Chapter 8: Eco/toxicology and the regulation of chemical hazards

But I remained to watch the throng, and there
I saw a thing I'd hesitate to tell
Without more proof—indeed, I should not dare,
Did not a blameless conscience stead me well.
Inferno, XXVIII:112-115, 8th Circle, Fraud, Schismatics.

1 Regimes of knowing and doing
In the early seventies, the regulation of environmental hazards of pollution moved into the heart of the polity in the Netherlands, England and the US. Under pressure of new environmental organisations, some spectacularly mediated disasters, and a growing group of alarmed scientists, governments accelerated pollution policy. New legislation was passed, existing legislation was expanded to add the protection of wildlife to the protection of human health, new regulatory agencies were formed, new policy instruments developed, and new groups of experts appeared on the scene of states’ environmental policies. As regulatory programmes fell into place, regulatory regimes were formed: complex concatenations of regulatory organisations, hazard evaluation specialists, their routines and tools, tests, models, extrapolation procedures, research institutes, etc., operating together to produce knowledge and regulation pertaining to how chemical substances were allowed to circulate in the world.

During the seventies, the contours of three key regimes were drawn, regulating the effects of pollution on non-human biota and mainly taking into account effects on aquatic wildlife: the regulation of surface water quality, pesticides, and industrial chemicals. At the conceptual heart of these regulatory regimes was the quest for safe levels of pollution or at least an attempt to reduce the most excessive effects of pollution through the production of rules and standards. In spite of innovations in pollution policy, such as attempts to find ‘win-win solutions’ to environment and economic production or to stimulation the internalisation of environmental considerations in the production process, these regulatory regimes form the backbone of pollution policies to this day. At the very least, they provided the institutional platform from which alternatives would later originate.

Between the three countries studied – and even between regulatory regimes in each of these three countries – the ways in which pollution was regulated varied considerably. These regulatory regimes targeted different sections of the production and use of chemicals via specific types of standards. For example, standards varied from process oriented, end-of-pipe,
to environmental quality and product standards; sometimes combined with levies. Beyond such instrumental differences, regulatory regimes involved different kinds of relations between regulators and regulated industries. Some regulatory regimes relied more on voluntary cooperation and bilateral negotiation with industry; others tended to organise wider negotiation processes; others still tended to avoid negotiated approaches and relied more on strict rules, with legal institutions as a locus of conflict resolution. Regulatory regimes also differed with respect to the way non-governmental actors were organised and their degree of access to regulatory decision making.

Such differences have been widely acknowledged and described in research on environmental policies. Less well-documented are the differing patterns in the way regulatory expertise is organised, positioned and legitimated in such regimes. In the public presentation of science in regulatory debate, ‘science’ has varying connotations, or varying connotations of ‘science’ are stressed. ‘Independent science’ is sometimes seen as a guarantee against excessive influence of political actors and sometimes scientists themselves are accused of interest politics, or of depoliticising what, according to some actors involved, is inherently deeply political. Regulatory science is sometimes presented as a mere instrumental resource or as the protector of reasonability, against ‘unrealistic’ or ‘excessive’ demands for environmental protection. In the public legitimation of regulatory decisions, such diverse discursive resources or ‘boundary texts’ are used to implicitly draw boundaries between what is to be considered science and what politics. These boundary texts do not only seem to vary with the nature of regulatory conflict, but also with traditions of regulatory regimes.

Not only does the presentation of science in public discourse differ, but these variations also reflect the different roles that regulatory scientists perform in regulatory regimes. Scientists do not just provide instrumental knowledge in regulatory decision making. They may also come up with strategic advice, new ideas for how to define policy problems and goals, help to structure regulatory debate, or take on more explicitly political roles, for example as environmental advocates. Depending on the structure of regulatory regimes, some of these roles become more important than others, and with varying roles come specific ways to package expertise, such as in (standardised) tests, models, or expert committees.

Intricately related to the varying roles that scientists play or are expected to play, is the question of the appropriate ‘distance’ between regulatory experts and politically accountable regulatory authorities. Regulatory research may become so closely associated with regulatory authorities, that it loses its critical function and only blindly reproduce the policy beliefs of the policy makers. Inversely, experts that operate at a larger distance from the policy process may lose sight of the issues at stake in
regulatory policy, undermine effective policy initiative with over-critical advice, or take off on tangents that may be academically challenging but of little policy relevance. In spite of the attempts to look for one best model for the organisation of expertise for policy, regulatory regimes show a wide variety of ways to deal with science.

I have described science/policy boundaries as the combined discursive, social, and material arrangements that structure the division of labour between experts and policy makers, i.e. the patterns in which the tasks and problems in the production of regulation are distributed over institutions and people broadly defined as scientific or political, how these cooperate with each other, and how they redefine each other in the process. I have found patterns in these boundaries, but patterns that vary between regulatory regimes and change over time, i.e. that lead to different forms of coordination but also demarcation of 'science' and 'politics'. Science and politics are not mixed in a random tangle, but the division of labour does not have one clear-cut 'optimum' either. Policy makers at regulatory authorities, even with political accountability, decide in scientific matters if scientists fail to speak with one voice, plan and design research programmes, write scientific papers. What is considered science and what politics in regulatory regimes is not fixed. Sometimes such boundaries are blurred, sometimes they are drawn sharply. The same issues can now be considered a matter for scientists, then a matter for policy makers.

Beyond the formal differences in structure and position of regulatory expertise, more substantial differences between the kind of knowledge that is used in regulatory decision making and how this knowledge is produced, require us to delve deeper into regulatory science. As part of regulatory regimes controlling chemicals, we also found particular strategies to define, investigate, operationalise, and evaluate hazards, ways of knowing the potential damage that chemicals could cause in the environment. Especially during formative periods of regulatory policy, we have run into experts presenting the cognitive resources to structure policy, but also specific tools such as toxicity tests to provide policies with manageable measurement instruments.

Inversely, the development of regulatory policies had consequences for these experts: as political support for regulation of chemicals rose, the institutionalisation of regulatory action resulted in regulatory regimes with considerable research opportunities for eco/toxicologists. The newly formed regulatory authorities quickly required more tools and tests; new ways to assess chemical hazards, in attempts to maintain industrial and agricultural production while meeting the demands of the environment and its advocates. Eco/toxicologists provided that knowledge. Where government agencies were

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not aware of such needs, eco/toxicologists were there to point them out, suggest ways in which hazards could be measured better, ways in which legal standards could be defined, targets of protection could be operationalised.

