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Science and precaution

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Report on

Science and Precaution

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Science and Precaution

Preface

The Concerted Action on Trade and Environment (CAT&E) is designed to provide an opportunity for the large and growing community of European researchers working on trade and environment issues to meet regularly, to discuss research hypotheses and methods, to review results, and to develop new lines of co-operative research. CAT&E will launch a dialogue with policy makers at all levels. It aims to create a process that can document the progress of research and generate new research impulses in this area. It seeks to advance the resolution of current conflicts between trade and environment. The information obtained in the course of the Concerted Action is annually summarised in state of the art reports and bibliographies in a fashion that is useful to both researchers and policy makers. The bibliographies focus on the most recent literature. The reports serve as an input to CAT&E's annual members' meetings and open conferences. To structure the reporting and discussions, the following themes have been identified initially (in random order; the theme of the present paper is underlined):

- ✓ Subsidies
- ✓ Government Procurement
- ✓ Investment
- ✓ TBT, SPS, and Labelling
- ✓ Trade and Development
- ✓ Trade, Environment and Human Rights
- ✓ Trade in Commodities
- ✓ Implementation Procedures
- ✓ Trade in Services
- ✓ Intellectual Property Rights
- ✓ Trade and Multilateral Environmental Agreements
- ✓ Dispute Settlement
- ✓ Transparency and Participation
- ✓ Sustainability Impact Assessment of Trade Agreements
- ✓ European Trade Policy Development
- ✓ Trade and Agriculture
- ✓ Trade, Environment and Labour
- ✓ Trade, Environment, and Public Health
- ✓ Science and Precaution
- ✓ Trade and Environment in the Architecture of International Governance.

Introduction and scope of the paper

The subject here involves the interrelations between science and precaution. We first introduce the notion of precaution through the emergence of the precautionary principle. We then define the scope of our study on science and precaution.

The emergence of the concept of precaution and of the precautionary principle

The precautionary principle has progressively emerged after it has been recognized that significant damage to the environment and human health have occurred that could have been reduced if measures had been taken despite scientific uncertainties on the causal links, often difficult to establish.[1]

The precautionary principle is currently articulated in many international, regional and national instruments, including political declarations and legal texts such as international treaties and national constitutions (Cameron et al., 2001; De Sadeleer, 2002). The normative importance and legal status may vary significantly: one of the guiding principles of the environmental policy of the European Union, it is also present in international soft law, such as conventions, recommendations and resolutions, which are not legally binding.

The Rio Declaration, adopted by governments at the 1992 UN Summit on Environment and Development (Rio Summit), describes the concept of precaution in the following way: "[I]n order to protect the environment, the *precautionary approach* shall be widely applied by States according to their capabilities. 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."

The precautionary approach is also evident in Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC, 1992), which states: "[T]he Parties should take *precautionary measures* to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost.

Since the Rio Summit, the positions on precaution between the European Union and the United States have diverged, giving rise to strong conflicts in the framework of the World Trade Organisation (WTO). This conflict was also apparent in other multilateral arenas, contributing at least in part to the United States refusal to ratify the Kyoto Protocol to the UNFCCC.

Nevertheless the concept of precaution acquires more and more importance as far as the responsibility of national governments is concerned to manage emerging risks not con-

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[1] European Environment Agency (2001).

fined to the field of the environment, but progressively enlarged to human health, as in the Resolution on the precautionary principle adopted by the European Council in Nice in 2000.[2]

Indeed, the concerns associated with the emergence of new risks able to create irreversible or very large damages are present everywhere in the world. In the majority of cases, they are transnational or global in nature, as the effects of national or regional measures to deal with these risks, whatever expression is used for the action to be taken: 'precautionary approach', 'precautionary measures', 'application of the precautionary principle' in the European Union, 'risk management' and 'risk assessment' in North America. Therefore, seeking for national and regional solutions compatible with a responsible management of risks of transnational character necessitates a better knowledge of cultures, administrative and legal practices and priorities of the different countries involved. This is necessary in order to make progress in the transatlantic dialogue on precaution but also on the dialogue on precaution between OECD and non-OECD countries. In that regards, the solutions have to be compatible development priorities of Southern countries.

