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THE EFFECT OF UNCERTAINTY ON THE THRESHOLD LEVELS TO WHICH THE PRECAUTIONARY PRINCIPLE APPEARS TO BE SUBJECT (1)

BY

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INTRODUCTION

The emergence of the precautionary principle can be traced from disenchantment with classical scientific culture, which, convinced of the linear nature of the universe, as predictable as the path of a cannon ball, could find a remedy for any problem. Scientific predictability comes up against staggering limits in the field of the environment. In many cases, scientists can admit only to ignorance. Not knowing how many species live on Earth, they are unable precisely to evaluate the scope and tempo of biodiversity loss. Contemporary science cannot deliver certainty; as at the end of the day, it throws up more questions than it solves. To some extent, the more is learnt in science, the more the limits to knowledge are understood.

In the end, the only certainty is uncertainty. What was true in the past is not necessarily true any longer; what is accurate at the local level is not necessarily so at the global level; today's predictions will not necessarily come to pass.

(1) This chapter builds on previous work by the author on the precautionary principle and in particular on its forthcoming book *Environmental Principles in an Age of Risk : from Political Slogans to Legal Rules* (Oxford University Press, 2002).

Metamorphosed into a "factor for revealing uncertainty", science raises suspicions and doubts as often as it offers knowledge. In any case, our understanding of the environment is no longer able to keep pace with our ability to modify it, and this gap widens when it comes to controlling environmental impacts. The entire foundation of the "assimilative" approach, which rests upon a blind confidence in science, is thus crumbling under the pressure of uncertainty.

The mere possibility of rapid and possibly irreversible modifications to the physical environment justifies the demand that measures be taken to anticipate such risks. In future, uncertainty should no longer be a reason to delay the adoption of measures intended to forestall environmental degradation. Precaution serves to prevent delay which is based on a pretext that the true nature of risks is not known. Inversely, it serves as a brake on precipitate action, by urging delay in executing projects the risks arising from which have not been sufficiently-well identified. Precaution thus takes the form of an injunction against action when the nature of risk has not been clearly identified and the form of an obligation to refrain from proposed action when such action might threaten the environment. This is a true Copernican revolution, whereby uncertainty henceforth becomes a central element of a decision-making process which formerly only recognised certainties.

By considering an uncertain future, the precautionary principle situates itself within a time dimension, a factor that has been conspicuously absent from earlier models. Yet this element is crucial; decisions taken today can no longer disregard ecological consequences, the complexity of which is becoming increasingly clear as our knowledge advances. Environmental management decisions taken today may have effects beyond the boundaries of a political mandate, legislature or human life. To regulate environmental effects in the present thus may in fact amounts to regulating in haste. Recourse to the precautionary principle is therefore justified by consideration of the long-term. From now on, time must be given time. This change in our perception of time will of course be reflected in

a change of style: today's choices must also reflect a still uncertain future.

The precautionary principle is invoked increasingly often : in relation to mad cow disease, the spread of genetically modifed organisms, the Belgian dioxin scandal and health claims linked to asbestos use, among other issues. Reflecting the adage "Better safe than sorry", the principle calls for the anticipation of risk. It has also assumed a legal role : legislators cite it, some judges draw inspiration from it, and important scholarly analyses have been devoted to it. Yet despite the success of the precautionary principle in the fields of national, European Community and international law, its outlines are far from clear. Accorded diverse definitions in these legal orders and in its application in case law, the principle has in fact been understood in a variety of ways. Chapter I reviews the definitions given of the principle in various legal systems, as well as its application in representative court decisions, in order to set out the problematic elements inherent in this norm. On the basis of these empirical materials, chapter II sets out difficulties that characterise the principle by considering the various thresholds to which its application appears subject.

Chapter I. — Origin of the principle

Arising in the mid-1980s from the German *Vorsorgeprinzip*, the precautionary principle was throughout the 1990s widely invoked within international legal circles and given legitimation in a large number of international treaties. It has come to occupy a significant position in international and European Community law as well as in certain national legal regimes, to the point where it overshadows a number of other principles.

A. — *International Law*

The decisions adopted by States within the North Sea Ministerial Conferences mark the first use of the precautionary

principle in international law (2). Its dominion in international law in the field of marine pollution has since steadily expanded (3).

The uncertainty surrounding the causes and effects of atmospheric pollution has also served to favour the use of the precautionary principle. Putting off measures to limit emissions of greenhouse gases or ozone depleting substances risked allowing the serious and irreversible accumulation of these gases in the atmosphere (4).

The precautionary principle rapidly moved beyond the fields of marine and atmospheric pollution to other areas of international environmental law. It was successively established as a general principle of environmental policy : on 25 May 1989 by the Governing Council of the United Nations Environment Programme (UNEP); on 16 May 1990 by the United Nations Economic Commission for Europe (UNECE) in Bergen; in July 1990 by the Council of Ministers of the Organization of African Unity (OAU) meeting in Addis-Adeba; in October 1990 by the Ministerial Conference on the Environment of the UN Economic and Social Commission for Asia and the Pacific (ESCAP); and in January 1991, by the

(2) Explicit reference is made to it in the 1984 Bremen Ministerial Declaration of the International Conference on the Protection of the North Sea, the 1987 London Ministerial Declaration of the Second International Conference on the Protection of the North Sea, the 1990 Hague Declaration of the Third Conference on the Protection of the North Sea, and the 1993 Esbjerg Declaration of the Fourth Conference on the Protection of the North Sea.

