesticides. In return the experimenters and the pig breeder's organisations were resolute in their decision to avoid the prevalent straw shortener CCC (and analogues). This provided good subject matter for both exponents of the Environment and Health Discourse Coalition, and for media attention.

These more populist processes have led to a type of partisan self-regulation of straw shorteners on the Danish market, which in fact had made it possible for politicians to sympathise with the Environment and Health Discourse Coalition's attempts to get rid of the straw shortening agents in human food. We can therefore interpret the latest development of public and political attention to straw shortening chemicals (i.e. chlormequat-chloride) as a kind of bypass of the still (very) stable scientific/toxicological closure of the straw shortening chemicals as safe. We can say that in this specific case expert (toxicological) knowledge of the substances was established as an obligatory point of passage that 'protected' the perception of the substances as safe in the early discussions, but that this 'bypass' has since made it possible to discuss and criticise the substances by evading that obligatory point of passage.

The obligatory point of passage still controlled 'certified' expert knowledge but no longer gave unique access to the political debate. The co-existence of these two very different perspectives on straw shortening chemicals is obvious as it is the Danish Veterinary and Food Administration that both vouch for chlormequat as being safe and also performs the testing that reveal residues in grain for human food. The latter is just based on regulations to prevent misrepresentation; if a brand is marketed as "free of straw-shorteners" this is tested by the authorities, and therefore the NFA serves both the Test Guideline Coalition and the Environment and Health Discourse Coalition.

The Minister was correct when she foresaw the case to be the first of many more to come where emerging knowledge would lead to swift reactions from the authorities (see quote above at p109). The later cases of interventions with references to the precautionary principle fall crudely in to two categories. The first comprises pesticides where actual prohibitions and voluntary withdrawal of products from the market has been the case; this development had a comprehensive focus and deviates therein from the straw shortener-case. The second type resembles the straw shortener case in the sudden awareness of formerly unknown potential negative effects as reason for public

and political attention, but these cases deviate as they were mostly resolved without prohibitions or law making.

It is emerging knowledge, especially, about food or substances in food that has led to 'snap' references to the precautionary principle, but also consumer goods that for example children come into contact with, which has given rise to the principle's verbal usage.

Case (examples)	Action
Sunscreen containing 4-MBC	EPA recommendation not to use the specific sunscreens on children under 12 years.
Phthalates in toys for infants (under 3-years)	Prohibition against phthalates in toys for children under three years.
Triclosan (used in toothpaste etc.)	Recommendation to avoid Triclosan in consumer goods
Creosote (Arsenic) for wood preservation in sandpits	The EPA recommended that the sand be shifted regularly and that new sandpits were made out of non-preserved wood
Olive oil (Norwegian authorities found a lot with residues of the carcinogenic benz(a)pyren)	The NFA requested retail shops to remove olive oils if the content was not documented. When the contaminated source was identified and isolated the olive oil bottles back went on to the shelves.
Functional food and vitamins	Denmark voted against the EU-directive that allows vitamin enrichment of food-stuff.
Food Make up	Denmark voted against the EU-directive that allows use of nitrates for colouring meat.
Antimicrobial feed Additives (in meat production)	

These cases do to some extent show that the authorities reactions to emerging knowledge and the precautionary principle has not yet been stabilised. One lesson that has been learned is to avoid prohibitions based on single experimental results, which in the straw-shortener case had proved to be untenable. Nevertheless, many of the cases are yet still characterised by hesitating authorities pushed by NGO and media attention.

7.17 Pesticides

It is with the first type of application of the precautionary principle, related to pesticides regulation that I find the most interesting lessons about the application of the principle of precaution. The Danish history of pesticides regulation, of which the straw-shortener case is one special and atypical instance, contains remarkable examples, which will prove useful in the discussion of the regulation of industrial chemicals.

The straw-shortener case took place concurrently with the halfway evaluation of the first Danish Pesticide Action Plan. The Danish Parliament had adopted the plan in 1986, and it represented the first tightening of the regulation of pesticides since the prohibition of the persistent and bio-accumulating organ-chloride insecticides, e.g. DDT, Aldrin and Dieldrin in the 1970s.

In the beginning of the 1980s the consumption of pesticides had increased significantly, and a general fear was that this could lead to negative impacts on animal life and possibly also the groundwater. The action plan involved that both the volume of active substances and the frequency of applications should be halved by 1997, and that half of the reduction should be obtained by January 1st 1990. Furthermore, the most problematic pesticides were to be reassessed and if necessary removed from the market. (Per Christensen: Pesticiderne rykker I fokus).

To secure this, amendments were made to the Act on Chemicals in 1987 so that producers and importers had to reapply to have the 'old' pesticides (re)approved. The 'old' pesticides had been assessed in the Poison Council, but only with respect to their risk to human health and domestic animals (bees) and the authorisations were without time limits (Lynæs et al., 1998: 119). Secondly, future authorisations would always be time limited, five and ten years respectively depending on the substance. Thirdly, a substitution principle was introduced for the assessment of pesticides:

> "Authorisation cannot be given to a pesticide if there exists other agents or methods with the same field of application, which on the basis of existing investigations or experiences is considered to be substantially less dangerous to health or substantially less hazardous to the environment, cf. §35 subsection 3[21]" (Kemikalieloven 2000/4/12, §35, subsection 2)

Fourthly the assessment was now based on an assessment based on sharpened environmental and health criteria and the approval was to be based on an aggregate estimate over the assumed risk if the substance was used. The 1987 amendment was also made necessary as the Environmental Appeal's Board in 1985 had put a question mark against the reassessment of the 'old' pesticides that had been initiated when the Law of Chemicals was put into force October 1980.

The regulation of pesticides had been regulated by a separate act before, but was in 1980 incorporated into the Law of Chemicals, where environmental considerations were also included. The sharpened set of criteria included that specific environmental and health related properties of a substance could result in the rejection of approval, e.g. unacceptable high mobility which indicated the substance would be a threat to the groundwater (Lynæs et al., 1998: 119-120).

At the halfway evaluation of the Pesticide Action Plan, it was clear that the partial aims for 1990 were far from being fulfilled. The volume of used active substances and the frequency of applications did not show a reduction of twenty-five per cent on the figures of the 1981-85 reference periods. The reassessment of the most problematic pesticides was seemingly being dragged down by means of complaints and piles of counter-evidence from the agrochemical industry for every prohibition the Environmental Appeal's Board made (see Lynæs et al., 1998).

[21] The following subsection of the Law of Chemicals contains a sentence that indicate that the substitution rule will be annulled with EEC harmonization of the pesticides regulation, and an exemption of biocides regulated by an EEC directive.

This situation also sheds light on the straw-shortener case and the EPA and the Minister's handling of the case. On the one hand the straw shorteners were not problematic in the eyes of the EPA, especially compared to the substances that were known to be problematic; hence it was more or less a waste of time to focus on the straw shorteners. The case provided on the other hand a situation where the otherwise untouchable agricultural alliances proved to have a breachable point.

The drawn out treatment of the complaints entailed wide discontent, and therefore was a policy window for tightening of pesticide regulations, which turned up in the beginning of 1994. It was one of the pesticides, atrazine, that due to complaints had not been banned, which turned up in the groundwater in considerable concentrations at a specific location, namely Ejstrupholm in 1993.

The Danish Parliament now discussed the issue intensively, and the delaying effect of complaints was removed from the Act of Chemicals. The producers now had six weeks to comment on the EPA's basic assessment, and the sections on party hearing in the administrative act (section 19-21) was abolished. A reference to these sections had been a part of the Environmental Appeals Board's justification of its decision in the straw-shortener case.

Now the EPA's decision could not be appealed to the Environmental Appeals Board, but the EPA was obliged to obtain an external expert statement, and the Pesticide Council was to give an utterance on the EPA decision (Kemikalieloven 1996/1/16: section 35e subsection 1-4). In 1995 the possibility for the producers to ask questions to the external experts stopped, because producers in specific cases had raised so many and so extensive a range of questions that the hearing procedure became too time consuming in comparison with the law's aim (Lynæs et al., 1998: 121).

With the limitations to the agrochemical industry's access to hearing and complaints, the phase out of the most problematic 'old' pesticides gained momentum. The reassessment was finalised in 1996. In 1994 20 pesticides with seven different active substances were prohibited, amongst these atrazine. In 1996 a further 110 pesticides with 12 active substances and in 1997 about 40 pesticides with 10 active substances were prohibited. Moreover about 550 of the 'old' pesticides were not approved by the reassessment, either because the producer did not apply, or because the application was rejected on account of insufficient documentation (Lynæs et al., 1998: 118).

The Danish pesticides regulation and especially the reassessment of old chemicals are based on a very specific assessment scheme that stresses specific inherent capabilities and that stress the presence of alternative methods or agents that can do the same job but with a considerably smaller risk to health and the environment.

This is an approach that we will see emerging in the regulation of industrial chemicals, which also will be discussed in the next and final empirical chapter.

8 Regulating Chemicals

/ From post facto to precaution

The events that we have dwelled with during the last 60 pages were one minor incident among a number of situations and cases where the basis of regulation of chemicals was questioned. The case gave us access to how agents of a number of constituencies interact and react when the established system for assessing chemicals' side effects is being pushed and threatened. In addition, it showed us how general concerns about non-wanted effects of chemicals (pesticides) were expressed even by the agriculture with terms that drew on a precaution-like base. The case in itself did not lead to the developments that we will study in the following, but it makes out an important basis for the understanding of the micro powers that stabilize and conserve the systems that we now will examine in broader terms. The straw-shortener case can in fact be seen as one of the results of the increased awareness of unintended effects of chemicals that partly will be unfolded in the following. It can – as one incident among others – be seen as laying the ground for the profound critique of the European chemicals regulation that emerged in the end of the last century, and which we will return to in the end of this chapter.

Three major themes will have my attention in the following. The first is the build up of the OECD chemicals testing regime and of the European chemicals regulatory regime, especially the sixth amendment. The second theme is the critique that partly propelled this development and that in Europe in the late 1990 manifest itself in a profound critique against the European regime for chemicals regulation. The third theme is the current revisions of the European chemicals regulation.

In an attempt to find the roots of this critique we will look at some of the discussions that in Denmark constituted the concern for how chemicals should be handled in society. The discussions of the 1970s is shown partly to link up with the critique that in the early 1990s lay the foundations to the revision of the European chemicals regulation, which began in the late 1990s and has not ended in 2004.

The story that will be winded up below is about how environmental and health concerns developed and have influenced the modes of regulation, and especially what role the precautionary principle has played and may come to play in the continuing narrative of chemicals and chemicals regulation.

The story will therefore touch upon the social construction of the testing regime that dominate the regulation of chemicals, and which today are being challenged explicitly by the precautionary principle. It will be clear, from the following pages, that the construction of the testing regime itself was influenced if not 'kicked off' by a radical critique that indeed was resting on arguments closely related to what today is being comprehended as the precautionary principle.

However, a detailed study of the construction of the testing regime will not be made in the present context, as this would grow beyond the scope and possibilities of this study.

The development of the internationally harmonised approach to management of chemicals can be divided into a number of phases that actually matches the present structure of the general paradigm for chemicals management. The regulatory discussions of the 1970s related to mostly to hazard identification and hazard assessment. In the 1980s was these discussions extended with risk assessment, not least out of the demand for an economically balanced approach. During the 1990s was risk management added as the new mantra in the regulation of chemicals. All in all the development can be comprehended as going from the concrete effects of specific substances to the abstract regulation through management.

In broad terms, the precautionary principle helped start the process in the early 1970s, but the need for a precautionary approach was not seen in the circles that developed the actual practises and tools. We can say that the demand for precaution was answered by an approach that was characterised by strong storyline which central message was that humanity now had the tools and capabilities to foresee and forestall adverse effects, and that this would lay open the possibility to continue to 'reap the rewards' from chemistry. Consider for examples the quote below that characterises the heyday of the first phase of development of the chemicals management framework:

> "Relatively few of the many thousands of chemicals on the commercial market today appear to pose serious problems to man's health or environment. From those that do not we have reaped many rewards. The problem is that we do not know enough about which chemicals actually do create problems. For the fact remains that any chemical can pose hazardous consequences when misused or inappropriately handled, stored or disposed.
>
> Recognising this essential dilemma, industrialised countries began in the early 1970s to take steps to seek to resolve and try to anticipate the problems posed to man and the environment by chemicals. It was quickly realised that action by any one country alone was inefficient and often insufficient; effective management of chemicals is a challenge of global concern and demands a significant degree of international collaborative action. This international dimension to the control of chemicals can be characterised in terms of the enormity of the task of managing chemicals; the common challenge posed: the extent of world trade in chemicals; and the global character of some chemical hazards."
>
> (Nichols & Crawford, 1983: 107)

This certain rationality was used to encapsulate the problem.

Around 1990 the second major phase began to take shape, and concurrently it became clear that the approach had some flaws. This development was probably related to the growing public attention to the general problem of chemicals. Until this point the public attention to chemicals (in Europe) had primarily been attached to high-risk-sites; such as dumps, production-sites and major spills. I unwind some of the background of the European chemicals regulation as it was in the 1990, before I proceed with the 2000s revision of the regulation. We will 'jump' between several levels, namely Denmark, Europe, the OECD, and to a limited extent the UN, as I draw

up an account of the development of the European chemicals regulation with a somewhat selective Danish perspective.

8.1 Changing perceptions of chemicals

In the following two sections are the changing perceptions of chemicals lined up. We start with the early Danish regulation of chemicals and continue with more general reflections on the changes in the western worlds' perceptions of chemicals after the end of WWII.

8.1.1 The first regulations: Poisons and Pesticides. Ad hoc'ism

This section gives an overview of the history of Danish chemicals regulation up to the beginning of modern environmentalism and environmental policymaking. A focal point of the description is the changing perceptions of chemicals and their adverse effects (toxicity etc.). The section aim at understanding the background and development of the principles the present regulation is based upon. The present regulation of dangerous substances is characterised by a long history of gemmating, which ultimately has led to a very complex set of rules.

The first regulation of chemicals in Denmark dates back to the Danish Law of King Christian V, and was aimed at pharmaceuticals and poisons, their production, distribution and use. In a royal ordinance from 1687 is it stated that only chemist's may produce and sell medicaments, and in 1779 was it added that dangerous preparations only could be sold to 'non-suspicious' persons. Furthermore were poisons to be kept separately, not to be mixed, and locked away. In 1796 was the regulation of chemists supplemented with a special ordinance on poisons. Eight specific poisons were only to be sold by royally privileged chemists; rat poison only to persons approved on a document with the priest's signature, and other poisons could be sold to artisans and manufacturers. In 1843 was the regulation liberalised; the number of poisons regulated was reduced to seven, authorised materialists was allowed to sell poisons to artisans and manufacturers. At the same time was a national regulation of colour-additives to foodstuff introduced, as only colouring agent stated on a positive list could legally be used. (Pagh, 2002).

In 1871 took the Health Commission (consultative body; in Danish: Sundhedskollegiet) initiative to have the regulation improved, but it should take quite some years before the regulation would be renewed again. Especially the widespread use of arsenic resulted in many accidents. It was normal practice, for example, to fight vermin and skin diseases on livestock by washing with an arsenic solution. The consumption of arsenic for this purpose was in 1875 round two and a half tonnes per year, and the Health Commission was concerned about the free accessibility to poisons. The strong resistance arose from representatives of the bourgeois in the parliament seeking to protect the rights of the individuals against state-guardianship (Engberg: 131-139). The arguments have a striking similarity with the contemporary watchword of the American National Rifle Association (NRA), 'Guns don't kill people, people kill people'. The preparatory Folketing Committee's rejection of the proposal stated that "The proposal does not pay regard to the interests of the production, business life, and the population, and it does that without getting closer to

the purpose, namely preventing accidents and crime." The preparatory Folketing Committee noted, to the proposed limitations to the use of arsenic for livestock washing with arsenic, that, "the essence of the problem is that the user must be a conscientious and watchful man who always takes the necessary precautions." The dominant opinion saw not the accessibility of the chemicals – hence – not the producers, nor the distributors, but the individuals using the chemicals as the problem. An ideological barrage that protected the liberty of the subject, using the personal responsibility as the prime argument, blocked the preventive regulation.

At last, in 1931, a general Law on Poisons that gathered the various rules on chemicals replaced the regulations from 1796 and 1843. The Law on Poisons was introduced with reference to the same problems as those the Health Commission had pointed to in the previous century: increased access led to an increased number of accidents where chemicals was involved, such as murder attempts, suicides, and accidents due to mistakes and confusion. The situation had been further aggravated, because of growing industrialism and the increased commercial use of chemicals.

The law was targeted at chemicals that were poisonous or hazardous to health, and the chemicals were selected because of experiences with their deleterious effects. It was especially in the growing agricultural sector the new chemicals found use, where poisons were widely used to control vermin and weed on crops and livestock.