In other words: eco/toxicology and these regulatory regimes have mutually structured each other, have heavily influenced each other’s agendas, problematics, or solution strategies. Different ways of doing environmental protection went hand in hand with different ways of knowing the potential hazards of chemicals. In order to identify some of these ways of knowing pollution, we had to open the black box of regulatory science. We had to look beyond what is portrayed in regulatory policy as ‘what has been shown by science’ into how regulatory science has shown this, how this regulatory science developed, and how regulatory science co-structured regulatory policy.

Once light falls into the black box, the richness of world of regulatory experts appears, with its competing ways of knowing, its peculiar disagreements and rich repertoire of means to overcome or eliminate disagreements. In the regulatory evaluation of chemicals with respect to their effect on non-human biota (or ‘wildlife’), the knowledge to assess effects of chemicals has been provided by eco/toxicology: a contested domain of research fields of ecology and environmental toxicology. From the perspective of these fields, the early seventies were not only remarkable because of the formation of regulatory policy, as environmental issues moved from the eccentric fringe into the heart of the polity. Simultaneously, and much less conspicuous, it was also the time in which some of the cornerstones of eco/toxicological knowledge were developed: the standardisation of environmental toxicity tests, the development of risk assessment, of biological monitoring tools, or of field testing techniques. Apart from new tools and theories, new expert communities formed, new associations, such as the Society for Environmental Toxicology and Chemistry or the Society for Ecotoxicology and Environmental Safety, new journals, and especially: new research institutes, mostly closely connected to the new regulatory agencies. The structure of regulatory regimes was very influential for the opportunities of these research fields to develop and especially for the way in which these fields developed with respect to each other, and hence for the boundaries between research fields in eco/toxicology.

I will start this chapter with a reiteration of the main conclusions of each chapter in order to turn to turn to some more general conclusions concerning the boundaries of regulatory science.

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2 Scott, *Seeing Like a State*. 
2 Boundaries and the division of expert labour

The boundaries between science and politics are never self-evident. In chapter 2, I argued that modernist definitions of what science and politics ‘really are’, essentialist demarcations of science and politics, do not help to understand the complex configurations in the division of labour in regulatory regimes. These ‘cage models’, as I have called them, may provide the modernist with criteria of how the division of labour in regulatory regimes should be organised, but in the practice of regulating chemicals such criteria are neither very revealing nor very helpful. On a descriptive level, we have seen issues that at some point were considered scientific, later political, and later scientific again. The operationalisation of protection targets, such as the protection of 95% of species as a criterion, provides an example of such an issue. In some regulatory regimes, the definition of such targets was an issue under the jurisdiction of scientists, in others it ended up in parliament, only to be packaged in a scientific tool again later. As a description of the complex interactions between scientists and decision makers, sharp analytic distinctions of what is and is not science provide a very poor representation of the contentious nature of such issues in regulatory regimes. Many regulatory debates are about what should be considered fact and what value, or political opinion, or a matter of power. The assumption that such a difference can be established by a third party, a distantiﬁed analyst, is based on the idea that these radical differences over what is fact and what is value are unfortunate misconceptions by the actors involved, which can be corrected once the true values and facts are distinguished. There is little support for such a possibility in the history of regulatory decision making and even less for the success of this strategy to resolve actual regulatory problems.

On a normative level, the attempt to implement an essentialist demarcation of ‘science’ and ‘politics’ itself appeared as a highly particular regulatory strategy, organised around a strict separation of ‘risk assessment’ and ‘risk management’. It was a strategy effective in only speciﬁc political conditions and with several drawbacks for the kinds of knowledge that can be considered, undermining the soundness of scientiﬁc evaluation as well as hiding issues of potential political relevance from view, rather than separating them clearly. The demarcationist division of labour between science and politics only makes sense in a world where political agendas have unlimited capacity, where there is no debate or ambivalence over what is fact and what value, where political institutions have the ability to settle every bit of scientiﬁc uncertainty no matter how trivial, or where scientists are always aware of their assumptions and willing to discuss them. Even in regulatory regimes that have been organised around a strict boundary between ‘science’ and ‘politics’, such a boundary rarely complies with the various ideal criteria of the cage model. The more regulatory regimes are organised to resemble
such a platonic ideal, the more they present the fatal shortcomings of it: they are typically badly equipped to deal with expert uncertainties or scientific disagreement, with societal contestation of regulatory knowledge, or with contesting conceptualisations of regulatory problems, such as produced by different fields of knowledge involved in regulatory science. The normative version of the cage model therefore forecloses participatory solutions to regulatory problems, especially in matters of the definition of problems, relevant knowledge and solution strategies. At best, a regulatory regime based on a cage model could have some merit in a situation where there are high degrees of consensus about the nature of the problem, the relevant knowledge, the goals, and desirable solution strategies - or in situations where actors care too little to actually enact their disagreements.

Inversely, the a-modernist ‘seamless network’ approach to science and politics is not very helpful either. The view that advises us to ignore the boundaries between science and politics as they have been organised in the discursive practices of regulatory regimes, leaves us with nothing to say about the actual patterns in the division of expert labour, nor about what is at stake in debates over regulatory reform. There may not be essentialist criteria that effectively describe the division of expert labour and provide adequate rules for a wise construction of such a division of labour, but this does not mean that all of a sudden we should ignore the existence of this division of labour and refuse to take the qualms of regulatory actors over them seriously. Favourite expressions of seamless network models such as ‘politics and science form a continuum’, or ‘there is always politics in science and science in politics’ may sound appealing, but they fall short of addressing the more acute questions: How are science and politics actually distributed in the operation and structure of regulatory regimes? How could or should their distribution be organised in the interest of fair environmental protection or democratic decision making? Here too, there is a gap between the analyst who claims that there are no boundaries, or only inconsequential side-products, and regulatory actors who seem to organise most of their work around such boundaries.3

The normative consequences of seamless network models result in an argument for one very specific form of regulatory regime: one in which the boundaries between science and politics are very vague and multiform. Contrary to a cage model, a seamless network model of science and politics suggests a proliferation of participation in regulatory proceedings, to a participation of everybody (and eventually everything, when even the boundary between people and things is declared a delusion). In its more

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3 Even though network theorists deny it (Latour, *Science in Action*), I fail to see how this does not imply a bad case of false consciousness on behalf of regulatory actors.
Machiavellian form, integration in the network even becomes an instrument for the interests of a key operator. As a model of regulatory regimes, the seamless network model corresponds perhaps most to regulatory controversies, where disagreements over problem definitions, relevant knowledge and solution strategies typically question and undermine previously established divisions of labour, dislodge science/policy boundaries.