(3) From the beginning of the 1990s, the principle has been set out more frequently in international instruments, such as, in the London International Convention on Oil Pollution Preparedness, Response and Co-operation of 30 November 1990, the Paris Convention for the Protection of the Marine Environment of the North-East Atlantic of 22 September 1992, the Helsinki Conventions on the Protection and Use of Transboundary Watercourses and International Lakes of 17 March 1992 and on the Protection of the Marine Environment of the Baltic Sea Area of 2 April 1992, the Charleville-Mézières Agreements of 26 April 1994 concerning the Protection of the Scheldt and Meuse Rivers, the Sofia Convention on Cooperation for the Protection and Sustainable Use of the Danube of 29 June 1994 and the Rotterdam Convention of 22 January 1998 on the Protection of the Rhine.

(4) The Vienna Convention for the Protection of the Ozone Layer of 22 March 1985 was adopted just as the scientific controversy over the effects of global ozone layer depletion reached its height. The Convention did not fix a reduction quota for emissions of chlorine into the atmosphere, but it did set in motion a regulatory process which rapidly resulted in the 1987 adoption of the Montreal Protocol on Substances that Deplete the Ozone Layer, which was subsequently amended several times in order to achieve the phase-out of all CFCs by 1995.

Environment Ministers of the Organisation of Economic Co-operation and Development (OECD).

It was eventually accorded universal recognition at the UN Conference on Environment and Development in Rio de Janeiro, which resulted in a Declaration (5) and two framework Conventions. The Framework Convention on Climate Change, signed in New York on 9 May 1992, shortly before the Rio Conference, obliges Parties "to take precautionary measures" and the Preamble to the Convention on Biological Diversity of 5 June 1992 provides that "where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat".

Since then, the precautionary principle has been taken up in the majority of bilateral and multilateral international treaties relating to environmental protection (6). Owing to its near-universality and to the development of certain State practices that recognise its validity, the principle should be considered as a rule of customary law, although this position does not yet enjoy unanimous support (7).

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(5) Principle 15 of the non-binding Declaration on Environment and Development of 16 June 1992 declares that "In 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."

(6) For recent developments concerning the precautionary principle in international law, see D. FREESTONE and E. HEY, "Origins and Development of the Precautionary Principle", in *The Precautionary Principle and International Law*, *op. cit.*, p. 3; P. BIRNIE, "The Status of Environmental 'Soft Law' : Trends and Examples with Special Focus on IMO Norms, in Competing Norms", in *The Law of Marine Environmental Protection* (Kluwer Law Int'l, London, The Hague, Boston, 1997), p. 51.

(7) See, for different views in the doctrine on this point : Ph. SANDS, *Principles of International Environmental Law*, Vol. I (Manchester University Press, Manchester, 1995), p. 213; J. CAMERON and J. ABOUCHAR, "The Status of the Precautionary Principle in International Law", in *The Precautionary Principle and International Law* (Kluwer Law Int'l, The Hague, 1995), p. 29; Z. PLATER, "From the Beginning, a Fundamental Shift in Paradigms : A theory and short history of environmental law", *Loy.L.A.L.Rev.*, 1994, p. 1000; H. HOHMANN, *Precautionary Legal Duties and principles of Modern International Environmental Law* (Graham & Trotman, London, 1994), p. 184; O. MCINTYRE and T. MOSEDALE, "The Precautionary Principle as a Norm of Customary International Law", *J.E.L.*, 9, 2 (1997), p. 221. *Contra* : P.W. BIRNIE and A. BOYLE, *International Law and the Environment* (Clarendon Press, Oxford, 1992), p. 98; D. BODANSKY, *Proceedings of the American Society of International Law*, p. 417; L. GUNDLING, "Literature Review of Precautionary Legal Duties and Principles of Modern International Environmental Law", *Y.I.E.L.* (1993), p. 643. It should be noted, however, that those authors who do

Despite its wide recognition in international treaties, international courts have until recently remained reluctant to accept the precautionary principle as a binding legal principle. In the WTO hormone case, the United States did not consider that the precautionary principle represented customary international law and suggested it was more an "approach" than a "principle" (8). Canada, too, took the view that the precautionary principle had not yet been incorporated into the corpus of public international law; however, it conceded that the "precautionary approach" or "concept" was "an emerging principle of law" which might in the future crystallise into one the "general principles of law recognized by civilized nations" within the meaning of article 38(1)(c) of the Statute of the International Court of Justice (9). The appellate body judged, however, that :

> "The status of the precautionary principle in international law continues to be the subject of debate among academics, law practitioners, regulators and judges. The precautionary principle is regarded by some as having crystallized into a general principle of customary international environmental law. Whether it has been widely accepted by members as a principle of general or customary international law appears less than clear. We consider, however, that it is unnecessary, and probably imprudent, for the appellate body in this appeal to take a position on this important, but abstract, question. We note that the panel itself did not make any definitive finding with regard to the status of the precautionary principle in international law and that the precautionary principle, at least outside the field of international environmental law, still awaits authoritative formulation".

While the Appellate Body stated that it was "unnecessary, and probably imprudent" for it to take a position on the legal status of the precautionary principle, it nevertheless noted that the the precautionary principle had a relationship to the SPS Agreement since the sixth paragraph of the Agreement's Preamble and Articles 3.3 and 5.7 reflected the principle (10). It also made clear that when a Panel is charged with determining whether sufficient scientific evidence exists to warrant

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not consider the precautionary principle as a principle of customary international law were writing before 1992; thereafter, the principle made important advances in international law.

(8) United States' appellee's submission, para. 92.

(9) Canada's appellee's submission, para. 34.

(10) *EC-Measures Affecting Meat and Meat Products* WT/DS26&48/AB/R, adopted on 13 February 1998.

a WTO member maintaining a particular measure, it "may of course, and should, bear in mind that responsible, representative governments act from perspectives of prudence and precaution where risks of irreversible, e.g., life-terminating, damage to human health are concerned". However, the precautionary principle does not by itself, and without a clear textual directive to that effect, relieve a Panel from the duty of applying the normal principles of treaty interpretation. The Appellate Body consequently held that the EC ban on hormone-treated beef was incompatible with the SPS Agreement : a principle such as the precautionary principle may not override the provisions of Articles 5.1. and 5.2. of the SPS Agreement (11).