Precaution by nature calls for progressive action, guided by the evolution of scientific knowledge (Von Moltke & Weill, 2004). Therefore the decision-making process has to find ways to adapt in a context of a continuously evolving knowledge and landscape for risks. Depending on how precaution is politically inscribed in legal texts, the judicial practice and therefore jurisprudence is also evolving (Noiville, 2003). In order to deal with potential risks, research is obviously needed in a large number of disciplines: political science, law, social and human sciences, mathematics, natural and engineering sciences. This paper is essentially focusing on the role of science and scientific experts in the implementation of precaution.

Science and precaution: a complex connection

All formulations of the precautionary principle (Sandin, 1999) indicate that due to scientific uncertainty on the (origin and characteristics of potential) risks to be dealt with, precautionary decisions have to remain open in order to be able to take into account future evolutions of scientific knowledge. This approach might be considered reasonable and even necessary when dealing with serious or irreversible damage. Nevertheless, it should be noted that the scientific comprehension of some phenomena (climate change) progresses very slowly as compared with innovation, the apparition of new products, processes and behaviours, the speed of exchanges of goods and with the spreading of diseases. Moreover, many of the questions raised by the effects of human activities on environment, health or security are of such a complexity that some will only be partially answered by scientists, and not necessarily in a very helpful way (Müller-Herold, 2004). Additionally, the discovery of new scientific and technical alternatives combined with a change of individual and collective behaviour takes a long time compared with the erosion of natural resources.

Due to the fact that science is inscribed in the precautionary principle in a vague and almost negative way[3], there is no clear consensus or even clear perception on what kind of

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[2] European Council (2000).

role science has to play in this principle, and therefore on what kind of science and scientific practices are needed. Another consequence of this formulation has been the expression of strong oppositions on the precautionary principle inside the scientific community itself. They have been expressed at different occasions like in the Heidelberg Appeal presented in Rio in 1992 and ten years later in the strong debates in France on the inclusion of the precautionary principle in the Charter of the Environment to be added to the French constitution which had some resonance at the international level[4].

Another important matter is the difficulty of explaining science in a way accessible to lay people and policy makers. This difficulty increases when such explanations have to be provided within a reasonable timeframe, given the rapid evolution of major scientific discoveries and technical innovations (for instance in genetics and at the nanometer scale). Therefore the precision of the status and role of scientists in the expertise of risks for decision making as well as in public debates and participatory procedures is crucial in our technical democracies (Nowotny et al., 2001; Liberatore et al., 2003).

Identification of relevant research hypotheses and survey of methodological approaches

This review is confined to the relations between science and precaution. We will set out in this section the main elements of the debate relating to science and precaution. Consequently, we will identify in which directions it might be interesting to undertake research in relation to the political debate and in relation to the measures already undertaken to deal with potential risks (gaps of research). We will consider first why and how the paradigm of precaution modifies the role of science and the practice of scientific expertise for potential risks compared to 'classical' risks clearly defined in terms of nature and probabilities of occurrence and magnitude. A second part is dedicated to the development and improvement of scientific expertise for precaution at the European and international level. We then will consider the debates and actions taken to integrate societal preferences in the identification, assessment and management of potential risks. Finally we will consider the trans-Atlantic aspects of precaution.

What science and scientific expertise is necessary for precaution?

In the text that follows we will distinguish science from scientific expertise. Scientific expertise is an assessment (state of the art of the literature) on a given question asked by policy-makers or non-governmental organisations (both public interest and business). When asked, scientific experts can complete this work by hypotheses or more developed scenarios, advices and propositions for actions. In contrast, during the practice of scientific research, the scientists identify the issues and set the research agenda in their area of interest which of course may be oriented for a part by the funders (State, companies, mixing of public and private funds) Very often, the time scale for the development of research initiated by scientists is much longer than the time scale for the provision of sci-

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[3] European Commission (2000).

[4] Precaution versus principles, *Nature* 429(6992), at 585.

entific expertise required by policymakers to inform decisions. Nevertheless, science and expertise are obviously connected activities, and enrich each other.

Science

A major part of the scientific practice useful in the context of precaution is related to the observation of the earth at different geographical and time scales in order to follow the evolution of the environment of the planet submitted to increasingly stronger anthropogenic stresses: in the study of ozone depletion and on climate change, scientists have played a major role of alert. In environmental sciences at large (environment and health) the scientific knowledge evolves through the intensification and systematisation of multidisciplinary work. Indeed it is necessary to accumulate sets of scientific elements collected by scientists of different disciplines and to use multidisciplinary analyses to be able to understand complex scientific phenomena and to distinguish in a given set of data important trends (as for example the growing incidence of a given pathology in a given human group).

