A cost/benefit analysis

About the Precautionary Principle • *by Maurizio Iaccarino*

Order is the key word of science. Scientists have tried to order and explain all the phenomena of the universe. They found that the planets and stars move along predictable paths, discovered the laws of gravitation and devised formulae to describe inheritance. For them, the universe is like a clock. Their mission is to discover and explain the mechanism of this clock and thus explain the laws that guide all natural phenomena. Faith in the ability of science to explain the world surrounding us gave rise in the 19th century to the movement of Positivism, which was based on the belief that science could ultimately solve all of humankind's problems and which influenced social theories. Positivism is now outdated, but 'scientific' mentality still shapes the thinking and actions of many people, particularly in the Western world. Expressions such as 'scientifically demonstrated' or 'there is no scientific evidence' are often used as irrefutable arguments.

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But as scientists moved forward to bring order into the universe, they found that Nature is more complex than they had anticipated. The 'complete' analysis of natural phenomena eventually turned out to be impossible, as by analysing something scientists inevitably modify it. Werner Heisenberg forged the uncertainty principle into mathematical equations and made it an essential part of science.

The public, however, still believes in science's ability to provide absolute answers and solutions to whatever ails them. So it is not surprising that after an

increasing number of health and environmental disasters—thalidomide/contergan, Chernobyl and BSE, to name a few—they are losing confidence in the scientists who first told them not to worry. As a consequence of this mistrust of new technologies, they now demand that every new technology should be examined for potential harm before it is implemented. Although this concept of precaution is

the full environmental and health impact only became clear years later.

This way of thinking started to change in the early 1970s with the principle of 'Vorsorge', a German word for 'foresight'. During this decade, Germany passed a number of environmental laws which demanded that the public sector should not only repair environmental damages, but also try to avoid them in the first place

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sensible, it is vague too. If 'scientific evidence' is the absolute argument, its absence can be interpreted in many ways. Thus, this precautionary principle has been used to delay or block technological advance. Indeed, within the scientific community—particularly among biologists—the appearance of the dreadful words 'precautionary principle' in science policy documents is now seen not as positive but as threatening the freedom of basic research.

The precautionary principle was originally born in the second half of the 20th century when people became increasingly concerned about the environment. The causes of environmental destruction were often unknown, and there was no scientific proof for the relationship between cause and effect. Prevention of the harmful effects was usually undertaken only after significant proof had been established. Often it was too late, or it turned out to be too expensive. When environmental groups wanted an activity to be stopped without having scientific proof of potential harmful effects, they were accused of being emotional and hysterical. DDT, nuclear power or *Waldsterben* are the legacies of an age of unfettered belief in technology, because

by appropriate planning or banning of harmful activities.

I wish to recall here the Asilomar conference which took place in 1975 for the purpose of discussing experiments in genetic engineering after a US National Research Council committee had recommended a meeting 'to deal with the potential biohazards of recombinant DNA molecules' (Berg *et al.*, 1974). At that time, the public was mostly unaware of these developments, but the scientists were concerned and proposed not only a moratorium, but also precautionary safety rules for handling recombinant DNA. 'Our concern is based in judgements of potential rather than demonstrated risk since there are few available experimental data [...],' they wrote, formulating an important aspect of the precautionary principle. And they also saw the possible drawbacks: 'The above recommendations are made with the realisation [...] that adherence to our major recommendations will entail postponement or possibly abandonment of certain types of scientifically worthwhile experiments.' The Asilomar moratorium was universally accepted and it is often cited today as an example of how to proceed when considering the use of a new technology. Indeed, such a

The Precautionary Principle in documents

1982 World Charter for Nature (UN General Assembly):

‘...where potential adverse effects are not fully understood, the activities should not proceed’

1990 Third International Conference on the Protection of the North Sea:

‘...(action should be taken even if there is) no scientific evidence to prove a causal link between emission (of wastes) and effects’

1992 Rio Declaration, principle 15:

‘where there are threats of damage, lack of full scientific certainty shall not be used to postpone cost-effective preventive measures’

2000 Communication from the European Commission about guidelines for EU research activities:

‘...the Precautionary Principle forms part of a structured approach to the analysis of risk, as well as being relevant to risk management. It covers cases where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern...’

moratorium may be useful to give the scientists enough time to assess the potential dangers and the acceptability of a new technology.

Later, this idea of considering potential health and environmental hazards and ways to prevent them found its way into many international statements, declarations, recommendations or conventions (for a more detailed list of statements see: http://www.ec.gc.ca/cepa/ip18/e18_01.html). The World Charter for Nature, approved in 1982 by the General Assembly of the United Nations, does not use the word ‘precaution’, but deals with

vidual or collective fears—it is quite often a problem of mass psychology. The precautionary principle is therefore often invoked when the public feels that there is danger in using this new technology.

Precaution is only needed if there is scientific uncertainty about the risks. If the relationship between cause and effect is known, we talk about prevention rather than precaution. Therefore, the precautionary principle aims at preventing the careless use of a new technology. It forces the initiator of a new activity to address detailed questions and it generates the need for more scientific information. The precautionary principle deals only with applications and use of scientific knowledge, and therefore it is not against science *per se*.

Precautionary action demands that measures must be taken to prevent health and environmental harm when introducing a new technology. This could mean postponing any action until sufficient sci-

entific evidence for its safe implementation is available.