The order of 27 August 1999 of the International Tribunal for the Law of the Sea in the Southern Bluefin Tuna cases, however, seems to view the precautionary principle in a much more favourable light. In that case, there was disagreement between Australia and New Zealand on the one hand and Japan on the other concerning an experimental fishing programme being carried out by the Japanese authorities. The complainants alleged that Japan, by unilaterally undertaking experimental fishing, had failed to comply with its obligation to cooperate in conserving southern bluefin tuna stock. The provisional measures requested by New Zealand were, *inter alia*, that the parties fishing practices be consistent with the precautionary principle pending a final settlement of the dispute. The Tribunal ruled that the "parties should act with prudence and caution to ensure that effective conservation measures are taken to prevent serious harm to the stock of southern bluefin tuna". Although the Tribunal could not conclusively assess the scientific evidence presented by the parties, since it recognised that there was scientific uncertainty regarding the conservation measures to be taken, it found that action should be taken as a matter of urgency to avert further deterioration of southern bluefish tuna stock. Each party was thus to refrain from conducting experimental programmes that involved catching southern bluefin tuna.

(11) Th. DOUMA, "The Beef Hormones Dispute and the Use of National Standards under WTO Law", *E.E.L.R.*, May 1999, p. 137.

B. — *European Community Law*

The precautionary principle was not among the first group of principles incorporated in the Treaty of Rome through its amendment by the Single European Act (SEA). It had to await the adoption of the Maastricht Treaty to finally take its place alongside the principles of prevention, rectification at source and the polluter pays (12).

The hopes placed in this new principle are just beginning to find concrete expression, although this development appears more advanced in the field of public health than in that of the environment. Its main appearance in the latter field is in regulations concerning dangerous substances (13) and genetically modified organisms (GMOs) as they relate to people and the environment (14).

In addition to the incorporation of the precautionary principle into the Environment Chapter of the EC Treaty, the European Court of Justice (ECJ) has not hesitated to consider the context of scientific uncertainty in various cases concerning health policy.

The Court of Justice rejected a complaint based on the existence of scientific proofs demonstrating the innocuousness

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(12) In the absence of Community laws that set forth the precautionary principle either explicitly or implicitly, courts may not invoke this or other principles set out in Article 130R of the EC Treaty, since these are addressed solely to Community institutions (see *Peralta* C-379/92, [1994] ECR I-3453; and, *R v. Secretary of State for Trade and Industry, ex parte Duddridge & others* ([1995] Env. LR 151) and *J.Env.Law*, 7, 2 (1995), p. 237, comment by D. Hugues.

(13) Directive 93/67/EEC on the assessment of risks of dangerous substances to man and the environment stresses their potentially undesirable effects on "the reasonably foreseeable exposure of man and the environment to that substance". In interpreting evaluation results of requests for authorisation of plant protection products, Member States shall, according to Directive 97/57/EEC, "take into consideration possible elements of uncertainty in the information obtained during the evaluation, in order to ensure that the chances of failing to detect adverse effects or of underestimating their importance are reduced to a minimum." Directive 98/8/EC concerning the placing of biocides on the market provides that the inclusion of an active substance in Annex I may be refused or withdrawn "if another Annex I active substance exists for the same type of product which, taking account of the state of scientific or technical knowledge, presents significantly less risk for health or for the environment."

(14) For instance, Directive 2001/18/EC on the contained use of genetically modified micro-organisms introduces a new stage in risk prevention by requiring users of modified micro-organisms to assess the risks their activities pose for human health and the environment even when these are still in doubt. Precaution also appears in Directive 90/220/EEC on the deliberate release into the environment of GMOs, which requires Member State competent authorities to assess the risks GMOs might pose to public health and the environment before allowing them to be released into the natural environment.

of five hormones, on the grounds that the Council acted within the limits of its discretion in choosing to retain a ban on the hormones in question, thus responding to the concern expressed by the European Parliament and the Social and Economic Committee, as well as by several consumer organisations (15). The Court of Justice and the Court of First Instance also adopted a precautionary approach in determining that the Commission had not committed a manifest error of appraisal by instituting a ban on the export of beef, since no delay was permissible when the most probable explanation of Creuzfeldt-Jakob's disease was exposure to bovine spongiform encephalopathy (BSE) (16). In an order of 30 June 1999, the President of the Court of First Instance dismissed an application for interim measures against an EC Regulation prohibiting the use of antibiotic additives in livestock feed which was being justified on the basis that the risk that BSE might be transmitted from animals to humans (17). The applicant had found an argument to establish the differences between his case and that which gave rise to the order of 12 July in the case *United Kingdom v Commission*, based on the fact that the terminal nature of Creuzfeldt-Jakob's disease and the grave risk it posed to human health was not an element in the present case. The President judged that "... without prejudging the examination by the Court of the assessment of the extent of the risk, which must be established by the institutions concerned when adopting a precautionary measure, the mere existence of the risk so identified is enough in itself to justify taking into account, in the balancing of interests, the protection of human health" (18). Consequently, BSE case-law does not imply that the Community institutions may not adopt measures on a precautionary basis in the absence of serious factors such as the grave risk posed to human health by BSE.

(15) ECJ, 13 November 1990, *Fedesa*, C-331/88, *ECR* I-4023, para 9.

(16) ECJ, 12 July 1996, *United Kingdom v. Commission*, C-180/96 R, *ECR* I-3903, para 93; Court of First Instance, 13 July 1996, T-76/96 R, *ECR* II-815, para 88.

(17) Case T-79/99R, *Alpharma* 30 June 1999.

(18) Case *Alpharma*, para 66.