The intention of the law was to extend the control with the uses of poisons and to prevent confusion, but beyond this, did the law build on the earlier regulations, i.e. stating that manufacturing of poisons requested permission, that labelling was requested, and that poisons was only to be sold by those approved by the law. (Pagh, 2002: 76). Unlike the earlier regulations, the 1931-law contained a complete list of substances that was regarded as poisons or poison-like. The list comprised about 75 substances and compounds plus preparations of these. Examples of substances are arsenic, mercury-compounds, prussic acid, potassium cyanide, chloroform, morphine, opium, and strychnine.

In 1932, the Pesticide Law passed was by the Danish Parliament. Contrary to the Poison Law was the purpose of Pesticides law to gain control with the quality of the growing number of agents, of which many had shown useless or even harmful for the crops the farmer wanted to protect. The law was largely a result of pressure from manufacturing and agricultural interests that had opposed the Poison Law, which was seen as a confining and constraining regulation. The Pesticide Law, which was targeted at pesticides for crop-protection, was in 1948 extended to encompass all agents for controlling plant diseases, weeds, and certain vermin (excluding rats). Especially swindle with preparations proclaimed to contain DDT and Hexachlorocyclohexane appears to have caused problems (Pagh, 2002: 77). To gain control was anybody who produced, imported, or sold pesticides obliged to notify this to the police. In 1939 was the competence moved to the National Chemicals Control (in Danish: Kemikaliekontrollen) that had been established in 1932 to perform control with the marketing and storage of pesticides. The regulation gave authorisation to the approved products, but stated minimum requirements regarding labelling of active compounds and fillers. This regulation was however supplemented with a general

prohibition against products with additives that reduced the effect of the active compounds, or that made the product more poisonous or dangerous than stated on the products label. In 1948 was further a rule of state recognition of pesticides. The rule did not hinder the marketing of products not recognised, but was simply a state quality assurance of the efficacy of recognised pesticides.

The sole focus on efficacy that had dominated the legislation up to and including the 1948-Pesticide law was gradually modified in the following years. The Poison Law was not able to fully counter the risks the pesticides posed to humans and livestock, which ultimately led to a revision of the Pesticide Law in 1954. The revision did two things. It increased control by introducing an approval system masked as a notification system. Like that the law gave the Minister of Agriculture authority to specify additional regulations on manufacturing and labelling, and it gave the Minister authority to prohibit sale of pesticides, "*beforehand clarity over the agents toxicity to man and creature is established*" (translated after Pagh, 2002: 78). This authority was indeed used, as marketing of a pesticide was prohibited unless the Poison Board, which also was established with the law of 1954 (in Danish: Giftnævnet), had classified the pesticide in one of the four then existing hazard classifications.

In the same move was pesticides totally exempted from the regulations of the Poison Law, as long as they complied with the regulations in the Pesticide Law with respect to the prevention of hazards, i.e. the labelling requirements.

In 1961 was the two regulations revised mainly to align the words of the law with the practise of the authorities. However, to the pesticides regulation was added two new fields where the Minister gained authority. The first was the possibility for regulating transportation of pesticides, which reflected the growing production and consumption. The second was the possibility for prohibiting marketing of pesticides that posed a risk to human health and / or livestock, and to prohibit products containing pesticides that serve pointless purposes. The backdrop for the latter was pottery-swallows intended for decorative purposes, but covered with the poisonous pesticide Parathion, and window cleaner agents with DDT.

In Denmark chemicals remained being regulated by the pesticide law and poison law until 1979 when the Danish Act on chemicals was passed.

8.1.2 Changing perceptions of Chemicals; 'toxicity' and 'hazard'

In the aftermath of the WWII were chemicals and especially industrial chemicals an unconditional good. This has changed:

> "There was no horizon. There were new polymers, which make up plastics and fibres, coming out every year. Then we had PVC. Then we had nylon, which came out just before the war. Then we had all sorts of polyesters ... You could go into a laboratory and they would tell you: "We are going to put out a new fibre every year, for – forever ..."
>
> If I went to a cocktail-party, when I was in pharmaceutical research, and people asked me what I do, and I said I was in pharmaceutical research. They would say: "Oh, that's wonderful. You're doing so much for us. You're saving lives; you're making our lives better. You're extending lives. That was great. That's changed. The reaction is very

> different now: - "Oh, you are the person that help us to spread these horrible things and kill all these birds, does this and stops us doing that". Very different reaction. Much more critical. People say: "Well look, how can we control this beast, that's been forced on us. These people – these so-called scientists – have let the genie out of the bottle. And it is not a beneficial genie. It's a disastrous genie. It's a bit like Pandora's Box, you know. Once you've opened it, you can't control it. You can't control what's happening".
>
> (Allan Hayes, Manager of one of Europe's leading chemical industry-conglomerates, ICI, in the TV-broadcast "Den kemiske arv" (The chemical legacy), DR1. April 18th 2001[22])

The processes that initiate changes in the perception of what toxic/dangerous/hazardous means will often start from crossings of knowledge and insights originating from very different domains; crossings that can be analysed as emerging storylines. It is experiences and awareness emerging from everyday life, professional context, and scientific discoveries. The environmental social movement has played a central role for the synthesis of different perspectives and emerging knowledge, and for an active public debate. It is therefore a complex combination of contextualised lay knowledge and scientific knowledge, social movements, etc., that prepare the ground for changes in the perception of what toxic/dangerous/hazardous means. It is crucial to stress that such changed perceptions not rest on scientific discovery. An example is the discussions over endocrine disrupting chemicals that have gained much attention worldwide since the middle of the 1990s (see e.g. Løkke, 1998, Colborn, Myers, & Dumanoski, 1996, EC Commission, 2001a). Already in 1950 it was demonstrated that DDT had a strong endocrine disrupting effect that dramatically influenced the development of both the primary and secondary sexual characters among cockerels (Burlington & Lindeman, 1950). Scientific discovery do not do it alone; changed perceptions of 'toxicity' and the safety of chemicals are intrinsically linked with changes in discourse. We can say that the possibility of perceptions of chemicals as more than good things represents specific parts of the developing environmental consciousness (Jamison et al., 1990, Hajer, 1995:8-41, Beck, 1986).

An important step on the road from the changed perceptions to changed regulation is the adaptation of new perceptions in pro-active national states and especially in intergovernmental politicy-making on environmental issues, which often has no juridical binding character (see e.g. Haas, 1992 or Brickman, Jasanoff, & Ilgen, 1985). Such contemporary but not formally or legally functional conceptions of chemicals are exemplified below.

[22] It was a recent publication by the very active Danish NGO The Ecological Council that gave me attention to this distinctive quote (Rank et al., 2003). That is hereby acknowledged.

Some contemporary definitions of how chemicals may be dangerous to health and the environment
Hazardous substances. At the 4th International Conference on the Protection of the North Sea was hazardous substances defined as "substances, or groups of substances, that are *toxic*, *persistent* and *liable to bioaccumulate*. In this definition *toxicity* should be taken to *include chronic effects* such as *carcinogenicity*, *mutagenicity* and *teratogenicity* and *adverse effects on the function of the endocrine system*." (Esbjerg Declaration, 1995: 37, Italics added)
Persistent organic Pollutants (POPs). At the Stockholm Conference under UNEP were the following definition of POPs made: "persistent organic pollutants possess toxic properties, resist degradation, bioaccumulate and are transported, through air, water and migratory species, across international boundaries and deposited far from their place of release, where they accumulate in terrestrial and aquatic ecosystems" (Stockholm Convention, 2001: 1)
Heavy Metals are metals or metalloids that has a density higher that 4,5 g/cm^3 , mainly lead, nickel, Cadmium, platinum, zinc, mercury and arsenic.

We can make a crude sketch over the development of the changing perceptions of chemicals, and especially their toxicity.

We have looked at the emerging regulation of chemicals in Denmark from before the Ages of Enlightenment and up to the final separation of the pesticides regulation from the regulation of poisons in the 1960s, and we have noticed that the regulations only was targeted at substances (uses) which obviously could have a damaging effect; poisons and pesticides. The perception of toxicity was especially based on the experiences with arsenic-based pesticides, which could lead to acute poisonings. We can call this perception for the *classical poisoning*. In this understanding, it is conceivable that DDT was perceived as a miracle cure that was awarded the Nobel price in 1947; DDT is not acute toxic but kills insects effectively (if they have not developed resistance towards the pesticide). This perception was dominated by a nature-society dualism, and a view of nature as resilient; chemicals were seen as man's helper in controlling nature, and possible negative feedback-loops from nature was even considered.

The next conceivable step in the development of perception of chemicals was still based on the perception of pesticides. The fears about pesticides gained a new twist in the 1960s. It was cancer that dominated the public debate, and the highly influential book by Rachel Carson, The Silent Spring (Carson, 1962) summarised a number of new trends in the perception of chemicals, and helped launch the modern environmental movement (Colburn: 167, Jamison & Eyerman, 1994: 99-100). In this perception was the fate of nature and humanity united; it was the effect of persistent synthetic pesticides and their durable and diffuse effects on both humans and wildlife that gained attention:

> "The new environmental health problems are multiple – created by radiation in all its forms, born of the never-ending stream of chemicals of which pesticides are a part, chemicals now pervading the world in which we live, acting upon us directly and

> indirectly, separately and collectively. Their presence casts a shadow that is no less ominous because it is formless and obscure, no less frightening because it is simply impossible to predict the effects of lifetime exposure to chemical and physical agents that are not part of the biological experience of man." (Carson, 1962: 168 quoted from Jamison & Eyerman, 1994: 97)

Jamison and Eyerman have a very interesting point about Carson's case-choice. In mid-1950s was the working title of the book was *Man Against the Earth*, and it was thought as critique against the contemporary technological optimism. It was not just a critique of the manmade pesticides but a critique of "the entire chemical and technological war against nature". But she realised that it would be effective focus on one type of pollutant (Jamison & Eyerman, 1994: 99), which turned out to be true indeed. The Silent spring has been proclaimed to be an uniting work that has played a very important role for activation of critique against pesticides and especially DDT and for the shaping of the environmentalist side of the critical social movement (See e.g. Eyerman & Jamison, 1991: 102-103, Dunlap, 1981: 3, 7, and Graham, 1970). We can frame the new conceptualisation of the disadvantageous side of the pesticides as the *insidious poisoning*. In the words of two OECD experts on the management of chemicals have the "concepts of »poisonous« and »harmful« […], over time, been extended from acute and obvious effects to include also subacute and chronic effects" (Nichols & Crawford, 1983).

The third major step in the development of the perception of chemicals had probably already been taken by Carson, but it did not gain broad reference before the 1990s. We may again point to a book balancing on the edges of science, journalism, and fiction, and which managed to pick up lurking criticism and make new combinations of existing knowledge. In 1996 was the book *Out Stolen Future* by Colborn, Myers, and Dumanoski published. The 1996 US Vice president Al Gore wrote in the foreword:

> "*Our Stolen Future* takes up where Carson left off and reviews a large and growing body of scientific evidence linking synthetic chemicals to aberrant sexual development and behavioural and reproductive problems." (Al Gore in Colborn, Myers, & Dumanoski, 1996: vi)

Centrally in this new perception was that the categories of effects now was dramatically broadened – cancer had until that point taken centre stage – the toxicologists dose-response dictum was questioned, and industrial chemicals as such was included as possible suspects (see Løkke, 1998 for an elaborate discussion). We can call this third perception of the adverse effects of chemicals for *the broad exposure*.

Elements of a 'precautionary principle' way of thinking were present already in *Silent Spring*. The critique made by Carson was based on a broad collection of evidence and knowledge. It anticipates a future which is seen as unwanted, and it visionary as is shows other possible directions and tracks that could render the extensive use of pesticides unnecessary; it call for precautionary actions both in terms of do's and don'ts, which can be tracked all the way up to present regulations of pesticides and changing practises in agriculture in direction of organic principles. In this sense, the silent spring live up to contemporary definitions of the precautionary principle of the 21st century (see e.g. EEA, 2001, and the discussion in chapter [above]). In broad

terms, *Silent Spring* related to the fear for cancer that had been present in the US society for decades. In 1958 succeeded the Senator James Delaney in introducing a landmark anticancer provision into the US Food and Drug Act, which has been denoted the first introduction of a precautionary principle into modern legislation (Bro-Rasmussen, 1999). The Delaney Clause, as it was called, required the Food and Drug Administration to ban any additive if experimental or epidemiological evidence had indicated it to be potential causes of cancer; it introduced a zero risk on potential carcinogens. This approach was in contrast to the remaining parts of the legislation on food additives, which was based on a relative safety concept and permitted the use of food additives as long as manufacturers could show the they were "reasonable certain not to harm human health (ibid, Brickman, Jasanoff, & Ilgen, 1985: 34). This is an excellent example on the co-existence of a precautionary approach and what later would develop to be the risk-assessment approach.

It is important to stress that these changing perception of chemicals did not happen in a vacuum, but in a political culture where environmentalism and environmental issues gained increasing attention. The world was increasingly being constructed as the-one-and-only world, and the 'modern environmentalism' differed from the earlier preservationist and conservationist movements in two important ways. It was driven by the idea of a global ecological crisis, which were nurtured by series of well-published eco-disasters such as massive oil spillages, the mercury poisoning of Minamata Bay 1932-1968 (discovered in 1956), and the ecological devastation of Vietnam in the 1960s (Carter, 2001: 4, Jamison, 2000: 21). Secondly was the 'modern environmentalism' a part of the rapidly growing social movement protest that called for radical changes in the values and structures of society.

The one-world view found expression in two influential lines of thinking articulated in the club of Rome's *Limits to Growth* on the one hand and *Blueprint for Survival* and *Small is Beautiful* on the other (Meadows, 1973, Goldsmith et al., 1972, Schumacher, 1973), lines which dominated the centre of the debate in early the 1970s and which therefore is important for the linking of discourse to regulation (Hajer 1995: 79).

The two approaches agreed in the assessment of the threatening disaster and the need for action, but differed in the view on how to accomplish this. *Limits to growth* presented a top-down approach that, in the words of Hajer, '[…] sought to remedy the environmental predicament through a further integration of organized management. The environment was in danger of becoming a runaway issue, both socially and physically, but careful planning, drawing on scientific insights, could restore the equilibria. *Limits to Growth* was oriented towards the world leaders and national élites which it hoped to unite for a joint approach to the problem.' (1995:84)

The second line of thinking marked with *Blueprint* and *Small is Beautiful*, which was seen as a corrective to the technocratic worldview of the *Limits to Growth*, emphasised a fundamental critique of society. The mode of production, existing capital-labour relations was problematised together with the lack of morality in industrialised society (Hajer, 1995:84). *Blueprint* and *Small is Beautiful* became constitutive elements of a radical environmental discourse that rejected the technocratic response to environmental problems defined in naturalistic terms, because the environmental

problem was seen as primarily a social and political problem. Technocracy was seen as leading to exactly the opposite of what it was claimed to do: instead of being efficient and rational, it was short-sighted and careless (Hajer, 1995: 89).

Hajer argues, however, that even though these two perspectives in many respects were very different – and even more outspoken supported different sets of actors – then did they have communalities in the characterisation of the problem as a matter of survival, and communalities in the focus on technological fixes and comprehensive planning techniques.

8.2 The creation of a regulatory framework

The framework for regulating chemicals took its starting-point in the second understanding of chemicals as problems that Carson had spurred in 1962. There was an urgent need to gain knowledge about the unintended side effects of pesticides in the environment, and this issue was first raised in the OECD in 1963. A joint US/Swedish proposal in 1966 led to a conference on "Research on the Unintended Occurrence of Pesticides in the Environment". At this meeting was a co-operative study programme initiated, which should elucidate aspects of the problem where the OECD member states could benefit from research co-operation. This initiative became an environmental forerunner in the OECD and preceded the Environmental Committee that where established in 1970, the same year the final reporting from the study programme was to be delivered. (OECD, 1971b: 15, 99-104).

It seems as if the discussions of regulating chemicals gained an autonomous internal expert driven momentum, which worked on the grounds of a technocratic approach out of reach of the active environmental movement.

No major European environmental groups had the issue of toxic chemicals as prime focus. Instead emphasis was placed on natural habitats or on other technologies, notably nuclear power that came to dominate the environmental discourse from the mid 1970s, and which was important part of a fundamental critique of the industrialised society. The low level of attention that chemicals gained was probably also due to a general orientation among European environmentalists to focus on ecological deterioration rather than threats to public health (see Brickman, Jasanoff, & Ilgen, 1985: 253 and Hajer, 1995: 90). It is therefore likely that the emerging regulations of chemicals in Europe were more open for technocratic approaches than were other parts of the emerging regulation of the environment.

Concurrently was the development characterised by a very intensive and long-lasting work on developing concepts and procedures, with the 1982-OECD report that defined the words used in chemicals regulation as a brilliant example of the harmonisation of concepts (Chemicals Control Legislation: An International Glossary of Key Terms; OECD, 1982a). The intensive work on both defining glossaries and laboratory practises had probably the consequence that the general environmental critique was subjected to substantial translations and harmonisations in the development of coping-strategies.

It is important to see the processes at both a national and an international level. A general picture of divergent strategies in a wide number of industrialised countries led to a situation where the trade with chemicals possibly could become seriously hindered.