A preoccupation not only related to global potential risks but also to local or global classical risks (for instance, extreme weather events) is therefore the development of observation means to produce more precise, more frequent, more homogeneous and better geographically distributed data, and to intensify the exchange of such data. This is crucial for the development of equitable early warning systems.

Gaps in research

Moreover, in the framework of international environmental agreements (climate change, biodiversity), it is very difficult to conduct negotiations on a fair basis if important sets of national data are lacking. On the other hand, due to the developments of spatial observations means with satellites, data at a proper scale do exist today everywhere. Major questions for tomorrow are therefore the following: How such data could be shared and harmonised taking into account political and legal aspects? What kind of guidelines scientists would establish in the interpretation of such data to be then used by negotiators? Natural, political and law scientists have to be involved in the research on these highly strategic issues.

It is commonly considered that scientific research is also very helpful for precaution in seeking new technological solutions in order to reduce anthropogenic stresses on the planet (greenhouse gases in the atmosphere, for instance, or chemicals in the environment[5]). There are two major difficulties in this attitude. First, it is clear that very new solutions (in the energy production for instance) will not be found in a short or event medium term. Therefore, only mixed solutions using at the same time organisational, financial and technical innovations will be able to tackle the problem at stake at a good level. In the majority of cases, the emerging solutions involve several actors (companies, States) and are not confined to the activity of a given economic actor or sector. Second, even when technological promising solutions do exist, it appears often very difficult to develop them industrially. Indeed the mode of financing and management of large companies do not currently allow the development of a research oriented in a substantial way towards solutions for sustainable development.

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[5] On how to promote more safe chemical products, see Lancaster (2002) and RCEP (2003).

Finally, the negative perception of science in the society associated to the fears of potential or even real negative impacts of scientific applications has grown continuously since the Second World War (Hiroshima and Nagasaki 1945). This aspect will be considered in the next section.

Scientific expertise

In order to include potential risks into a global system of governance of all kinds of risks, including prevention of risks (which cover the classical steps of risk assessment and risks management) in European institutions, a work has been conducted through a European Research program[6]. The approach developed by the interdisciplinary research team includes a conceptual analysis and guidelines for all steps of the decision making process. It classifies the types of risks (proven, plausible, etc.) and relates them to the appropriate type of risk management. For instance, controversial risks necessitate consultations with various stakeholders. This analysis introduces a new and very important exercise: pre-screening, i.e., the identification of potential risks. One of the great strengths of the study is its application to chemical products. The hazardous character of products can thus be assessed *before* they are marketed by using filters that consider a small number of measurable physicochemical properties. This reverses the current logic, by which we wait for alarm signals after a product has been released in the environment to undertake toxicological, ecotoxicological and epidemiological studies that thus face considerable methodological difficulties (Müller-Herold, 2004). Such an approach is currently not incorporated into the current European Proposal concerning the registration, evaluation, authorisation and restriction of chemicals, named REACH. Some propositions have recently been made to improve the REACH system for the evaluation of chemicals in order to render it more efficient at a systemic level (Hansson & Ruden, 2005).

Another direction to pursue in order to improve the efficiency and the robustness of scientific expertise for potential risks could be to find ways to share private and public data: in toxicology for instance, a lot of work has been already done in private companies (pharmacy, cosmetology) but a very small portion is publicly available.

Gaps in research

How to treat the systemic character of some risks (e.g. food security)?: How to develop more systemic approaches for the elaboration of rules and norms referring to the precautionary principle (who, how, which tractability, legitimacy) one the one side, and of methods for the scientific treatment of risks on the other side (including pre-screening)?

Private expertise: Design legal instruments to make part of the private expertise and data available for public authorities in order to enlarge the field accessible to public risk assessments and to consolidate the scientific knowledge. If we enlarge our scope to incorporate other non scientific dimensions of precaution, we point out the following gaps of research.

Implementation of the precautionary principle: What can we learn from what has been done on scientific - expertise - and legal - new legislation - tools for precaution? How to improve the implementation of the precautionary principle, especially in a systemic perspective? How can economic instruments be helpful?