C. — *National laws*

As the precautionary principle has met with unparalleled success in the international legal order, national legislators have followed suit by increasingly setting it out in the recitals of environmental codes of law or in framework laws. In German law, the principle has for some time now implicitly followed from sectoral laws relating to listed installations, biotechnology, nuclear energy, and water management (19). In France, the principle was introduced by the law of 2 February 1995 reinforcing environmental protection, which initiated the codification of environmental law (20). This Article (Article 1) defines the precautionary principle as "the principle according to which the absence of certainty, taking account of current scientific and technical knowledge, ought not to delay the adoption of effective and proportionate measures aimed at preventing a risk of serious and irreversible damage to the environment, at an economically acceptable cost". The use of the precautionary principle in environment policy in Belgian law was first recognised in a decree of the Flemish Region of 5 April 1995 and was reiterated in the Federal law of 30 January 1999 aimed at protection of the marine environment. Sweden has put precaution into a central position in its new Environmental Code, where § 3 states that : "any person operating or planning to operate an installation or to continue an activity must set in motion protective measures, conforming to the limitations and adopting the measures of precaution needed to foresee, prevent and avoid that the operation of the activity cause damage or nuisance for human health or the environment. To that end, recourse to the best environmental technique available is required".

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(19) For a fuller discussion of the role of the principle in the evolution of environmental law in Germany, the reader should consult : K. VON MOLTKE, *The Vorsorgeprinzip in West German Environmental Policy*, Appendix 3, Royal Commission on the Environment, 12th report, 1988; E. REHBINDER, "Prinzipien des Umweltrechts in der Rechtsprechung des Bundesverwaltungsgerichts : das Vorsorgeprinzip als Beispiel", in *Präventive Umweltpolitiek*, edited by U.E. Simonis (1988), p. 129; "Vorsorgeprinzip im Umweltrecht und präventive Umweltpolitiek", *Festschrift Sendler* (1991), p. 269; S. BOEHMER-CHRISTIAENSEN, "The Precautionary Principle in Germany", in *Interpreting the Precautionary Principle*, edited by T. O'RIORDAN and J. CAMERON (Cameron & May, London, 1994), p. 31.

(20) Code Rural, tel que modifié par la loi 1 95-101 relative au renforcement de la protection de l'environnement.

Since the objective of the principle is to govern decision-making under conditions of uncertainty in a global manner, it still needs to advance — perhaps in a more striking fashion — in other fields of law, such as health law. Nonetheless, seeking substantive indications of its existence, it soon becomes apparent that the principle is more clearly in evidence in national environmental law regimes than one might think. By according increasing importance to uncertainty, several legislative systems have already brought the principle into play without expressly referring to it. Doctrine acknowledges, at any rate, that national biotechnology laws represent one of its most important advances. It is above all at the level of litigation, however, that the principle comes into play, since jurisdictions have for years been enacting precaution without being aware of it.

Chapter II. — Systematisation of the principle

Although various legal definitions of the precautionary principle share common elements, the thresholds intended to delimit the scope of application of these common elements are themselves strongly caveated. These thresholds restrict the application of the principle by defining the risk to be averted (with proof based on "technical knowledge" required in some instances) or specifying the damage likely to occur (which, according to some definitions, should be "serious and irreversible"); moreover, these two thresholds may apply cumulatively. Once these thresholds have been crossed, a precautionary measure may be taken to avert the anticipated risk, but that measure should be proportionate. This last condition also gives rise to divergent interpretations (some definitions require that risk reduction measures not "entail excessive costs").

An attempt is made here to elaborate a systematic theory of the three threshold levels to which precautionary measures appear to be subject — risk, damage and proportion. Risk and damage are clearly distinguished. Risk refers to the possibility of an unfortunate event occurring. The ensuing damage is con-

sequential. International and national definitions of the principle provide the empirical basis for these reflections.

A. — *The effect of uncertainty on establishing risk*

When an event tends to recur, risk can be calculated on the basis of probability. It is thus possible to calculate a driver's risk of accident by reference to elevated alcohol levels, exceedance of the speed limit or failure to exercise particular care in bad weather. But when an event is merely expected as a possibility and normal experience provides no basis for forecasting the likelihood of it materialising, risk cannot be ascertained by calculating probability. The question then arises : in which category of foreseeability should we range such anticipated risks on the basis of the precautionary principle ? Should the principle apply to any suspected risk, or only to known risks ?

Three types of risk can, however, be distinguished. The highest category is that of *certain risks*, to which the principle of prevention corresponds. *Residual risks* form the lowest category. Purely hypothetical, such risks must be tolerated by society and therefore escape regulatory measures. As a result, neither the principle of prevention nor the precautionary principle applies to them. Only the final category, the *uncertain risks*, that is "risks" which are located between unacceptable risks and residual risks, falls within the scope of the precautionary principle.

1. *Certain risks*

Risks for which causation between an event and damage is demonstrated by irrefutable scientific proof do not in any case come under the precautionary principle. Such risks can be qualified as *certain*, since it is possible to calculate their probability and, on that basis, insure them. This characterisation may be surprising, since risk is by nature a question of chance and its occurrence is always uncertain. Yet what is "certain" here is precisely the link of cause and effect between an event that might occur and the damage anticipated as a result. Only

the length of time that will elapse before the risk occurs is unpredictable.

For example, since we know that climate warming due to increased greenhouse gas emissions will cause sea level to rise, this is a certain risk to the extent that we know it will happen, if not when it will happen — it could take place in 10 years or 100 years. In the same way, the risk of flooding caused by intensified use of agricultural land or of eutrophication caused by discharges of urban wastewater or slurry are certain risks, since we can establish causation between these human activities and the resultant ecological phenomena. That knowledge justifies adopting preventive measures.

2. *Residual risks*

If the precautionary principle imposes upon the decision-maker a mode of thinking that seeks to limit risks, must it therefore necessarily reduce him to inaction as soon as a risk is suspected? Does it apply in the same way to purely speculative risks? Must all Cassandras be taken seriously?