The case example to this was the emerging regulation of hazardous chemicals in relation to occupational health, which gained increased attention at the national level from the 1960s. In reaction to national initiatives was the first European regulation on chemicals made in 1967, "when it was recognised that provisions relating to the classification, packaging and labelling of substances on the market, in particular dangerous industrial chemicals, should be harmonised throughout the Community in order to eliminate the barriers to trade that national provisions in the Member States could represent." (EC Commission, 1998: 1). Chemicals was a commodity before they were potential problems, and therefore was national regulations naturally followed by attempts to mitigate possible trade barriers posed by national regulations. And chemicals were indeed a commodity characterised by a high level of international trade.

Therefore was logical when the OECD in 1970 established the Environment Committee, which was given three objectives:

> "To discuss common environmental problems, to examine possible solutions and to develop, where appropriate policies and guidelines for application in industrialised countries" (Nichols & Crawford, 1983: 45)

One of the first acts convened by the Environment Committee was to prolong the cooperation on pesticide-research by establishing a group of national representatives to examine the possibilities for co-operation on pesticides. This group noted that any type of chemical potentially was hazardous, "and that all chemicals merit scrutiny before use for possible effects in the environment as well as directly on man."

Concerns were directed to the widely used chemicals PCB, mercury and cadmium, and a standing subgroup called *The Sector Group on the Unintended Occurrence of Chemicals in the Environment* were established by the Environment Committee (Ibid: 45-46) with the following two main tasks:

> "- to encourage exchange of information between Member countries; and
>
> - to propose concerted approaches to problems which, in respect of use of chemicals »have international implications for environment, economy and trade«." (OECD, 1971a, quoted in Nichols & Crawford, 1983: 45)

The establishment of the Environmental Group in fact changed the agenda of the *Study Group on Unintended Occurrence of Pesticides*, here in the words from the final report from the group in 1970:

> "The original mandate of the group, reproduced in Annex I, was specifically directed towards elucidating those aspects of the problem where the Member countries of the OECD could best benefit from co- operation in research. However, during the currency of the study and subsequent to the approval of the mandate, developments within the structure of the OECD led to the creation of an Environment Committee with a mandate

> calling for examination of economic and trade implications of measures to improve the environment, as well as examination of the technical and research aspects. The final report of the group takes account of this change within the Organisation and the report now published advises on the type of investigations that could and should be made in the context of the enlarged mandate of the responsible committee." (OECD, 1971b: 5)

Trade became thereby a more explicit focal point for the OECD work on chemicals.

The subgroup initiated major studies of PCB, mercury and cadmium, which led to a council decision to restrict the use of PCBs, and a recommendation to reduce all man-made emissions of mercury to the environment, both in 1973 (see e.g. Some Recent OECD Initiatives in the Field of the Environment, 1973).

The international breakthrough for the global perspective on environmental problems came with the "watershed" 1972 UN Stockholm Conference (Carter, 2001). But the OECD already prepared the initial steps and we find probably therefore the elements to a framework for regulating chemicals in the UN conference that corresponds closely to the initiatives already pursued in the OECD. The conference recommended international cooperation in the control with pollutants, contaminants and the most harmful man-made chemicals, and the similarities to the OECD work is striking (see e.g. UN, 1973: Recommendation 74). A number of issues that we find in the following year's OECD negotiations and papers were mentioned in the recommendation, such as the international acceptability of procedures for testing pollutants, International division of labour, and development of international schedules of tests,

A key issue that was brought forward was the need "to provide awareness and *advance warning* of deleterious effects to human health and well being from *man-made pollutants*" (UN, 1973: Recommendation 74, italics added), and in this sense did the conference also refer back to a basic critique of chemicals.

Also the recommendation 76 presented the idea of early prevention (which also was the title of the conference) as central, and it reveals the very strong focus at cancer:

> "That a major effort be undertaken to develop monitoring and both epidemiological and experimental research programmes providing data for *early warning and prevention of the deleterious effects of the various environmental agents*, acting singly or in collaboration, to which man is increasingly exposed, directly or indirectly, and for the assessment of their potential risks to human health, with particular regard to the risks of *mutagenicity, teratogenicity and carcinogenicity*. Such programmes should be guided and coordinated by the World Health Organization;" (UN, 1973: Recommendation 76(a), Italics added):

Teratogenicity refers to defects in the developing foetus, which had been experienced at epidemiological levels with Thalidomide (a tranquiliser) in Europe in 1962, and with DES (a synthetic oestrogen) in the USA in 1971.

The general control of chemicals entered during the early 1970s the regulatory agenda in a number of OECD countries (Switzerland in 1969, Japan and Sweden in 1973) and the OECD subgroup broadened concurrently is focus and changed name to *The Chemicals Group*. In fact the Swedish regulation not only focussed on chemical

substances but also on products, and the act was probably the first official references to the need for precautions in relation to chemicals:

> "Anyone handling or importing products hazardous to man or the environment shall take such steps and otherwise observe such precautions as are needed to prevent or minimize damage to man or the environment. Particularly anyone manufacturing or importing such a product must carefully investigate the composition of the product and its properties from the perspective of health and environmental protection. The product shall be clearly labelled with data of importance from the point of view of protecting health and the environment." (Article 5 of the Act on Products Hazardous to man and the Environment, here quoted from Wahlström, 1999: 52).

The focus of the OECD Chemicals Group was still at chemicals that unintentionally was dispersed in the environment, but the attention was now turned towards the assessment of the chemicals. In 1974 led the work of the Chemicals Group to an OECD Council Recommendation that the member countries should work towards more harmonized approaches with respect to the general control of chemicals, and especially pre-market scrutiny of the chemicals (Nichols & Crawford, 1983: 46-47).

The emphasis on *new* chemicals was central. A prevailing perception of the existing chemicals was that the most problematic effects had been experienced. The world had been used as laboratory, as it was noted by the 1971 US President's Council on Environmental Quality:

> "Our awareness of environmental threats, our ability to screen and test substances for adverse effects, and our ability to monitor and predict … are sufficiently developed that we need no longer be limited in a purely reactive posture with respect to toxic substances. We should no longer be limited to repairing the damage after it has been done, nor should we continue to allow the entire population or the entire environment to be used as a laboratory." (Report of the Council on Environmental Quality on Toxic Substances, Washington DC 1971, here quoted from Nichols & Crawford, 1983: 13)

The lesson learned was that the 'early legislation' in contrast to the 'new generation of legislation' only had focussed on foreseeable hazards presented by chemicals that were intended to have impact on biological systems such as pesticides, pharmaceuticals, food additives, and in some cases also cosmetics and cleaning and hygiene products. Detrimental effects from industrial chemicals were therefore unanticipated. But it was the prevalent perception that these chemicals more or less were single cases:

> "Of course, these chemicals are but a few of the many thousands which are in common use in modern industrialised societies today. Most substances pose no known risk to human health or the environment. But unanticipated problems of major proportions have risen with respect to the manufacture, use and disposal of some. This fact coupled with the sheer number of the chemicals entering the environment and their increasing diversity of use, has indicated a need for more systematic and general controls." (Nichols & Crawford, 1983: 13)

The quote does however also reveal a concern that had grown during the late 1970s and early 1980s as the number of serious accidents and surprising findings such as the widespread occurrences of PCBs, and the newly recognized ozone-depleting effect of

the CFCs. But despite this was the pre-market assessment seen as the prime challenge, as the following quote display nicely:

> "It must […] be recognised that decisions to control chemicals will necessarily, and generally, be made in the face of uncertainties. *And this is, of course, especially true with respect to new chemicals. Until they are actually on the market in use, knowledge of their effects and, indeed, their pathways through the environment will simply be unknown.* There are three fundamental reasons for this. One is the lack of empirical data. Another is found in the complexities inherent in interpretation. Finally, the timeframe for decision making is too short to allow research projects to be undertaken to fill gaps in available knowledge. (Nichols & Crawford, 1983: 96, italics added)

An additional explanation to the strong focus at new chemicals may also be attributed to the chemical industries consistent resistance against testing of chemicals already at the market. It was industry's opinion that testing of the old chemicals would absorb research energy, that it would cut into the profit margins, and that it therefore should be avoided (Brickman, Jasanoff, & Ilgen, 1985: 221).

The assessment of substances at the pre-market stage therefore gained a top priority. The first step in the implementing the recommendation was to study the information needs and gaps with respect to pre-market scrutiny of chemicals, existing practises in pre-market and post-market controls, and the industry's approach to safety testing.

The first Guidelines for testing were recommended in 1977 after negotiations in the Chemicals Group and the Environment Committee, namely the "*Guidelines for Procedures and Requirements for Anticipating Effects of Chemicals on Man and the Environment"*. In OECD was the Guidelines perceived as a success as all OECD countries endorsed them. Same year was the OECD Chemicals Testing Programme launched, and five nations – West Germany, the Netherlands, Japan, US, and UK – volunteered to act as Lead Countries on the programmes on physical-chemical properties of chemical substances, degradation-accumulation of chemicals in the environment, ecotoxicology, long-term toxicology, and short-term toxicology (Nichols & Crawford, 1983: 48-49)

In 1978 the OECD was recognised as authoritative in the standard setting for testing and mutual data accept. This happened at the Hasselby meeting in April where the Western world's most highly industrialised nations and six international organisations met at Hasselby Castle in Stockholm to discuss international dimensions of the chemicals control issue at an informal level:

> "The meeting recognised the urgent need for improved national controls on toxic and hazardous chemicals. It called for harmonization of these efforts to utilise available resources effectively and to avoid economic dislocations. This meant the development of a framework which would allow governments to exchange essential data and other information necessary to evaluating hazards. To this end, the meeting identified the following priorities:
>
> - the development of consistent data requirements and testing methods;
> - the development of consistent standards for good laboratory practice and effective means of enforcing them;

- mechanisms to facilitate information exchange, both with respect to substance-related data and to administrative actions;
- the need to address problems of confidentiality of data, both to ensure international exchange of health and safety data and to provide adequate protection for legitimate trade secrets.

[…]

Recognising that work in some of these priority areas had already been initiated within the OECD forum, it was recommended that the Organisation's Chemicals Programme should be expanded to take account of these issues. Continued support for ongoing activities of other international organisations was also emphasised, although the need to avoid duplication was stressed." (Nichols & Crawford, 1983: 49-50)

The core issue was to develop a system that could safeguard against chemical risk *without* hindering trade with chemicals. At the Hasselby meeting was it for example noted that:

> "In general it can be said that the chance to avoid the risks for barriers to trade in chemicals is directly proportional to the success in agreeing on specific and technical details, and the extent to which nations will be prepared to trust each other with respect to certifications of quality of products." (Schmidt-Bleek & Bonberg, 1978: 17)

In 1979 was a new Division created in the OECD to deal solely with the chemicals projects, and this is the point where the OECD was generally accepted as the authoritative source to a globally harmonised test-strategy. The OECD chemicals programme was created.

8.3 Steps towards Risk Analysis & Risk Management

The political attention to chemicals as a general regulatory problem had grown during the late 1970s. Elements of what later has been coined as the new politics of ecological modernisation (see e.g. Weale, 1992) had begun gaining momentum at the national level, and this resulted in a strong focus at anticipatory strategies at the Minister level in OECD. This was reflected at the 1979 OECD Environment Ministers Meeting:

> "The two central themes of the meeting concerned the State of the Environment and the need to develop Anticipatory Environmental Policies. The meeting reflected changing national environmental policies and, in particular, the pressure felt in OECD countries to reach a better harmony between issues of environmental and economic concern." (Nichols & Crawford, 1983: 51)

The OECD chemicals programme was in fact not on the agenda of this meeting, but it never the less received substantial attention at the meeting. The issue of chemicals regulation and hence the programme probably 'fitted into' the new turn of the environmental politics. As we already have seen was the idea of uniting the control of environmental hazard from chemicals with continued economic growth central for the work that was initiated by the OECD already from the beginning of the 1970s. This concurrent focus at chemicals as problems and as substantially important technology and commodity made the programme an excellent example on what later has been characterised as ecological modernisations. Nichols and Crawford explain that the

Chemicals Programme was discussed at the Environmental Ministers Meeting exactly because of this:

> "[The Chemicals Programme] received considerable favourable attention at the meeting. This is because its aims are anticipatory in the sense of health and environmental protection as well as in the sense of avoiding unnecessary impact on the international chemical industry." (Nichols & Crawford, 1983: 51)

In this sense it seems as if the regulation of chemicals has worked as an exemplar or a metaphor in the OECD for the new politics of pollution as Weale has called the development of the ecological modernisation. It is further interesting to note the dual meaning of the concept of anticipation that embraces both the idea of prevention and that of proportionality.

Nichols & Crawford (Ibid) reported from the meeting that it was the Ministers perception that a successful regulation of chemicals would have to take the "entire life-cycle of a chemical – from inception to grave – […] into consideration". This would involve procedures for managing chemicals that would exceed the mere hazard assessment, and some of those noted at the minister's meeting was:

> "An estimation of the size of the population exposed, the mobility of chemicals in the environment, the genetic and other kinds of risks associated with chemicals, the costs and benefits of delaying use, and of available substitutes. A number of Ministers felt that international agreement on common methods of risk analysis is needed. They also noted that issues relating to import and export control need early review." (Nichols & Crawford, 1983: 51-52)

The shaping of the next level of the regime for managing chemicals – i.e. the level of risk assessment – had reached the minister level in the OECD.

But this level would imply that the previous level was ready developed; the hazard assessment had to be standardised to serve as a fundament for the risk assessment procedures. Therefore, the "Hazard Assessment Project" was initiated by the Chemicals Group in December 1979. The project was co-ordinated by the Step Systems Group led by Sweden. The group had earlier developed the Minimum Pre-marketing set of Data (MPD), and this work became the basis for the Hazard Assessment Project (OECD, 1984: 8-9).

A slight confusion may be created here. In newer literature is hazard-assessment as concept winded up, and overtaken by the risk-assessment concept. This can e.g. be seen in the 1995 state-of-the-art work on risk assessment of chemicals (Van Leeuwen & Hermens, 1995) where hazard assessment is defined as the "comparison of the intrinsic ability to cause harm (see hazard) and expected environmental concentration, often a comparison of PEC [predicted environmental concentration] and PNEC [predicted no effect concentration]. Sometimes referred to as risk assessment." (Van Leeuwen & Hermens, 1995: 348). However, hazard assessment is in the body of this work reduced to be hazard identification and a part step in the risk assessment / management process (Van Leeuwen & Hermens, 1995: 3).

By contrast was hazard assessment perceived in the original "Hazard Assessment Project" as a combined assessment of both chemical's potential to harm biological systems, and it's potential for exposure. Hence, the Project included guides for assessing both:

- physical/chemical parameters and biodegradation
- Toxicity and other biological effects
- Intended Uses
- Suggested Disposal Methods
- Expected Mode of Transport

Later would the latter three issues be included in the risk assessment phase.

In 1980 the Chemicals Programme was formally reviewed at a High Level Meeting of the Chemicals Group of the Environment Committee (OECD, 1981). The meeting was considered a success, stressed by the good attendance and participation of Ministers and senior chemicals administrators from all of the member countries. The report from the meeting enhanced this impression with quotes from the Canadian Deputy Environment Minister and the US EPA Administrator:

> "The Chairman, Mr Seaborn, said afterwards that the Meeting represented »a major step in bringing our countries together in the control of chemicals«. One of the Vice-Chairmen, Mr Costle, regarded it as »perhaps the most significant international meeting on chemicals« and that »it marked a major breakthrough in international co-operation in this field«. (OECD, 1981: 29)

It is very characteristic that the issues discussed was perceived as mainly technical and administrative questions; namely the OECD Test Guidelines; an updating mechanism for the OECD Test Guidelines; the OECD Principles of Good Laboratory Practise; the OECD Minimum Pre- marketing Set of Data; and the (OECD, 1981: 31). The fifth issue – Mutual Acceptance of Data – has been considered to be the major achievement of the meeting (Nichols & Crawford, 1983: 52):

> Agreement on Mutual Acceptance of Data may, however, be considered the major achievement of the meeting. Acceptance of this principle ensures that data used in assessment of chemicals must be accepted as valid by all OECD countries provided certain procedures have been followed. These are use of the Test Guidelines and adherence to the OECD Principles of Good Laboratory Practice.
>
> With approval of this principle by the High Level Meeting, international harmonization moved from the realm of desirable policy goals, to reality. Formal adoption of the principle by the OECD Council Decision in 1981 established clearly the commitment of OECD countries to such harmonization (see Chapter 3).