The development of scientific expertise for precaution

After the important sanitary crises that have taking place in Europe and elsewhere during the last decade, national and regional institutions have been developed, modified or created in Europe, dedicated to the scientific assessment of risks. It is therefore today possible to analyse such initiatives (Lafond, 2001; Von Moltke & Weill, 2004). It has then been observed that the doctrine of separation of the functions of evaluation and management of risks has been introduced and applied very differently in European countries. Only Germany would apply it strictly at the institutional level for food safety. The plurality of administrative, political and territorial structures, the uncertainties into decision-making processes, the specificities of economic sectors (like food or pharmacy), generate a large diversity of systems for the evaluation and management of safety risks in European countries. Additionally, as is shown by the European Food Agency, it is still difficult to find ways to make national and European authorities complementary. However, it could be argued that the European level should focus primarily in the collection and homogenisation of data, monitoring and early warning. Precaution indeed implies to measure and to monitor numerous factors of low amplitude (air and soil pollution, bioaccumulation of given substances) during long periods. That would necessitate important material and human means associated with an adequate process for arbitration[7].

The European level cannot grasp some important aspects contributing to the risk experienced by European citizen. First, the risk depends on the risk management modalities at the national level or even below. Second, the real risk is linked to practices, behaviours and preferences at the national or local scale too, especially in the food sector (Godard, 2001b).

At the international level, the Intergovernmental Panel for Climate Change (IPCC) do represent a unique organisation of scientific expertise at the international level dealing with a global environmental problem. The IPCC has been created in 1988 by the World Meteorological Organisation and the United Nations Program for the Environment. The missions of the IPCC assumed by scientists coming for everywhere in the world are to gather, to analyse and to synthesize all the scientific work published on the different aspects of climate change. Every five years the three IPCC working groups publish evaluation reports and synthesis reports. The following aspects of IPCC: The reasons that have allowed the creation of such an organisation and the successes and weaknesses of the IPCC process and reports have already been partly analysed (Le Treut, 2004).

Gaps in research

How to improve and to generalise the European tools for expertise on risks: An important area for the development of research is the monitoring and evaluation of the new institutions for risk assessment and risk management in Europe at the national and regional level. Such a work would be very useful for the improvement of such authorities. The evaluation has to take into account several factors: public health, as well as political, diplomatic, economical and judicial dimensions. Indeed, a collective rigorous effort for improving new structures for the implementation of precaution – in its scientific an techni-

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[6] PRECAUPRI (2003).

cal and judicial aspects, as well as for education and information – is essential. It is the price to pay to develop efficient tools and methods for the apprehension of risks understandable by different populations and actors. It also the only way for being in capacity to elaborate attractive models for other regions in the world and international instances (Codex Alimentarius).

What can be learned from the experience of the IPCC?: It is today a major issue to see how lessons already learned in the IPCC process could help to build an international expertise useful in other negotiation instances as for example the Convention on Biological Diversity.

The apprehension of science by society in the treatment of potential risks

The emergence of controversies inside the European civil societies after the major crises related to the AIDS-contaminated blood and the Bovine Spongiform Encephalopathy (BSE), and the growing oppositions to the dissemination of GMOs in European plain fields for culture and food have raised very intense debates and actions in different directions. First, it has becoming urgent to improve or to (re)build national and European institutions in charge of risks in order to avoid new "precautionary failures". The modifications and reflections have addressed institutional and organisational aspects of scientific expertise, mentioned in the previous section II, but also procedural and legal aspects (Hermitte, 1997; 2000; Weill, 2001). In parallel, a lot of work has been conducted on how to take properly into account societal preferences in the acceptability of risks – nature and level - (Noiville, 2003a; 2003b). Different participatory processes of lay citizen in societal controversies with high scientific and technical content (citizen panels, juries, etc.) have been developed in Europe. In that regard, the Danish Board of Technology, an institution organising the consultation of lay citizen on emerging technologies and reporting to the Danish Parliament, is the most elaborated participatory system in Europe. The public consultation on controversial issues including scientific and technical aspects in other European countries is far from being so well established, as for instance in France (Weill, 2003c).

Gaps of research

Participatory processes and the issue of representation: A reflection has still to be conducted to precise how the results of participatory processes on societal controversies of high scientific and technical content can be satisfactorily exploited in national or regional Parliaments. The issue of representation is here crucial (Manin, 1997).