Such strictness would be an exercise in exaggeration. Most authors consider that it would be excessive to try to avert all the risks that could be suspected. In any case, many of the consequences of our activities are unforeseeable because they arise in a context that is itself unpredictable. Risks are everywhere. We accept some of them while rejecting others. Driving a car, taking a plane, using electricity, having sexual relations : all of these involve running a risk in one way or another. To avert all risks, we would have to prohibit gas cookers because electric cookers are less likely to give rise to accidents — clearly an absurd suggestion. Suspending a Damoclean sword over any technical activity suspected of entailing environmental risk would put an end to innovation, discourage the spirit of enterprise and compromise technological progress.

The adage *When in doubt, do nothing* should not overshadow a complementary saying : *There's such a thing as being too careful*. To avoid having the best become the enemy of the good, the principle's field of application must exclude those risks characterised as residual : that is, hypothetical risks resting on

purely speculative considerations without any scientific foundation. Speculation, conjecture, intuition, warnings, denuncations or implications should not suffice in and of themselves to justify an attitude of precaution.

3. *Uncertain risk*

If "certain" and "residual" risks are outside the application of the precautionary principle for the reasons set out above, the principle should nevertheless apply to the risks situated between these two extremes. The occurrence of such risks remains quite controversial at the scientific level, but it is not unreasonable to anticipate their occurrence on the basis of certain data, even if those data have not yet been fully validated. In other words, strong presumption should be sufficient basis for an appeal to precaution, whereas simple intuition excludes its use. The application of the principle should depend on minimal evidence of the probability of a risk; failing this, scientific uncertainty — which serves to advance knowledge — would be transformed into a sterile debate and would eventually serve to discredit research. The precautionary measure must therefore be linked to a minimum of knowledge — that is to say, to scientific grounds with a demonstrated degree of consistency.

The wording of several definitions confirms this desire to maintain the principle within the limits of the reasonable. For example, the Paris Convention for the Protection of the Marine Environment of the North-East Atlantic calls for "reasonable grounds for concern", while the preparatory text for the French Barnier law stresses that a precautionary measure may only be taken "when there are serious grounds for concern about the state of the environment". However, certain definitions of the precautionary principle go so far as to exclude the scientific demonstration of causation : for example, the formulation of the Declarations of the Parties at the second conference on the North Sea and of the Nordic Council at the international conference on pollution of the seas in October 1989.

On the other hand, precaution by definition demands that knowledge of the more or less predictable nature of a danger

should not have to be entirely validated. Indeed, consideration of numerous definitions makes clear that the principle is to apply even if certainty about the occurrence of an event is not "absolute" or "total" (21), or if "scientific research has not fully demonstrated the existence of a causal link" (22).

The precautionary principle may henceforth be applied if there are "serious grounds" for concern even when irrefutable proof is lacking. That is to say, the threshold should be set neither too high nor too low. If it is too high, the principle would be devoid of substance; if too low, the principle would become inoperable. A middle course should thus require public authorities to demonstrate that a risk is considered scientifically likely (a "reasonable scientific plausibility") (23). That condition would be fulfilled when empirical scientific data — as opposed to simple hypotheses, speculation or intuition — make it reasonable to envisage a scenario, even if it does not enjoy unanimous scientific support.

The principle may consequently apply to all ecological risks for which a cause-and-effect relationship is not clearly established. This would be particularly appropriate for delayed pollution, which does not become apparent for some time and for which full scientific proof is difficult to assemble. In the case of delayed pollution, analytical results do not provide a

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(21) See, among others, the formulations set out in the ministerial Declaration of the second international conference on the protection of the North Sea, the ninth recital of the Convention on Biological Diversity, Article 3.3 of the Framework Convention on Climate Change, and Principle 15 of the Rio Declaration : Article 3(3) of the 1992 United Nations Framework Convention on Climate Change "The parties should take the precautionary measures to anticipate, prevent or minimise 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".

The Preamble to the 1992 United Nations Convention on Biological Diversity :

"Noting that it is vital to anticipate, prevent and attack the causes of significant reduction or loss of biological diversity at source".

(22) Cf. the definition of the precautionary principle in the Scheldt-Meuse Agreements, Articles 2(a) and 3. 2 (a)) of the 1994 Agreements concerning the Protection of the Scheldt and Meuse Rivers : *a*) the precautionary principle : "by virtue of which the implementation of measures intended to avoid potential significant transboundary impacts from the discharge of dangerous substances is not postponed on the grounds that scientific research has not fully established a causal link between the discharge of those substances on the one hand and a potentially significant transboundary impact."

(23) J. Hickey and V. Walker, "Refining the Precautionary Principle in International Environmental Law", *Va. Envtl. L. J.*, 1995, p. 447.

sufficient basis for evaluating the efficacy of actions already taken or measuring the extent of damage avoided. Since feedback from experience is too slow, the expert must extrapolate what is known beyond normally permitted limits and assign a greater or lesser degree of probability to possible future developments. In this way, he will find himself led by circumstances to try to predict the unpredictable. Delayed pollution must be combatted in the name of the precautionary principle without having to use weak proof to try to demonstrate the likelihood of ecological damage.

Some legislators do not consider a requirement for only a minimal degree of knowledge to be sufficiently strict. This is particularly the case for the French law of 1995, which makes the use of the precautionary approach conditional upon scientific and technical criteria of such rigour that it can in practice only be applied to certain risk.

The degree of uncertainty peculiar to ecological risk marks a break with the characterisation of certain risk and residual risk. It is thus possible to conclude that if the precautionary principle *a priori* excludes purely residual risk and does not concern certain risk, it nonetheless requires a highly sophisticated understanding of the probability of the risks situated between these two extremes. In this way, it strongly resembles the strategy of delayed preventive action, although the two should not be confused. We will see below that the need to avert uncertain risk is even more essential when damages may prove to be significant or irreversible.