Both models fall short when we try to understand (changes in) historic patterns in the division of labour, and in relating to the issues that regulatory actors are concerned with, including the ways in which actors themselves perceive boundaries in regulatory regimes. In the most sympathetic reading, they represent exceptional situations in regulatory regimes. However, there is no need for either modernist reification or a-modernist nullification of boundaries. The alternative approach to the division of expert labour is to study the patterns empirically: show how boundaries are drawn, how these patterns vary under different conditions, and what the consequences of various patterns are for the way regulatory regimes deal with pollution hazards. In this analysis, there is no need to either assume analytic boundaries for the division of expert labour, or deny the existence of boundaries altogether.

Boundaries are therefore not the same as demarcations. Demarcation, the drawing of difference, is but one part of the effect of boundaries, as they also coordinate work between practices (or, when routinised practices are involved, institutions). Demarcation and coordination are the two sides of the coin of the division of labour. Hence I have defined boundary work, with a minor modification to Shapin’s definition as such: Boundary work defines a practice in contrast with other practices, protects it from unwanted participants and interference, while attempting to prescribe proper ways of behaviour for participants and non-participants (demarcation); simultaneously, boundary work defines proper ways for interaction between these practices and makes such interaction possible and conceivable (coordination).

The issue is to grasp the patterns of boundaries that are drawn sharply in some regulatory regimes, and blurred in others. It is also to look at the production and mobilisation of boundary devices: the texts, objects, and people (TOP) that are at stake in boundary work, brought together in organisations that in turn can operate as boundary devices themselves. This TOP-scheme obviously does not have explanatory value in itself: it does not suggest why or when boundaries will be drawn one way or another. It merely serves as a reminder that boundaries can be packaged in different ways. We need not restrict ourselves to discursive devices to mark boundaries, but should include social and material ways to organise a division of labour also. If we are to understand boundary configurations, we cannot stick to the

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4 Shapin, “Discipline and Bounding”.

discursive boundary work that goes on ‘above the table’ and ignore the social and material work ‘underneath the table’. In that sense, the TOP scheme does add explanatory resources to an understanding of boundaries.

3 Eco/toxicology

If regulatory regimes are considered from the point of view of the sciences that compete for positions of experts in these regimes, a different kind of division of labour appears. The boundary between ‘science’ and ‘polities’ turns out to be directly related to the division of labour between research fields. It becomes clear that regulatory science is not a homogenous whole, but consists of competing approaches, each with their own set of professional and research organisations. In the story of the debates over the meaning of ‘ecotoxicology’ and the attempts to create an interdisciplinary field between (or in combination of) ecology and environmental toxicology, the boundary work between fields was performed with constant reference to issues of regulatory policy. For example, the preferences for single species or multiple species tests were not just debated in terms of which of these were ‘more realistic’, but also with respect to usefulness for regulatory decision making. Arguments of cost, (insufficient) standardisation, or clarity of endpoints of testing were mixed with traditional scientific issues of validity or reliability.

When regulatory regimes for environmental hazards of chemicals were formed, the science of chemicals may have been ‘underdeveloped’ from the present-day vantage point, but these regulatory regimes did not arrive in a scientific void. In each of the countries studied, there were research traditions that preceded regulatory initiatives. In fact, it was the scientists of these older research traditions that had helped to put wildlife effects of pollution on the political agenda in the first place. The division of expert labour as it was constructed in relation to regulatory regimes started in older national traditions of research, with their specific jurisdictions and intellectual heritage. In this case, these involved ecology and the early studies on aquatic toxicity (for example by fish physiologists) that would later develop into environmental toxicology. By the end of the sixties, there had been some first attempts to develop such toxicity tests, but at that point environmental toxicology was not a developed research field with its own research centres or professional organisations. Ecology was much more developed. It had a long tradition in England, including in a regulatory context through advice on pesticide hazards. In the Netherlands, ecologists were already relatively well established at universities and at the start of prosperous academic growth. In the US, the first doctorates in ecology were conferred in the early seventies, but the presence of ecologists in environmental issues was so prominent that one commonly referred to ‘the ecological problem’.

However, it was not just the relative strength of these national research traditions in general that set the stage for the eco/toxicological boundary work
of the seventies. Boundary work is crucially dependent on the expectations of researchers for the future, on where they identify chances for further development of research or advisory practice, and on where they perceive threats. In addition to the presence of national traditions in (competing) research fields, it is therefore important to look at these fields in their contemporary time frame. In the early seventies, most American ecologists saw the best perspectives for research in an academic context. Their professional associations continued to have trouble getting a grip on policy involvement, especially due to large groups of consultants that devalued ecological expertise. Failing to claim a solid jurisdiction in regulatory policies and seeing high-strung policy expectations undermined, most ecologists aimed for the expansion of academic research and academic funding. This was the very same time when the US EPA was eagerly in search of ways to evaluate pollution hazards. At its own research institutes, it found a more responsive answer to its needs from the fish biologists that developed tests for specific regulatory needs. A decade later, the gap in the jurisdiction of regulatory expertise was filled by a new and self-conscious profession, largely originated at regulatory research institutes and well on its way to establish itself at a handful of American universities. By then, regulatory assessment tools such as sub-chronic early life stage aquatic toxicity tests were already ten years of development and meticulous standardisation ahead of the kind of tests suggested by ecologists like John Cairns. Another decade later, American environmental toxicology had its own PhD programmes, research journals, an active professional organisation catering for the specific needs of a regulatory science, ready to leap across the Atlantic and set up a similar organisation in Europe.

Developments were not as clear-cut in England, but they do provide interesting contrasts. Ecologists in England were also present at regulatory research institutes in the early seventies (and beyond). Given the structure of regulatory regimes in England, the elite character that I have compared to a 'court', university scientists would not have had easy access to regulatory research even if they had wanted to. Although English academic ecologists too were suspicious of involvement in environmental policy and weary of the potential politicisation of their field, the representation of ecological research at (government) regulatory research institutes meant that regulatory interest in environmental toxicology developed next to ecology. In any case, perspectives for the energetic development of these areas of regulatory research were rather limited in the eighties, when environmental regulatory policy was generally on a backburner. Environmental toxicology in England took off as a regulatory science at the end of the eighties, when regulatory reforms created new perspectives, not only for the traditionally regulatory

5 De Wilde, Discipline en Legende; Gieryn, “Boundaries of Science”; Abbott, The System of Professions.
research institutes, but very hesitantly also for a few research groups at universities.