The acceleration of new technologies, their origin, sense and societal implications: Considering the acceleration of the emergence of new technological devices on the market since forty years and the major modifications they generate in societal habits (see for instance the role played by computers, Internet, mobile phones and electronic chips), a lot of work remains to be done to describe this evolution, especially by human and social scientists, in different directions: How can it be inscribed in the long period of the human evolution ? What is at the origin of the fears and phantasms associated? Due to the huge economic stakes associated to the development of new technologies (biotechnologies,

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[7] It is not easy to choose the most important factors to monitor, and to determine the pertinent level of precision for their measurement.

nanotechnologies, new technologies of communication), how is the sphere of science impacted? What are the most important modifications (negative and positive) to be seen in individual and collective behaviours due to the proliferation of technologies? What are the major problems we could face tomorrow? Such issues are too often very partially treated and without sufficient independence and distance by researchers today.

Transatlantic aspects of precaution

The emergence of the precautionary principle in Rio, and its affirmation in the European Community law, in particular, have led to very intense conflicts between the European Union (EU) and the United States (US) submitted to the dispute resolution body of the WTO. There is apparently an unresolvable logical conflict between the WTO agreement that regulates health measures – the Agreement on the Application on Sanitary and Phytosanitary Measures (SPS Agreement) – and the precautionary principle. The SPS agreement, in cases of conflict, requires that the State refusing the importation of a product for health reasons furnish sufficient scientific proofs. Nonetheless, examination of the recent jurisprudence of the WTO Appellate Body on the Hormone Beef case[8] shows that it has "… interpreted the SPS agreement much more broadly than the literal language suggests …" (Noiville 2003a: 71).

The oppositions on the precautionary principle between US and EU at the WTO and elsewhere have different origins. They can be pragmatic and tactic – a State that wants to protect its internal market and producers can evoke the potential existence of risks for a given product (e.g. EU for hormone beef) or the absence of risks (e.g. US for GMOs). They can be more deeply related to different philosophical approaches and therefore to different cultures, administrative, research, innovation and trade practices. They expressed themselves technically in the procedural framework at the WTO, in particular in the different perceptions of the scientific elements necessary to assess a given risk. Indeed the defence of the precautionary principle by the European Union in the World Trade Organisation seemed to be partly entangled into a debate only focused on the quality of purely scientific risk assessments (Christoforou, 2002). Recently propositions to introduce the so named "other factors" to allow a given country to refuse the importation of some products, for example because of cultural preferences, have merged (Noiville, 2000). It has also been argued that the procedure to conduct risk assessment inside the Codex Alimentarius could be improved (Pascal, 2004).

More broadly, work has been done to analyse the conflicts between multilateral environment agreements an the agreements arising from the WTO. That is, while the WTO agreement require a State that wants to restrain trade in a given product to provide scientific proofs of risks, the multilateral environment agreements (MEA) based upon the precautionary principle – such as the Kyoto and Cartagena protocols – appear more open to limiting trade on the basis of scientific uncertainty on potential risks (Bourrinet, 2002).

A lot of work has been dedicated during the last decade on the different apprehensions of precaution on both sides of the Atlantic (Graham, 2002; Wiener 2002; Tickner, 2004).

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[8] World Trade Organisation, *European Communities – Measures affecting Meat and Meat Products (*Hormones), WT/DS26/AB/R, Report of the Appellate Body, adopted 13 February 1998.

Comparisons between risk management in the US and the EU have been conducted either generally (Löfstedt, 2001; Vogel, 2003; Wiener, 2003; Tickner, 2004) or on case studies[9] (Wiener, 2002).

Conclusions

The concept of precaution, of precautionary approach, as well as the inscription of the precautionary principle in political and legal texts have emerged and developed during the last two decades. Therefore the efforts realised to implement the precautionary principle in the EU and precautionary approaches elsewhere are still at an early stage. Nevertheless, the local, national, regional or international improvements in the management of risks, where potential risks are now included constitute a major progress, because it is now recognised that scientific certainty is not necessary to act. Such initiatives obviously need to be pursued, continuously monitored and adapted. As far as scientific aspects are concerned a lot of work has to be made to be able to effectively proceed to the change of paradigm from "risk assessments", pertinent for risks for which probabilities can be defined to the "treatment of potential risks that necessitates to develop new methodological approaches like pre-screening. In that regard systemic approaches have to be developed in the conception of scientific tests (Hansson, 2005).