B. — *The effect of uncertainty on damage*

Having weighed the probability of a suspected risk occurring, the decision-maker will naturally wonder about how to protect against it. Should he reduce, if not eliminate, the risk in question — whatever the importance or severity of the damages it may entail? Or should he, on the contrary, intervene only if the stakes are high enough?

His attitude is likely to vary depending on the probability that a risk will materialise and, above all, the importance of the anticipated damage. He will have to avert risks that are likely to give rise to serious damage, even if they are of low

probability. On the other hand, he could not reasonably be expected to act to avert a weak risk or a high risk of negligible damage. Thus, the scope of possible damage gives meaning to *sensu lato* risk.

Although inter-ministerial declarations relating to the protection of the North Sea note the existence of potential damage without specifying its precise nature, most authors believe that a threshold must be set in order to avoid the precautionary principle being watered down through over-use. They consider that it should only apply to risks entailing non-negligible damage (24). Several definitions lend support to this theoretical interpretation. Thus, the Climate Change Convention and the Bergen and Rio Declarations only recognise recourse to the principle in order to avert "threats of serious or irreversible damage", while the French law of 2 February 1995 authorises application of the principle — and this is an important nuance — only to "avert a threat of serious *and* irreversible damage" [emphasis added].

For other issues, damage is specified in slightly less abstract terms. In the Convention on Biological Diversity, the principle should counter a "threat of significant reduction or loss of biological diversity". The Paris Convention for the Protection of the Marine Environment of the North-East Atlantic turns to the principle when pollution "may bring about hazards to human health, harm living resources and marine ecosystems", while the Scheldt-Meuse Agreements requires that dangerous substances have "a significant transfrontier impact" in order for the principle to come into play.

The decision-maker is thus obliged to restrict the application of the precautionary principle to certain categories of damage; agreement, however, has not yet been reached on how to define those categories.

Most definitions require the presence of at least serious — or significant — damage. These are highly subjective concepts, which are perceived quite differently depending on location,

(24) A. Nollkaemper, "What you Risk Reveals what you Value and Another Dilemnas encounterd in the Legal Assaults on Risk", in *The Precautionary Principle and International Law* (London, Kluwer, 1995), p. 83.

period in time, and persons affected. The fundamental importance of climatic conditions to maintaining life on earth leads people to take the prospect of global warming seriously. The wide range of disturbances which will result from this process obliges States to demonstrate a duty of care. No one doubts that the issue is one where humankind confronts a threat of serious damage. But what about other types of risks that might arise? In the eyes of the layman, the loss of an endemic species of flower from a tropical forest will appear quite insignificant. After all, such forests contain thousands of other, similar species. However, if the species that is threatened with extinction conceals as-yet undiscovered medicinal potential, firms that might engage in its commercialisation and the sick whom it might cure will sustain a real loss.

Gauging the serious or significant character of the consequences of a risk is even more difficult when interaction with other risks is likely. As long as it remains isolated, a blow to the environment will not necessarily give rise to serious damage. But it need merely be repeated or interact with other assaults on the environment suddenly to take on unexpected dimensions. Economists call this phenomenon the "tyranny of small decisions" because of the perverse effects that may result from a large number of micro-decisions that individually have no importance for environmental protection but which, taken together, give rise to considerable damage (25). Should such risks be disregarded? Or should they, on the contrary, be countered with a view to their cumulative effects? *A priori*, the latter. In the framework of the North Sea Conference, at any rate, the precautionary principle is formulated to ensure that low-level threats whose accumulation could pose a serious danger are taken into account.

The degree of severity needed to trigger the implementation of the precautionary principle could certainly be made more

(25) J. Van Dunné (ed.), *Non Point Source River Pollution : The Case of the River Meuse* (Kluwer Law International, London, 1996).

objective by the use of economic criteria. For instance, the principle might apply only when the cost of repairing damage exceeds a specified sum of money. However, this would be to forget that the principle fits into a logic of decision-making rather than one of indemnisation. In contrast to the polluter pays principle, it seeks to prevent, regulate or even forbid an activity rather than to indemnify its victims. Precaution is above all conceived as a means of avoiding damages that might give rise to extremely high levels of compensation. The principle therefore does not really fit into the concept of risk coverage that characterised the Welfare State, where everything is ultimately considered reparable. Rather, it reminds us that we cannot always attribute an economic value to things; some damage is irreparable, beyond the power of money to fix. In such cases, precaution provides a boldly innovative approach which recognises the importance of the individual elements that make up the environment. Determining the seriousness of environmental damage on the basis of purely monetary criteria makes no sense in this framework.

The risk of irreversible damage might appear easier to determine than the risk of serious damage, since irreversibility may be scientifically, objectively determined. An irreversible situation is irrevocable : it is impossible to return to the point of departure. Neither cadavers nor extinct species can be brought back to life. But does all irreversible damage necessarily fall within the scope of the precautionary principle? Is not any serious bodily injury — not to speak of death — a form of irreversible damage for its victim, which no amount of money can truly compensate? If we follow that logic, the majority of damage could be considered irreversible, and the principle would thus have to apply to a multitude of risks, undoubtedly reducing its effectiveness. For that reason, the criterion of irreversibility does not necessarily constitute a satisfactory approach to the question.

The French Law's definition of the precautionary principle combines criteria of seriousness and irreversibility. This may at first glance appear obvious, since irreversible damage is by definition serious. We should ask ourselves, however, if it is

always correct to combine the concepts of seriousness and irreversibility : for while irreversible damage is always serious, the opposite is not necessarily the case. For example, experience has taught us that the often spectacular marine pollution caused by oil spills is largely reversible. Yet marine spills should certainly fall within the scope of the precautionary principle owing to their seriousness.

