NEITHER ACCEPTABLE NOR CERTAIN - COLD WAR ANTICS FOR 21ST CENTURY PRECAUTIONARY CULTURE

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Abstract

Precaution is regarded as the paradigmatic approach to uncertainty. Either proposed as a form of radical prevention or, as put forward recently, as an innovative normative procedure to handle uncertainties in advancing human activities, it nevertheless finds its source in Cold War research dealing with the uncertainties of a potential nuclear war. The work of Herman Kahn and the Club of Rome in its first report *The Limits to Growth* are shown to be exemplary in understanding the present 21st century discussion on precaution. Two themes specifically emerge in the discussion about precaution, which includes two examples: the shift from the scientific aim of securing objective knowledge (which we will specify in due course) towards acceptability and the exigency to manage uncertainty. Both themes are closely related. In the final analysis we will see that neither acceptability nor the management of uncertainty, respectively, is acceptable or attainable. Precaution will render nothing within the confines within which it is regarded to function.

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1 Introducing precaution

The can things with the sharp little edges/That can cut your fingers when you're not looking/The soft little things on the floor that you step on/They can all be DANGEROUS.

As the lyrics of *The Dangerous Kitchen* by Frank Zappa show, one can never be too careful. The song has an absurd quality that is not easily missed when you actually hear it. The music intensifies the text, until it saturates your mind. Whether this song exemplifies a perspective now dominant in our Western world culture, we cannot tell. However, precaution, the main theme of this issue, *is* intensely portrayed in Zappa's lyrics.

In this contribution I want to critically assess precaution for what I believe it is: neither new nor innovative, yet problematical at best and injurious at worst. Nevertheless, in their recent report *Onzekere Veiligheid*, the Dutch Scientific Council for Government Policy (Wetenschappelijke Raad voor het Regeringsbeleid) suggest a *new* precautionary paradigm.[1] In a few words, the WRR posit that precaution expresses alacrity to respond proactively vis-à-vis uncertainty considering people's vulnerability and that of society and the natural environment. Thus precaution is not so much a form of radical prevention, whereby precaution will only come into its own when the potential for serious irreversible damage is suspected, but is regarded as a paradigm shift towards the centrality of the vulnerability of the environment and the concomitant potential risks of activities.[2] This shift highlights the fact that we are not so much confronted with risks but with uncertainties that subsequently require an adequate translation into *potential risks*, which in turn need to be pursued and managed proactively. If precaution is espoused as normative, organisational processes need to be structured in such a way that early warnings with regard to uncertainty are integrated into corporate policies.

Simply put, precaution generates policies that focus on uncertainty. As the most widely cited definition of the precautionary principle states:

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.[3]

This formulation of the precautionary principle is considered the most

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[1] Wetenschappelijk Raad voor het Regeringsbeleid (WRR) *Onzekere veiligheid. Verantwoordelijkheden rond fysieke veiligheid* (Amsterdam: Amsterdam University Press 2008) [*Uncertain Safety. Responsibilities of Physical Safety,* Scientific Council for Government policy].
[2] *Id.,* at 125.
[3] See <http://www.unep.org/Documents.multilingual/Default.asp?DocumentID=78 &ArticleID= 1163&l=en> (accessed 9 April 2009).

authoritative among the many formulations that can be found nowadays.[4] It is also known as the triple-negative definition: '*not* having scientific certainty is *not* a justification for *not* regulating'.[5] It can be found in abundance in national and international legislation and treaties.[6] In view of the many legal experiences with precaution, of which we will give two examples shortly, the most widely accepted understanding of the precautionary principle, the Rio definition included, should be construed in a strong way.[7] Concisely, precaution is taken to mean that prohibitions should be imposed on activities that have an uncertain potential to impose substantial harm, unless those in favour of these activities can show that they present no (appreciable) risk.[8] This is illustrated most poignantly in *The Final Declaration of the First European 'Seas at Risk' Conference Annex I*:

The principle of precautionary action requires that:

1. the lack of scientific certainty regarding cause and effect is not used as a reason for deferring measures to prevent harm to the environment. Science, while important in providing evidence of effect, is no longer required to provide proof of a causal link between pollutant/disturbing activity and effect, and where no clear evidence is available one way or the other the environment must be given 'the benefit of the doubt';
2. the environmental implications of each and every planned activity are considered first – the use of the 'economic availability' reservation in the application of precautionary measures, e.g., when considering the adoption of clean or cleaner technology/production processes, is inconsistent with this, and must be abandoned;
3. the 'burden of proof' is shifted from the regulator to the person or persons responsible for the potentially harmful activity, who will now have to demonstrate that their actions are not/will not cause harm to the environment;

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[4] J.D. Graham, 'Decision–analytic refinements of the precautionary principle' (2001) 4 *Journal of Risk Research* 127.

[5] C.D. Stone, 'Is there a precautionary principle?' (2001) *Environmental Law Reporter* 10789.

[6] A. Trouwborst, *Evolution and Status of the Precautionary Principle in International Law* (The Hague: Kluwer Law International 2002); The *Convention on Biological Diversity* also incorporates a similar definition of the precautionary principle, when is mentioned in the preamble 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, …' See <http://www.biodiv.org/convention/articles.asp?lg=0&a=cbd–00> (accessed 9 April 2009).

[7] R.B. Stewart, 'Environmental Regulatory Decision Making Under Uncertainty' in T. Swanson (ed.), *An Introduction to the Law and Economics of Environmental Policy: Issues in Institutional Design (Research in Law and Economics, Volume 20)* (Leiden: Elsevier 2002) at 71; C.R. Sunstein, 'Beyond the Precautionary Principle' (2003) *Public Law and Legal Theory Working Paper No. 38*. This paper can be downloaded at <http://ssrn.com/abstract_id=307098> (accessed 9 April 2009).

[8] Stewart, above n. 7.

4. if the 'worst case scenario' for a certain activity is serious enough then even a small amount of doubt as to the safety of that activity is sufficient to stop it taking place;
5. potentially harmful activities are avoided where, either public debate has not concluded the activity to be a social necessity, or less harmful alternatives exist…. [9]

The idea of 'possible risk' will be understood to require some sort of threshold of (scientific) plausibility. However, under the precautionary principle, the threshold burden is minimal, and once it is met, there is something like a presumption in favour of stringent regulatory controls. As Douma remarks (the perspective that Kahn had on nuclear war springs to mind here):

> … The default rule applied in both the EC and the WTO that the burden of proof rests with the regulating authorities, obliging them to demonstrate the existence of a risk, should be applied in a precautionary manner. The threshold of producing such proof should not be set too high …. [10]

Conversely, the reversal of the 'burden of proof' within the precautionary context shifts the explanatory burden of the regulator to the person or persons responsible for the potentially harmful activity, who will now have to demonstrate that their actions are not causing or will not cause harm to the environment and to human health. If the 'worst case scenario' for a certain activity is serious enough, then even a small amount of doubt as to the safety of that activity is sufficient to stop it taking place. Although Douma envisions a minimal threshold of proof for regulating authorities, this threshold is set quite high for the societal parties – economic or otherwise – involved, which need to present substantial proofs of *safety*. As Holmes Rolston III remarks:

> Chemicals, unlike persons, are not innocent until proven guilty but suspect until proven innocent. So the burden of proof shifts, and it is now up to the industrialists to dispatch it. This puts them again on the frontier, technologically and morally …. [11]

The term 'continuous assessment' of science and technology comes to mind when one discusses precaution within these terms, necessarily with the aid of science and technology. Conversely, the notion that absence of evidence indeed is not evidence of absence seems to be running through the precautionary debate, regardless of whether it is seen as radical prevention or, in the analysis of the WRR, a paradigmatic safeguard for a vulnerable world. It seems then

[9] C.W. Backes and J.M. Verschuuren, 'The Precautionary Principle in International, European, and Dutch Wildlife Law' (1998) 9 *Colorado Journal of International Environmental Law & Policy* 43.
[10] W.T. Douma, *The Precautionary Principle. Its Application in International, European and Dutch Law* (The Netherlands: University of Groningen 2003).
[11] H. Rolston III, *Environmental Ethics. Duties to and Ethics in the Natural World.* (Philadelphia: Temple University Press 1988) at 319.

that we need to embrace a precautionary *culture*, though the term is not used by the WRR. This is ironic, since critics of the precautionary principle, of which I am one, are reproached for their limitation of the precautionary principle as radical prevention, while *in fact* precautionary culture on a much wider scale than that proposed by WRR is extensively assessed *and* criticised by many.[12]

To properly set the wheels of criticism in motion we need to go back some 50 odd years, in particular to the *RAND* project. Here we will show in passing that the WRR has unknowingly revived a perspective on life, society, and the natural environment that had already been institutionalised during the Cold War. The Cold War perspective on the uncertain future came to 'full bloom' in the 1970s with the first report to The Club of Rome. This backdrop gives us at least three threads of the precautionary tale that need to suffice here: (i) *Cold War* cautions and the limits to growth; (ii) examples; (iii) science, risk, and precaution. Two themes specifically emerge in a discussion about precaution: *the shift from the scientific aim of securing objective knowledge (which we will specify anon) towards acceptability ánd the exigency to manage uncertainty*. Both themes are closely related and will surface subsequently in the threads we will follow. In the final analysis we will see that neither acceptability nor the management of uncertainty is acceptable or attainable, respectively.

2 'On Thermonuclear War' and 'The Limits to Growth'

Not long after the end of WWII, the world began to worry yet again about war. The nuclear age presented itself on the viewing screens of the military and citizens alike, with devastating effects. Society as we knew it could be obliterated at the push of a button. As a child, I often spotted Lockheed F104 Starfighters performing their daily routine flights. Their thundering engines were awe-inspiring but added to the gloomy and apprehensive atmosphere in the Netherlands living under the threat of 'the bomb'. These fears spawned a specific albeit somewhat forgotten 'scientific response'. Science was now not only used to enhance the sophistication of nuclear and non-nuclear weaponry, it

[12] See for example R. Pieterman, 'Culture in the Risk Society. An Essay on the Rise of a Precautionary Culture' (2001) 22 *Zeitschrift für Rechtssoziologie* 145; A. Burgess, *Cellular Phones, Public Fears, and a Culture of Precaution* (Cambridge: Cambridge University Press 2003); C.R. Sunstein, *Laws of Fear: Beyond the Precautionary Principle* (Cambridge: Cambridge University Press 2005); J.C. Hanekamp and S.W. Verstegen, 'The problem of the precautionary principle: the paternalism of the precautionary coalition' in J. Panton and O.M. Hartwich (eds.), *Science vs superstition. The case for a new scientific enlightenment* (Buckingham: University of Buckingham Press 2006); R. Pieterman, J.C. Hanekamp and L. Bergkamp, 'Onzekere voorzorg bedreigt rechtszekerheid' (2006) 81 *Nederlands Juristenblad* 2 [*Uncertain precaution threatens legal security*].

was used in ways similar to those in contemporary precautionary culture. Risks and uncertainties relating to thermonuclear war were tackled with a scientific gusto unheard up until then, with risk assessment and management of nuclear exchange as key elements therein.