It does not mean that the role of civil society in the acceptability of risks has to be undermined, as the interactions between lay citizen, scientists and scientific experts. A lot of work has in fact also to be done to find satisfactorily methods of public consultation and of involvement of the civil society in the definition of research and scientific expertise priorities (Nowotny, 2001; Liberatore, 2003). Huge efforts have also to be devoted for seeking compatibilities between the different regimes of risk management that interfere at an international level at the WTO and between MEAs and the WTO.

Bibliography

Abdel Motaal, D. (2005). Is the World Trade Organization anti-precaution? *Journal of World Trade* 39(3), 483-501.

Bourrinet J. & Maljean-Dubois S. (Eds.) (2002). *Le commerce international des organismes génétiquement modifies*. La Documentation française.

Cameron J. (2001). The status of the precautionary principle in international law. In: Cameron, J., O'Riordan T. & Jordan A. (Eds.) (2001), *Reinterpreting the precautionary principle*. Cameron May International Law Publishers.

Cameron, J. & Abouchar, J. (1996). The status of the precautionary principle in the international law. In: Freestone, D. & Hey, E. (Eds.), The precautionary principle in international law. Kluwer.

Cameron, J., O'Riordan T. & Jordan A. (Eds.) (2001). *Reinterpreting the precautionary principle*. Cameron May International Law Publishers.

Christoforou, T. (2002). Science, law and precaution in dispute resolution on health and environmental protection : what role for scientific experts? In: Bourrinet J. & Maljean-Dubois S. (Eds.) (2002), *Le commerce international des organismes génétiquement modifies*. (pp. 213 – 283). La Documentation française.

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[9] For a focus on GMOs, see Vig & Faure (2004).

Daemen, T.J. (2003). The European Community's evolving precautionary principle – comparisons with the United States and ramifications for Doha round trade negotiations. *European Environmental Law Review* 12(1), 6-19.

European Environment Agency (2001). *Late lessons from early warnings: the precautionary principle 1896 – 2000*. Environmental issue report n°22. Luxembourg: Office for the Official Publications of the European Community.

Fisher, E. (2002). Precaution, precaution everywhere : developing a common understanding » of the precautionary principle in the European community. *Maastricht Journal of European and Comparative Law* 9(1).

Funtowicz, S. (2002). Post-normal science and uncertainty. In: Tickner, J.A. (Ed.), *Precaution, environmental science, and preventive public policy*. Island Press.

Godard, O. (2001a). Le principe de précaution, un principe politique d'action. *Revue juridique de l'environnement*, Numéro spécial 2000 'le principe de précaution', 127-144.

Godard, O. (2001b). Risque théorique et risque reel. *La Recherche* 339, 86.

Godard, O. (Ed.) (1997). *Le principe de précaution dans la conduite des affaires humaines*. Paris: Ed. de la Maison des Sciences de l'Homme et INRA-Édition.

Graham, J.D. & Hsia, S. (2002). Europe's precautionary principle: promise and pitfalls. *Journal of Risk Research* 5(4), 371-390.

Graham, J.D. (2001). *Opening remarks*. Conference on U.S., Europe, Precaution and Risk Management: A comparative Case Study Analysis of the Management of Risk in a Complex World. Bruges, 11 January 2002.

Hansson, S.O. & Ruden, C. (2005). Improving the Scientific Basis for Decisions in the REACH System, In: Weill, C. (Ed.), European *Proposal for Chemicals Regulation: REACH and beyond*. (pp 46-51). Iddri proceedings, n° 2. Paris: Iddri.

Harremoës, P. (2003), "Ethical Aspects of Scientific Incertitude in Environmental Analysis and Decision Making", Journal of Cleaner Production, forthcoming.

Harremoës, P., Gee, D. (2002). How to exercise precaution -Topology of no-know in relation to environmental decision-making. Special plenary lecture, Conference on Rio+10, Achievement and Challenge. The Environmental Institute, Dublin: University College Dublin.

Henry C. (2004). The essence of the precautionary principle. In: Moltke, K. von & Weill, C. (Eds.), *European Precautionary Practice, workshop, Paris – 3-4 December, 2002, proceedings.* (pp. 36-39) Paris: Iddri.

Hermitte, M-A. & David, V. (2000). Evaluation des risques et principe de precaution. Les Petites affiches, n° 239.

Hermitte, M-A. (1997). L'expertise scientifique à finalité politique, réflexions sur l'organisation et la responsabilité des experts. *Justices – Revue Générale de Droit Processuel* 8, 79-103.