Finally, we must ask ourselves whether the desire to determine damage on the basis of these criteria does not lead to a paradox since whether damage occurs remains the subject of scientific uncertainty. How can one anticipate the seriousness, irreversibility or collective character of damage that may never arise? The scope of the damage feared is in effect no more assessable than risk *sensu stricto*. Given the complexity of ecological processes and their reactions to possible assault, determining what damage may be anticipated is always something of a gamble.

The time element also affects the facts. Ecological damage may show up belatedly, since chemical and biological effects do not necessarily become evident immediately — but when they do appear, they tend to be irreversible or to require major efforts to eliminate them. Such is the sad fate in store for numerous aquifers suffering from slow but progressive pollution; they will eventually become unusable as a source of drinking water. We can of course learn from past experiences when facing similar situations. However, that would be to overlook the fact that the precautionary principle applies precisely to hypotheses where clear experience is lacking. Any attempt to establish a hierarchy for types of damages being serious or insignificant, irreversible or reversible, collective or individual would come up against the uncertainty inherent in the anticipated risk.

The precautionary principle is therefore not a comprehensive means by which to evaluate the scope of "damage". In the long run, the political process rather than legal inference will have to determine which items are most precious to us and then erect a firewall of precaution to protect them from external threats.

C. — *The effect of uncertainty on the proportionality of measures*

Even if we agree to recognise that suspected risk is real and may entail considerable damage, the decision-maker must still be convinced that the game is worth the candle. Risk reduction necessarily implies redistribution of resources, to the detriment of certain socio-economic sectors — a sacrifice that may be deeply resented during times of economic slowdown. The decision-maker will thus be forced to choose between reducing risks that have been only weakly demonstrated or meeting more immediate needs. This cruel dilemma has arisen in a particularly acute form in the case of the continued operation of several nuclear power plants in Ukraine and Bulgaria, where government leaders are confronted with a choice between supplying their populations with electricity while exposing them to a considerable danger of radiation or avoiding any possible risk of a nuclear accident by closing down these obsolete installations. At this level, in contrast to the usual application of the precautionary principle, where the decision-maker balances the cost of a policy measure against the cost of inaction, a third parameter comes into play and complicates decision-making. The causal link between a hazardous activity and resultant ecological damage is merely suspected at this stage, but cannot yet be demonstrated. Ignorance thus replaces full understanding of the risk involved, disturbing the decision-making process.

The decision-maker will undoubtedly be inclined to weigh the ecological cost of inaction against the socio-economic cost of the measure intended to avert the anticipated risk. Yet such "cost-benefit" analysis is no longer valid, since the comparison between various parameters is unbalanced by the uncertainty surrounding the risk. Even if the decision-maker is convinced that the seriousness of possible ecological damage outweighs the economic advantage of not taking action, he will hesitate to intervene simply because he has reason to believe that the risk will not materialise. The cost of pollution avoidance measures will then be augmented by the cost of uncertainty, which will act as a substitute for the internalisa-

tion of externalities (26). In this way, doubt leads to underestimating the cost of ecological damage in comparison to the cost of redistributing economic resources which is implicit in the adoption of a preventive measure. What price can we assign to damage that has not yet been caused? Once a risk is better understood, however, the decision-maker can more easily weigh the probable benefit of intervention against the cost of inaction.

Several authors propose using the principle of proportionality to mitigate any excesses that might arise from an insufficiently nuanced application of the precautionary principle (27). If the risks must be weighed, the same should be true of precaution. In its decision of 8 August 1978 on the operation of the Kalkar fast breeder, Germany's Federal Constitutional Court recalled that "it is appropriate to proceed to a reasonable evaluation of the risks" (28). Proportionality should in any case lead the decision-maker to evaluate the need for and usefulness of proposed measures by considering how they will affect the interests of the various parties affected by a decision. A precautionary measure will be deemed disproportionate and should be abandoned if it brings into question in an inappropriate manner interests that are worthy of legal protection.

According to some definitions, the proportionality of a precautionary measure should be assessed by means of a cost-benefit analysis based on economic criteria. The explanatory memorandum of the French law proposes that the cost of a precautionary measure should be "correlated with the seriousness of the risk and the economic capacity of the operators". By requiring that the "cost" of the measure be "economically acceptable", the legal definition of the principle confirms this interpretation. A similar position was adopted in 1990 by the

(26) G. Brüggermeier, "The Control of Corporate Conduct and Reduction of Uncertainty by Tort Law", in *Law and Uncertainty. Risk and Legal Processes*, edited by R. Baldwin (Kluwer Law Intl., London), 1997, p. 65.

(27) In favour of applying the precautionary principle, see E. Rehbinder, "Precaution and Sustainability : two sides of the same coin?", in A. Kiss & F. Burhenne-Guilmin (Eds), *A Law for the Environment : Essays in Honour of Wolfgang E. Burhenne* (IUCN — The World Conservation Union, 1994), p. 103.

(28) BVerfGE, 49, 89.

British government (29), when it undertook to develop a precautionary policy :

> "to limit the use of potentially hazardous substances or to avoid the dissemination of potentially hazardous substances, even when the state of scientific knowledge does not make possible a definitive judgement, as long as the balance of costs and benefits of this action justify it."

This concern is also expressed in international law, notably in the Climate Change Convention, which states that the precautionary principle should lead to the adoption of measures that are "cost-effective so as to ensure global benefits at the lowest possible cost". Several provisions of European Community law set out a similar requirement (30). Thus, Article 174(2) of the Treaty provides that "in preparing its action relating to the environment, the Community shall take account of ... the potential benefits and costs of action or of lack of action."