During WWII, engineers and scientists provided key inventions, such as radar and the atomic bomb. Research and development were seen as even more important in the battles of the future, which undoubtedly would come. The founders of the project Research and Development conceived of *RAND* as a way of retaining and enhancing, for the US Air Force, the considerable benefits of civilian scientific thinking. The project got under way officially in December 1945, and in March 1946 *RAND* was launched as a freestanding division within the Douglas Aircraft Company of Santa Monica, California. This was the genesis of the earliest 'think tank'.

> Operations research, the brainchild conceived in the war years by the young men in the Office of Scientific Research and Development (OSRD), evolved in the 1950s into the speculative fabrications of systems analysis. *RAND* was its nursery. It was at *RAND* that the civilian defence intellectual who specialised in systems analysis took form ….[13]

Herman Kahn was one of the leading researchers at this newly developed research institute, and one of the most controversial. Kahn began his career in the late 1940s with the *RAND Corporation* as a physicist and mathematician. While working at *RAND*, his co-directorship of the Strategic Air Force Project inspired him to write *On Thermonuclear War*. Published first in 1960, the study simultaneously elevated him to national and international pre-eminence and made him the focus of much derision. *On Thermonuclear War* was the first book to analyse systematically the possible effects of nuclear war and the possible strategic options under various circumstances. In a later study, he expressed his basic investigative approach – which has a very precautionary ring to it – to nuclear war as follows:

> I can believe the impossible', Father Brown notes, in one of G.K. Chesterton's wonderful priest-detective stories, 'but not the improbable'…. Unlike Father Brown, we believe not only the impossible and the improbable, but also the implausible, the unlikely, and the unproven. We believe in them and we take them seriously, especially when they involve what is probably the central issue of our time – nuclear war. [14]

In the middle of the 20th century, researchers within the US military, and Kahn in particular, tried, with the aid of science, to deal with history before it happened. As Ghamari-Tabrizi observes:

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[13] S. Ghamari-Tabrizi, *The Worlds of Herman Kahn. The Intuitive Science of Thermonuclear War* (Cambridge, Massachusetts: Harvard University Press 2005).

[14] H. Kahn, *Thinking about the Unthinkable in the 1980s* (New York: Simon and Schuster 1984).

The problem for national security was always the unknown unknowns. How can you defend against No Discernable Thing? … [T]his book is precisely about the unknown unknowns of national security. It is about how analysts in the Cold War developed ways to fill in the ciphers of strategic uncertainty. It explores the peculiarly inventive quality of strategy, *how uncertainty becomes the wellspring of extravagant threat scenarios*. However much nuclear war planning – the fighting, termination, and survival of it – was presented to the public during the Cold War as a practical question for scientific deliberation, war planning could never be a matter of fact. Whether humankind could survive a nuclear war could only be resolved with reference to one's own beliefs about the social and natural world. To flesh out a world where clever men fashioned Something out of Nothing … I offer a tale about Herman Kahn, a virtuoso of the unknown unknowns.[15]

Assessing risks and trying to frame 'unknown unknowns' constituted Kahn's playground, and from the 1960s onwards they were probed increasingly with fallible computer models. In *On Thermonuclear War* Kahn realised that uncertainty stalked the strategist at every point in his analysis. The multiple dimensions of uncertainty gave rise to the 'gap', Kahn's favourite and most compelling of notions. The concept of a 'gap' represented the unexpected and unknown possibilities that emerged from the mix of old and new weapon systems of both the US and the USSR at any one time.[16] The 'gap' comprised either 'knowledge' – the other knows more of certain weapons technologies; 'procurement' – the other has more weapons; or 'operations' – the other has more insight into current strategic forces. Kahn's core problem was this: *how to prop up hypothetical vulnerabilities, above all unknown and undetectable ones, with exigency*. Kahn himself noted that

[t]hese unnoticed operational gaps may determine the course of events and are most likely to cause catastrophic failures of the system, but until one is faced with a disastrous failure, it is most difficult to take them seriously. In general, the only way to find operational gaps is by intense observation of the whole system, reflection on unconventional possibilities, and paper and pencil studies. This means that any gaps that are found will look hypothetical and unreal. It will be difficult for rigid thinkers, the budget-minded, the 'by assumption' type of analyst, the loyal member of an operating organisation, or the partisan advocate to take such worries seriously.[17]

Taken as a whole, Kahn's Utopian drive was 'simply' to transcend every earthly limit through human ingenuity, resolve, and technical and scientific prowess. In other words, being aware of the limitations of assessments, Kahn nevertheless thought it possible to overcome these limitations by 'informed

[15] Ghamara-Tabrizi, above n. 13, at 1. Italics added.
[16] H. Kahn, *On Thermonuclear War* (Princeton, Princeton University Press 1962) at 324.
[17] *Id*., at 325. Compare with WRR report, above n. 1, at 178.

judgement and intuition in addition to rigorous analysis'.[18]

At this point, work stemming from the Cold War touches at the heart of the precautionary culture we know today. Despite the fact that the WRR hails its own precautionary insights as novel, more than half a century later the work of Kahn cum suis precedes their work on multiple levels, including the way issues are actually phrased. Substitute the term nuclear war for, for example, nanotechnology, food safety, or phthalates and we have arrived in the 21st century with its precautionary preoccupations. However, the required bridge between on the one hand these mid-20th century nuclear worries and current precautionary fears on the other hand is found in the first report to The Club of Rome, which posited solutions to the 'world problematique' of which nuclear armament was just one of the many issues raised.[19] All the same, its rise to fame was deeply embedded in the gloomy Cold War atmosphere that vexed Western citizens to such an extent. The notions of the report, in other words, found the fertile soil of nuclear threat that was very much felt in the 1960s and 1970s.

The Limits to Growth highlighted the impact of human behaviour on the earth's natural resources and the global society and tried to establish a link between the level of world economic growth and the extent to which our environmental resources are being depleted and polluted. Although The Club of Rome aimed to denounce the harmful effects of a productivity-oriented development policy, it wanted above all to demonstrate that, by pursuing growth, humankind was heading towards global catastrophe, one very much reminiscent of a nuclear doomsday. The main focus was exponential growth in a complex and closed world-system. The main preoccupation was the survival of humankind – bogged down by a political structure not deemed acceptable and not capable of handling the 'world problematique' – on a planet with obvious limited resources and clear political tensions, the most pronounced of which was the threat of nuclear war.

The Club of Rome's principal objective was to analyse and to understand – again with the aid of science-driven systems analyses run on computers – the basic interdependencies that link all the problems facing humankind across the globe, whatever the nature, very much like Kahn tried to do in relation to the effects of a nuclear exchange. The perception that they all interconnect was coined with the term 'world problematique'. It covers a vast sphere of innumerable difficulties confronting humankind, such as social injustice, malnutrition, poverty, illiteracy, unemployment, population growth,

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[18] Kahn, above n. 14, at 457.

[19] D.H. Meadows and others, *The Limits to Growth; A Report for the Club of Rome's Project on the Predicament of Mankind* (New York: Potomac Associates 1972); See for an analysis: J.C. Hanekamp, S.W. Verstegen and G. Vera-Navas, 'The historical roots of precautionary thinking: The cultural ecological critique and "The Limits to Growth"' (2005) 8 *Journal of Risk Research* 295.

and the obsession with growth, inflation, the energy crisis, monetary problems, and the degeneration of cities, damage to the environment, the nuclear threat, and political corruption.[20] The term 'world problematique' pointed to the general feeling of anxiety – not just facts – felt by modern humans in the face of the uncertainty and complexity that came to be known as the 'predicament of mankind'.

The fundamental thesis of exponential growth in a complex and closed world-system resulted in the projection that no matter how the future unfolds, collapse is imminent unless humankind curbs its growth, both economically and demographically. The Club of Rome, at that time, explicitly linked the risks of science and technology – nuclear power – to the inevitability of centralised assessment and abatement strategies. The goal of these assessment strategies was to gauge new technology in relation to the premeditated checks on growth:

> This ignorance about the limits of the earth's ability to absorb pollutants should be reason enough for caution in the release of polluting substances. The danger of reaching those limits is especially great because there is typically a long delay between release of a pollutant into the environment and the appearance of its negative effects on the ecosystem .… (at 89)
>
> Pollution generated in exponentially increasing amounts can rise past the danger point, because the danger point is first perceived years after the offending pollution was released. (at 151)
>
> We have felt it necessary to dwell so long on an analysis of technology because we have found that technological optimism is the most common and the most dangerous reaction to our findings from the world model. Technology can relieve the symptoms of a problem without affecting the underlying causes. (at 159) [21]

In the view of The Club of Rome science and technology needs to be assessed on a continuous basis in order to keep a firm grip on its development in order to maintain the envisioned steady-state requirements of economy and humanity in order to keep exponential growth at bay. The common enemy of exponential growth would hopefully unite humanity and thereby overcome political differences and nuclear destruction.

This view on science and technology and the role of governmental policy-making comes together in the precautionary principle, as we know it today. Kahn tried to tackle all uncertainties in relation to the risks of nuclear war and its aftermath, while The Club of Rome, within the same historical setting, tried to rise above the 'world problematique' and resolve uncertainties through strong international government that opened up the possibilities for precautionary global assessments of science and technology. *Both* approaches, however, carry the naivety of the ostensible potential to transcend earthly limits

[20] A. Peccei, *Human Quality* (New York: Pergamom Press 1977).
[21] Meadows and others, above n. 19.

through human ingenuity, resolve and technical and scientific knack. *Both* posit the centrality of science. Before we come to that, however, we will first discuss two examples in which precaution and science have their role to play.

3 Risk and precaution – two examples related to human health[22]

Chloramphenicol (CAP)[23] was the first antibiotic to be produced synthetically on a large scale; it was first shown to be effective against typhoid and was subsequently used extensively against a broad variety of pathogenic micro-organisms.[24] However, it has fallen out of favour in the West due to a rare yet serious side effect relating to medicinal use: namely, aplastic aenemia (in which the bone marrow ceases to produce red and white blood cells). Moreover, research has indicated that it is possibly a genotoxic carcinogen, although only at concentrations 25 times higher than could be achieved with the highest medical dosages.[25] Parenthetically, CAP is still very widely used in low-income countries because it is exceptionally cheap, and in the West it is also still widely used, albeit mostly in topical preparations (ointments and eye drops) for the treatment of bacterial conjunctivitis. CAP is banned for veterinary use.

A broad-spectrum antibiotic, CAP was detected in 2001 in shrimp imported into Europe from Asian countries; the discovery was understood to be yet another food scandal. The initial European response was to close European borders to fish products, mainly shrimp, from these countries and to make laboratories work overtime to analyse numerous batches of imported goods for the presence of this antibiotic. Some European countries went so far as to have food products containing the antibiotic destroyed, as public health was deemed to be at stake. This regulatory response spilled over into other major seafood-importing countries such as the United States.