Dutch ecology dominated regulatory research on pollution in the seventies, especially via the involvement of the regulation of water pollution. Academic ecology tended to be organised more around functional ecology, with only limited applications in pollution policies (e.g. eutrophication), but there were also strong traditions of structural ecology. It was especially structural ecologists that were involved in the development of regulatory tools such as sampling techniques for biomonitoring or diversity indexes for water quality assessment. However, this divided community did not manage to produce an answer to the regulatory needs of the eighties, when policy makers were eagerly looking for ‘hard’ indicators that could be used in a norm-setting policy that would weigh up against other policy fields. The jurisdictional void was filled (and co-defined) by environmental toxicology. Parts of Dutch environmental toxicology initially developed in close contact with ecological research. In the second half of the eighties, a powerful alliance was made between the environmental toxicologists of Utrech University, the RIVM and the department of the Environment, importing American notions of risk assessment and steering towards increasing formalisation of expertise. Nevertheless, even this more physiologically oriented coalition developed in light of the traditional ecological critiques.

The discussions that went on around the boundary text ‘ecotoxicology’, the attempts to construct and stabilise a division of labour in eco/toxicology through definitions or representations of the field, as well as the boundaries constructed through professional organisations, research journals, or academic training (see chapter 4), only make sense if we place them in light of potential jurisdictions in regulatory regimes and the strategies of researchers towards them. What makes the analysis complicated is that eco/toxicologists were also key actors in the construction and definition of these jurisdictions, as they helped to define and construct the regulatory evaluation of chemicals. Whether they managed to do so, did not just depend on the strategies they developed under the conditions of institutionalised divisions of labour among eco/toxicologists, but also on the structure of regulatory regimes and in particular the patterns in science/policy boundaries, which warranted further inspection.

4 Packaging expertise: the US standardisation of eco/toxicity tests

In order to reconstruct exactly how the division of expert labour in US regulatory regimes was constructed, we looked in more detail at the science/policy boundary in routine regulatory decision making (rather than in a controversy). American regulatory regimes showed a strong tendency to
standardise their expertise. This standardisation involved the packaging of expert knowledge of toxicity testing or hazard evaluation into objects and especially texts, such as the detailed protocols for performing aquatic toxicity tests. The objects involved in aquatic toxicity testing were not normally provided from a central source (with exceptions, such as during round-robin testing), but protocols relied heavily on standardised equipment that was widely available, accommodating the wide distribution of testing laboratories.

In order to maintain the levels of standardisation, layers of control were added on top of the detailed instructions contained in toxicity protocols, such as laboratory certification programmes, instructional videos, or reliability testing. This produced tests that could travel, not to anywhere in general, but to the specific locations where regulatory action took place: to (certified) laboratories performing test for regulatory applications, to the offices of risk assessors, and potentially to the cross fire of counter-expertise in courtrooms. It was also in these specific locations that technologies were deployed to guarantee their stability. Certification schemes required the presence of documentation or supporting technologies in laboratories, the results of standardised test found their place in assessment schemes that attempted to routinise hazard evaluation, and the standard tests were harnessed to travel to courtrooms by means of their certification by large groups of experts, by their legal status, and ultimately even by experts trained for courtroom witnessing. In order to achieve this local (and relative) stability, tests had already travelled a long journey before that: from laboratories where the tests were conceived, usually into the laboratories of the US EPA for further development, into the long negotiations over standardisation in forums such as ASTM and EPA’s public feedback workshops.

Standardised ecotoxicity tests became boundary devices packaging the specific boundary configuration of US regulatory regimes, and were in turn used to reproduce these boundaries. The division of labour between ‘science’ and ‘politics’ that they entailed consisted of a specific selection of endpoints and extrapolation procedures that were the result of extensive negotiation, but that could be presented as hard science. In that sense, they fitted the sharp demarcation of science and politics typical of US regulatory regimes, both in public discourse and in organisation. However, the regime which managed to pacify regulatory decisions to the largest degree, in the regulation of industrial chemicals, was not based on a very formal use of standards, but of a negotiation over testing details in the framework of highly standardised testing methodology. In addition, the seemingly formalised decision making had its counterpart in the extensive negotiations that preceded the introduction of tests and assessment procedures, including with experts that worked in
industry. It therefore becomes more interesting to look at these regulatory regimes in terms of how the formal and informal are distributed over front and back regions of regulation.

The gradual and not always immediately successful development of standardisation strategies, via consensus-building standardisation organisations, EPA-sponsored and controlled development work, as well as legal certification, shows that the process did not come about automatically. Rather, it was the result of a careful honing of ways to pacify regulatory decision making through a learning process of decades. The differences between regulatory regimes in the US shows that this standardisation was dependent on the specific conditions of the individual regimes, including the views and beliefs of regulatory actors, among whom I have paid most detailed attention to the experts at the US EPA. Nevertheless, the failure to make use of mesocosm tests that did not go through the lengthy standardisation process indicates the structural conditions for strategies for regulatory testing and evaluation that went beyond the views of EPA officers.

Standardisation, per definition, involves exclusion of what is non-standard, deviant, outside of the norm. In the case of American regulatory regimes, this exclusion involved ecological forms of knowledge. On the one hand, the ecologists suggesting multispecies tests were already confronted with the ‘lack of standardisation’ argument by the end of the seventies. Their tests had not gone through the multi-million dollar development schemes that had so radically reduced duration and cost of aquatic toxicity tests (such as the development of early life stage tests of a few days to replace full-life cycle chronic test of several months or even years). On the other hand, the considerable efforts involved in carrying tests through the standardisation process and the specific (non-academic) returns involved, meant that ecologists tended not to invest in standardisation negotiations. Multi-species tests were eventually largely positioned in function of the further development of single-species tests through validation studies. The importance of the standardisation process is underlined by the fact that some microcosm tests developed for industrial chemicals did find their way into modest applications in regulatory evaluations (and later effectively into GMO evaluations).