Heyvaert, V. (2005, forthcoming). Guidance Without Constraint. Assessing the Impact of the Precautionary Principle on the European Community's Chemicals Policy. *Yearbook of European Environmental Law* 6.

Jasanoff, S. (2000), Commentary: "Between risk and precaution – reassessing the future of GM crops". *Journal of Risk Research* 3(3), 277–282.

Jasanoff, S. (2001). Ordering life: law and the normalization of Biotechnology. *Notizie di Politeia* XVII, 62, 34 – 50.

Kourilsky, P. & Viney, G. (2000). *Le principe de precaution*. Rapport au Premier ministre, Odile Jacob, La Documentation française.

Lafond, F.D. (2001). The creation of the European food authority, institutional implications of risk regulation. *European Issues* 1.

Lancaster, M. (2002). *Green Chemistry: An Introductory Text*. Cambridge: The Royal Society of Chemistry.

Le Treut, H. (2004). How can Expertise be Organised at an International Level. The case of IPCC. In: Moltke, K. von & Weill, C. (Eds.), *European Precautionary Practice, workshop, Paris – 3-4 December, 2002, proceedings.* (pp. 33-35) Paris: Iddri.

Levidow, L. & Carr, S. (2000). Unsound science? Transatlantic regulatory disputes over GM crops. *Int. J. Biotechnology* 2(1/2/3), 257–273.

Levidow, L. (2002). Ignorance-based Risk Assessment? Scientific controversy over GM Food Safety. *Science as Culture* 11(1).

Liberatore, A. & Funtowicz, S. (Eds.) (2003). *Science and Public Policy*, Special issue on democratising expertise, expertising democracy 30(3), 199-203.

Löfstedt, R.E. & Vogel, D. (2001). The changing character of regulation: a comparison of Europe and the United States, with commentaries by Renn. O., Slater D., & Rogers M. *Risk Analysis* 21(3), 399–416.

Manin, B. (1997). *The principles of representative government*. Cambridge: Cambridge University Press.

Moltke, K. von & Weill, C. (Eds.). *European Precautionary Practice, workshop, Paris – 3-4 December, 2002, proceedings.* Paris: Iddri.

Müller-Herold, U. (2004). Type II Ambiguity and Precautionary Screening with respect to Large-Scale Chemical Threats in the Environment. In: Moltke, K. von & Weill, C. (Eds.), *European Precautionary Practice, workshop, Paris – 3-4 December, 2002, proceedings.*Paris: Iddri.

National Research Council of the National Academies (2003). *Beyond the Molecular Frontier - Challenges for Chemistry and Chemical Engineering*. Washington, D.C.: The National Academic Press.

Noiville C. (2003a). Brèves réflexions sur la reconnaissance d'un droit à la différence alimentaire dans le commerce international. *Sociologie du travail* 45, 63-76.

Noiville C. (2003b). *Du bon gouvernement des risques*. Paris: PUF.

Noiville, C. & Sadeleer, N. de (2001). La gestion des risques écologiques et sanitaires à l'épreuve des chiffres. Le droit entre enjeux scientifiques et politiques. *Revue du Droit de l'Union Européenne* 2, 389-449.

Noiville, C. (2000). Principe de précaution et Organisation mondiale du commerce. Le cas du commerce alimentaire. *Journal du Droit international* 2, 263-297.

Nowotny, H., Scott, P. & Gibbons, M. (2001). *Re-Thinking Science – Knowledge and the Public in the Age of Uncertainty*. Polity Press and Blackwell Publishers Ltd.

Pascal, G. (2004). Relations between Scientific Experts and Public Policy-makers on the Area of Food". In: Moltke, K. von & Weill, C. (Eds.), *European Precautionary Practice, workshop, Paris – 3-4 December, 2002, proceedings.* (pp. 43-46) Paris: Iddri.

PRECAUPRI (2003). *Report of the EU STRATA project PRECAUPRI, The application of the precautionary principle in the European Union*. May 2003.

Royal Commission on Environmental Pollution (RCEP) (2003). *Twenty-fourth Report, Chemicals in Products - Safeguarding the Environment and Human Health*. Available at: http://www.rcep.org.uk (last visited 17 October 2005).

Rogers, M.D. (2001). Scientific and technological uncertainty, the precautionary principle, scenarios and risk management. *Journal of Risk Research* 4(1), 1-15.