The legislative background to this mainly European response in part is to be found in Council Regulation EEC No. 2377/90 (now superseded by Regulation EC No. 470/2009 as of the 6th of May 2009 we will comment on below), which was implemented to establish maximum residue limits of

[22] Here we will not discuss environmental effects and occupational risks in relation to exposure.
[23] J. Ehrlich and others, 'Chloromycetin, a New Antibiotic From a Soil Actinomycete' (1947) 106 *Science* 417.
[24] J.C. Patel and D.D. Banker, 'Chloramphenicol in Typhoid Fever. A Preliminary Report of Clinical Trial in 6 Cases' (1949) 22 *British Medical Journal* 908.
[25] IPCS–INCHEM (Chemical Safety Information from Intergovernmental Organisations), <http://www.inchem.org/documents/jecfa/jecmono/v33je03.htm> (accessed 9 April 2009);
IPCS–INCHEM (2) (Chemical Safety Information from Intergovernmental Organisations), <http://www.inchem.org/documents/jecfa/jecmono/v23je02.htm> (accessed 9 April 2009).

veterinary medicinal products in foodstuffs of animal origin.[26] This so-called 'MRL Regulation' (maximum residue limit) introduced Community procedures to evaluate the safety of residues of pharmacologically active substances according to human food safety requirements. A pharmacologically active substance may be used in food-producing animals only if it receives a favourable evaluation. If it is considered necessary for the protection of human health, maximum residue limits ('MRLs') are established. They are the points of reference for setting withdrawal periods in marketing authorisations as well as for the control of residues in the Member States and at border inspection posts.

EEC No. 2377/90 contains an Annex IV listing of pharmacologically active substances for which no maximum toxicological levels (Tolerable Daily Intake: TDI) can be fixed, either from lack of toxicological or pharmacological data: for example, the absence of a definable NOAEL (No Observed Adverse Effect Level) or LOAEL (Lowest Observed Adverse Effect Level) or because of genotoxic characteristics of the compound in question.[27] These substances are consequently not allowed in the animal food-production chain. Zero tolerance levels are in force for Annex IV for reasons that can be classified as follows:

- Lack of scientific data de facto makes the establishment of a TDI unfeasible;
- The absence of a TDI and the subsequent impossibility to establish an MRL is understood in regulatory terms as 'dangerous at any dose', requiring zero tolerance regulation en lieu with Article 7 of Regulation 178/2002/EC;
- With the introduction of zero tolerance, a veterinary ban on Annex IV compounds (such as CAP) is in place, whereby the listed compounds, when producers' compliance is achieved, would disappear from the food chain;
- When zero tolerance was implemented, analytical equipment was only capable of detecting at the Limit of Detection (LOD) of ppm (parts per

[26] 'Council Regulation (EEC) No. 2377/90 of 26 June 1990 laying down a Community procedure to set up maximum residue limits of veterinary medicinal products in foodstuffs of animal origin' (1990) L224 *Official Journal of the European Communities* 1–8; 'Regulation (EC) No 470/2009 of the European Parliament and of the Council of 6 May 2009 laying down Community procedures for the establishment of residue limits of pharmacologically active substances in foodstuffs of animal origin, repealing Council Regulation (EEC) No 2377/90 and amending Directive 2001/82/EC of the European Parliament and of the Council and Regulation (EC) No 726/2004 of the European Parliament and of the Council' (2009) L152 *Official Journal of the European Communities* 11.

[27] Genotoxic agents (chemicals, ionising radiation) are those capable of causing damage to DNA. Such damage can potentially lead to the formation of a malignant tumour.

million; mg per kg); nowadays LODs are at least ppb (parts per billion; µg per kg), obviously depending on analysed chemicals.

No tolerable daily intake (TDI) could be established for CAP due to the lack of scientific information to assess its carcinogenicity and effects on reproduction, and because the compound showed some genotoxic activity.[28] Overall, CAP – and other Annex IV substances – should not be detected in food products at all, regardless of concentrations. The presence of CAP in food products, which can be detected by any type of analytical apparatus, is a violation of European law and deemed to be a threat to public health. In consequence, food containing the smallest amount of these residues is considered unfit for human consumption.

The core regulatory framework in European food law is Regulation 178/2002/EC, the General Food Law.[29] According to this Regulation, 'food' (or 'foodstuff') denotes 'any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans'. The scope of Regulation 178/2002/EC concerns 'all stages of the production, processing and distribution of food ...' and its general objective is to provide 'a high level of protection of human life and health and the protection of consumers' interests ...'. This Regulation thus sets general rules for all products that are brought to market. Importantly, the Regulation also constitutes the European Food Safety Authority (EFSA) and defines the Authority's task and fields of competence and authority.

With the installation of the EFSA, *precaution* is specifically referred to as a key principle in food regulation, which broadens the explanation of the emergence of the CAP scandal. Especially in relation to antibiotics used in animal rearing, regulation is pervasive and precautionary. This is partly related to reducing the chronic exposure through food as much as possible, but is also in part due to a precautionary risk averseness. Article 7 of the EFSA describes the precautionary principle as follows:

1. In specific circumstances where, following an assessment of available information, the possibility of harmful effects on health is identified but scientific uncertainty persists, provisional risk management measures necessary to ensure the high level of health protection chosen in the Community may be adopted, pending further scientific information for a more comprehensive risk assessment.

2. Measures adopted on the basis of paragraph 1 shall be proportionate and no more

28 IPCS-INCHEM (Chemical Safety Information from Intergovernmental Organisations). See webpage <http://www.inchem.org/documents/jecfa/jecmono/v33je03.htm> (accessed 3 February 2009).

29 'Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety' (2002) L31 *Official Journal of the European Communities* 1.

> restrictive of trade than is required to achieve the high level of health protection chosen in the Community, regard being had to technical and economic feasibility and other factors regarded as legitimate in the matter under consideration. The measures shall be reviewed within a reasonable period of time, depending on the nature of the risk to life or health identified and the type of scientific information needed to clarify the scientific uncertainty and to conduct a more comprehensive risk assessment.

The unfeasibility of zero-tolerance came to the fore as a result of the analytical progress made in the last two decades of the 20^{th} century. CAP proved to be more ubiquitous in food – albeit at extremely low levels – than mere abuse could probably account for.[30] Moreover, it was clear that medicinal products, such as CAP, were banned for veterinary use not because of inherent risks at low-level exposures, on the contrary. JECFA (Joint Expert Committee on Food Additives, FAO) could not establish an Acceptable Daily Intake for lack of scientific data. In Europe this was expediently and erroneously translated, specifically within the context of the precautionary demands in the General Food Law, as 'dangerous at any dose' and officially regarded as such.

The regulatory and practical failure of zero-tolerance, and thereby the precautionary approach of food-safety, resulted in a regulatory shift.[31] The European Commission published a decision on 11 January 2005, according to which CAP no longer is regulated at zero level but at the MRPL (Minimum Required Performance Limit) level.[32] The MRPL for CAP is set at 0.3 ppb. Prior to this decision, MRPLs were whatever low concentration levels regulatory laboratories in the European Community could detect and confirm. With this decision MRPLs have now been given legal status in terms of explicit levels of concern. Regulation EC No. 470/2009, as the new regulatory standard for the establishment of residue limits of pharmacologically active substances in foodstuffs of animal origin we referred to above, specifically refers to the issue of LOD's when it states in the preamble that 'As a result of scientific and technical progress it is possible to detect the presence of residues of veterinary medicinal products in foodstuffs at ever lower levels.' This has caused considerable problems that need to be amended of which this new regulation, superseding among others EEC No. 2377/90, is regarded as a step forward.

Ultimately, the precautionary regulatory position and human health perspective proved to be untenable in the case of CAP (but also for other antibiotics not allowed in the food chain and part of the Annex IV such as

[30] J.C. Hanekamp, G. Frapporti and K. Olieman, 'Chloramphenicol, food safety and precautionary thinking in Europe' (2003) 6 *Environmental Liability* 209.
[31] J.C. Hanekamp and E. Calabrese, 'Chloramphenicol, European Legislation and Hormesis' (2007) 5 *Dose-Response* 91.
[32] 'Commission decision of 11 January 2005 laying down harmonised standards for the testing for certain residues in products of animal origin imported from third countries' (2005) L16 *Official Journal of the European Union* 61.

nitrofurans) in the face of human health requirements and, more importantly, progressing scientific knowledge. Indeed, the term precaution is not mentioned once in Regulation EC No. 470/2009.[33]

A *second* example, and a more complicated case considering the interaction between policy and the advancement of scientific knowledge, concerns man-made chemicals in casu phthalates. Phthalates are liquid organic compounds added to hard polyvinyl chloride (PVC) to act as softeners or plasticisers. These substances make the polymer more malleable and hence more versatile. Due to their low cost and excellent performance characteristics, phthalates are found in a wide range of products that contain PVC. They are used for medical devices, particularly fluid containers (e.g. blood and plasma), tubing, and gloves, as well as household and industrial items such as wire and cable coating, flooring, and clothing. The vast majority of phthalates are used in the production of flexible PVC. The phthalates that concern us here are DEHP (Di(2-ethylhexyl) phthalate), DBP (Dibutyl phthalate), BBP (Butylbenzyl phthalate), DINP (Di-iso-nonyl phthalate), DIDP (Di-iso-decyl phthalate), and DNOP (Di-n-octyl phthalate).

Overall, phthalates are known for their relative innocuous toxicological behaviour, both acutely and chronically. Nevertheless, they have been the focus of intense campaigning by environmental NGOs who brought the potential risks of those compounds to the fore from the 1990s onwards, as part of the NGO campaign against chlorine. The argument ran that if phthalates are manoeuvred out of the equation, the production of chlorine-containing PVC becomes industrially unattractive.[34] In terms of toxicity young children and babies were, and still are, the focus of attention, obviously for emotive reasons:

> Children in contact with soft PVC toys may, therefore, ingest substantial quantities of phthalates during normal play, especially from toys specifically designed to be chewed. This is of concern, as phthalates are known to present a number of hazards. Although acute toxicity appears to be low, phthalates have been shown to cause a range of adverse effects in laboratory animals following longer exposure, including damage to the liver and kidney and, in some cases, effects on the reproductive tract ….[35]

Despite (or rather *because* of) the provisional nature of scientific research phthalates toxicity, in December 1999, the European Commission adopted measures to prohibit the use of phthalate softeners in PVC toys and childcare

[33] *Joint FAO/WHO Technical Workshop on Residues of Veterinary Drugs without ADI/MRL.* (Bangkok, Thailand 24-26 August 2004) at 37.

[34] R. Stringer and others, *Determination of the Composition and Quantity of Phthalate Ester Additives in PVC Children Toys - Greenpeace Technical note 06/97* (Exeter: Greenpeace Research Laboratories 1997).

[35] B. Durodié, *Poisonous Propaganda. Global Echoes of and Anti-Vinyl Agenda* (Washington DC: Competitive Enterprise Institute 2000).

articles intended for oral use by children under three years of age.[36] Specific reference was made to precaution:

> The Commission considers that, should the use of DNOP, DIDP, BBP, and DBP be allowed to replace DINP and DEHP, as a consequence of the prohibition of these two substances as plasticisers in the products in question, the exposure of children to them would increase and consequently the risk would be higher. Therefore, the Commission, adopting a precautionary approach, considers that this Decision should also apply to them; ….

The six phthalates under scrutiny here are now regulated under Directive 76/769/EEC.[37] DEHP, DBP and BBP are not allowed beyond concentrations of 0.1% (by mass) in toys and childcare articles. The term 'childcare article' denotes any product intended to facilitate sleep, for relaxation, hygiene, sucking, or the feeding of children.[38] DINP, DIDP, and DNOP are only banned beyond the same concentrations as above in toys and childcare articles that can be placed in the mouth. In all other toys and childcare articles, these compounds are still allowed.