In more general terms, formalised expertise, embedded in a test, a model, or a protocol, has regulatory advantages in the sense that these tools can create relatively stable points of reference in regulatory decision making. It is important to note that they can only do this if certain conditions are met. They have to be generally accepted by regulatory experts, since even standardised tests can be deconstructed if sufficient resources are mobilised in a controversy. A large part of their strength does not come from the degree to which their rules are detailed or to which their repeatability has been shown,

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6 Star, “Invisible Work”.
but from the certification they have received and the breadth of their support among experts. These requirements increase as access to the arena of regulatory expertise is easier and the details of regulatory assessment are publicly available, possibly used in legal action. In other words: potential opposition has to be neutralised beforehand and the nature of the opposition is crucially dependent on the structure of the regulatory regime at hand.

This standardised expertise also has some considerable drawbacks: one-sided reliance on it marks the boundaries of science in a sharp way, can (rather than resolve) create conflict that may undermine effective regulatory action, for example with stalling litigation tactics. In addition, this organisation of expertise can lead to a funnel of expertise: only knowledge that is operationalised in this standardised format can be considered in regulatory evaluations. Valuable non-standardised knowledge may have to be excluded from regulatory assessment. This could involve knowledge of newly discovered environmental effects (e.g. the debate over pseudo-hormones), or knowledge of highly particularistic properties of a particular chemical (e.g. radically different toxicity at different acidity levels), or knowledge about actual practice of chemical use that is typically highly abstracted in models and assessment protocols (e.g. the field conditions in which a pesticide is used, the realism or practicality of protective clothing or of spraying instructions).

In the case of eco/toxicity testing, such a funnel has occurred with respect to single species testing, although this has been partly repaired by the introduction of more ecological processes into the frame of environmental toxicology. The remarkable dominance of single species testing can be interpreted as a technological trajectory: investments in this frame created an advantage during the 1970s, largely as a result of very well-intended American investments in their development, that ecological alternatives could not compete with. Time and time again, the possibility of using tests for other parameters was discarded because such tests were ‘insufficiently developed’.

A similar fate hit the heavy artillery of ecological testing, the mesocosm, in spite of attempts to catch up its development. In this light it is quite remarkable that mesocosm have operated only in regulatory regimes where there was space for negotiation over testing details, framed by generic rather than highly standardised testing protocols. Part of this trajectory is the alliance between the US EPA regulators and environmental toxicology, receiving regulatory funding and developing in the pleasant shade of regulatory attention. Ecologists saw other avenues, initially in an academic setting, and later in other policy fields, such as conservation. Under these circumstances, the ecologists who remained interested in environmental pollution were not able to produce the kind of abstracted, objectified biology for which American regulatory regimes had a strong affinity.
One way to compensate for these drawbacks of these 'funnelled', highly standardised tests and assessment schemes in chemical regulation is to build in safety margins. We have seen various 'safety factors' and 'assessment factors' used in regulatory assessment, some based on expert opinion and some in turn made into a rule (but ultimately no less based on informed opinion). A weak point in the assessment factors is that they are vulnerable to the argument of over-protection: if they are designed to err on the safe side, to compensate for the inherent limitations of single species testing, then this leads to the quest for the backdoor, a way to avoid alleged over-regulation. This is the role that multispecies tests ended up in by the end of the eighties: the outsider expertise that could be used to lower standards otherwise too strict. This is not to say that informal, personalised expertise is 'better', as it presents different drawbacks, as we found through the contrasting patterns of regimes in other countries.

5 Contrasting patterns

England and the Netherlands provided contrasting patterns in the division of expert labour. Both between countries and between regulatory regimes, the science/policy boundaries were organised in markedly different ways while with also respect to eco/toxicology the division of labour took on different patterns and a different route of development. This variation could be related to differing structures of regulatory regimes, in addition to variation of research traditions and boundary work of eco/toxicology. I will briefly recapitulate the differences here.

Until the second half of the eighties, the English regulatory regimes described were typically structured as (royal) courts: access to the nitty-gritty of regulatory decision making was limited to a relatively limited range of trusted and co-opted actors, a pattern that was especially striking for the organisation of expertise. Regulatory authorities relied on a select group of expert institutes, bound to the policy culture of 'reasonability' and high levels of discretion. This involved personalised science/policy boundaries that were presented in public as strict, but were combined with more flexible and contingent practices of regulatory decision making. In the back region of decision making, issues of science and policy were accommodated rather than strictly separated. In the public defence of these boundary configurations, science was associated with reason rather than rules, with people rather than texts or objects.

In striking contrast to the US, limited standardisation of eco/toxicological tests did not prevent test results from being considered in regulatory assessments, as was illustrated by the use of 'failed' US mesocosm studies in English pesticide assessments. Although eco/toxicological methodology was developed in England also (and occasionally even went through a limited certification process), standardisation was not nearly as
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extensive as in the US. This did not lead to the same effects of exclusion of non-standardised expertise, in principle creating more space for ecology to develop a regulatory practice. Because English regulatory regimes showed strong aversion of using legal channels of conflict resolution, this meant that one of the powerful drives behind standardisation in the US was absent. However, the 'court' structure of regimes led to different kinds of exclusion, not operating via standardisation, but via the restricted range of research institutes and experts that had access to regulatory decision making. One of the remarkable differences with the US and England was the low degree of involvement of the academic world in regulatory expertise, with the exception of very few advisory committees more distanced to routine decision making, such as the Royal Commission on Environmental Pollution.

In spite of this general pattern, regulatory regimes in England also showed variation and change over time. The structure of regulatory regimes started to shift after the mid-eighties, caused by a number of developments. Firstly, there was the privatisation of the traditional 'court' research institutes. Although regulatory authorities continued to rely strongly on their traditional sources of expertise, at least this meant that these research institutes diversified their sources of income. Nevertheless, the privatisation did not in itself break through the high levels of secrecy, as the confidentiality of civil servants was replaced with the commercial confidentiality of consultants. Secondly, the continued failure of the regulation based on voluntary cooperation, extensive negotiation with regulated industry and pragmatic use of environmental quality standards as main success indicator, continued to fall short of its promises. This also created a widening gap between the promise of public control of regulatory policy and the practice of restricted access. Thirdly, there was the expanding involvement of the European Union in environmental regulation, producing (legal) resources that could be mobilised by environmental movements, but also methodological resources that guided development of new regulatory initiatives.