Rogers, M.D. (2003). Risk analysis under uncertainty, the precautionary principle, and the new EU chemical strategy. *Regulatory Toxicology and Pharmacology* 37, 370-381.

Rogers, M.D. (2004). Genetically modified plants and the precautionary principle. *Journal of Risk Research* 7(7-8), 675-688.

Sadeleer, N. de & Noiville, C. (2002). Les organismes génétiquement modifiés (O.G.M.) au regard du droit communautaire. Examen critique de la directive 2001/18/C.E. *Journal des Tribunaux, Droit Européen* 88, 81 – 85.

Sadeleer, N. de (2002). *Environmental principles, from political slogans to legal rules*. Oxford University Press.

Sandin, P. (1999). Dimensions of the Precautionary Principle. *Human and Ecological Risk Assessment* 5, 909-922.

Sandin, P. et al. (2004). Precautionary defaults – A new strategy for risk assessment. *Human and Ecological Risk Assessment* 10(1), 1–18.

Stirling, A. & Mayer, S. (2000). Precautionary approaches to the appraisal of risk: a case study of genetically modified crops. *Int. J. Occup. Environ. Health* 6, 342.

Tickner J.A. & Sadeleer, N. de (2004). The precautionary principle in Europe and in the US: a comparative analysis. In: Dumoulin, M. & Duchenne, G. (Eds.), *L'Union Européenne et les Etats Unis: Actes de la VIIIe Charie Glaverbel d'études européennes 2002-2003*. (pp.329-382). Brussels: Peter Lang.

Tickner J.A. (Ed.) (2002). *Precaution, environmental science, and preventive public policy*. Island Press.

Vig, N.J. & Faure, M.G. (2004). *Green Giants? Environmental Policies of the United States and the European Union*. MIT Press.

Vogel, D. (2003). The politics of risk regulation in Europe and the United States.*Yearbook of international environmental law* 3.

Weill, C. (2003b). *L'expertise dans les champs du principe de précaution, propositions, recommandations, et commentaires*. Les notes de l'Iddri n°3, 44 p.

Weill, C. (2003c). Can consultation of both experts and the public help developing public policy? Some aspects of the debate in France. *Science and Public Policy* 30(3), 199-203.

Weill, C. (Ed.) (2003a). *Expertise et principe de precaution*. Archimède et Léonard, Hors Série n°17, Les carnets de l'AITEC.

Weill, C. (Ed.) (2005). *European Proposal for Chemicals Regulation: REACH and beyond*. Iddri proceedings, n° 2. Iddri, 76 p. Proceedings of the Iddri workshop, Paris, 15 June 2005.

Wiener, J.B. & Rogers, M.D. (2002). Comparing Precaution in the United States and Europe. *Journal of Risk Research* 5(4), 317-349.

Wiener, J.B. (2003). Whose Precaution After All? A Comment on the Comparison and Evolution of Risk Regulatory Systems. *Duke Journal of International and Comparative Law*, 207.

Zaccai, E. & Missa, J-N. (Eds.) (2000). *Le principe de précaution, significations et conséquences*. Editions de l'Université de Bruxelles.

Official texts

European Commission (2000). *Communication from the European Commission on the precautionary principle*. COM (2000)1 final. Brussels: European Commission.

European Commission (2001). *Strategy for a Future Chemicals Policy. White paper*. COM(2001)88 final. Brussels: European Commission. Available at: http://europa.eu.int/comm/environment/chemicals/pdf/0188_en.pdf (last visited 18 October 2005).

European Council (2000). *Resolution on the precautionary principle*. Annex III of Conclusions of Presidency, European Council of Nice, 7-9 December 2000.

Proposal COM(2003) 644 final

Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL amending Council Directive 67/548/EEC in order to adapt it to Regulation (EC) of the European Parliament and of the Council concerning the registration, evaluation, authorisation and restriction of chemicals"

Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency and amending Directive 1999/45/EC and Regulation (EC) {on Persistent Organic Pollutants}

Response from the European Communities to Comments submitted by WTO Members Under G/TBT/N/EEC/52 (Regulation concerning the Registration, Evaluation and Authorisation on Chemicals (Known as REACH COM(2003) 644 final)). Available at: http://europa.eu.int/comm/enterprise/reach/docs/reach/eu_wto_response_041028.pdf (last visited 18 October 2005).