The provisionally agreement to confirm to these principles was approved in May 1981 by OECD Council and thereby was the basis of a harmonisation regime for the regulation of chemicals a political reality. With this in place, the development of a management regime could take shape. The overall Programme for Chemicals was developed that year jointly by the OECD Management Group and Chemicals Group with the following major components:

i) The development of methods and guidelines for hazard assessment;
ii) Analysis of approaches to step sequence schemes for testing chemicals;
iii) The updating of the OECD Test Guidelines, their modification to take account of new scientific advances and the introduction of new Guidelines as necessary;
iv) Analysis of the economic and trade dimensions of chemicals control including possible impacts on innovation and economic aspects of decision making;
v) Priorities for assessment and control of existing chemicals;
vi) Concerted action, where necessary, on specific chemicals;
vii) Review of the principles underlying administrative and legislative approaches to chemicals controls;
viii) The development of mechanisms to facilitate information exchange to meet the needs of regulators; and
ix) Implementation of Council actions and High Level Meeting conclusions on chemicals control including the completion of expert work on confidentiality, the Glossary and GEP.11

(Nichols & Crawford, 1983: 53)

Nichols and Crawford summarized in 1983 the status of the management of chemicals as follows:

> "It is clear that the decision-making process on chemicals requires a great deal of flexibility in the selection, use and trade-offs between various factors. On the other hand, the interests of the chemical industry and the community at large dictate that approaches be developed which encourage the production of rational, consistent and credible results, which can be readily understood and relied upon in planning both domestically and internationally." (Nichols & Crawford, 1983: 98)

This is immensely central for the understanding of the dilemmas of the chemicals regulation. On the one hand was there very early established accept of the uncertainties inherent in assessing chemicals and therefore the need for flexibility and room for scientific creativity in the assessment of the specific chemical. This is clear in the guidelines for the Minimum Pre-marketing set of Data (MPD) that states:

> "PROVISIONS FOR FLEXIBLE APPLICATION OF THE
> OECD MINIMUM PRE-MARKETING SET OF DATA
>
> 1. Those conducting the tests must have the option to omit or substitute tests so long as they can scientifically justify their course of action and demonstrate the equal or superior performance and predictive power of replacement tests (omissions/ substitutions).
>
> 2. Those undertaking the assessments must have the option at any time to require information beyond the MPD in individual cases so long as they can justify their course of action (additions/substitutions)."
>
> (Nichols & Crawford, 1983: 59)

On the other hand the industry and the regulators were interested in clear and unambiguous rules for testing and for interpreting the test results. The use of the words "rational, consistent and credible results" is remarkable, and it is stumbling close to attach the opposite to the 'flexible approach'.

8.4 The "New Generation" of Chemicals Regulation in the Seventies and Eighties

Concurrently with the built-up of the OECD basis for harmonisation was a regulatory frame established. A prevalent perception was that the 'new generation legislation' was in contrast to the 'old generation legislation', which had been focused at the more obvious suspects – chemicals that were biologically active or that was intended for intake. The new generation legislation was supposed to identify problems at the pre-market stage, and to be applied in principle to all chemicals. The first-movers in establishing this type of regulations was examined by the OECD in 1975-76 (OECD, 1976):

- Canada (Environmental Contaminants Act of 1975),
- France (Bill on the Control of Chemicals Dispersed in the Environment – Proposed in 1975, passed in 1977),
- Japan (Chemical Substances Control Law – 1973),
- Norway (Act Concerning The Control of Products Hazardous to Health and Environment – proposed in 1975, passed in 1976),
- Sweden (Act on Products Hazardous to Man or the Environment – 1973),
- Switzerland (Law on Trade in Toxic Substances of 21st March, 1969),
- United Kingdom (Control of Pollution Act 1974 Section 100), and
- United States of America (Toxic Substances Control Act – pending 1975, passed in 1976).

The report reproduces the states' reason for enacting the regulations, and these are well represented by the Japanese explanation:

> "The need for comprehensive measures to prevent environmental pollution by "persistent" chemicals (such as PCBs, DDT, etc.) was recognised following occurrence of several environmental crises related to chemicals, e.g. Minamata disease (caused by mercury) and the Kanemi rice bran oil incident (by PCBs). It was found that in such cases existing legislation was inadequate to effect control. For this reason, the Government proposed a bill to provide for prior examination and regulatory measures for all chemicals. The Chemical Substances Control Act was enacted in September 1973." (OECD, 1976: 14)

But beside this primarily reason for the establishment of legislation for the control with side effects of chemicals, started the trade and economic implications of the regulations getting explicit political importance for the national approaches to the regulation from the end of the 1970s. It was of course this prospect that had activated the OECD attention to the issue, which is clear from the number of OECD publications, dealing with these issues, and published in the 1970s and early 1980's[23].

[23] See e.g. The Impact of Chemicals Control upon Trade, Innovation and the Small Firm (OECD, 1982b) Economic Aspects of International Chemicals Control (OECD, 1983), Proceedings from the international meeting on the control of toxic substances in 1978 (Schmidt-Bleek & Bonberg, 1978).

The most important event that marked the transition to the new type of regulations, and the enhanced attention to the market and trade implications of the regulation was the enactment of the US Toxic Substances Control Act called TSCA. The TSCA did not address any specific substances but represented an influential attempt to define the universe of chemicals and thereby create the legislative framework that made it possible for the US EPA to track the numerous industrial chemicals produced or imported into the country. The EPA could now screen chemicals and require reporting or testing of those that possibly could pose an environmental or human-health hazard, and the EPA could ban the manufacture and import of those chemicals would be assessed to pose an unreasonable risk. The TSCA was basically a framework for pre-market notifications to new chemicals. But to define what is new imply the definition of what is old, and therefore the TSCA included a Chemical Substance Inventory of chemical substances manufactured for commercial purposes, where "manufactured" included "imported" for purposes of the same requirement. The inventory of "existing" chemicals, that is chemical substances already in commerce, was build up during an initial reporting period, and any substance not on this Initial Inventory was covered by the for pre-market notification for new substances (see LIBRIZZI, 1977, USEPA, 2003).

In Europe was the enactment of the TSCA seen as a provocative step; the TSCA was perceived by industrialists as a major threat to the continued access to the important American market, and officials was troubled by the US solitary approach to the regulation (Brickman, Jasanoff, & Ilgen, 1985: 276). Brickman, Jasanoff and Ilgen illustrate the frustration with the following quote from a UK spokesman:

> "I cannot understand the language of the Act. In its wording a chemical substance is not a chemical substance; the environment is not the environment … "manufacture" means "import"; in short, everything means everything – including everything else. There also exists international machinery (notably in the OECD) – effective, intelligent, well-serviced machinery-for discussing these subjects, exchanging information, and obtaining advice from individual governments. You have chosen to ignore that machinery. When you know what you want to do, and have something to say to us which we can understand, approach us through proper channels. . . . Until then do not expect the international community to compensate for the defects in your own approach to problems." (Remarks of Alan Smith, Washington, D.C., March, 1977 reproduced after Brickman, Jasanoff, & Ilgen, 1985: 276-277)

According to Brickman, Jasanoff and Ilgen (1985: 277) did officials and industrialists in Europe realise that the future negotiation strength for the setting of international standards covering the chemical market would require an internal European agreement. In this way became the TSCA the occasion that accelerated the development of the new chemicals legislation in Europe. West Germany and the United Kingdom had for some time been discussing their own programmes for chemicals screening, but for various reasons did they both see advantages in first reaching agreement at the EC level. Especially the West German Chemical Industry was characterised by a high level of export to EC countries (50%), which made it intrinsically important to have harmonised pre-market legislation. The only EC

member that proceeded with the enactment of chemical screening legislation was France. The proposal made in 1975 was passed in 1977, which should be seen as reflecting three circumstances; a prompt response to the TSCA; a growing environmental pressure from the mid-1970s; and a hope to increase the French leverage over the ongoing EC-negotiations (Brickman, Jasanoff, & Ilgen, 1985: 278).

8.4.1 Establishment of the Current European System for Assessment of Chemcials

The EC-Commission reacted promptly to the TSCA by issuing a proposal to establish a common framework for national notification schemes. The proposal consisted of frame regulation that should harmonise member state pre-market notification schemes. It would take three years before the discussion was tied up with the sixth amendment of the directive 67/548/EEC on classification and labelling of dangerous substances. Two issues dominated the discussions, where the positions of West Germany and the United Kingdom represented the two antagonistic extremes. The first issue regarded the extent of exemptions from testing requirements, and the second was the degree of flexibility allowed to national authorities in adapting the testing requirements to individual substances or classes of substances (Ibid).

The British argued that all new chemicals manufactured or imported in volumes less than one tonnes should be exempted from full notification, and that national authorities should have substantial degrees of freedom to define testing requirements for specific substances (Ibid). The German position was opposite. At ministry level was it seen as important to secure that requirements imposed on German industry would be matched by requirements in other countries, and the German industry, "wary of overzealous bureaucrats and the volatility of domestic politics, wanted a full delineation of their obligations to be defined at the EC level" (Ibid: 279). Therefore was it possible for the Germans to have industrial accept to the "Stufenplan", which was a plan based on a tired approach to the testing – much alike the step-sequence work that was initiated in the OECD in 1977 with Sweden as lead country (ibid, Nichols & Crawford, 1983: 49). The German officials advocated with this plan an approach with a 0.1 tonnes threshold for notification. The negotiations were stuck until both the TSCA and the French law was implemented in 1979. In May the Germans accepted the one tonnes threshold and in return did the British accept a modified form of the Stufenplan, though with considerable flexibility incorporated at all levels.

The Sixth Amendment went further than the TSCA with respect to data requirements. Under the TSCA industry was not required to perform additional tests for the pre-marketing notification (PMN), but just to submit all available data on the notified substance. Under the Sixth Amendment was the data requirement determined by the foreseen production volume of the substance as shown in Figure 8.1, so that the data requirements are reduced if production / import was below 0,1 tonnes and 1 tonnes, and increased if volume exceeds 100 tonnes and 1000 tonnes. This implies that the producer or importer of a new substance in contrast to the TSCA are required to produce eventual missing data. The Sixth Amendment was at that time perceived as "the EC's crowning achievement in the area of chemical control." (Brickman, Jasanoff, & Ilgen, 1985: 279).

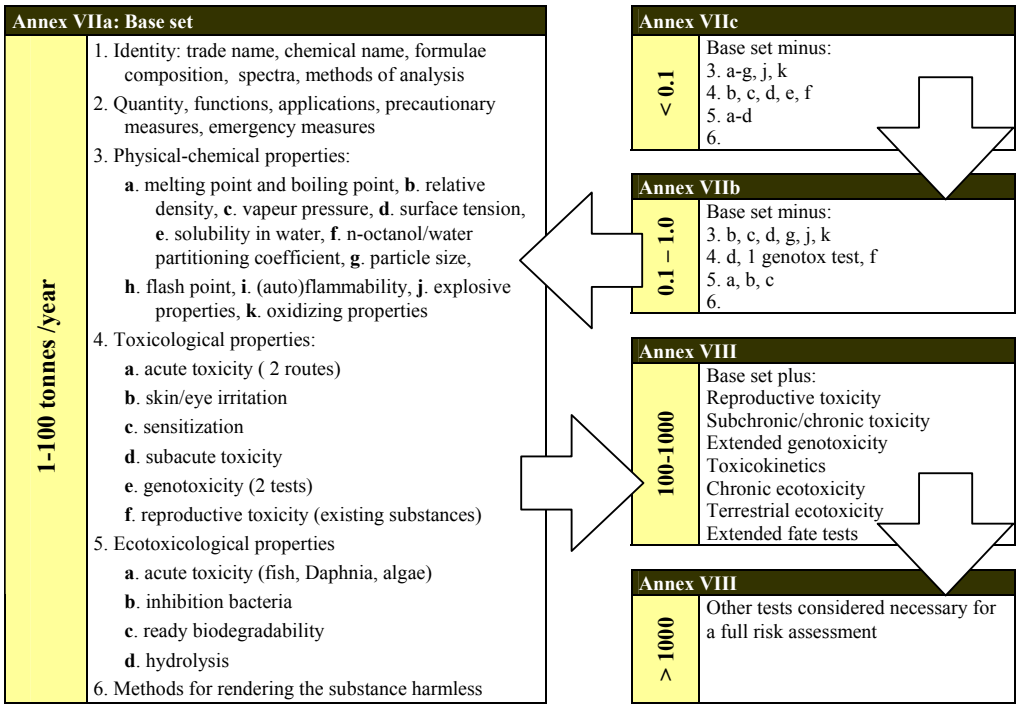


Figure 8.1 The tired approach of the Sixth Amendment (EC Commission, 1979: 21-28). *Substances has to be tested according to production / import volumes. The first category is volumes smaller than 100 kg and the last is volumes larger than 1,000 tonnes. After Vermeire & Van Der Zandt (1995: 294).*

The substances to be tested according to this scheme was all new chemicals, but the definition of these necessitated, just as under the TSCA, the identification of existing chemicals. September the 18th 1981 was set as the terminal date that divided all chemicals at the European market in 'old chemicals' and 'new chemicals'. The substances eligible for the European Inventory of Existing Commercial Chemical Substances – the EINECS-list – was those marketed in the period from January 1st 1971 to September the 18th 1981. The inclusion of a substance on this list had the consequence that the substance could and still can be marketed without any further notification, unless specific conditions or suspicion would give occasion for notification and eventual evaluation (EC Commission, 1979, GEISS et al., 1992, EC Commission, 1990). Therefore, there was a substantial economic incentive for the industry to have as many substances as possible notified as 'existing substances'. It took several years to register which substances had been marketed up to the terminal day of the Sixth amendment, but well into the 1980's the was 100.106 different substances registered. It has been suggested that the chemical industry, to save inconvenience and expenses due to registration, may have registered substances that was expected to be marketed (Bro-Rasmussen et al., 1996: 34). The list represented an immense effort, and it was not finalised before 1986; and the official publication came in 1990 e.g. the Danish version of the EINECS (EC Commission, 1990; GEISS et al., 1992: 24-25).

The Sixth Amendment was followed by the Seventh Amendment in 1992 (Directive 92/32/EEC) that outlined how the notification and risk assessment process should proceed for new substances, and in 1993 was the detailed principles for how to carry out the risk assessment adopted with Directive 93/67/EEC. This directive was and is supported by more detailed technical guidance documents (TGDs – see http://ecb.jrc.it/new-chemicals/) on environmental and consumer exposure assessment, occupational exposure assessment and testing strategies for the endpoints ecotoxicity, inhalation toxicity, genotoxicity, reproductive toxicity, carcinogenicity and sub-chronic/chronic toxicity (Vermeire & Van Der Zandt, 1995: 295).

8.4.2 Attitudes to existing chemicals

But the existing substances, that was defined while defining the new chemicals, was not embraced by any systematic regulation before 1993, even though the work under the Hazardous Substances Directive from 1967 (67/548/EEC) did continue. Subsequent directives did prescribe similar requirements to specific groups of dangerous chemical preparations such as (after Smeets, 1981):

- the "Solvents directive" (73/173/EEC, June 4 , 1973) concerned with dangerous preparations and certain substances solely intended for use as solvent
- the " Paints directive " (77/728/EEC, November 7, 1977) concerning paints, varnishes, printing inks, adhesives, and similar products.
- the " Pesticides directive " (78/631/EEC, June 26, 1978).

It must have been obvious to all involved parties that alone the volume of the EINECS lists was a problem. At the general level noted the two OECD chemicals experts, Nichols and Crawford, in 1983 that the existing chemicals should be assessed, and that the small amount of available data was the central problem:

> "This is not to say that no data exist on these many chemicals. In developing its products, industry has generated a great deal of information. The problem is that it is not readily accessible to government. Some of the data are available in the literature, but have not been gathered and evaluated for government decision making purposes. *Review of these chemicals **is** necessary because most were marketed before the state of the art in chemicals testing had advanced beyond approaches focussing on efficacy and immediate health effects testing*."(Nichols & Crawford, 1983: 99, italics added)

The reason why the focus was mainly targeted at the new chemicals did the two experts explain with two reasons, which also has been reflected upon in the previous parts of this text:

> "In the OECD and other international forums work on the management of chemicals generally has focussed on new chemicals. There are two major reasons for this. First, it reflects national initiatives to tackle the general control of chemicals in stages. Secondly, a programme aimed at the management of new chemicals establishes preventive approaches to chemicals management. This reduces the number of chemicals on the market about which little is known with respect to environmental and long-range health effects." (Nichols & Crawford, 1983: 99)

At the 1980 conference "CHEMISTRY - MAN - ENVIRONMENT : The price we pay for Progress: The hazards of the halogenated hydrocarbons" arranged by 74 NGO's had it mainly been representatives for OECD and the EEC that explicitly addressed the issue of the existing chemicals, here Crawford from the OECD (Crawford, 1981: 197):

> "As I noted earlier, there are today many chemicals on the market which have been subject to little analysis. We know that some of these could pose serious health and environmental problems; A major question facing chemical regulators is, simply, how do we select from these 70,000 chemicals those in need of further analysis. Thus, one future area of international work will be consideration of the criteria necessary to make such a selection. Once such selection is made, the work that has been accomplished with respect to new chemicals will be critical to the evaluation of existing chemicals. Of course the order of magnitude of the possible economic effect of regulation is greater for existing than new chemicals so current OECD work on trade-offs, risk assessment and decision-making will be also very important in looking at this issue."