Such sources of pressure did not lead to breakthroughs in each of the three regulatory regimes simultaneously, nor to similar patterns of development. Starting in 1985, the shift to a statutory scheme for pesticides and consequently to more openness and a gradual formalisation of assessment criteria, continued to support a highly informal and negotiated practice of pesticide hazard assessment. In the regulation of water, hesitant formalisation of the regulatory approach occurred at the end of the eighties. It came with the more independent regulatory position of the National Rivers Authority, the development of lists of priority chemicals with stricter discharge limitations, but also with the development of ecological methodology to determine environmental quality. In industrial chemicals we found the strongest tendencies to conform to European approaches, especially through the harmonisation of risk assessment procedures and through the introduction of
new sources of eco/toxicological expertise in the policy process, but here too the tradition of negotiation with industry over regulation continued. In other words: the science/policy boundaries in these regimes continued to show subtle differences, even under similar developments in the national and European regulatory context.

In the Netherlands, these differences between regulatory regimes were sharper. The regime of pesticides was very similar to that in England in some respects: high levels of secrecy, extensive negotiation over hazard evaluation, and a strong reliance on voluntary cooperation. Marked dissimilarities, at least in the seventies and eighties, were the ‘departmental corporatism’ that set a stage for expert evaluation with an ambivalent science/policy boundary, and the stronger legal mandate of regulatory authorities. These differences became much smaller at the end of the eighties, after the English regulatory scheme became statutory and even after the Dutch regulatory authority was put at more distance from government. A remarkable exception was the fact that the Dutch regulatory regime no longer claimed to be organised around a politics-versus-science boundary, but on a policy-versus-implementation basis. Nevertheless, implementation was still delegated to experts, clearly labelled as such.

The regulation of water pollution had a particular structure set in the Dutch regional water boards and the system of levies. Especially through the extensive local responsibilities in physical management, water regulation offered job opportunities for ecologists. A significant change came in the second half of the eighties with the development of water quality criteria and the increasing reliance of the department of the environment on a more formalised approach to eco/toxicological assessment. Starting with review documents, this developed into derivation schemes for water quality criteria that made use of methodology developed by the US EPA and that came to resemble more strongly US patterns of regulatory evaluation. This development was even stronger in the regulation of industrial chemicals, where the risk assessment schemes came with a sharper science/politics boundary, resulting in the attempts to develop models and formalised assessment schemes. In contrast to the US, the key process here was not an adversarial court system, but the introduction of American methodology, the professional ethic of separation of science and politics of the risk assessment approach, combined with the strategy of the department of the environment to rely more on quantified science as a means to get a stronger position among other departments.

Focusing specifically on the consequences for the development of regulatory science, these contrasting patterns in the Netherlands and England created a different set of opportunities for eco/toxicology: the unintended high levels of exclusion of ecology from regulatory science did not occur as strongly and opportunities for blurring of boundaries in eco/toxicology were
generally better. Nevertheless, the processes behind this were dissimilar. In England, ecologists were not pushed out of regulatory regimes through standardisation as in the US, but continued to participate in regulatory regimes on a modest level. However, the selective mobilisation of expertise in England also meant that this participation was limited to a small group of ecological researchers in government research institutes. Simultaneously, the opportunities to develop methodology were limited due to the modest perspectives for funding. Regulatory interests in ecology did provide modest chances, for example in the development of the RIVPACS model or the continued interests in mesocosms, but such interests did not weigh up against the international dominance of environmental toxicology.

In the Netherlands, it was the structure of science policy, in particular, along with the interest in ecology in (local) water regulation that time and time again pushed ecology into the arena of regulatory research, even at times when it seemed to have acquired a backlog in regulatory methodology in comparison to environmental toxicology. The main instruments of this mobilisation were research programmes of an interdepartmental nature, in combination with advisory organisations for research policy. In contrast to the central position of the US EPA in American regulatory research and to a larger extent than the Natural Environment Research Council in England, research policy was an engine of integration, even if each individual research programmes did not offer as many options for ecologists. This form of research policy – focused on bringing even academic research to bare on regulatory issues already in the early eighties – is one of the crucial processes behind ecology’s closer involvement in regulatory research in the Netherlands than in the US and even England. Similar integrating tendencies could be found in the development of environmental science teaching programmes, some of which were specifically tailored to pertinent areas of environmental policy. Other processes involved the possibility of Dutch ecologists to construct alliances through different regulatory regimes, for example via the department of water or the department of agriculture. The fragmented institutionalisation of Dutch environmental policy thus also supported pluralism of expertise, while research policy stimulated integration.

This did not mean that, by 1995, at the end of the period researched, the Netherlands had created the interdisciplinary ‘ecotoxicology’ that some ecologists had envisaged around 1980. Rather, there was a combination of a detailed allotment of regulatory research between the two fields and a better perspective for mutual influence and cooperation. The confrontation with the energetic alliance around risk assessment led by the department of the environment did not result in the exclusion of ecology, but in an intricate division of labour organised around specific sections of regulatory policy and

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in a stronger exchange that created the particular brand of Dutch eco/toxicology. This consisted of an environmental toxicology that developed answers to ecological counter-views, built more ecological aspects into its evaluation schemes, but also provided niches for in-between positions (such as that of the ecotoxicologists at the Free University). Throughout the eighties and nineties, the triangle of relations between environmental toxicology, chemistry and ecology suggested by Koeman returned as a powerful and generally accepted mnemonic of this complementarity.

6 Regulatory regimes, science, and the state

Because of the two-way constituting interaction between regulatory policy traditions and research communities (the 'co-constructin of regulatory regimes'), it would be too crude to reduce the division of expert labour in eco/toxicological regulatory regimes in these countries to either the existence of national traditions of research or the structure of regulatory decision making. National traditions of research develop in response to research opportunities and, in eco/toxicology, these research opportunities were structured by regulatory policies. Inversely, regulatory policies in environmental affairs do not develop in isolation of research traditions. On the contrary: researchers play crucial roles in signalling, defining and operationalising regulatory issues, as well as in the construction of targets of environmental protection and the ways to measure goal attainment. It is therefore essential for the understanding of the structure of regulatory regimes to 'look into the black box of science', analyse the constitutive roles of scientists, the succession of generations of experts or the precise origins of concepts and the tools, tests, and material resources used by them. These resources too are structured by boundaries, namely the boundaries of research fields, constructed in cooperation or competition between scientists and the dominant research agendas or tools in their fields. In as far as these are these boundaries have become routinised, they form institutionalised patterns that structure what should and should not be asked, who should and should not participate in research, or what does and does not belong to the right tools for the job. My analysis of eco/toxicology suggests that members of scientific fields do not just draw boundaries with respect to other scientific fields based on intellectual competition or in-group/out-group strife. On the contrary, it seems boundary issues emerge especially where scientists compete or form alliances for resources: research funding or facilities, jurisdictions of professional (regulatory) practice, or even cultural recognition. In that sense, scientific fields operate more like professions than the stereotype of disinterested academic research.