In a move to ban phthalates altogether, DBP, DEHP, and BBP have now been put on the so-called Substances of Very High Concern (SVHC) list.[39] In the framework of the authorisation process, Member States Competent Authorities or the European Chemicals Agency may prepare dossiers for the identification of substances of very high concern. These substances are defined in Article 57 of Regulation (EC) No 1907/2006 (the REACH Regulation) and include substances that are carcinogenic, mutagenic or toxic to reproduction (abbreviated as CMR compounds); persistent, bioaccumulative and toxic

[36] 'Commission Decision of 7 December 1999 adopting measures prohibiting the placing on the market of toys and childcare articles intended to be placed in the mouth by children under three years of age made of soft PVC containing one or more of the substances di-iso-nonyl phthalate (DINP), di(2-ethylhexyl) phthalate (DEHP), dibutyl phthalate (DBP), di-iso-decyl phthalate (DIDP), di-n-octyl phthalate (DNOP), and butylbenzyl phthalate (BBP)' (1999) L31 *Official Journal of the European Union* 46.

[37] 'Council Directive 76/769/EEC of 27 July 1976 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' (1976) L262 *Official Journal of the European Union* 201.

[38] 'Directive 2005/84/EC of the European Parliament and of the Council of 14 December 2005 amending for the 22nd time Council 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 (phthalates in toys and childcare articles)' (1976) L344 *Official Journal of the European Union* 40.

[39] See <http://echa.europa.eu/consultations/authorisation/svhc/svhc_cons_en.asp> (accessed 9 April 2009).

(abbreviated as PBT compounds) or very Persistent and very Bioaccumulative (vPvB); identified, on a case-by-case basis, from scientific evidence as causing probable serious effects to human health or the environment of an equivalent level of concern as those above (e.g. endocrine disruption).[40] It is proposed for DBP, DEHP, and BBP that they are identified as CMR, and we will look further shortly into these phthalates.

Phthalates have been in widespread use for some 50 years, and have been subject to many scientific assessments in relation to their safety. The IARC (International Agency for Research on Cancer) has categorised BBP[41] and DEHP[42] as not classifiable as to carcinogenicity (category 3), the C in the CMR labelling.[43] It should be noted that for DEHP the evaluation has been downgraded from 2B (*possibly* carcinogenic to humans) to 3. This means that for two of the three phthalates on the SVHC list there is no persuasive evidence that they are carcinogens. There is a lack of data concerning the carcinogenicity of DBP. However, phthalate esters are known to induce peroxisomal proliferation in the liver of mice and rats, which is related to tumour formation.[44] Many peroxisome proliferators have been shown to induce tumours when administered to mice and rats at high dose-levels for long periods, despite being non-genotoxic. It has also been shown that humans are insensitive or even non-responsive to peroxisome proliferators. Hence, carcinogenicity in humans related to phthalates' exposure is highly

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[40] 'Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC' (2007) L136 *Official Journal of the European Union* 3.

[41] IARC, *Some Chemicals that Cause Tumours of the Kidney or Urinary Bladder in Rodents and Some Other Substances - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 73* (Lyon: World Health Organization 1999).

[42] IARC, *Some Industrial Chemicals - IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Volume 77* (Lyon: World Health Organization 2000).

[43] See for the recent European assessments of the European Chemicals Bureau on DBP, DEHP, and BBP: European Chemicals Bureau, *Dibutyl phthalate (DBP) - European Union Risk Assessment Report Volume 29* (Brussels: European Chemicals Bureau 2004); European Chemicals Bureau, *Bis(2-ethylhexyl)phtalale (DEHP)- European Union risk Assessment Report Volume 80* (Brussels: European Chemicals Bureau 2008); European Chemicals Bureau *Benzyl butyl phthalate (BBP) - European Union risk Assessment Report Volume 76* (Brussels: European Chemicals Bureau 2007).

[44] Peroxisomes are single-membrane sub-cellular organelles, present in most eukaryotic cells and organisms. The peroxisome fulfills essential metabolic functions in lipid metabolism. The peroxisome also plays a key role in free radical detoxification.

implausible.[45] There is now a scientific consensus that liver peroxisome proliferation in rodents is not relevant for human risk assessment. Concerning mutagenicity, the M in the CMR labeling, all three phthalates are considered to be non-mutagenic substances, which leaves us with reprotoxicity.[46]

Reprotoxicity seems to be the most critical of the effects of exposure to phthalates. Based on all the available toxicological evidence, it can be surmised that effects on reproduction and development are the most sensitive end-points on which to base the risk assessment of phthalates. Focussing on reproductive disorders of newborn and young adult males, these seem to be common and/or increasing in incidence. It has been hypothesised that these disorders may comprise an overall testicular dysgenesis syndrome (TDS) with a common origin in fetal life.[47] This has been supported, to some extent, by findings in animal models involving fetal exposure to DBP, as well as other studies.[48] However:

> It is unfortunate that many people wrongly consider that the TDS hypothesis is centered on the idea that it is caused by exposure to environmental chemicals, in particular, endocrine disruptors. The original hypothesis stated that there are likely to be multiple causes of TDS, one of which is exposure to environmental chemicals. However, there is still only limited evidence to support this possibility.[49] Perhaps confusion has arisen because the TDS hypothesis states that ''endocrine disruption,'' as encapsulated by altered testosterone production/action by the fetal testis, is at the center of the hypothesis …, but this alteration could result from any genetic, lifestyle, or environmental factor that causes dysgenesis. Nevertheless, as studies with DBP and certain other phthalates have demonstrated, environmental chemicals that can cause dysgenesis and/or inhibit testosterone production or action, obviously have the right credentials for causing TDS. Whether the human fetus is exposed to sufficient levels of such chemicals to result in any adverse effect remains a point for debate, and is unlikely to be resolved easily because of the inherent difficulties in both obtaining accurate chemical exposure data for the early human fetus and then relating this to clinical outcomes months or decades later.[50]

Concisely, phthalates still seem, when reviewing the scientific findings so far,

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[45] R.C. Cattley and others, ‘Do Peroxisome Proliferating Compounds Pose a Hepatocarcinogenic Hazard to Humans?’ (1998) 27 *Regulatory Toxicology and Pharmacology* 47.
[46] See above n. 43.
[47] R.M. Sharpe and N.E. Skakkebaek, ‘Testicular dysgenesis syndrome: mechanistic insights and potential new downstream effects’ (2008) 89 *Fertility and Sterility* 33.
[48] See for example E. Mylchreest and others, ‘Dose-dependent alterations in androgen-regulated male reproductive development in rats exposed to Di(n-butyl) phthalate during late gestation’ (2000) 55 *Toxicological Sciences* 143.
[49] S.H. Swan and others, ‘Decrease in anogenital distance among male infants with prenatal phthalate exposure’ (2005) 113 *Environmental Health Perspectives* 1056.
[50] Sharpe and Skakkebaek, above n. 47.

innocuous chemicals, that is non-carcinogenic and non-mutagenic, with reprotoxicity as the potential exception for some phthalates. Furthermore, the latter is part of the wider context of the proposed multiple-cause testicular dysgenesis syndrome. This leaves us with a complex scientific issue that European policymakers have simply circumvented by banning phthalates from the realm of the consumer, despite the fact that exposure to these compounds from especially food (except perhaps for DBP and DEHP) is well below the Tolerable Daily Intake (TDI), which is an estimate of the quantity of a chemical in food or water which can be ingested daily over a lifetime without posing a significant risk to health.[51]

Even though in the mid 1990s nothing was even remotely clear concerning the involved risks, a precautionary ban seemed appropriate as no scientific certainty (whatever that may be) is required (see below), or as Ewald proposes in relation to the function of precaution:

> For one must take all hypotheses into account, even and *in particular* the most dubious, one must be wide open to speculation, to the craziest imagined views. … With precaution, science becomes a principal of challenge. … Effectively science today interests us less by producing new knowledge than introducing new doubts. … [A]ll that can be excluded is that anything should be excluded.[52]

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[51] TDIs are derived from No Observed Adverse Effect Levels (NOAEL) established in animal experiments. TDI= NOAEL/100 (or 200 in the case of DBP); 'Opinion of the Scientific Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food (AFC) on a request from the Commission related to Butylbenzylphthalate (BBP) for use in food contact materials Question N° EFSA-Q-2003-190' (2005) 241 *The EFSA Journal* 1; 'Opinion of the Scientific Panel on Food Additives, Flavourings, Processing Aids and Material in Contact with Food (AFC) on a request from the Commission related to Di-Butylphthalate (DBP) for use in food contact materials. Question N° EFSA-Q-2003-192' (2005) 242 *The EFSA Journal* 1; 'Opinion of the Scientific Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food (AFC) on a request from the Commission related to Bis(2-ethylhexyl)phthalate (DEHP) for use in food contact materials Question N° EFSA-Q-2003-191' (2005) 243 *The EFSA Journal* 1; 'Opinion of the Scientific Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food (AFC) on a request from the Commission related to Di-isononylphthalate (DINP) for use in food contact materials Question N° EFSA-Q-2003-194' (2005) 244 *The EFSA Journal* 1; 'Opinion of the Scientific Panel on Food Additives, Flavourings, Processing Aids and Materials in Contact with Food (AFC) on a request from the Commission related to Di-isodecylphthalate (DIDP) for use in food contact materials Question N° EFSA-Q-2003-195' (2005) 245 *The EFSA Journal* 1.

[52] F. Ewald, 'The return of Descartes's Malicious Demon: An Out line of a Philosophy of Precaution', in T. Baker and J. Simon (eds.), *Embracing Risk, the changing culture of insurance and responsibility* (Chicago: The University of

A decade later, the issue of reprotoxicity has come to the fore more clearly, yet has not been elucidated to the extent of mechanistic understanding within the multi-causal web of TDS. It might be argued that precaution, in hindsight, was warranted for the relevant phthalates and Ewald is on track with his understanding of precaution. However, science, as a means to choose between rival hypotheses about the hidden structure of the world,[53] is thereby sidetracked and can *here* only serve as a retrospective confirmation *or falsification* of suspected risks, despite the fact that the latter is hardly ever honoured by lifting a ban or reversing precautionary legislation.[54] Justice delayed is justice denied. Moreover, one potential example in favour of some precautionary legislation (the scientific jury is yet to come in with regards to the matter of reprotoxicity) does not exonerate the precautionary principle as such, far from it. It is less than evidence in favour of the expediency of precaution, as precaution can by definition function *only ex ante* that is without the comforts of retrospection. Retrospection is not precaution. Thus we are left here with the nagging question: 'How does science work in precautionary culture?' We will address this in due course.

4 Schematising opposing views on science and risk in a cautious culture – towards acceptability[55]

Worldviews shape and influence the process of scientific inquiry. Clearly, good science is worldview neutral, that is to say that it is not aligned to, nor does not support, any particular ideology, religion or worldview *over another*.[56] Indeed, theories, hypotheses and concepts should be accepted in the light of

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Chicago Press 2002) at 289. I gratefully acknowledge Tobias Arnoldussen for supplying me this reference.

[53] P. Godfrey-Smith, *Theory and Reality* (Chicago: University of Chicago Press 2003).