At that conference was the only explicit NGO-reference to the problem with existing substances not tested was made by Karim Ahmed & Jacob Scherr (Ibid: 156) from the Natural Resources Defense Council who coined the weaknesses of the concurrent European strategy with respect to the existing chemicals:

> "In the U.S., under the Toxic Substances Control Act, the federal Environmental Protection Agency (EPA) is authorized to require retrospective testing by manufacturers of compounds placed on a priority list by an Interagency Testing Committee. At present, there is no similar counterpart regulatory authority vested with any of the E.E.C. member states. This is indeed a glaring regulatory omission in European countries. One can only hope that future legislation will follow-the U.S. example in creating a program for testing of existing chemical substances."

However, at that time was the overarching focus aimed at the problems from hazardous wastes, and probably not without reason:

> "In the U.S. today, over 40 million tons of hazardous wastes are generated each year and the problem of safely disposing this waste material continues to elude any easy solution. There is, at present, an almost nightmarish concern about the potential contamination of groundwater supplies by existing hazardous waste sites." (Ibid: 157)

This overarching focus on hazardous wastes are also to be found e.g. in FoE's comment to the Stockholm Conference (Friends of the Earth, 1972).

To me this raises a number of questions. Why did it take so long time before the 'old' chemicals came under the spotlight? Was it because of specific political settings that did not facilitate a focus at the rather abstract issue of regulation of effects that we de facto do not know? I will in the following section – to get a little closer to this – elucidate the environmental and labour-related attention to the issue, and thereafter proceed to the developments that today has led to the EU Commission's proposal for a new strategy for the regulation of chemicals.

The regime for chemicals regulation developed in an environment of concerned experts and technocrats, who seems to have been quite isolated from a general public

debate and critic. When we interpret documents from the first phase of the creation of the regime we can find reference made to Rachel Carson's Silent spring, to Meadows Limit's to growth, and to Blueprint for Survival. An important example on this is the introducing chapter in the manifest book about chemicals management in the 1970s and 1980s "managing Chemicals in the 1980s" by Nichols and Crawford (1983: 11). However, there was no effective platform for continued public influence with respect to the development of the chemicals regulation-regime.

Scholars discussing the social movements of the 1970s may give us various perspectives to explain this. I introduced this chapter with pointing to two possible explanations, i.e. that the movements were mostly concerned with ecological deterioration and with nuclear power (Brickman, Jasanoff, & Ilgen, 1985& Hajer, 1995 op cit). One of the discussions that emerge from the literature is whether the movement was single issue oriented or focused at systems critique. I will propose that it was both. Hajer (1995) describes nuclear power as emblematic for the movements of the 1970s; "centralized, technologically complex and hazardous, an reinforcing all those trends in society which environmentalists most fear and dislike – the increasing dominance of experts, threatening the freedom of the individual, and reinforcing totalitarian tendencies" (Cotgrove 1980: 338, here quoted after Hajer, 1995: 91). On the other hand were a lot of the environmentalist activities targeted at concrete and visible problems. Chemicals were naturally central for the types of problems targeted but mainly so in shape of toxic waste problems and hazardous production-sites. The focus at concrete problems is not identical with a single issue focus, but case focuses have the tendency of singling out problems, even though there may be a general critical analysis behind, and this may be exaggerated through translations in the news coverage system and the political system.

Furthermore was the type of chemicals regulation that was in the making in the international fora and especially in the OECD characterised a highly specialised approach that depended on centralised or a least harmonised employment of expert knowledge. The emerging chemicals regulation had therefore neither the systems critique that was inherent in the critique against the employment of nuclear power, nor had it the appeal of the disastrous effects of hazardous chemicals in uncontrolled waste-disposal and risky production-sites. The environmental movement constituted – most outspoken in continental Europe – an independent discourse coalition with alternative life styles and new organisations structures including alternative communicative practises such as mass demonstrations, and separate newspapers and radio stations (Hajer, 1995: 90). It is therefore comprehensible that the type of chemicals regulation discussed in the OECD had low relevance for the contemporary environmentalists of the 1970s – the regulation was simply perceived as not targeting the basic problems that were perceived as causing environmental degradation, but on the contrary as furthering international trade and covering up for its diverted problems. As Jamison et al notes did the environmentalism attack "what was seen as a global tendency towards formalised expertise and bureaucratic organisation in knowledge production", and endorsed a radical democratic vision of a science for the people (Jamison et al., 1990: 186)

8.5 Critique of Chemicals

So where did the critique of chemicals go after the Silent Spring? In the search for the answer will we in the following pay special attention to processes that took place at the Danish domestic scene in the 1970s.

We start, however, at the international level: In the making of the Silent Spring had Carson departed from the profound and general critique of human use of synthetic chemicals and had instead targeted the use of pesticides. This should probably be seen as a strategic move, as pesticides were easier to convey as a public issue. But separate actor-groups reintroduced during the 1970s – at very different levels – the general critique of chemicals. The first group was central for the developments described in the previous sections. These actors were e.g. the experts dealing with international cooperation on establishing knowledge about adverse effects from pesticides. The preparatory OECD workgroup had been given the task to assess "the problem of persistent pesticides" but the group extended on own initiative the original mandate by also including certain other chemicals with similar behaviour in the work that was taken over by the environmental committee when it was formed in 1970 (OECD, 1971b: 5). The singling out of pesticides from other types of chemicals was perceived as 'artificial'. Hence, there was already from the beginning of the 1970s a movement among experts towards an integrative view on the problems related to chemicals. This type of what we can call 'concerned experts' seems to have played an important role for the creation of regimes for understanding and dealing with environmental problems, possibly as translators of concerns and critic formed and articulated by other actors and groupings. It is important to see that these experts principally representing the national state in international for a was different from or at least only loosely connected to the critical wave within the scientific community that during the 1960s gave word to the new environmental consciousness, and which grew into general public debate in the late 1960s (Jamison et al., 1990: 9).

The next two types of groupings was both movement-based, but approached the chemicals from different angles. The first of these was the radical environmental movement governed by a fundamental critique of the modern industrial society, and the technologies that it employs. The second grouping was concerned with care for occupational health. Common for both of these groupings was that they grew out of the anti-authoritarian student revolts of the 1960s. However, the crossovers between the two groupings were limited despite this communality.

8.5.1 Movement based Critique

The environmental movement had at the outset been concerned with synthetic chemicals as the prime technological artefact defining the environmentalist 'other', but nuclear power became increasingly the symbol of everything that was wrong with society (Jamison et al., 1990: 186; Hajer, 1995: 92). This transformation of the primary symbol for what was wrong with the industrialised society must be explained by a combination of a number of factors, of which those related to nuclear power has been discussed by a number of scholars (see e.g. Hajer, 1995; Flam, 1994; Rüdig,

1990)[24]. The more straightforward character of the nuclear power compared to chemical technology made it more useful as basis for critique. Nuclear power was one very specific and centralised type of energy supply, which furthermore was internally related to nuclear warfare, whereas chemical technology tended to be an extremely integrated type of technology associated to almost any part of society, which made it more difficult to 'single out' and isolate the broad phenomena for critic.

This is probably why chemicals mainly received attention from the environmental movement as specific examples of the industrial societies malfunction (see e.g. Læssøe, 1987 and Jamison et al., 1990 for elaborate discussions of the new environmentalism in Denmark, Sweden and the Netherlands).

The second movement grouping focussed at the problems related to chemicals in the working environment. This second movement grouping was far the most important in shaping the critique of chemicals in Denmark, which also was stressed by the fact that NOAH, a Danish variation of Friends of the Earth, ended up supporting the working environment perspective. In relation to chemicals Changed NOAH by the end of the 1970s from the traditional focus of the environmental criticism with distinctive outset in the limits to growth discussion and the systems ecology paradigm system that characterised environmental activities in general (see Jamison, 1993). Instead began NOAH in the late 1970s to discuss occupational health in a societal context, and did so in a way that supported the positions that during the 1970s was developed among employee's organisations. This move was made out of the consideration that polluting substances at work did not differ from polluting substances in nature, and that it therefore would be important to bridge the conflicts that often had emerged between workers and environmentalists when NOAH had been campaigning against specific industrial sites (See Ansbæk, 1977; Ansbæk, 1979). NOAH approached the working environment question at a time when the chemicals critique was developed from being a radical outpost to become a position generally adopted by the labour-movement.

8.5.2 Danish Critique of Chemicals in the Working Environment

The 1970s critique of chemicals started in occupational context in Denmark as an offspring from the anti-authoritarian movements and the student protests of the late 1960s in the cooperation between academics and workers beginning in the 1970s and in some parts of the Union (especially in the General Workers' Union), and before chemicals became a central issue for the Danish labour movement in the late 1970s (see e.g. Gregersen, 2000). In a number of spectacular reports were concrete problems with chemicals in the working environment criticised. Important was the painter report, the linoleum report, and related struggles to remove organic solvents from the workers environment (see e.g. Glud, Jensen, & Nielsen, 1971; Petersen et al., 1972). An other important case was the building workers' Unions boycott actions against epoxy products which ultimately resulted in the introduction of special regulations of these products in 1978 (see e.g. Nielsen & Poulsen, 1986 and Jørgensen, 1985).

[24] It is important to stress that this shift predominantly occurred in Europe; the accident at the Three Mile Island nuclear power plant in Harrisburg, USA, 1979 led to a de facto moratorium on further construction of plants, which took the wind out of the sail of the radical movement in the USA. (see Hajer, 1995: 93, Rüdig, 1990: 3)

In the Linoleum-report from 1972 was the lagging control with new substances problematized:

> "Finally did The National Board of Health confirm: »there exist no arrangement ensuring control with all the substances that are used. If a new substance are introduced and used to a certain extent – either in the private households or at the workplaces – then will The Danish Working Environment Service or we [The National Board of Health] pay attention to the substance. But we have no active body in the sense that we demand that all companies must report what [substances] they use, or anything like that! « It is very scary that any company can use any chemical substance without any duty to report it and have the effects investigated. I ought to be so that all companies were required to declare which new substances they intended to use. The use should be prohibited if investigations show that the substance was injurious to health." (Petersen et al., 1972: 41-42)

The critic formulated i.e. in the painter report, and the linoleum report did indeed have a shaping effect on the developing approach to chemicals in the working life, and it was critique and arguments of a similar kind that ultimately would lead to the passage of the bill on the Danish Product Register in 1981 (Bekendtgørelse om registret for stoffer og materialer (Gældende) 1981/9/14) that redeemed parts of these demands, and which still is in force.

However, in the early 1970s was the occupational health concern mainly targeted at the consequences of the ever more effective industry e.g. in shape of automation and increased speed in working, and with the development of the Health and Safety at Work Act, that was to regulate the problems; namely that the improved standard of living that had been experienced since the mid 1950s had only sparsely been accompanied by corresponding improvements in the conditions of the working environment (Arbejdsmiljøgruppen, 1973:133).

The minister had in 1971 appointed a committee that should analyse issues related to the working environment and make recommendations for action. The committee consisted of prominent representatives from different research institutions and expert organisations, and it had a supporting committee with representatives from the relevant government offices and interest parties from the two sides of industry (the committee's mandate in Arbejdsmiljøgruppen, 1973: 133, 136).

Chemicals appear in the committee's third report from 1975, where explicit reference was made to the radical reports, i.e. the painter report and the linoleum report made by academics and workers in the early 1970's, as important documentation of the lagging control with chemicals in numerous businesses (Arbejdsmiljøgruppen, 1975: 34-35). However, the report did not advance critic of the bill to the Health and Safety at Work Act but reflected the act. The importance of the report in the present context is rather that it also reproduces both general and specific positions in relation to chemicals regulation in the early 1970s. The report reproduced some of the contemporary arguments pro and contra to a tightened regulation of chemicals, of which I have reproduced the following four because they relate to conception of incertitude and level of proof.

Contra regulation arguments	Pro regulation arguments
"It creates feeling of insecurity among the population to raise [attention to] a number of problems related to insidious dangers, such as carcinogenic substances and congenital malformations, when one cannot indicate how the problems are to be solved."	"Problems will certainly not be solved, if they are not raised. In a democratic society is it fundamental that the public attention is being drawn to the social problems now and in the future. Otherwise is it an illusion to believe that people sensible can take position on the problems."
"Our present life is based so substantially on substances and preparations that a considerable restriction will make it difficult to maintain our present Welfare State."	"Damage and harm stemming from the working environment burden the community household. Moreover, one should not let a minority pay with failing health for the majority's welfare."
"We know too little to justify drastic intervention."	"We know a good deal and we will get far with that we do know, especially if add the knowledge of the single countries in international co-operation. Besides, it must be questioned whether ignorance should lead to that we must manufacture and take the risk, or if we should wait until we have knowledge that can provide safety [translated from word that also means certainty]."
"Full safety [certainty] cannot be obtained."	"It is not a question of an either-or situation, but a question of how far one is willing to go. The higher requirements, the more is the research relating to safety furthered. Experience show that greater knowledge usually lead to increased safety requirements. Our ignorance has – so far – more often concealed unknown risks than unreasoned fear."

Table 8.2 Positions pro and contra to a tightening of chemicals regulation in Denmark in the early 1970s.
From Arbejdsmiljøgruppen, 1975: 35-36.

The committee's position was that a tightening of the chemicals regulation was needed. The existing legislation was criticised as diffuse, that no authority had comprehensive view of the body of laws, and that the existing knowledge and research made a too weak basis for an adequate regulation (Arbejdsmiljøgruppen, 1975: 38). The committee recommended that a new committee should give a concrete recommendation for how society could improve the control the use of hazardous substances and preparations considering the working environment, the environment, and the public health in general. The new committee should consist of members from relevant government departments, administration, and institutions, from management and labour, and from other interest groups, implied consumer and environmental interests (Ibid: 39). The committee had a number of suggestions that a future committee should consider in the making of a comprehensive chemicals strategy. Central for these suggestions was inspiration from recent initiatives in Norway and Sweden to solve problems with chemicals in the in working environment. Two issues got special attention in the committee-report's description of these initiatives: 1) the establishment of central registers over substances and preparations used in the working environment, which existed in Norway as a parliamentary motion in 1974) and 2) the establishment of supplier-responsibility with respect to knowledge of composition and possible hazards related to the product in Sweden in 1972.

The committee's recommendation was that the control with chemicals in the working environment should be improved by in a number of areas including use of positive lists for substances in a gradually extended number of applications, by supplier responsibility for information about hazards related to products, and by safety procedures including information duty and use of least harmful substances.

The supplier responsibility should be tightened:

> "Suppliers of substances and preparations must inform costumers and users about the product, e.g.:
>
> *by* declare the contents of the products, either directly on the packaging or – if the supplier want to keep the manufacture process secret - in return for a fee to an information central office,
>
> *by* using easily understood and adequately informative labelling that guide how the product is handled"
>
> (Arbejdsmiljøgruppen, 1975: 154)

The committee recommend further that hazards should be avoided by substituting hazardous substances with safe substances or at least less hazardous substances and suggested that this should be furthered with taxes on dangerous substances or on the use of these substances (Ibid: 53). As a rather radical suggestion did the committee suggest to extend the workers existing right to come out on strike in case of unsafe working conditions, to include situations with *suspicion* of hazard, especially when new substances was included. (Ibid: 54)

Discussing the importance of setting up limit values and exposure norms, did the committee criticise that the existing practise in the western industrialised world by focussing on "*visible or marked* symptom of illness or nuisance [… and by …] stressing more or less isolated alterations in cells and organs" tendentiously were allowing too high limit values. The committee argued that the fixing of limit values basically was a political decision, because the decision often would have to be based on a number of assessments:

> "Limit values are therefore not demarcating sharp limits between harmful and harmless exposures. In principle should concentrations of harmful airborne substances be as low as possible, not least out of consideration for eventually unknown long-term effects.
>
> The working environment group [the committee] therefore find that, by using strict criterion for setting limit values, will it be possible to generally reduce the gradual run down caused by harmful airborne substances etc." (Arbejdsmiljøgruppen, 1975: 45).

The report recount a rather detailed and differentiated view on the problems of chemicals in the working environment and it documents the dissemination of the concern.

The health and safety at work act was passed December 17th 1975 by the Danish Parliament, shortly after the publication of the committee's report, and at that point did chemicals in the working life gain broader more attention. The Minister of Labour (Erling Dinesen, the Social Democratic Party) acknowledged, when the act was passed, that the act did not sufficiently take into account solutions of chemical

occupational health problems (LO, 1980: 48). The Act was passed with votes from the Social Democrats, the Social Liberals, and Christian People's Party. Against was the Conservatives, the Liberals, the Progress Party, and the left-wing Socialists, accusing the act either for being interfering with the employers rights, or for being empty symbolic politics. The leader of the Socialist People's Party, Gert Petersen, explained the blank vote:

> "We regret very much that it was not possible for the majority to accept what is called positive-lists, i.e. pre.-market approval of dangerous substances and preparations. Accordingly, new substances and preparations may not be utilized before they are approved by the Danish Working Environment Service." (Gert Petersen quoted in AAA, 1985)

The argumentation originally formed by radicals likes the AAA was partly adapted by the Danish Trades Union Congress and a number of union federations and trade unions during the last part of the 1970s. The increased attention to chemicals in the working life can be traced in the Danish Trades Union Congress' report where chemicals in 1975 for the first time appear as an issue:

> "One of the most serious single occupational health problems is unreservedly the chemical working environment problems. In preparation for the establishment of an adequate regulation of these chemical problems, did LO [the Danish Trades Union Congress] set up an expert committee December 1975, which shall go through the chemical problems and advance proposals to the trade-union movement's efforts in this area." (LO, 1976: 39)

The union required, during the years after the approval of the health and safety at work act, that all chemical substances in the working environment should be tested and approved within 15 years, and that no new substances should be approved after a five-year period.