It is cause for grave concern that formulations of this type could make implementation of precautionary measures dependent upon a purely economic analysis. Such a methodology would prevent the authorities from taking precautionary measures that might compromise the economic viability of the parties to whom they are directed. This could give rise to serious problems. First, this methodology does not address the issue of defining what "costs" are "economically acceptable", and for whom. In addition, it will never be accurate as long as economic analysis remains incapable of correctly internalising all externalities. Indeed, the uncertainty inherent in precaution increases the possibility that ecological interests could systematically be compromised compared to competing interests since, as recalled above, the gravity of suspected damage can only be known in an approximate manner. The fact that causation may not be entirely clear — continuing the theoretical conflict as to how this question should be handled — also serves to complicate the decision-maker's task. In any event, such a calculation can never be as precise as might

(29) 1990 White Paper "This Common Inheritance".

(30) See especially Directive 91/339/EEC concerning the placing on the market of PCB-PCT, amending Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations.

be the case for a measure adopted in a hypothetical stable universe where risks could be completely mastered.

For these reasons, balancing the disadvantages of a precautionary measure against the advantages it is meant to secure cannot be limited to carrying out a classical cost-benefit analysis. It must also take into account other, non-quantifiable, values at the economic level. We should note, moreover, that most of the definitions of the principle found in international law do not contain restrictions referring to "economically acceptable" costs. In fact, some national laws go so far as to proscribe weighing ecological against economic interests, on the grounds that fundamental values should be protected at any price. For example, the Federal Appeals Court of the District of Columbia has judged that the US Clean Air Act should be applied independently of economic considerations (31). Ultimately, it is reasonable to wonder to what extent the criterion of economic balance should continue to be allowed in cases where precautionary measures refer back to a constitutional right to environmental protection.

In assessing the proportionality of a precautionary measure, we should also consider non-targeted risks that might arise : to refuse to run a risk is often to accept other, opposite risks. Even if the decision-maker is convinced of the need to intervene in order to eliminate a risk, he may have to abandon the planned measure if it is likely to give rise to a different hazard (32). He may find himself confronting competing scenarios which, as the following examples illustrate, are difficult to prioritise.

In order successfully to eliminate the risk arising from nuclear catastrophe, it would be necessary to close all nuclear plants. But could this not lead to the risk of accelerating global warming through the increase in fossil fuel use that would inevitably result from such a step ? Is it appropriate to combat famine worldwide by opening the way for the growth of biotechnology or, on the contrary, must we put a brake on

(31) *Natural Resources Defense Council v. US EPA*, 824 F.2d (D.C. Cir. 1987), p. 1163.

(32) Some US authors go so far as to defend the thesis that policies based on a precautionary approach act to generate risks whose scope exceeds those of the risks that have been avoided. Cf. F. Cross, "Paradoxical Perils of the Precautionary Principle", *Washington & Lee Law Review*, 53 (1996), p. 851.

its development in the name of still uncertain risks? Should the construction of dams be encouraged on the grounds that they could produce clean energy, even at the cost of the irreplaceable ecosystems that will be submerged in the process? Or should we endeavour to conserve natural resources at any price? What about the construction of high-speed trains? Should this be encouraged because these trains compete with other, more polluting modes of transport with no consideration for the natural areas that will be disturbed by the infrastructure they require?

The concept of the general interest is inherent in the approach to ecological risk. In practice, however, that general interest will be defined in a variety of ways by different societal groups. Therefore, at the end of the day, it will again fall to the political establishment to arbitrate between the conservation of biodiversity and the production of less polluting energy, between modernising agricultural production and genetic upheaval, etc., on the basis of the values it upholds. Yet the ramifications of these alternatives should, at the very least, be clarified in the light of the precautionary principle, with the aim of ensuring that final decisions conform to the general interest.

Conclusions

The precautionary principle has been put forward as the best as well as the worst of principles. Applied strictly according to the letter, it would condemn us to inaction. As the proverb *Grasp all, lose all* reminds us, the principle would become inapplicable if taken to the extreme : it would lose its way, a substitute for good intentions. On the other hand, to place absolute faith in the competence of techno-science is sooner or later to court irreversible damage which could be averted by timely action. We no longer have a right to err. But at what price action? That is the question. While a certain number of markers must be fixed to prevent the precautionary principle resulting in absurd decisions, it is nevertheless essential that these be set out intelligently in order to use precaution wisely.

Conscious of these problems, both legislators and courts are attempting to define the scope of the precautionary principle within the limits of what is reasonable, by gradually giving shape to risk, anticipated damage and the scope of policy measures. But careful consideration of several definitions makes it clear that the limits being set for the principle at times contradict its stated objective. Is it reasonable to require that a decision be based upon the existence of relevant scientific and technical data in the case of hypothetical damage which would be both significant and irreversible and where the decision will not even seriously affect socio-economic interests? Under multiple conditions of this sort, recourse to the precautionary principle is subject to excessive precaution.

Throughout this Chapter an equitable path has been sought that would preserve the useful effect of the precautionary principle without paralysing innovation. Several conclusions have been drawn from this exercise. Even if the principle does not require that the probability of damage be fully demonstrated, it should nevertheless not take purely hypothetical risks into account. Speculative considerations are thus excluded. Common sense would also suggest that the principle not apply in the case of an extremely low probability of very slight damage. Thus, the injury to be averted should be reasonably specific, even if the much-cited criteria of seriousness and irreversibility are not always satisfactorily met. Finally, proportionality should not be limited to measuring the cost of the socio-economic sacrifices that will be caused by a precautionary measure. Rather, it should be broadened to take into account long-term non-economic advantages for society as a whole.

To conclude, we should ask ourselves if it is reasonable to expect such conditions to be reflected in normative texts. The nature of a legal principle is precisely *not* to be the subject of a complete and exhaustive definition in positive law; what is sought is a flexible norm able to adapt to the heterogeneous situations in which it will be used. Any attempt to define a legal principle by overly-precise wording could definitively restrict its meaning, thereby rendering it useless. Moreover,

although a legal principle may remain vague, its scope will gradually be clarified as it is applied in various situations. Legal analysis will carry out this beneficial work.