[54] See e.g. relation to bacterial resistance and Antibiotic Growth Promotors: I. Phillips and others, 'Does the use of antibiotics in food animals pose a risk to human health? A critical review of published data' (2004) 53 *Journal of Antimicrobial Chemotherapy* 28; A. Bezoen, W. Van Haren and J.C. Hanekamp, *Emergence of a Debate: AGPs and Public Health* (Amsterdam: Heidelberg Appeal Foundation 1999).

[55] Derived from: J.C. Hanekamp and A. Bast, 'Why RDA's and UL's are incompatible standards in the U-Shape Micronutrient Model. A philosophically orientated analysis of micronutrients standardisations' (2008) 28 *Risk Analysis* 1639

[56] M. Weber, *On the Methodology of the Social Sciences* (New York: Free Press 1949).

considerations that involve transparent, and reproducible empirical evidence,[57] other (accepted) theories, and overt *epistemic* values such as consistency, simplicity, integrity, and descriptive, explanatory and predictive power only.[58] These epistemic values are essential as no theory or hypothesis can ever be verified completely. A scientist is rationally entitled to hold his/her beliefs in relation to the theories at hand with a commitment that surpasses the strength of the evidence (for *or* against).[59]

> Progress requires that most scientists get themselves in the grip of a theory which they aim to develop and defend, and without simply trying to dispose of it as fast as possible.[60]

Securing objective knowledge therefore does not abide by the expectations, wishes, and demands of the *global audience* – citizens, NGOs, economic parties, governments, and so forth. Science does not easily accommodate majority consensus views or, for that matter, minority views. Here, the term objectivity involves some kind of impartiality, a lack of bias, basically distinguishing between two ways of forming beliefs about the hidden structure of the world: one way that is dependent on, say, caprice, prejudice, expectations (and other non-epistemic determinants); and one that avoids such influences.[61] Objectivity as defined ties into the *impersonal notion of evidence* as understood in science. If scientists try to convince the rest of the scientific community of the adequacy of the explanations they have put forward in order to have their theories accepted as a part of the *corpus* of scientific knowledge, then their evidence *e* cannot constitute personal reasons for believing hypothesis *h*. The scientists claim that *e* provides grounds for *anyone* to be convinced that *h*. Although evidence in science should not be relative to a person it is contextualised in relation to historical and epistemological circumstances surrounding the evidential claim. Scientists can *invoke* evidence the moment it is understood as evidence, within the context of a certain theory grasped by the

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[57] See for a discussion thereon: L.J. Snyder, 'Is Evidence Historical?' in M. Curd and J.A. Cover (eds.), *Philosophy of Science. The Central Issues* (New York: W. W. Norton & Company 1998) at 460.

[58] M. Stenmark, *How to Relate Science and Religion. A Multidimensional Model* (Cambridge: Wm. B. Eerdmans Publishing Co. 2004). (Religion is referred to in the wider context as worldviews).

[59] M. Stenmark, *Rationality in Science, Religion, and Everyday Life. A Critical Evaluation of Four Models of Rationality* (Notre Dame, Indiana: University of Notre Dame Press 1995) at 136; see also: W.E. Jones, 'Explaining Our Own Beliefs: Non-Epistemic Believing and Doxastic Instability' (2002) 111 *Philosophical Studies* 217.

[60] W.H. Newton-Smith, *The Rationality of Science* (London, New York: Routledge 1981) at 75.

[61] P. Godfrey-Smith, *Theory and Reality* (Chicago: University of Chicago Press 2003).

experts. Before that, evidence is still evidence yet simply not recognised as such.[62]

With the *modern* use of science, risks can, and in fact are, assessed as a result of which public policies are constructed that add measurably to especially public health and safety.[63] This 20th century development came about within the context of the tremendous increase and diffusion of wealth, which boosted health unequivocally in not only Western world population.[64] With growing wealth and health came the institutions that, through science, tackled health and safety issues both on the short and long-term. The 20th century problems of poverty-induced undernourishment on account of economic depressions and war, for instance, proved to be powerful drivers for scientists to develop one of the first food standards – the RDAs (Recommended Daily Allowances) for vitamins and minerals – that improved overall 20th century public health decisively.[65]

Then again, with the rise of *precautionary culture*, the role of science as a means to secure objective knowledge (as defined above) has noticeably changed. In modern Western societies, as material needs are met for most people, the logic of wealth distribution that has shaped the Western world, loses its immediate relevance,[66] subsequently assenting to the logic of risk distribution.[67] A society in which citizens are privileged to enjoy and to value their health, wealth, safety, security, and longevity paradoxically becomes gripped by the hazards and potential threats unleashed by the exponentially growing wealth-producing forces that mark the later stages of modernity.[68] Previously, during the early stages of modernity, these hazards were not prioritised because coping with and surmounting poverty, hunger, and disease

62 Snyder, above n. 57.

63 R.C. Barnard, 'A New Approach to Risk Assessment Integrating Scientific Evaluation and Economic Assessment of Costs and Benefits' (1996) 24 *Regulatory Toxicology and Pharmacology* 121.

64 J.M. Hollander, *The Real Environmental Crisis. Why Poverty, Not Affluence, Is the Environment's Number One Enemy* (Berkeley, Los Angeles, London: University of California Press 2003); J.M. Friedman, *The Moral Consequences of Economic Growth* (New York: Alfred A. Knopf 2005).

65 I. Leitch, 'The Evolution of Dietary Standards' (1942) 11 *Nutrition Abstracts and Reviews* 509; A.E. Harper, 'Contributions of Women Scientists in the U.S. to the Development of Recommended Dietary Allowances' (2003) 133 *The Journal of Nutrition* 3698.

66 U. Beck, *Risk Society: Towards a New Modernity* (London: Sage Publications 1992).

67 J.C. Hanekamp, 'Precaution and Cholera: A Response to Tickner and Gouveia-Vigeant' (2006) 26 *Risk Analysis* 1013.

68 A.P.J. Mol and G. Spaargaren, 'Environment, Modernity, and the Risk-society: The Apocalyptic Horizon of environmental Reform' (1993) 8 *International Sociology* 431.

were the overriding societal interests. As Beck asserts:

> The driving force in the class society can be summarized in the phrase: *I am hungry*! The collective disposition of the risk society, on the other hand, is expressed in the statement: *I am afraid*![69]

Therefore, in contemporary *post-modern* society the goal of affluence yields to that of life-term (indeed inter-generational) safety.[70]

Concomitantly, in economically and industrially highly developed societies, diverse regulation of a mainly precautionary nature[71] has found its way into many areas.[72] The shift of societies to a culture of precaution galvanises citizens' insistence on *advance proof* that activities and products pose no long-term risk to human and environmental health.[73] Scientific research and regulation caters for this 'risk management of everything'.[74] Lest we forget, there *is* a strong desire among mass-public citizens in the Western world to believe that they live in, and need to live in a world made predictable by science. There is an equally strong desire among elite citizens working in the media, business, and government to appear to be doing the right thing by ritualistically consulting *seemingly au fait* analysts and consultants (technocratic, scientific, religious or otherwise) from well-known institutes in order to 'grasp the future'.[75] Science as a result has become heavily politicised and commercialised. The increasing public and political focus on safety, security, and predictability propels scientific research in growing and disparate fields, initiating, for lack of a better term, the 'scientification' (or perhaps the objectification) of risk and uncertainty.[76]

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[69] Cited from: M.J. Cohen, 'Risk Society and Ecological Modernisation. Alternative Visions for Post-Industrial Nations' (1997) 29 *Futures* 105.

[70] See for a commentary thereon: G.B. Gori, 'Science, Imaginable Risks, and Public Policy: Anatomy of a Mirage' (1996) 23 *Regulatory Toxicology and Pharmacology* 304.

[71] The precautionary *principle* has been incorporated in more than 50 multilateral agreements. A. Trouwborst, *Evolution and Status of the Precautionary Principle in International Law* (The Hague: Kluwer Law International 2002).

[72] J. Stern and J.B. Wiener, 'Precaution Against Terrorism' (2006) *Harvard University Faculty Research Working Papers,* available at <http://ssrn.com/abstract=902373> (accessed 9 April 2008).

[73] A. Burgess, 'Flattering Consumption. Creating a Europe of the Consumer' (2001) 1 *Journal of Consumer Culture* 93.

[74] M. Power, *The Risk Management of Everything: Rethinking the Politics of Uncertainty* (London: Demos 2004).

[75] See for instance: P.E. Tetlock, *Expert Political Judgment: How Good Is It? How Can We Know?* (Princeton: Princeton University Press 2005).

[76] See for instance: I. Forrester and J.C. Hanekamp, 'Precaution, Science and Jurisprudence: a Test Case' (2006) 9 *Journal of Risk Research* 297; see further: U. Beck, 'The Anthropological Shock: Chernobyl and the Contours of the Risk

Still, scientists are quite aware of the limitations of scientific knowledge. As mentioned, verification within science is beyond our capabilities. Indeed, examples abound in which science comes up with surprising new insights that overturn old ideas and concepts. In the celebrated BBC documentary *The Ascent of Man*, Jacob Bronowski memorably assessed what science in fact is:

… Science is a very human form of knowledge. We are always at the brink of the known; we always feel forward for what is to be hoped. Every judgement in science stands on the edge of error and is personal. Science is a tribute to what we can know, although we are fallible. In the end, the words were said by Oliver Cromwell: 'I beseech you, in the bowels of Christ, think it possible you may be mistaken'.

When we expand our demands for safety, as precautionary culture does, into a by definition *unknown* distant future, the confines of even our best scientific knowledge will surface progressively more poignantly. Here we enter the realm of uncertainty, and cross over from modernity to post-modernity:

Because we don't drop dead [because of the implementation of a technology; *authors*], we allow ourselves to draw our boundaries of consideration much narrower than they should be. *Boundaries over space and time* are nearly always much narrower than the boundaries that include the cause. When the boundaries are made appropriately larger, they embrace more of our ignorance and more ambiguity ….[77]

Those who entertain seriously the conviction that science ('the boundaries of consideration') should transgress its fundamental confines of space and time in order to address the many perceived long-term risks, need quite a robust belief in what science *can* and *must* deliver. On the one hand, they can find obvious support in the fact that citizens of the Western world *have* experienced increasing wealth, safety, security, and longevity *because of* science and technology. On the other hand, however, a high level of confidence regarding what science is supposed to deliver is offset by a high level of scepticism with regard to what science cannot and should not do. In modern society, scepticism about science's capacity to secure objective knowledge, illustrated by the erosion of the idea or ideal of autonomous knowledge and autonomous law,[78]

Society' (1987) 32 *Berkeley Journal of Sociology: A Critical Review* 153; J. Bourke, *Fear. A Cultural History* (London: Virago Press Ltd. 2005).

77 C. Raffensperger and J. Tickner (eds.), *Protecting Public Health and the Environment: Implementing the Precautionary Principle* (Washington DC: Island Press 1999) at xvii, italics added.