Summer 1975 the General Workers' Union (SiD) in Denmark published a devastating criticism of the existing hygienic limit values. *Life, Honour, and Welfare under "the Wings of Science"*, as the report was titled, forwarded the same point of view on limit values as did the committee, though in an aggravated tone:

> "One feels powerless in word and action when concluding on the present report's facts that loud and clear tell that the intention with the American norms never has been to grant an effective protection against exposures during a whole working life." (Demsitz, 1975: 1)

As in most parts of the western world were the Danish hygienic limit values based on American norms, but the value basis of the American norms were received with uneasiness by the General Workers' Union's consultant. Especially was the author concerned with the use of the words *believed, nearly,* and *small* in the preamble to publication with the norms*:*

> "Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is *believed* that *nearly* all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a *small* percentage of workers may experience discomfort from

> some substances at concentrations at or below the threshold limit, a smaller percentage may be affected more seriously by aggravation of a pre-existing condition or by development of an occupational illness" (TLVs® Threshold Limit Values for Chemical Substances in Workroom Air Adopted by ACGIH for 1974, quoted in Demsitz, 1975: exhibit no 2, italics added)

The General Workers' Union's executive committee took the report very serious; the union had before attempted to persuade the Danish Working Environment Service and the Ministry of Labour to tighten the limit values, but without results. Now the union found that its case was reinforced and the executive committee made the following statement: "We have lost all confidence in the existing norms, and until long-term scientific experiments considering the individuals health and safety exists, then will we allow the worker the benefit of the doubt and use the lowest documented norms" (Quoted in Rabing, 1975a). The executive committee approached concurrently the LO, suggesting that the General Union should take initiative to recommend new tightened hygienic limit values, and the request was answered, as it was reflected in the Danish Trades Union Congress' congress-report. The assembly was held in October and the expert committee was set up in December and should review existing relevant knowledge and on that basis produce a list that the Danish Trades Union Congress could recommend (Rabing, 1975a; Rabing, 1975b).

However, it took several years before new limit values would be adapted, even though the expert committee was asked to deliver within a short term. In the meanwhile were a related and central discussion opened, namely the questions of pre-market notifications and pre-market approvals. While this question was settled in the EEC during the late 1970s in such a way that substances market before a certain date (September 18th 1981) was to be notificated before marketed, was a slightly more profound strategy was followed in Denmark, and in Sweden and Norway. The demands regarding pre-market approvals began to have broad support in 1977. The newly appointed minister of labour Sven Auken, who took over the position as after Erling Dinesen that year[25], announced that new legislation on pre-market approvals should be made. The Danish authorities in the Ministry of Environment and the Labour Ministry was preparing a registration of chemicals, and there was agreement that this registration organizational should be located in the newly established National Institute of Occupational Health, and the Minister of labour found that if it was possible to use positive lists for the use of additives in foodstuff, then should it also be possible for the use of substances and preparations used out in the production (Sørensen, 1977a). Concurrently was the LO ready with the first comprehensive proposal as to how problems with chemicals at the workplace could be controlled, which included the work done on limit values. The Ministers initiative was welcomed, and the Unions position was at this point that prohibited dangerous substances easily could be substituted:

> "We must reject [the understanding] that strict measurements against the use of dangerous substances will lead to problems for industry and employment. With the highly

[25] Dinesen had been in charge at that position for the social democrats from August 27th1963 to September 8th 1977, interrupted in 1968 to 1971 and in 1973 to 1975 when a centre-right and then a Liberals government seized power.

developed technologies of today will there easily be found at new and better substance to replace the one that was prohibited yesterday" (Bent Nielsen quoted in Sørensen, 1977b)

The Danish Trades Union Congress articulated the demand for pre-market approvals the following year (1978). The direct occasion was the so-called "epoxy executive order", which was the authorities' attempt to prevent the escalation of a year-long conflict over the use of epoxy products in the building branch. Again the General Workers' Union had been pushing for stricter control. Concurrently with the publication of the "Under the Wings of Science" report in 1975 had the building workers, organised in the same union, asked the LO secretary for working environment to do something about the epoxy-problem. The secretary had forwarded the problem to the Danish Working Environment Service but the requested working committee that should deal with the problem was not appointed until the autumn 1977 (Monggaard, 1978). The working committee was set up as an ad hoc group under the subcommittee for chemical substances and preparations under the occupational health council that was a consequence of the enactment of the health and safety at work act July 1977. We can perceive this as a struggle with a chain of important groups pushing the 'problem' around as indicated in the figure below.

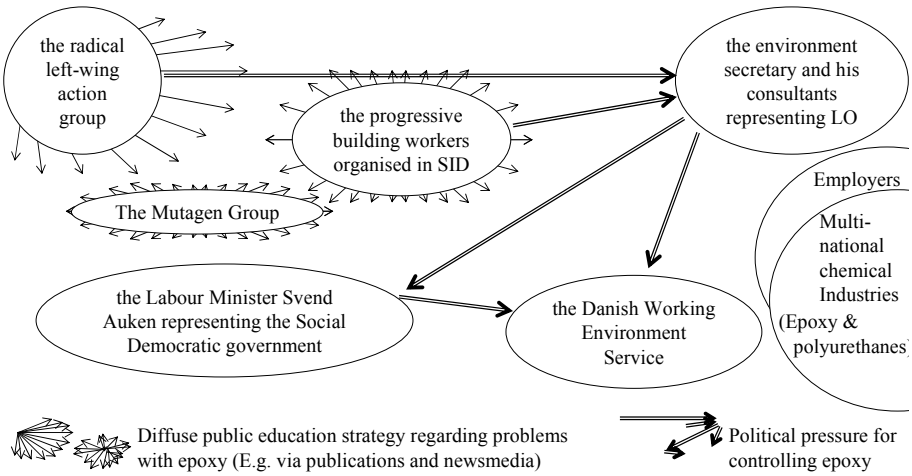


Figure 8.3 Chain of main actors in the epoxy case up to 1978.
In 1975 the building workers in the General Workers' Union began to fight epoxy as a problem. The pressure on the LO was made in alliance with the Action Group Workers Academics. LO pushed the Working Environment Service, who could not afford the needed man-hours, turned then to the Minister who pointed at a recently released number of position to the Working Environment Service. However, the Working environment Service did not initiate the work before 1977, summer 1978 published the mutagen group its spectacular results, and by the end of 1978 had Denmark one of the world's strictest regulations of epoxy and polyurethane products – even so in the opinion of the radical Action Group (AAA, 1985: 13).

Summer 1978, when the draft to executive order on epoxy was finished and the environmental secretary announced the demand for pre-market approvals, was the pressure for progress dramatically increased. That summer a report was published by an independent research team called "the mutagen group" at the Danish University of

Pharmaceutical Sciences. The group had used the Ames' test on epoxy components and showed that the components could be connected with a risk for cancer. The research results were published in an international scientific journal (Andersen et al., 1978), but concurrently the results was presented at a conference June 3rd 1978 in Odense on the epoxy-issue held with participation from the building workers' executive committees from Copenhagen, Århus, Odense and Aalborg. The conference became the start of a one and half year's long conflict and campaigning for a total prohibition of epoxy products (Meyer, 1979; AAA, 1985).

Seen from the Danish Trades Union Congress' perspective would it have been good if the epoxy-case could have been closed with the executive order, as a grass-root driven conflict could reduce the Unions value as negotiator. The Union saw the epoxy-case as a front-runner for how chemicals at the workplace should be regulated, and did so in a pragmatic manner:

> "There is no reason to demand a total prohibition of epoxy products. It is possible to regulate the use with the new executive order, and basis to have the worst phased out. Next step must be pre-market approvals of all substances entering the working environment and minister of labour Svend Auken say that he, with basis in the health and safety at work act, will consider pre-market approvals." (Bent Nielsen quoted in Monggaard, 1978)

Bent Nielsen expressed the Danish Trades Union Congress's discontent with the situation, after one year with the epoxy-conflict and brusque debate. The conflict hindered, from his point of view, broad progression in the chemicals control by contributing to a situation where "there is being made stopping with regard to new and effective executive orders that could secure workers against health risks" (Nielsen, 1979).

The demand that Danish Trades Union Congress had put forward in 1978 was that after a five years deadline should it be illegal to introduce new chemical substances in the working environment before they where examined short-term and long term effects. Furthermore, the same legislation should prescribe that substances used also had to be tested and approved for the specific uses.

But the union started a retreat from the demand for general pre-market approvals not very long after. Shortly after the announcement of the demand was the question brought up for discussion at a round table discussion reported in the union's magazine in 1979. The invited experts warned that the demand as to have all substances evaluated could be difficult to realise, and the forum pointed with approximate agreement at an alternative strategy that would not require all substances tested.

A key issue for the discussion was the immense number of chemicals that had to be tested. The union's demand would, according to one of the experts, literally taken imply that all the four million registered chemical substances and the 6000 weekly added substances should be tested. The union's consultants objected that the marketed number of substances was considerably lower than the number registered in scientific literature, and implicitly, that the requirement as to have all substances tested therefore was more viable than the experts indicated. This was rejected with the argument that

all registered substances in principle were available for any manufacturer, instead, was the expert's argument, should the strategy focus on local control rather than universal approval:

> "If concerned action is to be made against the harmful effects from this flood of substances, then must there be labour-control where the formulations are being made. This would give the labour-side control over what substances are being used." (Uffe Sæbye in Engen & Monggaard, 1978)

Like this did the experts oppose a strategy that would rely on systematic testing and approval or various restriction-levels of use-regulation of the single substances, and pointed instead at the problematique as a lever to obtain increased labour-control at the workplaces. This position was furthermore strengthened by experiences from the USA saying that the cost and time per substance would be 1 million dollars and two years. The idea was that increased labour control instead should further the development of safer chemical technology:

> "It is possible to make sound substitutions for hazardous substances. But the capitalistic mechanism demands the chemists to develop the most inexpensive substance with the broadest possible technological effect. No company in the world has brought in the heath-concerns on equal terms. [But] this should be a requirement to the development of new substances." (Uffe Sæbye in Engen & Monggaard, 1978)

The experts point was that the large number of substances would be better controlled, or could possibly only be controlled, by giving more influence to the workers. At this point in time the Union still maintained the demands for approvals of all chemical substances in the working environment (see Nielsen, 1978), but they would soon soften the requirements.

The Danish Trades Union Congress was placed in a dilemma between the radical proponents for a stringent pre-market approval strategy (positive list strategy) and job-considerations. The then secretary for environment and the environmental adviser of the Danish Trades Union Congress who dealt with these issues recall that the radical cooperative between workers and academics had criticisms against the union's pragmatic position. From the union's point of view were the radical proponents well-provided but irresponsible extremists, and if their advice was followed, then would it block for any industrial production (Nielsen, 2004, Elikofer, 2004).

The Danish Trades Union Congress was, on the other hand, met by cost-efficiency requirements from the national policy level, despite the prevalence of Social Democrat led governments in the 1970's and early 1980's. The a weak Social Democrat minority government had to make deals to keep control, and part of the centre and rightwing parties' pressure on the Social Democrats was requirements for cost efficiency assessments of the measures made to protect the workers. The Danish parliament required in 1980 that the minister of labour should issue guidelines directions for the assessment of economic consequences of measures (LO, 1981: 63 and LO, 1982: 71).

Bent Nielsen recall they ironically had noted that railing at scaffolding sites should be obligatory when workers could drop and become crippled, but not if the height of the platform was so high that the worker would die from falling and therefore would not

strain the public finances (see also Jørgensen, 1984). This situation may have had importance for the Danish Trades Union Congress' strategy that aimed at the local and concrete problems such as those related to asbestos, epoxy and organic solvents, and with the struggle for achieving improvements not by use of personal protective equipment but by eliminating or enclosing the problem whether it being noise or chemicals.

8.5.3 The Danish Product Register

These discussions at the Danish national political level coincided with the unilateral initiatives in France, the non-EEC countries Sweden and Norway, and the development of the European chemicals regulation that gathered speed in 1977. The Danish as well as the Swedish and the Norwegian reflection of the international development did however get a slightly more radical character than seen elsewhere. What in the OECD and in the EEC debates took shape as pre-market notifications of 'new substances', was in the Scandinavian context transformed to discussions of pre-market *approvals* of both 'new' and 'existing' substances. The challenge for the Danish politicians was therefore to balance these two agendas, and to accomplish this was a dual strategy followed. The foreseen European requirements for a harmonised chemicals regulation was followed up in the development of the act on chemical substances and products, and the domestic requirements for a tightened control with both new and existing chemicals was pursued in an amendment to the health and safety at work act.

The new Act on Chemicals in 1979 was a law reform that replaced separate legislative elements (mainly the poison law and the pesticide law) and incorporated the requirements of the EEC-Commission's proposal for a sixth amendment, hereunder specifications of how new and existing substances should be perceived, and how new substances should be notified. In the motivation for the bill before the third reading in the parliament, the majority behind the bill stressed its interconnectedness with the bill on the amendment to the health and safety at work act, and the leftwing minority parties stressed that the law ignored the existing substances, and to the second reading had the Danish Communist Party severely criticised the bill for being a unimaginative reply to "the demands from LO, federations and unions for beforehand approvals of chemical substances" (Møller & Jensen, 1979). However, when the act was passed May 1979 LO found that the Act was an important step on the road to beforehand approvals because the act caused that no new substance could be used without first being notified to the authorities (Monggaard, 1979).

The second legislative element that should meet the domestic demands for a tightened chemicals control was the amendment to the health and safety at work act. The amendment of the section 49a made it possible for the Danish authorities to require information about substances used at Danish work places, and with the intention that existing chemicals should be notified by stages. The minister acknowledged that the law did not introduce a general beforehand approval of existing substances, as had been required by parts of the labour movement and the opposition, but argued that the chosen strategy gave the authorities the possibility to prioritise the efforts (see Folketingets skatte- og afgiftsudvalg, 1979: 1357-58).

The register was enforced with an executive order October 1981 that detailed the purpose, procedures for registration, confidentiality, and circumstances for complaints (See Bekendtgørelse om registret for stoffer og materialer 1981/9/14; Honoré, 1981;Flyvholm et al., 1992). Substances produced, used, or imported should be notified to the register with information about composition of the preparation which the substance form part of, known health issues etc. he criterion for notification was that a component of preparation was listed on the hazardous substances list. Furthermore was it intended that the register should enhance the substitution clause that had been introduces in the section 49c amendment to health and safety at work act.

Sweden and Norway established concurrently with Denmark corresponding registers. Denmark had, with the register, succeeded making a compromise making it possible to register chemicals used in the working environment without coming in conflict with the EEC free market regulations. Those, who were calling for actual positive lists for all chemicals, criticised the register for being without any consequence for the reality at the work place, but the major actors interested in the working environment were satisfied. The normal view is that the achievements of the 1970s and 1980s in question of controlling problems with chemicals and noise; the improvement in the physical working environment were profound.

8.5.4 1980s: Chemicals Becomes an Environmentalist's Subject

We will now leave the occupational health scene – or rather: the occupational health actors left the chemicals regulation-scene. This should not be understood as occupational health struggles with chemicals at the workplace had stopped – the contrary was the case. Rather, this should be understood as the general discussion about how the regulation of chemicals should be regulated was covered by the closure that had been reached with the act on chemicals and the amendment of the health and safety at work act, and the creation of the product register. The battles did indeed continue but they related from this point mostly to specific discussions of specific substances, and not to the more general discussion of how chemicals should be regulated. This tendency probably reinforced as the probably most important discussion that related to organic solvents was halted at the European level, and at the domestic level was transformed to a discussion about the consequences of Denmark's affiliation to the EEC. At the general level had the major actors on the occupational health scene decided that the issue of chemicals had landed on a suitable place – other issues had apparently greater importance. The chemicals issue was furthermore landed at a technocratic dead-end that was not on top of the agenda among those progressive academics who was concerned with occupational health and who had helped fuel the critique against chemicals during the 1970s. The focus was now more targeted on how to enforce the workers control with his or her own situation that challenged the employer's right to manage, and the economic recession resulted in a generally increased pressure on the achieved progresses in the working environment. The large number of known and un-known chemicals on the market did not disappear as issue, but new forms of critique of chemicals became more dominant.