The term precautionary principle implies that a potentially harmful activity—such as the use of a new and untested technology—is planned or is already taking place, and that a sector of society is lobbying in its favour. It also implies that other people are worried about potential environmental or health risks resulting from this technology. The principle demands a prior assessment of potential risks and benefits. The Rio document also uses the terms ‘lack of full scientific certainty’ and ‘cost-effective’ measures. These terms imply that at least some scientific evidence and economic cost/benefit analysis are also elements of the precautionary principle.

In 1999, the UNESCO organised the World Conference on Science to discuss ‘Science and the Use of Scientific Knowledge’ to describe ways in which to implement technological advances sensibly. The final declaration makes it clear that the concept of science is different from that of technology; at the same time it recognises that basic and applied science are very much interrelated so that, quite often, one cannot define a problem as basic or applied.

The conference also approved the Framework for Action, which describes risk assessment and the precautionary principle. However, these two concepts are quite different and, in some circles considered antithetical. The proponents of the precautionary principle criticise risk assessment because it is based only on the scientific knowledge presently available, while the potential harmful effects may be related to yet unknown parameters. In risk assessment, absence of evidence is often interpreted as evidence for the absence of risk. Risk assessment is

performed by public authorities or agencies without involving the public. Moreover, it is related to a cost-benefit analysis, and thus accepts some harmful effects. Risk assessment assumes that society as a whole must deal with the potential harm caused by a new technology, while the precautionary principle implies that the proponents of a new technology must prove that there is no harm and eventually pay for the negative consequences.

The Asilomar moratorium is often cited as an example of how to consider the use of a new technology

it in an implicit way. The International Conference on the Protection of the North Sea held in 1990 demands action even if there is *no scientific* evidence. But the most cited document about the origin of the wording ‘precautionary principle’ is the Rio Declaration on Environment and Development.

The definition of precaution has three elements: threat of harm, scientific uncertainty and precautionary action.

The threat of harm is not an objective term; it cannot be measured. It deals with indi-

The World Conference on Science’s Framework for Action

Paragraph 34:

‘All countries should emphasize capacity building in vulnerability and risk assessment’

‘[...] we live in a complex world with an inherent uncertainty about long-term trends. Decision makers must [...] encourage the development of new forecasting and monitoring strategies. The precautionary principle is an important guiding principle in handling inevitable scientific uncertainty, especially in situations of potentially irreversible or catastrophic impacts.’

(http://www.unesco.org/science/wcs/eng/key_documents.htm)

The criteria of the European commission for the implementation of the precautionary principle

Proportionality means that the measures to be taken should be proportional to the level of accepted risk.

Non-discrimination means that uniform actions should be taken if situations are comparable.

Consistency means that measures should be of comparable scope and nature to those that have already been taken in equivalent areas where all scientific data are available.

Cost/benefit analysis implies that the overall costs are evaluated, not only in economic terms, but also in terms of acceptability to the public. Moreover, it recognises that health protection takes precedence over economic considerations.

Subject to review and **assigning responsibility** are self-explanatory.

(http://europa.eu.int/comm/off/com/health_consumer/precaution.htm)

The precautionary principle was first proposed by people concerned about the environment, but today it is increasingly used whenever people worry about the introduction of any new technology. Indeed, as it is impossible to prove that there is no risk in connection with a new technology, the possibility of abuse, i.e. completely blocking a new technology, is large. As a consequence, modern-day

of genetically modified plants in the USA or mobile phones in the UK. Today, after a period of acceptance, the public opinion is changing and is demanding additional studies about potential long-term health and environmental risks.

With this experience, the EU is attempting to define the term precautionary principle more clearly. A better definition would indeed help to prevent harmful effects of new and untested technologies but would also make it harder for scare-mongers to block a new technology. Interestingly, the latest document about EU research activities states that the Euro-

However, this will not always be possible, because scientific facts are not the main parameters that influence public opinion. One of the merits of the precautionary principle is to express the feeling of apprehension that is generated by the use of a novel technology. Although anxiety about a new technology is often irrational, we have to deal with it. Risk assessment, on the other hand, is a rational analysis of the uncertainties of natural phenomena.

We should respect the need for precaution expressed by public opinion. Scientific knowledge should be used with precaution, but in the end we cannot prevent its influence on our beliefs and actions.

*'fatti non foste a viver come bruti,
ma per seguir virtute e conoscenza'*

*'you have not been created to live as
ignorant,
but to follow virtue and knowledge'*

Dante, The Divine Comedy

Berg P. *et al.* (1974) Potential biohazards of recombinant DNA molecules. *Science*, **185**, 303.

The author is at the International Institute of Genetics and Biophysics in Naples, Italy and was formerly Assistant Director-General for Natural Sciences at UNESCO.
E-mail: iaccarin@iigb.na.cnr.it

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The precautionary principle deals only with use of scientific knowledge and therefore is not against science *per se*

Luddites have manipulated public opinion and successfully blocked the introduction of genetically modified plants although the potential benefits, particularly for third world countries, may indeed be huge. These groups would interpret the Asilomar moratorium as an acknowledgement of danger and an argument for prohibiting genetic research.

Another problem is that the public may change its mind from acceptance to refusal, so the precautionary principle is invoked after the new technology has already been introduced without prior discussions or objections. This is the case

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pean Commission will use scientific results and progression to refine the definition and implementation of the precautionary principle (<http://europa.eu.int/comm/research/area/com2000-612-en.pdf>). Furthermore, the commission issued guidelines on the precautionary principle last February that attempt to regulate it by introducing certain criteria.

I think such guidelines are very useful to orient the public in a rational way.