78 See fo example R.M. Unger, *Knowledge & Politics* (New York: The Free Press 1975).

lent aid to the shift to the notion of *inter-subjective* knowledge.[79] It is merely a matter of degree to claim that all knowledge is related to interests and power.[80] 'Finding the truth' has throughout the 20th century been increasingly accompanied by 'winning the power struggle'.[81] New knowledge always carries the potential risk that it will upset agreed-upon concepts, policies and power structures based on 'established' scientific knowledge. Science thus finds itself between Scylla and Charybdis. On the one hand it is looked at as the discerning field of authority and advice, and not without cause. On the other hand it is regarded as being the all-pervasive origin of many risks that might materialise in a distant future.

Part of the scientific community has sought to respond to this dilemma and thereby helped shape the approach of *acceptability*.[82] Because of their likely positive social and environmental outcomes, for instance, particular directions in scientific and social inquiry should be favoured.[83] Put differently, scientific inquiry, at the same time, should be explanatory, normative, practical and self-reflexive. Ideally, the acceptability approach should empower people with capacities to reason critically and to assess sharply the conflicting (scientific) argumentations that play an important role in their lives.[84] The UK government's inquiry into the purported adverse health effects of mobile phones, concluded that in future 'non-peer reviewed papers and anecdotal evidence should be taken into account' as part of the process for reaching decisions on these matters.[85]

The modern scientific effort to secure objective knowledge in precautionary culture is transformed into the post-modern goal of *acceptability* and strategies of, for instance, safety through governance, as it is thought that society is continually threatened by numerous unknown dangers. At this juncture science cannot secure objective knowledge as we are dealing with remote probabilities that might (or might not) materialise in a distant future. A

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79 M. Polanyi, *Personal Knowledge. Towards a Post-Critical Philosophy* (London: Routledge 1958).

80 See on this discussion: J. Ravetz and S. Funtowicz, 'Post-Normal Science – an insight now maturing' (1999) 31 *Futures* 641; J.R. Ravetz 'What is Post-Normal Science' 1999 31 *Futures* 647.

81 B. Williams, *Truth & Truthfulness: An Essay in Genealogy*. (Princeton: Princeton University Press 2002); see also: M. Foucault, 'Truth and Power' in M.P. Lynch (ed.), *The Nature of Truth. Classic and Contemporary Perspectives* (Cambridge, Massachusetts: The MIT Press 2001).

82 G. Boger, 'Subordinating Truth-Is *Acceptability* Acceptable?' (2005) 19 *Argumentation* 187.

83 M. Raskin, *Story Telling Time*, available at <http://www.zmag.org/Science_Wars/raskin.htm> (accessed 8 December 2008).

84 Boger, above n. 82.

85 Independent Expert Group on Mobile Phones, *Mobile Phones and Health* (Didcot: National Radiological Protection Board 2000) at 102.

culture of fear has emerged.[86] The modern approach centres on risks that can be assessed more or less confidently, and policies, which aim to prevent major health problems, will include the majority of the population, as the history of RDAs has shown.[87] Conversely, the more post-modern approach deals with health risks that are much more explicitly viewed as uncertain, as underlined by the latest WRR report, and are explicated in the examples we discussed above. Ewald emphasizes this with the notion that

> [p]recaution starts when decisions must be made by reason of and in the context of scientific uncertainty. Decisions are therefore made not in a context of certainty, nor even available knowledge, but of doubt, suspicion, premonition, foreboding, challenge, mistrust, fear, and anxiety.[88]

In what way then is precaution beneficial here? It seems that the deemed benefits lie in managing, or even perhaps containing, uncertainty. This was the aspect that disturbed Kahn the most in his attempts to frame the contours of nuclear war, and seems to be at the core of what we now call sustainability that is

> the ability of humanity to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are made consistent with future as well as present needs.[89]

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[86] F. Furedi, *Culture of Fear: Risk-Taking and the Morality of Low Expectations* (London: Continuum International Publishing Group 1997); see also Bourke, above n. 76.

[87] Hanekamp and Bast, above n. 55.

[88] Ewald, above n. 52, at 294.

[89] World Commission on Environment and Development (WCED), *Our Common Future* (Oxford: Oxford University Press 1987); Despite the popularity of the 'Brundtland definition' of sustainability, already in the 18th century Hans Carl von Carlowitz coined the term 'nachhaltige Entwicklung' (sustainable development) in relation to forestry (1713). A shortage of wood was becoming problematic in Germany and the rest of Europe because of increasing population and declining stocks of wood for heating and industrial energy production. Moreover, wood was a major construction material for houses, buildings and ships. Von Carlowitz therefore proposed that in the exploitation of forests, an equilibrium between production and consumption should be maintained as to the benefit of present and future generations(!). 'Nachhaltende Nutzung' – continuous exploitation – of forests could thereby be achieved; H. van Zon, *Geschiedenis en Duurzame Ontwikkeling. Duurzame ontwikkeling in historisch perspectief: enkele verkenningen* (Rotterdam: Netwerk Duurzaam Hoger Onderwijs 2002) [*History and Sustainable Development. Sustainable development in an historical perspective: selected studies*].

Perhaps, sustainability should best be understood as the attempt to end uncertainty about humanity's future in a world 'tainted' by human hands.

5 Sustainability or the 'end of uncertainty'

The precautionary principle seeks to advance the timing and to tighten the stringency of *ex ante* regulation. On these sliding scale dimensions, regulation is 'more precautionary' when it intercedes earlier and/or more rigorously in order to preclude uncertain future adverse consequences of particular human activities.[90] The axiom put forward in the precautionary principle is for a given human *activity* that may have a specified or unspecified *effect* on the environment and/or human health, the precautionary principle is supposed to designate *the remedy*.[91] Precaution is viewed as the core principle for achieving a 'sustainable' (global) society where the risks and uncertainties, which ill-considered scientific and technological developments might present for contemporary and future generations, are contained. The hopes are that the precautionary principle will generate a new law system with universal girth that will protect the present and future generations against the environmental and health risks associated with the highly and technologically evolved production methods and consumption patterns. *Precaution therefore is regarded as the lodestar on the road to sustainability*.

The *Bergen Ministerial Declaration on Sustainable Development in the ECE Region* of 1990, for example, states that 'In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation …'.[92] Prudence is required to prevent damage to the world's ecosystems, in order to ensure that the environment has a good future and that it should not be further shaken by recourse to technologies whose effects are controversial or uncertain. Technology that might be inimical to sustainable development should perhaps not be used at all, or used only moderately, or be subject to certain safeguards.

Now, sustainability is not an easy goal to define or indeed to comprehend. Many societies have been sustainable only by regular adaptation. In this context, the environmental historian McNeill notes that history offers many examples of apparently unsustainable societies that nevertheless endured

[90] J.B Wiener, *'Precaution in a Multi-Risk World'* (2001) *Duke Law School Public Law and Legal Theory Working Paper Series,* Working Paper No. 23.
[91] N.A. Manson, 'Formulating the Precautionary Principle' (2002) 24 *Environmental Ethics* 263.
[92] J. Peel, *The Precautionary Principle in Practice: Environmental Decision-Making and Scientific Uncertainty* (Annandale, Australia: The Federation Press 2005).

for long periods of time.[93] The *World Commission on Environment and Development*, named after its chairperson the then prime minister of Norway Gro Harlem Brundtland, has defined sustainability most famously (see above). However, many more definitions are in existence particularly adding to the complexity of the issue.[94]

In the past, as is the common perspective, the impact of human societies on the physical world is regarded as relatively limited. The unprecedented scientific and technological developments of the last two centuries have made it possible for man to damage not only large areas of the globe we inhabit, but the globe itself.[95] However, the negative effects of these developments on human health or the environment are not always apparent at once. Few would have predicted a century ago what the motorcar has done to change the world, or that asbestos might have fatal effects on factory workers. When King James the Sixth of Scotland (and First of England) published his 'Counterblaste to Tobacco', his was probably a minority opinion. Nowadays, the medical profession worldwide, not to mention the WHO, would echo his condemnation of smoking as

> a custome lothsome to the eye, hatefull to the Nose, harmefull to the braine, dangerous to the Lungs, and in the blacke stinking fume thereof, neerest resembling the horrible Stigian smoke of the pit that is bottomelesse.[96]

Precaution and sustainability are closely related to each other. One could argue that they are both sides of the same coin. As such, the precautionary principle impresses upon us a moral obligation to take care of the environment, of

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[93] J. McNeill, *Something New Under the Sun. An EnvironmentalHhistory of the Twentieth Century* (New York: W.W. Norton & Company 2001).

[94] S. Murcott, 'Appendix A: Definitions of Sustainable Development,' *AAAS Annual Conference, IIASA 'Sustainability Indicators' Symposium* (Seattle: Massachusetts Institute of Technology 1997).

[95] The point has been made, however, that changing the face of the earth has been systematic and widespread throughout human history, not just in the past 200 years. For example, some 50,000 years ago hunter-gatherers arrived in Australia and fundamentally transformed its ecosystem with the use of fire. Some 11,000 years ago, hunter-gatherers' technology played an important, perhaps decisive, part in the extinction of most of the megafauna in the Americas. Moreover, 1,200 years ago the Maori landed in New Zealand and promptly killed off all the giant Moa and turned the eastern plain of the South Island from a forest into grassland. Were these hunters-gatherers 'systematic' in their effect on nature? Decidedly so. They burned fields and forests seasonally when dry but not too dry, and harvested animals in accordance with their predictable behaviours and migrations; see for further reading: R.D.E. MacPhee (ed.), *Extinctions in Near Time: Causes, Contexts, and Consequences* (New York: Kluwer Academic, Plenum Publishers 1999).

[96] See <http://www.laits.utexas.edu/poltheory/james/blaste/> (accessed 9 April 2009).

humankind, our children, and our children's children. Indeed, as stated by the European Commission:

> The dimension of the precautionary principle goes beyond the problems associated with a short or medium-term approach to risks. It also concerns the longer run and the well-being of future generations.[97]

Similarly, the World Commission states that 'hope for the future is conditional on decisive political action now to begin managing environmental resources to ensure both sustainable human progress and human survival'.[98]

Thus, uncertainty about the future of us humans and the planet needs to be tackled in a manner that is sustainable. Precaution is the farsighted means to attain a level of certainty about our way of life and how to make adjustments in accordance with this sustainable perspective. Whether or not this is at all feasible hinges on the viability of the precautionary principle. This viability is the subject of the next paragraph.

6 Neither acceptable nor delimiting uncertainty – a critique of the logic of precaution

The justifications advanced by proponents of the precautionary principle for adopting its prescriptions revolve around the inevitable limitations in our ability to predict which activities will cause severe, irreversible harms.[99] Uncertainty

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[97] Commission of the European Communities, *Communication from the Commission on the Precautionary Principle* (Brussels: Commission of the European Communities 2000).

[98] See the World Commission on Environment and Development, above n. 89, at 18.