New issues relating to chemical production-sites began to surface in the news media during the 1980s. This was e.g. the Danish pesticide manufacturer Cheminova, and its

emissions and waste disposal (see TV-Aktuelt, 1981; TV-Aktuelt, 1981), a risky chlorine production site in the capital Copenhagen (see e.g. TV-Aktuelt, 1985), and the Prom's chemical manufacturing industries (see e.g. Søndagsavisen, 1987). Also the Bhopal catastrophe played an important role in the shaping of the public media's presentation of the chemicals problematique. Concurrently emerged a new type of environmentalism with the major aim to point out the lacking compliance with the Environmental Protection Act both among local authorities and industries, and to stress the shortcomings of the existing legislation (see Larsen & Christensen, 1985). These processes and events were of great importance for the increased public awareness of the issue of chemicals during the 1980s.

The second important element relating to chemicals in Denmark in the 1980s was the introduction of tightened regulation of pesticides that also was described and discussed in the previous chapter. An interesting similarity between the regulation of occupational health regulation and the regulation of pesticides was the introduction of substitution clauses, which in the pesticide regulation came to have fairly profound impact on the number of permitted pesticides.

The 1980s was also the period when farmers and agricultural consultants had observed possible adverse effects from the use of pesticides, and by that engendered the research that spurred the intense debates that was covered in the previous chapter. The straw shortener case can thereby be seen as one discreet emblem for both the generally raised awareness of the possibility of un-intended side effects from chemicals, and the specifically increased intensity in debates over the regulation of pesticides.

The German Vorsorge Prinzipe started getting translated e.g. by the Bremen Declaration, where it became precautionary measures in shape of best available technology (BAT) to the reduction of airborne pollutions (Bremen Declaration, 1984: section D3), and as discussed in chapter 1.

Finally, the 1980s was also the decade when the Brundtland report was produced. *Our Common Future* took part in a fundamental change of the environmental discourse that successfully raised the environment to become an issue (almost) in line with traditional high level policy-areas such as international security policy by linking it to economic concerns (see e.g. Hajer, 1995: 12, 100). Furthermore, this report produced the basis for the Earth Summit in 1992 that constituted a global consensus on a specific wording of the precautionary principle.

However, In Denmark was the critique raised in the 1970s sustained by a number of actors, including parts of the union and some academics at universities and in the administration (see e.g. Jørgensen, 1985).

The discussion on the existing chemicals surfaced again in the mid 1980s, when the European Commission put pressure on the Danish Government as to have the harmonisation of the sixth amendment pre-market notifications effectuated, meaning that substances notified in an other EEC member country immediately could be marketed in Denmark. This was in the contemporary debate interpreted as the then 40.000 substances registered in the EU freely could be marketed in Denmark

(Sokkelund Radio, 1985, Frit slag for kemikalier, 1985, Nej til farlige kemikalier, 1985). The Parliament's Environment and Planning Committee asked the same year the Environmental Minister which of the many substances used by Danish industry was most ecologically and health-wise harmful? And the DEPA answered that it was only a few of the used substances for which there existed data on e.g. toxicity, but that they were working on the case (Dansk industri bruger 40-50.000 kemiske stoffer, 1985).

In the beginning of the 1980s the OECD set up two expert groups to develop suggestions as how to assist member countries in optimizing the rational and cost-effective selection of existing chemicals for health and environmental purposes. One of the proposed methodologies was the use of Structure-Activity Relationship (SAR) for the determination of whether a chemical could have (unwanted) biological effects. The reports came out in 1984, and this prompted the Danish authorities to initiate work with that methodology September 1985. The English summary from the report that came out in 1987 states:

> "We are all surrounded by a large number of chemical compounds. Some of these may affect human beings and other organism in a harmful way. The effects on the living organism are known for smal1 groups of chemicals but we know very little what biological effect the majority of the existing chemicals may have. QSAR (Quantitative structure-Activity Relationships) is one way of coping with missing biological activity data of chemicals. This approach is suggested as a tool in estimating unknown biological activities in the OECD- report "CHEMICALS ON WHICH DATA ARE CURRENTLY INADEQUATE: SELECTION CRITERIA FOR HEALTH AND ENVIRONMENTAL PURPOSES:" 1984. As a consequence of this suggestion, the Danish QSAR-project was established in September 1985 to examine strengths and limitations in using QSAR in estimating biological activities and as a tool in the regulation of existing chemicals." (DEPA, 1987: 163)

The SAR/QSAR strategy would in the coming years become one of the authorities' favourite strategies to cope with the missing data was to apply computer models to the prediction of effects. In the US was this type of computer-modelling applied since 1981 as substitutes for much-more expensive laboratory-experiments to predict aquatic toxicity in the absence of test data (Cash & Nabholz, 2001). This was probably the first time this type modelling was used for that purpose, and the appliance was coterminous with the anti-environment Reagan administration's ruling in the White House[26], and this practice was continued in the testing of new chemicals since 1992 (Goldman, 2002: 11028). In a joint EU/US EPA evaluation of the methodology was the European position that the tool was not enough developed and that it underestimated the severity of several elements (USEPA/EC, 1994: 53). Probably for these reasons has the use of SAR (Structure-Agency Relation) and QSAR models for regulatory purposes often been seen as symbolic, in the interest of a cost-cutting industry, and therefore as problematic in the regulation of chemicals.

[26] See Dryzek (1997) for an elaborate description of the Reagan-administration's anti-environmentalism.

8.6 The first steps to a revision of the regulation

In the following, we extend the focus to the European scene with a starting point in the Danish initiation of the discussion of the non-assessed chemicals.

In the mid 1990s ascended the discussion about the large volume of existing and mostly non-regulated chemicals again. Both the product registers and the EINECS register increased the attention to the high number of substances not embraced by the sixth amendment and to the lack of data. Alone the number of substances on the lists had an argumentative quality that made it attractive in the media's punch lines. We could trace this awareness already in the 1980s both in public discussion, and in the authorities' dispositions especially with respect to the use of computer models in the prediction of adverse effects.

The precautionary principle had been 'opened' as a policy concept in the Maastricht Treaty in 1992 without any clear definition. This presented therefore an opportunity for pro-environmental member-states and environmental NGOs who had been using the principle in relation to the chemical pollution of the North Sea for several years.

The intensified debate took place concurrently with what I in the chapter-introduction called the third step in the development of the perception of chemicals (at page 128). This change was stabilised in the fourth North Sea Conference's confirmation of the generations target of ceasing discharges, and losses of hazardous substances, the extended toxicity-concept and the confirmation of the precautionary principle as the overarching principle for achieving a sustainable, sound and healthy North Sea ecosystem (Esbjerg Declaration, 1995: 18). Jointly with the environmental NGOs took The Danish representatives and Environmental Minister Sven Auken active part in these extensions hereunder the acknowledgement of endocrine disruption as an adverse endpoint (see e.g. Løkke, 1998: 77-78).

By the early 1990s was the present chemicals policy in Europe in place. It was probably the part of the environmental field that was most closely regulated at the EU level, and correspondingly one of the most harmonised legislative fields in the EU. Simplified, the following three components made out the core of the present closure on chemicals legislation, of which I introduced the first two in the beginning of this chapter (see Establishment of the Current European System for Assessment of Chemcials, p128):

1. Classification and labelling of dangerous substances and preparations[27,28].
2. Evaluation and control of the risks of existing substances[29].

Restrictions on marketing and use[30].

[27] Directive 67/548/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances.
[28] Directive 88/379/EEC on the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous preparations.
[29] Council Regulation (EEC) 793/93 on the Evaluation and Control of the Risks of Existing Substances.

The three cores covered problem-identification, problem-qualification, and problem-management. The closures that this legislation institutionalises are based on following principles:

The Single Market is a key objective, putting the Internal Market on the same footing as protection of human health and environment.

Sharp distinction between 'existing' and 'new' substances.

Strong demand for proofed causality between the single substance and the single adverse effect, through the performance of risk assessment with proof of harm of the single substance is a prerequisite for action

As I have described above had the awareness of the systems weeknesses been latently present for quite some time but it had been limited to expert circles. In 1995 launched the Danish Board of Technology a project that should problematize and discuss the problem of non-assessed chemicals. The project was set up as an expert group consisting of experts from academia and state research institutes. The timing of that project seems to have been overwhelmingly perfect, as it is widely referred to as the first systematic public discussion of the problem of *non-assessed chemicals in the EU*, as the English title was. The Danish EPA was invited to take part in the project but declined, probably because they themselves were working on a coping-strategy.

The expert groups mandate was described in the preface to the report:

> "About 15 years ago the American National Research Council reported, that no information was available about the possible toxicity of 80 % of the more than 50.000 industrial chemicals in use in the USA. Simultaneously, from Europe it was informed that a vast majority of the more than 100.000 chemicals which by the European Commission had been registered as marketed within the EU, had never been subjected to investigations or evaluations for effects on health and environment, e.g. toxicity, carcinogenic properties, global and/or local effects on the environment etc. Any such investigation is technically, scientifically, temporally and economically demanding, and because of the size of the problem, societies were facing a large - almost insurmountable problem.
>
> In the spring of 1995, the Danish Board of Technology decided to initiate a review process dealing with the still unsolved problem of non-assessed, existing chemicals. An expert working group was established to perform a review which should describe/analyse the problem in order to 'promote the understanding and submit the problem to debate'. The Danish Board of Technology asked the question whether:
>
> > '… the many non-assessed chemicals pose a risk of a ticking bomb, which constitutes a latent threat to the health of human beings and/or the environment ?'
>
> and the working group was requested

[30] Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations.

> … to focus on the non-assessed, existing chemicals and to evaluate proposals for strategies towards more fast and earlier investigations of them. The consequences of such strategies should be part of the considerations of the working group, and possibly a plan of action or elements of such plan should be suggested for presentation and discussion in a public debate - primarily in a forum of political decision-makers and interested parties, but possibly also calling upon a broader interested and informed public.
>
> In its review work, the working group should deal not only with the possibility of achieving a highest possible reduction in the workload required for the assessment of chemicals. It should also consider possibilities for reduction of toxic or environmental risks that might result from the use of chemicals." (Bro-Rasmussen et al., 1996: 5).

The key recommendation of the report was that the risk assessment of the existing substances should be short-circuited:

> "the working group recommends that demands for chemical testing and assessments are made more stringent, in order that
>
> **not only new, but also all existing chemicals are included in a notification and regulation system extending from the present practice, in which chemicals are classified individually for hazardous properties and characteristics independently and individually.**
>
> But in so doing, it is accepted
>
> **that decisions for aligning all chemicals into chemical groups, blocks or clusters are made by analogy or calculation from one chemical to another, from chemical/biochemical or structural relationships (cf. QSAR) etc., and**
>
> **that 'the most dangerous' chemical in each group shall be the determinant for classification of all group chemicals .**
>
> Following a detailed outline of this principle, it can be expected that incentives will develop, and that data and documentation needed for regulation of all chemicals will be created considerably faster. This will occur
>
> **because a vast number of individual chemicals guided by an established 'precautionary principle', can be drawn into the regulation schemes merely on the basis of the outlined group or block relationships, but also**
>
> **because producers and importers undoubtedly will be increasingly motivated to create the necessary data and to develop the experimental and more profound documentation needed for their individual assessment and regulation demands.**" (Bro-Rasmussen et al., 1996: 31-32)

The expert group abstained from making the general group-classification more specific. In a following international conference with participation from experts, administrators, and politicians from Denmark, the EU, the OECD, and from NGOs and Industry was the report generally endorsed, but the specific hope for group classification and QSAR as a solution did only receive moderate support (Danish Board of Technology, 1997).

The Danish EPA received with reservation and to some extent rejection the expert group's recommendations in correspondence to the Danish Board of Technology. One of suggestions that were rejected a first, but never the less later adapted, were to label

substances according to the test and assessment status, e.g. “not completely tested and assessed” or “not tested and assessed” (Bro-Rasmussen et al., 1996: 34).

There was nevertheless also interesting communalities between elements of the critical report and the EPA’s discussion paper that was published later that year (Miljøstyrelsen, 1996b), namely the focus on QSAR as a possible way forward, and on the precautionary principle. In the Danish EPA arose the idea that the QSAR methodology could be used in an opposite way compared to the rebuked US-practise; instead of using the methodology for the approval-procedure, it could be used for a bulk screening of non-assessed chemicals (Miljøstyrelsen, 1996a; Tyle, 2003). The first official Danish List of Undesirable Substances with environmental data generated with QSAR came in 1998 (DEPA, 1998a).

8.6.1 The Critique and the Enlargement in 1995

An important premise for the focused critique leading to the current EU revision of the chemical policy was the enlargement with Austria, Finland and Sweden in 1995 (se e.g. Andersen & Liefferink, 1997). Together with Denmark and the Netherlands, these three countries in April 1998 tabled a note at an informal meeting among the EU environmental ministers, suggesting the development of an overall policy for chemicals in form of a framework directive, including short- and long-term goals.

Table 8.1 The first steps towards a new EU chemical policy.

Date of event	Description
March 1998	Informal discussion between Austria, the Netherlands, Finland, Denmark and Sweden on the European chemicals policy. (KEMI, 1998)
April 1998	The informal meeting of environmental ministers in Chester (environmental council) acknowledges the March paper. The Commission undertakes to review the legislation on chemicals. (UK Presidency, 1998)
September 1998	The European Environment Agency and UNEP publish a report, which draws attention to the problems with the current policy on chemicals. (EEA & UNEP, 1998)
November 1998	The European Commission publishes a working document on the operation of four major legal instruments in the EU chemical policy. (EC Commission, 1998)
February 1999	The European Commission holds a stakeholder Brainstorming workshop in Brussels, entitled "Industrial Chemicals: Burden of the past – challenge of the future". (Cartwright, 1999)
June 1999	The Environment Council calls upon the Commission to submit a policy document outlining a new chemicals strategy takes a positive step towards a fundamental review of the EU chemicals. (EC Council, 1999)

In the so-called “five-country-paper” played the precautionary principle an important but subordinate role in relation to the adjustment of risk assessment concept (KEMI, 1998). The five-country-paper at first initiated the ongoing revision process within the EU framework, which is sketched in the table above. Shortly after the meeting, also Germany endorsed the document and the arguments.

The paper revealed a language that was in the line with the discourse of ecological modernisation, stressing first-mover advantages, development of new markets and long-term improvements performance, all related to improved environmental and health standards through risk reduction.

The five-country-paper stressed four issues as being important for the future EU chemical policy (KEMI, 1998: 3-4):

- Operative goals should be adapted.
- The responsibility of different stakeholders should be clearly defined.
- General guidelines on precaution and safe management of chemicals should be adopted.
- The speed of marketing new products and procedures for risk assessment should be adapted to each other.

Four issues was stressed in relation to responsibility, namely:

- The industry, limiting the freedom to produce and use chemicals, by reversing the burden of proof that a substance are "harmless", from the present status where the authorities must proof that a substance pose a risk, before invoking restrictions.
- The industry, requiring the industry to be both *responsible* for assessment and risk reduction measures, and *restrictive* when using and placing products at the market.
- The European Commission, calling for a clear distribution of responsibilities, so as to e.g. risk assessment gives rise to risk reduction measures.
- The industry, calling for the consumers' right to know with respect to possible impacts on human and environment.

(KEMI, 1998: 3)

Guidelines on Precaution and Safe Management
The proposed guidelines corresponds to the BAT concept (best available technology), focusing at 1) using the least harmful chemical or technology in order to avoid and minimise emissions and exposure, 2) minimising use of chemicals, and 3) minimising risk when using a chemical (KEMI, 1998: 4).

Adjusting Marketing and Risk Assessment
The precautionary principle played explicitly a central role as a safeguard for man and nature against possible negative consequences of speeding up the assessment procedures. This meant mainly that substances should be restricted without performing a risk assessment if there was no clear need for the substance and there existed doubts about negative effects on humans and environment. Risk assessment should be applied in occasions with a clear need for the substance, and within the assessment, special attention should be given to vulnerable groups. Beyond speeding up the regulation by omitting risk assessments in cases with substances posing evident hazard, it is also proposed to perform 'focused' and thereby resource-saving risk assessments, when appropriate (KEMI, 1998: 4).

The procedures for problem identification were further suggested to be simplified by procedurally issue ban against substances that are bio-accumulative and persistent or have irreversible toxic effects. Furthermore, it was suggested that industry must be requested to carry the burden of cost for the necessary assessment work.

Finally it is proposed that a "self financing mechanism should be introduced, obliging industry to carry the burden of cost for the necessary assessment work". This refers to the discussion of 'true' costs of using chemicals (see e.g. EEA & UNEP, 1998: 25).

In April 1998 the environmental ministers of the EU member countries met in Chester to discuss the Community's approach to the safe management of chemicals. Here they welcomed the five-country-paper and declared agreement with the critique of the missing progress in the risk assessment programme, and the need for making the risk assessment more effective.

However, the language of the conclusions from the meeting is significantly different from that in the five-country-paper. This mainly by the weight given to the importance of "guiding principles" of "the economic and social benefits that the use of chemicals brings to society and to the quality of life", and of "maintaining an effective single market for chemicals" (UK Presidency, 1998: 1-2).