The structure of the science/policy boundary is an integral part of the way regulatory regimes are organised. The typical pattern of organisation of a regulatory regime is embedded in the science/policy boundary just like it is
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embedded in institutionalised demarcation of regulatory tasks (limited versus extensive), the form of relations with societal actors (functionalised/-constituent), and the pattern of involvement of legal institutions in the regulatory regime (see chapter 7). These characteristics of regulatory regimes are not independent of each other. Innovations in the way the science/policy boundary is organised tend to result in a rearrangement in the other institutional elements. For example, processes of standardisation of expertise imply a boundary between science and politics that is drawn more sharply. This will threaten to restrict or at least restructure the space for negotiation between regulatory agencies and societal groups, especially under conditions of polarisation. This does not mean that regulatory regimes tend towards some sort of stability where all four characteristics are in balance. Regulatory regimes are in flux, sometimes through marginal changes, sometimes through more radical innovations. Regulatory experts pick up new methodologies abroad, different generations of experts move into crucial positions and bring along their own approach, political crises lead to new mandates or restructure avenues for legal challenge of regulatory decision making. I have suggested the use of Kingdon’s policy window/policy closure terms to describe this discontinuous process of change, and the notion of institutional isomorphism to track the origins and nature of regulatory innovations through coercive, mimicking, or professional processes.

The resulting description of national patterns is one that does not look for underlying national institutions that express themselves in specific regulatory regimes. It is one in which the typical national patterns become a common denominator for patterns found in various national institutions, among which regulatory regimes. While macro-institutions structure the opportunities for regulatory regimes, the development of regulatory regimes themselves has changed the conception of the state, the way state agencies interact with society or the role of scientific expertise in policy making. The regulation of environmental pollution has innovated the way policy makers interact with experts or with pressure groups. The history of water management in the Netherlands forms a nice example of how regulatory regimes can provide institutional models for the rest of the polity, as it is commonly considered as an institutional model for a distributed Dutch state. One could stretch the claim beyond environmental regulation. For example, similar arguments could be made for the redefinition of the role of the state by American regulatory action in the Prohibition or the War on Drugs.

Whatever the conception of the relation between national patterns and ‘sector’ patterns in regulatory regimes, the pattern of institutionalisation of expertise is a crucial element of regulatory regimes that can no longer be ignored. There is overwhelming evidence from STS that expertise is constitutive to regulatory regimes, just as coalitions, bureaucracies, regulatory agencies, or pressure groups are. STS has also shown that the organisation
and outcomes of scientific expertise are not self-evident, but that there are processes going on ‘in science’ that are both interesting for social scientists and of considerable potential relevance. Given these results, a systematic refusal to open the black box of regulatory science is a mistake a social scientist studying regulatory decision making cannot afford to make.

7 Boundaries

What can we conclude about boundaries of regulatory science in a more general sense? I have argued for three key principles to study boundaries of (regulatory) science, constituting a conceptual apparatus for studying boundaries. Each of these three has been developed in this study and has led to wider implications for how we understand and study science and expertise.

7.1 Multiple boundaries: beyond language

Boundaries should be analysed as they are embodied in boundary devices: texts, objects, and people. These three elements are available to actors to mutually define and structure the boundaries between science and policy as well as between research fields. We can analyse how material boundary devices (objects) distribute a role for scientists and a role for policy makers (people), for example when a risk assessment model structures how experimental results need to be put in and what the consequent choices are for the policy maker. Textual devices are used to define the role of the scientist and the policy maker, such as the notions of risk assessment/risk management. These boundary devices help to structure boundaries, which means that they make certain outcomes of boundary work more likely than others (not determine them). In this sense, they embody power: the possibility to alter the outcome of social interaction. The various forms of embodied boundaries interact, work together or conflict with each other in the organisation of the demarcation and integration of politics and science.

A description of boundaries therefore has to account for their multiple forms. Because boundaries are embodied in texts, objects, and people; because these are organised in complex organisation in patterns that can be idiosyncratic or innovative; because boundaries are disputed; or simply because boundaries vary between regulatory regimes, there is not one identifiable and clearly definable boundary between science and politics. Even a ‘map’ of all the various ways in which politics and science are bound in the context of one specific regulatory regime is an impossible job. Although perhaps displeasing to the analytic mind, ‘the boundary’ between science and politics in regulatory regimes turns out to be a complex patchwork where distinctions between science and politics are indeed drawn all the time, but often in contradicting and ambivalent terms. Boundaries in regulatory regimes can indeed be described as sharp, vague, or ambivalent, but one should remain aware that these are crude generalisations, helpful to
understand the dominant dynamic of regulatory decision making but not necessarily of all cases of sub-issues.

The consequence of multiple boundaries is that we should analyse boundaries 'beyond language': not merely as a matter of cultural representation of scientific practices, but of structuration of scientific practices and more specifically: of the division of expert labour. The fact that we ourselves, as analysts of this division of labour, seem to be mostly confined to language to express this division of labour, does not relieve us of the duty to grapple with the silent discourse of tests, experimental practices, social networks, or unspoken rules. Moreover, a creative and constructive contribution to the debate over the division of expert labour should not have to restrict itself to the systematising of already existing conceptual maps of this division of labour used by actors, but it will have to relate to these maps as they are so crucial for regulatory discourse.

7.2 Institutional constructivism: beyond boundary work

Boundaries should not just be seen as a matter of 'work', but also develop structural properties. As this boundary work routinises, it leads to institutionalised boundaries: routines, rules, standard procedures, habitual behaviour, accepted and unproblematised conceptualisations, combined in the structure of complex organisations such as regulatory bureaucracies. Although it is true that such institutions would cease to exist when actors no longer reproduce them, it would be nonsensical to assume that actors have the simple choice not to reproduce them. In fact, most of the time, actors are not even actively aware of all the institutionalised boundaries that they are reproducing. To change boundaries means to invent new routines, new words, new apparatuses, and/or new organisational structures. It means that power must be shifted, interests redefined or countered. In such a process, boundary work always relies and builds on other, previously institutionalised boundaries. Therefore, the term 'boundary work' as an action category should be complemented and balanced with a structural notion of 'boundary'.