[99] Although the literature critical of precaution is growing, the mainstream of legal and scientific literature is supportive of precaution. For an overview – though higly incomplete – from different fields of inquiry of the mainstream position on precaution see among others W.Th. Douma, 'The Precautionary Principle' (1996) 49 *Úlfjótur* 417; O. McIntyre and T. Mosedale, 'The Precautionary Principle as a Norm of Customary International Law' (1997) 9 *Journal of Environmental Law* 221; C. Raffensperger and P.L. deFur, 'Implementing the Precautionary Principle: Rigorous Science and Solid Ethics' (1999) 5 *Human and Ecological Risk Assessment* 933; S. Haller, 'A Prudential Argument for Precaution under Uncertainty and High Risk' (2000) 5 *Ethics and the Environment* 175; K.K. Jensen, 'The Moral Foundation of the Precautionary Principle' (2001) 15 *Journal of Agricultural and Environmental Ethics* 39; D. Kriebel and others, 'The precautionary principle in environmental science' (2001) 109 *Environmental Health Perspectives* 871; D. Vanderzwaag, 'The Precautionary Principle and Marine Environmental Protection: Slippery Shores, Rough Seas, and Rising Normative Tides' (2002) 33 *Ocean Development & International Law* 165; M. Faure and E. Vos, *Juridische afbakening van het voorzorgbeginsel: mogelijkheden en grenzen* Gezondheidsraad studie A03/03 (The

abounds when human activities are reviewing. Rolston remarks that

> [w]ith ever higher technology, it seems that our power to produce changes overshoots increasingly our power to foresee all the consequences. … In a way our ignorance outpaces our knowledge; thus, we are asking for trouble unless we slow down the introduction of potentially more potent novel changes *with adequate pretesting*. The unforeseen consequences outnumber the foreseen consequences, and the bad unforeseen consequences greatly outnumber the good unforeseen consequences. Serendipity is rare in high technology.[100]

The logical difficulty of precaution is the fact that any true node in a decision tree *must at the very least have two branches*: we may either undertake a certain action or we may refrain from undertaking it.[101] Each of these choices – action and inaction – entails consequences, both foreseen and unforeseen. Both carry uncertainties. However, it is crucial to remember that a decision *not* to undertake an action is as much an action as is the undertaking of it. As such, not acting opens us to the risks of sins of omission:

> A legal parallel may be instructive here. In the context of sales transactions, a seller who fails to disclose to the buyer certain known and relevant information, but who has otherwise been truthful, harms the buyer. The seller has not misrepresented a material fact, there is no fraud in this transaction. Rather, the failure to disclose the information itself is the harm. The harm comes from an inaction on the part of the seller, not from a bad action. Inaction no less than action carries with it the potential for harm.[102]

So we are confronted with a Catch-22. To which choice of the very simple two-option node in the decision tree should we apply precaution? Each branch, obviously, carries with it certain foreseen risks along with certain unforeseen risks. But as the unforeseen risks for each branch may well be devastating, how

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Hague: Gezondheidsraad 2003) [*Legal contours of the precautionary principle: possibilities and limitations*]; J. Tickner and M. Martuzzi (eds.). *The precautionary principle: protecting public health, the environment and the future of our children.* Background document for the Fourth Ministerial Conference on Environment and Health, Budapest, Hungary, 23–25 June (Copenhagen: World Health Organization 2004); M. Deblonde and P. Du Jardin, 'Deepening a Precautionary Policy' (2005) 18 *Journal of Agricultural and Environmental Ethics* 319; World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), *The Precautionary Principle* (Paris: United Nations Educational, Scientific and Cultural Organization 2005).

[100] See above n. 11, at 319, italics added.

[101] W.J. Mckinney and H. Hammer Hill, 'Of Sustainability and Precaution: The Logical, Epistemological, and Moral Problems of the Precautionary Principle and Their Implications for Sustainable Development' (2000) 5 *Ethics and the Environment* 77.

[102] *Id.*

can we decide which branch to take?[103] The precautionary principle therefore does not provide any guidance whatsoever. As Sunstein explains:

> The real problem with the Precautionary Principle … is that it is incoherent; it purports to give guidance, but it fails to do so, because it condemns the very steps that it requires. The regulation that the principle requires always gives rise to risks of its own – and hence the principle bans what it simultaneously mandates. I therefore aim to challenge the Precautionary Principle not because it leads in bad directions, but because read for all it is worth, it leads in no direction at all. The principle threatens to be paralyzing, forbidding regulation, inaction, and every step in between. It provides help only if we blind ourselves to many aspects of risk-related situations and focus on a narrow subset of what is at stake. That kind of self-blinding is what makes the principle seem to give guidance; ….[104]

The precautionary principle therefore engenders an impossible arrangement, as risks are on *all* sides of the societal and regulatory equation. To 'decide on a safe course', in this case precautionary inaction, results in the formation of other and new (and most probably unforeseen) risks, which, by definition, evokes a secondary precautionary response, ad infinitum. In other words, even if an effect of human activity is catastrophic, that fact alone cannot rationally compel us to impose a precautionary remedy unless we *also* know that the remedy itself does not lead to catastrophic results. Obviously we do not know the effect of the precautionary remedy, since we do not know the effect against which precautionary regulation is targeted. It is one thing to be aware of a certain detrimental or destructive *phenomenon*; for example cancer; it is quite another thing to *know* this phenomenon to be an effect of, say, exposure to certain man-made chemicals.

Thus, even if we grant that the phenomenon of low-level exposures to these chemicals could potentially result in, for instance, the horrifying prospect of human extinction (as we are all exposed to, say, numerous reprotoxic phthalates, which in the long run could impair our reproductive capabilities), it does not follow that we must impose a precautionary remedy, much less that we should disregard the *probability* that the dreaded *effect* actually could materialise. Why? Because it could be that the remedy will bring about an outcome that also leads to human extinction:

> Consider a wild story. The Kyoto Treaty is ratified by the U.S. Senate and signed into law by President Bush. All signatories to the treaty abide strictly to its demands. A global economic depression results. Massive social unrest ensues. Totalitarian dictatorships arise in Russia and the United States. War starts and nuclear weapons are launched by both sides. The predictions of the nuclear winter model prove to be

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[103] *Id.*

[104] C.R. Sunstein, *Laws of Fear: Beyond the Precautionary Principle* (Cambridge: Cambridge University Press 2005) at 14.

perfectly accurate. Within five years, cockroaches rule the planet. The moral? We had better not do anything about greenhouse gas emissions.[105]

Obviously, this line of reasoning and the subsequent conclusion seem absurd. As it stands, however, the precautionary principle does not exclude this scenario or any other apocalypse, *as it fails to prohibit any catastrophic possibilities from its realm of application*. To reiterate Ewald's point: '… all that can be excluded is that anything should be excluded.' The implementation of the precautionary principle only requires the mere possibility of catastrophe (as proposed in the strong versions of the precautionary principle), and since mere possibilities are easy to construct and limited only by the imagination, any application of the precautionary principle will be confronted with a fatal problem: the reasoning it employs can be used to generate a demand for a contradictory course of action. To reiterate the point made in *The Final Declaration of the First European 'Seas at Risk' Conference Annex I* (see above):

> … If the "worst case scenario" for a certain activity is serious enough then even a small amount of doubt as to safety of that activity is sufficient to stop it taking place.

The precautionary principle speaks as though it is an exogenous panacea for environmental and social ills. But precautionary regulation is not an exogenous solution; it is itself an endogenous (i.e. societal embedded) and fallible human activity. Indeed, it is a form of technology, and as such it can create risks, and ones risks that are as real as the risks it is targeted against. The overall problem is flawed human institutions (whether economic, bureaucratic, or otherwise), perhaps most adequately referring to the fundamental (biblical) notion that humans are sinful creatures and are incapable of truly overseeing (or wanting to see) all consequences of their actions.[106] Indeed, '… no one can know beforehand the exact consequences of any portfolio of policy measures, …' as Prins and Rayner observe in relation to the Kyoto Protocol.[107] And they are both by no means skeptics when considering climate change; far from it.

Indeed, according to the burden of proof approach, advocates of precautionary regulation would be required to demonstrate the absence of counterproductive (catastrophic) effects resulting from the effects of the

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[105] Manson, above n. 91.

[106] M. Westphal, 'Taking St. Paul Seriously: Sin as an Epistemological Category' in T.P. Flint (ed.), *Christian Philosophy* (Notre Dame, Indiana: University of Notre Dame Press) at 200.

[107] G. Prins and S. Rayner, 'Time to Ditch Kyoto' (2007) 449 *Nature* 973; See further: G. Prins and S. Rayner, 'The Wrong Trousers: Radically Rethinking Climate Policy' (2007) *Joint Discussion Paper of the James Martin Institute for Science and Civilization, University of Oxford and the MacKinder Centre for the Study of Long-Wave Events, London School of Economics.*

precautionary regulation itself. The practical consequences of regulation are quite uncertain and could well be catastrophic. Advocates of precaution typically could not meet this burden. The precautionary principle would preclude further regulation or, as stated above, would require a subsequent precautionary response and so on and so forth.[108] Therefore, the precautionary principle is self-defeating.

With precaution we enter a vicious circle of (scientific) uncertainty. The uncertainty of harm requires a precautionary curtailment or ban of a certain activity, which in future might be resolved by scientific research. But the possibility of scientific certainty is precisely the thing that is here under dispute: what level of 'certainty' is required to satisfy the precautionary requirements? As the European Commission states in its communication on precaution:

> Hence, … measures adopted in application of a precautionary principle when the scientific data are inadequate, are provisional and imply that efforts be undertaken to elicit or generate the necessary scientific data. It is important to stress that the provisional nature is *not bound up with a time limit but with the development of scientific knowledge*.[109]

Thus, a precautionary ban will most likely have an 'enduring temporality'.

In all this lies the fundamental epistemological problem facing those proposing to use the precautionary principle: it *appears to commit* us to taking the branch of inaction ('When in doubt, don't.'), despite the obvious associated problems, which we have explained above. As the example of Manson shows, there is absolutely no reason to believe that the branch of inaction will be any less destructive than the branch of action. Recognising this, we find ourselves paralysed into inaction by indecision, and thus into the acceptance of unknown, unforeseen, and potentially unacceptable risks. 'The precautionary principle's prescription for quietism actually ends up committing us to a nonrational, and probably irrational, embracing of unforeseen risks. Surely this cannot be right'.[110]

The hidden value underneath the debate on risk, uncertainty, and precaution seems to be 'preferring inaction' through, say, a Principle of Preferring Inaction (PPI).[111] Ultimately, with precaution, the search for *safety in stasis* is expounded.[112] The PPI is an additional assumption, in no way entailed by precaution itself and may actually result in violations thereof should inaction turn out to be more damaging than action. Proponents of the value of

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108 F.B. Cross, 'Paradoxical Perils of the Precautionary Principle' (1996) 53 *Washington and Lee Law Review* 851.
109 See above n. 97.
110 Mckinney, above n. 101.
111 *Id.*
112 A. Bramwell, *The Fading of the Greens: The Decline of Environmental Politics in the West* (New Haven, London: Yale University Press 1994) at 86.

precaution have yet to adopt clearly or defend at all the PPI. In view of its hidden character, this is unlikely to happen. Adherence to the so-called 'cultural ecological critique' of green thinking seems to underscore the PPI.[113] The generally acceptable 'green' perspective generates the ideological milieu in which the precautionary principle operates and thrives. As Mckinney and Hammer Hill note:

> … Assuming a smoothly functioning and balanced ecosystem, preferring inaction to action may make sense. At that first node on a decision tree, standing in the Garden, we may well counsel Adam and Eve not to eat. However, the significant environmental problems which tend to be the focus of current sustainability debates are problems of highly industrialized or newly industrializing societies. In fact, it is precisely the industrialization of a society that tends to generate these problems. We have a long, and often less than sterling, history of environmental actions, and we cannot reasonably act as if we faced an environmental tabula rasa.
>
> Using the notion of environmental equilibrium to support the application of the PPI to current issues in environmental ethics commits, from a phenomenological point of view, a fundamental error – it ignores the facticity of Dasein. One of Heidegger's (1962) fundamental insights into the nature of human being is that people find themselves in situations that often are not of their own making, but which serve as inescapable frameworks for their actions. This is the facticity, or the thrownness, of Dasein into the world. The situations into which Dasein is thrown, whether or not Dasein bears any responsibility for the creation of them, both open and foreclose certain courses of action as realistic possibilities for Dasein's being in the world. And each situation has its own history, its own background, against which the horizon of possibilities opens up. But for a full appreciation of possibilities that are present to hand in a situation, Dasein must recognize and understand the historical basis of the situation. In the context of environmental actions, we cannot ignore the historical roots of the decision tree between whose branches we today must choose ….[114]

The epistemologically compelling and ultimately essential ethical question still remains to be resolved: 'How are we to act in the face of uncertainty?' Are we then to return to the flawed positivistic concept of evidentialism as e.g. Bertrand Russell, for instance, would have it?