Furthermore, the precautionary principle was drawn out as most important together with "a soundly based scientific assessment of the risks to health and the environment" and "an analysis of the socio-economic consequences of the decision" (UK Presidency, 1998: 2). Obviously, the two latter arguments are counterbalancing the precautionary principle in the sense of how strict the resulting chemical policy should be. In line with this, there was "differing views on the relative importance to be given to these three considerations" (UK Presidency, 1998: 2).

At the meeting, the Commission agreed to undertake a review of the central directives and regulations, governing industrial chemicals, and to explore the weaknesses of the instruments (UK Presidency, 1998: 3).

8.6.2 The joint EEA and UNEP Report on Chemicals in the Environment

In September 1998, the European Environmental Agency and the United Nations Environmental Programme published a joint annual message with the title "Chemicals in the European Environment: Low Doses, High Stakes?" The report stressed the need for adopting the precautionary principle in chemicals regulation, and thereby the need for a substantial change in the approach to chemicals regulation.

The precautionary principle – with reference to definition in the Rio Declaration on Environment and Development - was applied to chemicals as it was argued that the principle is emphasised by public authorities as "a *prudent* response to potential chemical hazards". Two mutually related reasons, explaining this was put forward. The emphasis on the precautionary was firstly seen as a response to the present situation with very limited data on chemicals actually used, and with an increasing awareness of the scientific complexity and uncertainty associated with the assessment of chemicals' impacts (EEA & UNEP, 1998: 19).

The interpretation was that persistent and bio-accumulating substances should be regulated without waiting for evidence of toxicity:

> Instead of assuming chemicals are "innocent until proven guilty" of damage via strong evidence of toxicity and actual harm, the new approach assumes hazardous potential from the chemical's ability to persist and bio-accumulate in animals or the environment. (EEA & UNEP, 1998: 20)

Further, it was emphasised in the report that this application of precaution had been advanced as a more equitable and cost-effective approach.

8.6.3 The Commission Evaluation of the Regulation of Industrial Chemicals

The evaluation from the European Commission was published in November the same year. The conclusions pointed in two directions. On the one hand, the conclusions can be interpreted as saying that the EU legislation on Chemicals is outdated, and on the other, that the problem is lacking implementation, due to low priority and resource shortage.

The Commission's evaluation differs significantly from the member state critique with respect to the perception of the precautionary principle. The precautionary principle is being pushed 'downstream' away from the science feeding the risk assessment, towards the outlet of the risk assessment, as the principle is assigned with the role of guiding the risk communication:

> "In general the findings […] recognise the role of sound science and highlight the need to meet more fully the concerns of the outside world by giving full consideration to the precautionary principle." (EC Commission, 1998: 8)

The precautionary principle seems to be represented in the report mainly as a legitimising concept, meeting the 'the concerns of the *outside world'*. What the outside world might be is an open question, but the phrasing alienates the principle from the authors, i.e. the Commission. Further, the principle was guarded by the concept of 'sound science'.

Explaining the contemporary attention to the chemicals legislation, the report point at three issues:

> Currently there is wide spread *public concern* about the effects of chemicals on human health and the environment as well as the *fear about new potential threats as in the case of endocrine disrupters*. This concern is exacerbated by the co-called "*burden of the past*". (EC Commission, 1998: 2, Italics added)

The reluctance to accept the critique was also to be found in relation to the risk assessment of the existin chemicals (Regulation (EEC) 793/93):

> The basic principle of the Regulation is that controls on hazardous chemicals should be based on an assessment of the actual risk to human health and the environment, rather than the hazardous properties of the substance only. This approach, based on sound science, is strongly supported by Industry. (EC Commission, 1998: 6)

The report gives the highest importance to the following four issues:

> "Hazard identification as the initial key step in protecting both human health and the environment from the potential harmful effects of industrial chemicals;
>
> The *distinction* between hazard identification, risk assessment and risk management;

> The concept of the *"burden of proof"* in relation to the different instruments of hazard identification, risk assessment and risk management;
>
> Ascertaining the number of "existing" industrial chemicals which constitute the "burden of the past" and of drawing up a clear strategy for assessing these for their harmful effects *in order to address the public concern*." (EC Commission, 1998: 8)

Major findings was that the procedures (for classification, labelling, and publication) were too slow (1-2 years), lacking implementation, too complicated labelling systems, lacking compliance with requirements. Hereto came that the follow-up to dangerous substances was assessed as inadequate.

The report consists of both the main report and four annexes discussing the four legal instruments in detail. The annexes are 20-40 pages whereas the main report is 14 pages. In these technical annexes, the precautionary principle was only reflected in different contexts. The first is in the annex concerning the testing of the existing chemicals, where the principle was connected to the co-called 'burden of the past':

> "Given that all chemicals are potential dangerous, it was reasonable that precautions are taken to assess each chemicals to ensure that appropriate steps are taken to reduce the potential risks associated with their use to an acceptably low level" (EC Commission, 1998: 91 ("Discussion"))

The second context was the so-called "limitations-directive", which is concerned with restricting the marketing and use of dangerous substances and preparations listed in the annex to the directive. In the findings on the limitations directive, the authors refer the to Rio definition of the precautionary principle, stressing the dimension of cost-effectiveness. The main hope is to avoid Member States requesting derogations under Article 100a section 4 to keep stricter national legislation[31].

This reference to the Rio Declaration is unlike the EEA/UNEP report that stresses both the position that all chemicals are possible dangerous and that a precautionary approach will be long-term economically favourable.

At the following Environmental Minister Council meeting, December 1998, affirmed the council the need for a new chemicals policy that should reflect the precautionary principle and the principle of sustainability in order to warrant both a high level of protection for human health an environment in the rapidly developing marked for chemicals and a efficient working internal market.

At a stakeholders workshop in Brussels 1999 presented the major European stakeholders and their positions in the chemicals discussion and towards the precautionary principle.

There was a broad agreement that the precautionary principle – as a technical issue – should not be not a mantra, but had to be defined and applied in a practical way (Cartwright, 1999: 8), but it was disputed whether there was need for a fourth category for risk assessment: "limited data, limited concerns leading to temporary precautionary

[31] Examples was PCP, cadmium, and creosote.

action". Criteria would need to be established for this and the burden of proof could be reversed requiring further information before precautionary action ceased. (Ibid: 9)

The industry approach was open for discussing problems with the progress in the risk assessment of chemicals but stressed that it was fundamental to preserve the risk approach (Ibid: 10).

The NGOs had the opposite position: hazard should be used instead of risk, thereby could uncertainty be reduced, and the possibility to keep science free of manipulation would be improved. Furthermore was it the position the overall use of chemicals should be reduced. This should be obtained partly through a minimisation of the use of chemicals, partly by a stringent use of the substitution principle (Ibid: 11).

8.6.4 The environment Council Take the First Step

At the Environmental Ministers Council meeting June 1999 was the Commission given a clear mandate to develop a new strategy based "the precautionary principle, the goal of sustainable development and the environmental safety and the efficient functioning of the internal market" (EC Council, 1999: 19). The Commission was asked to:

> "to submit the policy document outlining a new chemicals strategy at the latest by the end of the year 2000" (EC Council, 1999: 21).

8.7 Steps to REACH

A number of important steps outlined below in Table 8.2 followed the first development, ultimately resulting in the Commissions proposal for a new chemicals strategy REACH that was presented November 2003.

Following the Council decision to initiate the revision of the chemicals regulation began a unique NGO campaign with the aim to influence the development of the future European chemicals policy, uniting environmentalists and consumers' organisations. In addition, the European chemical industrial association Cefic initiated an intensified effort centred on stakeholder events in 1999 and 2000. The detailed negotiations and strategies of the involved parties not studied in the present analysis, it is however evident that massive lobbyism has taken place.

REACH stands for Registration, Evaluation and Authorisation of Chemicals and it is basically a compromise between the very strict testing requirements to 'new' substances and the weak requirements to the 'old' substances, and thereby a compromise between an increased protection of health and the environment and a facilitation a chemical innovations. The improved protection of health and the environment should be reached by a generally increased knowledge about the properties and uses of the existing chemicals, and by an increased speed of the risk assessment process and improved placing of responsibilities. The role of the precautionary principle has been centred on the questions of how the assessment of chemicals possibly can be speeded up. The weight given to the principle, and possible

also the interpretation, has changed during this process, which is evident when the Commissions 2001 white paper and the final 2003 proposal are compared.

Date	Event
December 1999	Industry stakeholder event aiming at increasing the level of understanding between the various stakeholder groups (competent authorities from member states, MEPs, the EU Commission, NGOs, Trade Unions and downstream users).
October 2000	NGO conference "Chemicals under the spotlight" aiming at influencing the new EU chemicals strategy. The conference was a part of a European NGO-campaign on chemicals policy (Dyekjaer & Boye, 2000)
December 2000	2nd Industry stakeholder event
March 2001	White paper on the Chemicals Policy released by DG environment and DG Enterprise. (EC Commission, 2001b).
October 2001 - February 2002	Technical working groups made up of stakeholder experts on particular topics covered by the White Paper, from authorities in the Member States, industrial associations and NGOs.
September 2002	2nd NGO conference "European chemicals policy reform – from paralysis to action"
May 2003	Commission Proposal: REACH. The draft is a compromise between DG environment and DG Enterprise.
October 2003	Final Proposal to REACH is published.
November 2003	The Proposal is passed on to the Commission and the European Parliament

Table 8.2 The latest steps to REACH

The precautionary principle was detailed in the white paper as having implications both in the assessment process to prevent damage to human health and the environment and for a systematic substitution strategy of dangerous by less dangerous substances. With respect to the risk assessment process was the principle given a special role in case the process was unduly delayed and where there was an indication of unacceptable risk: "In particular, should a producer of a given substance delay the filing of information or test results, the central entity would be entitled to conclude the assessment" (EC Commission, 2001: 5, 20).

The Commissions final proposal has played down the importance of the precautionary principle. Instead of giving the principle specific interpretations in relation to the regulation of chemicals was the principle only referred to in broad terms as a corrective measure to the overall purpose of an effective functioning of the common market for chemical substances, with reference to the rather ambiguous Communication on the Precautionary Principle (EC Commission, 2003: 19; EC Commission, 2000). The immediate and linguistic weakening of the precautionary principle does also show in the text of the final proposal. In earlier drafts was producers and importers required to secure that substances, that may adversely affect human health or the environment, would not emitted from the product. This was a provision that included the knowledge that some substances, e.g. phthalates and certain brominated flame-retardants, may be emitted even though the leak is not a functional part of the product concept. This requirement was reduced in the final proposal to only encompass substances that intentionally are released from consumer products (EC Commission, 2003: 20, 58, 73).

An important REACH mechanism that shall speed up the assessment process is the pointers to chemicals of 'very high concern'. The concept is that alone some specific

inherent characteristics of a substance will lead to a requirement for authorisation. The authorisation procedure will be applied to substances that can be classified as carcinogenic, mutagenic or toxic to reproduction (CMR) in one of the two strictest categories, to substances that are persistent, bioaccummulating, and toxic (PBT), to substances that are very persistent and very bioaccummulating (vPvB), and substances of equal concern such as endocrine disrupting substances (EC Commission, 2003: 16, 32). Compared to the classification and labelling directive (Council Directive 67/548/EEC) are the PBT and the vPvB criteria new in the REACH proposal and these do reflect the precautionary principle by taking into account properties that has implications for future and possible effects rather than focussing on the substance's adverse effect that presently are known. Furthermore, the category 'substances of equal concern' opens up for the possibility of adding effect categories, and may thereby assist that the framework will not be locked by restraints in the present knowledge. Endocrine disrupting chemicals can be seen as a test for the flexibility of the authorisation approach, and environmental NGO's has already questioned whether endocrine disruption will be included beyond the integration into tests for reproductive toxicity. The development of tests for identification of such substances is ongoing and it is foreseeable that internationally accepted tests will be adapted, but will this result in an extra authorisation category that will lead to actual assessment of these effects in the authorisation procedures?

The REACH data requirements has been compared to the classification and labelling criteria by a Swedish research team (Hansson & Rudén, 2004: 25-33), and it is revealed that the data required for substances produced in volumes less than 10 tonnes will not be sufficient for any classification or authorisation. Only for substances produced in volumes exceeding 100 tonnes will enough data be available to potentially trigger the REACH authorisation process (ibid: 32). The consequence is that quite a high number of substances and products potentially still will be left without classification and labelling, either because the substance has been assessed as harmless or due to lack of data. Whether the small production volume substances will remain invisible for the new regulatory approach is a central question that remains standing.

8.8 Discussion

The first wave of chemicals regulation was encouraged by precaution-based public concern for the adverse effects of chemicals. In this first wave was a strong, thoroughgoing belief human's ability to cope with these adverse effects on a traditionalist scientific basis where scientific based data are collected until evidence can be established and consequential policies can be made. This belief is traced back to the early discussion of chemicals regulation in the 1970s, and it is evident in the establishment of the European strategy for the risk assessment of existing chemicals in 1992.

The use of the concept 'precaution' is therefore not enough in itself; the concept has to be followed by recognition of both the capabilities and the limitations of scientific method and practises that reflects this recognition. In fact we may even extent the concept of science to embrace the precautionary principle as suggested by Stirling

(2001: 64-68) who differ between narrow and broad science regimes. What would this imply for the regulation of chemicals? One lesson that should be learned is that chemicals are far too important to be left with the experts, and therefore will it be of great importance to leave the new regulatory system open for uncertainty. Naturally, there are multitudes of possibilities to do this, but I will point to two core issues relating to transparency and simplicity. One of the criticisms against the 'old' regulatory system referred above was that the consumer had no possibility to see if a substance was without label because the substance was harmless or because the substance was non-assessed, and it was suggested that these substances should be question-marked, which also has been suggested recently (Bro-Rasmussen et al., 1996, Hansson & Rudén, 2004). A second possibility, which Hansson and Rudén also has suggested, is to extent two new ecological concepts – persistency and bioaccumulation – to a new tired approach that breaks with the volume-based approach that characterises both the old system and the new REACH proposal. These two parameters are relatively simple to assess and they give essential information about the substances environmental-chemical characteristics, and may thereby give an alternative key to a prioritised tiered approach.

PART FIVE: CONCLUSIONS

9 Conclusions

Even though the precautionary principle only was spelled out as a principle during 1970 to 1992, budding from the German Vorsorgeprinzip, to the Rio Conference's Principle 15 on Precautionary Action, has the principle in a tacit form and embedded in practise existed in a much-longer period. This has been examined in the context of chemicals, where the of use of chemicals in industrial society has been under critique at least since Rachel Carson's Silent Spring. It was precautionary principle like arguments that kicked-off the chemicals regulation as we know it today. There was a great belief in humanity's ability to control the adverse effects of chemicals. And indeed, the ability was great but the latest developments show that it was not great enough. One basic dimension of this is the 'irrational' element of the critique; the argument that chemicals should be used with caution already at the outset.

The creation of the regulatory framework that took place internationally since the early 1970's and in Europe up to the end of the 20th century can be perceived as triggered by a first wave of precaution carried by the social critique of the 1960s and 70s. The new reform of the European chemicals policy, REACH, can be perceived as a second wave of chemicals regulation reform triggered by critique that invokes the precautionary principle. What is new in this view? What can we learn from that contemplation? In the first wave was the reaction of a reductionist type and tendentiously in accordance with the industrial society's logic where risks are controlled without basic changes in industrial practise. It is the task in the second wave – which we are in the middle of right now – is to participate in the struggle for transforming the industrial societies' logic. There are strong tendencies that the new policy may fall in pit-falls similar to those that characterised the first wave of regulatory frameworks for chemicals control.

In Denmark the development of precautionary-like discussions and measures has started in the field of occupational health, then moved to the field of pesticides, and seemingly it is the field of industrial chemicals that is next. Along this development has the perception of chemicals as possible harm-doers become more detailed and sensitive.

The Danish straw-shortener-case indicates important features about the precautionary principle in action. The very basis of the case was the existence of competing scientific approaches as to how chemicals (in this case pesticides) should be tested; and this indicates that diversity in approaches and early involvement of different stakeholder interests and consequently different test-designs combined with openness can play an important role for the development of policies informed by a precautionary principle.

The European Commissions communication on the precautionary principle maintain that it is imperative to reserve the precautionary principle to the risk management phase. The examined cases cause reason to question this, and to propose an ad hoc approach that partly or temporarily can bypass the full risk assessment. In this sense, it is proposed to base an ad hoc risk management on intrinsic properties or what has

been termed hazard assessment, partly to overcome the large 'burden of the past' partly to motivate economic stakeholders to produce improved data.

In the analysis, it has been showed that international harmonisation plays an all central role for the regulation of chemicals and it is showed that these regimes potentially can hinder alternative approaches to the assessment of (chemicals) technologies. International regimes are unavoidable but a reform that would render the regimes more open to alternative assessments – or rather – regimes that less readily can be used by industrialist to rule out inconvenient results is needed. This alternative understanding of harmonisation should acknowledge the existence of uncertainties and competing views of existing knowledge, and thereby enhance the ability to reframe problems and enhance the possibilities of open deliberation of the technological risks of chemicals.

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