The fear of reifying such institutions by presenting them as harder than they 'actually' are ultimately leads to the dead end of seamless network models. A one-sided analysis of boundaries-in-the-making via a focus on boundary work may show the constructed nature of the division of expert labour, but has little more to say once this point is made and little to add to how the division of expert labour can be restructured.

Nor do we have to forfeit the constructed nature of the division of expert labour, or for that matter of science itself. From an epistemological point of view, the analysis of regulatory science presented in this study is distinctly constructivist. Knowledge of environmental effects of chemical substances is not a matter of straightforward reflection of processes in 'the environment', but the result of the enormous amounts of work of regulatory
scientists, work that is performed in light of requirements of policy, framed by
policy beliefs and approaches just as it is framed by traditions in competing
fields of research. It is work that is only possible because of the extensive
array of measuring devices of monitoring schemes, of standardisation boards,
of previously constructed standards. It is also work that is guided by beliefs of
what is science and what is political and beliefs of what the role of experts in
the policy process is or should be. However, this constructivist position in
itself is not very interesting and remains an in principle position if we cannot
say anything beyond ad hoc stories stating that environmental science is
'constructed'. In spite of the creativity of research and the remarkable
capacities of (environmental) researchers to build new networks and explore
new research opportunities, these processes occur in an already structured
environment of research and regulatory policy. Just as scientific equipment,
research procedures or theories can become 'black boxed' as they are
routinised, so can regulatory decision making, science policy, or the
involvement of experts obtain a routine character. In other words: we need to
understand the patterns of institutionalisation in which the construction of
scientific knowledge occurs, an institutional constructivism that goes beyond
the epistemological fascination that has dominated STS since the early
eighties. We know that scientific knowledge is constructed. The interesting
question is why scientific knowledge is constructed in one particular way and
not another.

7.3 Variable boundaries: beyond modern versus a-modern
Boundaries between such social domains as 'science' and 'politics' should be
understood as variable. They should not be defined analytically and a priori,
but they should be studied empirically, as they are organised and embodied in
social practices. I found that the science/policy boundary takes various forms
between different regulatory regimes, from a sharp boundary, to a vague
boundary, to an ambivalent one where the presentation of a sharp boundary in
public hides more pragmatic dealings in the back region that is not public.
Such boundaries are important elements in the institutional framework of
regulatory regimes as they are part of different patterns of the integration of
science and decision making and of the legitimation of decisions of regulatory
agencies.

Regulatory agencies want scientific advice they can rely on, in the very
specific meaning of: advice that will offer clear answers that match the policy
beliefs in use, match the format of decision making, or that has a maximum
likelihood of surviving third party attempts at critical undermining, but that is
not the only form of advice regulatory agencies want. They may want creative
new ideas for new emerging policy problems, they may want to be kept
informed of potential new problems, or they may value the occasional critical
reflection on their operation. Already the wide range of the kind of advice
decision makers expect from the experts suggests that there is not one kind of division of expert labour. Out of the nature of regulatory work the bulk of the scientific need of regulatory work may require the more instrumental kind of advice, but this is a consequence of the construction of a specific task domain of regulatory agencies, i.e. the production of decisions on large numbers of individual cases, and of the context of societies where ‘science’ is valued as a repertoire of legitimation.

As I have shown, this is not the end of the story, but only the beginning. Firstly, what it means to have advice that matches policy belief and format, and will stand questioning, varies radically between regulatory regimes. Even for routine, instrumental advice there is no single best model. This is why solutions for the problem of the division of expert labour that are popular in the regulatory world, such as ‘transparency’ or ‘harmonisation’ fail: they suppose one optimal solution and thereby deny the multiform nature of expert advice, of science, of regulatory politics, and of the way regimes are embedded in national institutions. They ultimately presuppose a ‘transparent’ or ‘harmonised’ society.

Secondly, where scientific advice is not available, regulatory agencies tend to stimulate its creation, via research programmes, support for ‘useful’ research, or simply by providing a market for jobs and regulatory testing. This construction of regulatory science by the state explains why, especially in older regulatory regimes, it is often near impossible to find pertinent ‘independent research’. Moreover, the creation of a regulatory regime does not only involve the negotiation and institutionalisation of a science/policy boundary, but also leads to changes in the boundaries between scientific fields, altering the division of expert labour even into research science.

Thirdly, this is not a one-way relation: competing fields of knowledge vie for the position of experts for a policy domain and attempt to form a coalition with policy makers. Because of the constitutive power of such a coalition, its potential to develop stable institutions, and the fact that it creeps into language, (test) objects, as well as the structure of personal relations, I have insisted on calling this a regulatory regime. In the forging of such a coalition, typically the key conceptual elements of a regulatory regime are defined.

This type of analysis means we do not choose a priori between a cage model or a seamless network, between the celebration or denial of modernity. The cage model points at a separation between science and politics as a core property of modernism, the network modern ultimately denies the very existence of modernity. Although the regulatory regimes I studied are all organised around some form of boundary between science and politics, this division of labour takes different forms and varies over time. To the extent that one could still see a hallmark of modernity in this differentiation, it turns out to be variable, both in time and context. A strict division of labour
between science and politics in a regulatory regime breaks down in times of controversy or conflict, is reorganised in a different form, may be weakened to allow for more public participation in even the most technical aspects of environmental hazards. A study of the boundaries between science and politics in regulatory regimes suggests that we live in multiple and variable modernities, rather than one stereotypical form: various forms of modernity that are periodically abandoned and reconstructed into new forms. The very abstract traits that they seem to have in common are not very informative about the day-to-day realities of regulatory decision making. To the extent that regulatory regimes manage to be reflexive about their differences and changes, they may have the ability to weigh strengths and weaknesses of various ways to integrate science and politics, various ways to organise a division of labour between experts and decision makers, in particular when regulatory disagreement offers a window for change and a reflection about alternatives. This is where there is a role for comparative studies of regulatory regimes: to describe regulatory alternatives, to candidly point at their strengths and weaknesses, especially those that are unforeseen or ignored, and to engage in the debate over regulatory futures. Much remains to be done here and I myself have only partially managed to follow my own unsolicited advice. Perhaps that is what it means to live not in one modernity, not in a society that has never been modern, but in a society that can reflect on many different modernities.