> We ought to give to every proposition which we consider as nearly as possible that degree of credence which is warranted by the probability it acquires from the evidence known to us.[115]

or as William Clifford stated in his 'Ethics of Belief': 'To sum up: it is wrong always, everywhere, and for anyone, to believe anything upon insufficient

[113] Hanekamp and others, above n. 19.
[114] Mckinney, above n. 101.
[115] B. Russell, 'Pragmatism' in B. Russel, *Philosophical Essays* (London: George Allen & Unwin 1966 [rev. ed. from 1910]) 79, esp. at 86.

evidence'.[116] Surely not. This would bring us nowhere: that is, in neither direction when considering the two-node decision tree. In light of evidentialism, we will always have insufficient evidence, for either node.[117] Evidentialism will not illuminate our uncertainty nor will it increase our knowledge of the world we live in. It will only spawn some form of scientism, that is the defective notion (we cannot explore here) that science alone is deemed to be capable of elucidating and resolving genuine human problems (poverty, social inequity, global warming, pollution, food safety, and etceteras) whereby all human affairs can be reduced to science.[118]
Nevertheless,

> [c]hemicals, unlike persons, are not innocent until proven guilty but suspect until proven innocent. So the burden of proof shifts, and it is now up to the industrialists to dispatch it. …[119]

Such an approach as proposed by Rolston, and embraced by most proponents of precaution, would inadvertently and paradoxically spawn some form of precautionary evidentialism, which indeed underscores *too* high a level of confidence regarding what science is supposed to deliver. The precautionary evidentialist challenge would now *not* be to prove the *presence* of some form of risk, to which proponents of precaution rightfully protested, but to prove the *absence* of any and all risks! Precautionary quietism subsequently develops, as science can never rise to the occasion of precautionary evidentialism. Proving a negative is a *probatio diabolica* that is impossible. Science and technology cannot be concerned with testing every possible consequences of a given action. The WRR's proposition to maximise the assessment and management of uncertainty in relation to human activities is not only untenable but in fact unacceptable. Science is limited, and can only deal with plausible consequences: 'It localizes its predictions by conjoining the generalization with a set of auxiliary assumptions (A)'.[120] Rolston remarks that businesses must '… not use complexity to dodge responsibility. Environmental causal links are multiple, incremental and long term. Their discovery is slow'.[121]

The proposed solution to complexity and 'the lack of vision in framing the set A' is to assume the *worst* case and subsequently seek to avoid it. Unfortunately, this takes us no closer to safe and accurate decision-making than does assuming the *best* case. If policy-makers are to prescribe action,

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116 See <http://ajburger.homestead.com/files/book.htm#will> (accessed 9 April 2009).
117 Stenmark, above n. 59.
118 For a thorough critique thereof see M. Stenmark, *Scientism. Science, Ethics and Religion* (Aldershot: Ashgate Publishing Limited 2001).
119 Rolston III, above n. 111.
120 Mckinney, above n. 101.
121 Rolston III, above n. 11, at 315.

sustainable development policies require the precautionary principle in order to prescribe sustainable actions; then the precautionary principle renders policy-makers helpless, bearing in mind the infinite number of unforeseen detrimental outcomes. In view of this epistemological conundrum, to 'err on the side of safety' is impossible. It is neither acceptable nor will it reduce uncertainty with regard to our actions. With the sustainable perspective and its precautionary implementation, a history of humankind, however flawed and faltering, is denied, for the benefit of present and future generations. The tabula rasa of Utopia lures, although this discussion is for another time and another place.[122] What is left then is to tie the different strands of the debate together.

7 Some concluding remarks

Different threads in the precautionary tale have been woven together in this contribution. We first showed that the latest take of the WRR on precaution, although labelled as novel, could easily (sic) be traced to the work of Herman Kahn some half a century ago. Together with the 'extension' of *The Limits to Growth*, the precautionary tale started to grow in the Western world in which uncertainty was one of the core determinants.[123] The role of science in society changed therewith from a means of securing objective knowledge (in the impartial sense) to producing acceptable results.[124] Precaution, with the aid of science thus understood, is regarded as the way out of this conundrum en route to a sustainable future.

Therefore, the precautionary principle, as the core tenet of sustainable development, must have a solid and intelligible logical and epistemic foundation upon which to build. This foundation is problematic, to say the least. Thereby, the concept of sustainable development is problematic. If the moral obligation to avoid the potential harm of acting now and especially in the future leads us into inaction, clearly, there will also be those situations where the obligation to avoid harm from inaction must lead us into action. In both cases, the means by which we assess the consequences of our 'actions' (broadly construed as action and inaction) are the same. Are we to act in order to avoid the harmful consequences of inaction? Are we to refrain from action in order to avoid the harmful consequences of action? Methodologically speaking, the decisions are equally problematic, given the nature of inductive inference and the historical essence of science and technology. As a result, sustainable

[122] This contribution is part of my thesis in the field of theology and philosophy on the problematical Utopian perspective of precautionary culture.
[123] Hanekamp and others, above n. 19.
[124] See for example A.F. Chalmers, *What is this thing called Science?* (Queensland: University of Queensland, 1999, 3rd ed.); A.F. Chalmers *Science and Its Fabrication* (Minneapolis: University of Minnesota Press 1990).

development and its carrying principle of precaution, become highly problematic, and quite possibly unfeasible, in the face of these logical, epistemological and historical difficulties.

Science does not supply direction in terms of precautionary conduct. Precautionary policies in relation to banned veterinary medication brought forth, in the light of growing scientific and technological capabilities, the potential to detect in the range of parts per billion, which are to be regarded as toxicological insignificant. Yet from a precautionary perspective the involved risks cannot be excluded, as it fails to prohibit any catastrophic possibilities from its realm of its application. Only when Annex IV substances are completely absent from food (at zero concentration) the risks are deemed, obviously, completely absent. Technological analytical innovation had become the driver of zero tolerance policies and subsequently and not surprisingly generated a serious regulatory impasse.[125] Phthalates, in use for more than 50 years, have never been known for their toxicity, despite extensive scientific reviewing. The 1999-ban of a number of phthalates was inspired by precautionary sentiments, predictably in the face of scientific uncertainty regarding the potential risks. Although ambiguity in relation to reprotoxic risks of exposure remains, the mutagenic and carcinogenic nature of phthalates have been dismissed, for the present (in light of our current knowledge). However, as the protagonists of precaution like to stress: *absence of proof is not proof of absence*, whereby the vicious precautionary circle is institutionalised.

Thus scientific ambiguity and the purported acceptability requisite have proven to be ideal a priori tenets to shape industrial and societal development to political needs, paradoxically with the help of a precautionary shaped evidentialism.[126] However:

> … no single all-purpose number … expresses ‘acceptable risk’ for a society. Values and uncertainties are an integral part of every acceptable problem. As a result, there are no value-free processes for choosing between risky alternatives. The search for an ‘objective method’ is doomed to failure and may blind the searchers to the value-laden assumptions they are making .... Not only does each approach fail to give a definitive answer, but it is predisposed to representing particular interests and recommending particular solutions. Hence, choice of a method is a political decision with a distinct message about who should rule and what should matter.[127]

The ‘scientification’ of risk and uncertainty, therefore, is a feeble disguise for the fact that precaution empowers bureaucracy.

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[125] J.C. Hanekamp, ‘Veterinary residues and new European legislation: a new hope?’ (2005) 1 *Environmental Liability* 52.
[126] Hanekamp and others, above n. 19.
[127] B. Fischhoff, S. Lichtenstein and P. Slovic, *Approaches to Acceptable Risk: A Critical Guide* (Oak Ridge, TN: Oak Ridge National Laboratory and U.S. Nuclear Regulatory Commission 1980).

Raising the acceptability benchmark in the context of guaranteeing safety subverts the aim to secure objective knowledge. It is always possible to assume that a particular risk exists and subsequently project more stringent policies, yet *impossible* to prove or assume that any and all possible risks are *absent*. As a case in point for the latter, Weinberg pointed out that a study designed to detect an increased mutation frequency of about 0.5% following low dose radiation (at a 95% confidence level) would involve an experiment requiring 8 billion mice.[128] Thus, the search for *acceptable* levels of exposure related to a high level of safety results in regulatory itineraries that persistently drive ever-increasing scientific input and output and additional and more stringent regulation. This development, in my view, fuels 'doubt beyond reasonable proof' licensing open-ended policy structures and thereby raising the spectre of relativism. '… then we fall prey to the vicissitudes of popularity …, primarily in the form of *ad populum* arguments'.[129]

> Science is tentative, exploratory, questioning, largely learned by doing. One of the world's leading physicists was famous for opening his introductory classes by saying that it doesn't matter what we cover, but what we discover, maybe something that will challenge prevailing beliefs if we are fortunate.[130]

Incontrovertibly then, the most critical and most volatile problems cannot be solved without the effective marshalling of expert scientific knowledge and judgment. Securing objective knowledge about safety, health, and the like, despite the inherent and attendant value judgments, pre-eminently remains a scientific task, and a challenge for and to the precautionary future. This is attainable only if the scientific community is perceptive of its own values and frames, and is not aligned to a particular worldview, including the precautionary worldview. In light thereof, *abandoning the accepted idea of assessing and managing uncertainty is the only option*, as Ghamari-Tabrizi concluded on her work of Herman Kahn:

> … the human will is not the author of the universe …. The living world is no modular tool or resource for extraction. The error is just here. … The nonhuman world, that alarmingly uncivil reality, is not molded by wishes, may yet be uncoercible, may yet stand fast against resolve. … Slighting this, Kahn lunged into a body of fog, winning victory from no resistance at all. This is kitsch, a stroke against nothing.[131]

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[128] A.M. Weinberg, 'Science and Trans - Science' (1972) 10 *Minerva* 209.
[129] Boger, above n. 82.
[130] N. Chomsky, 'Rationality/Science'(1995) *Z Magazine*, available at <http://www.chomsky.info/articles/1995----02.htm> (accessed 8 December 2008).
[131] See above n. 13, at 312.