

Precautions & nature

All over the world, there is increasing interest in a simple idea for regulation of risk: In cases of doubt, follow the Precautionary Principle.¹ Avoid steps that will create a risk of harm. Until safety is established, be cautious; do not require unambiguous evidence. In a catchphrase: better safe than sorry.

In ordinary life, pleas of this kind seem quite sensible, indeed a part of ordinary human rationality. It can be hazardous to interfere with natural processes, and we often refuse to alter the status quo because of a salutary fear of adverse side effects. Shouldn't the same approach be followed by rational regulators as well?

My central claim here is conceptual. The real problem with the Precautionary Principle in its strongest forms 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 that 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. Protection of nature often makes sense, but the

Cass R. Sunstein, a Fellow of the American Academy since 1992, is Karl N. Llewellyn Professor of Jurisprudence at the University of Chicago. He is the author of numerous publications, including “The Second Bill of Rights: FDR’s Unfinished Revolution and Why We Need It More than Ever” (2004), “Laws of Fear: Beyond the Precautionary Principle” (2005), “Infotopia: How Many Minds Produce Knowledge” (2006), and “Worst Case Scenarios” (2007).

© 2008 by the American Academy of Arts & Sciences

1 The literature is vast. See, for general discussion, Poul Harremoës et al., eds., *The Precautionary Principle in the 20th Century: Late Lessons from Early Warnings* (London: Earthscan, 2002); Arie Trouwborst, *Evolution and Status of the Precautionary Principle in International Law* (London: Kluwer Law International, 2002); Tim O’Riordan and James Cameron, eds., *Interpreting the Precautionary Principle* (London: Cameron May, 2002); Joel Tickner, ed., *Precaution, Environmental Science and Preventive Public Policy* (Washington, D.C.: Island Press, 2002); Carolyn Raffensberger and Joel Tickner, eds., *Protecting Public Health and the Environment: Implementing the Precautionary Principle* (Washington, D.C.: Island Press, 1999).

Precautionary Principle is not a helpful way of identifying when, and how much, protection of nature makes sense.

For those interested in precautions, the initial question is this: what exactly does the principle mean or require? There are at least twenty definitions, and they are not compatible with one another. We can imagine a continuum of understandings. At one extreme are weak versions to which no reasonable person could object. At the other extreme are strong versions that would require a fundamental rethinking of regulatory policy.

The most cautious and weak versions suggest, quite sensibly, that a lack of decisive evidence of harm should not be a ground for refusing to protect natural processes. Controls might be justified even if we cannot establish a definite connection between, for example, low-level exposures to humanly introduced carcinogens and adverse effects on human health. Thus the 1992 Rio Declaration 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."

The Ministerial Declaration of the Second International Conference on the Protection of the North Sea, held in London in 1987, is in the same vein: "Accepting that in order to protect the North Sea from possibly damaging effects of the most dangerous substances, a Precautionary Principle is necessary which may require action to control inputs of such substances even before a causal link has been established by absolutely clear scientific evidence." Similarly, the United Nations Framework Convention on Climate Change offers cautious language: "Where there are threats of serious or irreversible damage, lack of full scien-

tific certainty should not be used as a reason for postponing [regulatory] measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost."

The widely publicized Wingspread Declaration, from a meeting of environmentalists in 1998, goes further: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not established scientifically. In this context the proponent of the activity, rather than the public, should bear the burden of proof." The first sentence just quoted is a mildly more aggressive version of the statement from the Rio Declaration. It is more aggressive because it is not limited to threats of serious or irreversible damage. But in reversing the burden of proof, the second sentence goes further still. Of course everything depends on what those with the burden of proof must show in particular.

In Europe, the Precautionary Principle is sometimes understood in a still stronger way, as asking for a significant margin of safety for all decisions. According to one definition, the Precautionary Principle means "that action should be taken to correct a problem as soon as there is evidence that harm may occur, not after the harm has already occurred."² The word "may" is the crucial one; almost all of the time, there will be "evidence that harm may occur," if "may" is not understood to require some threshold of probability. In a comparably strong version, the Final Declaration of the First European "Seas At Risk" conference says that if "the 'worst case

2 <http://www.logophilia.com/WordSpy/precautionaryprinciple.asp>.

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."³

The weak versions of the Precautionary Principle state a truism – uncontroversial in principle and necessary in practice only to combat public confusion or the self-interested claims of private groups demanding unambiguous evidence of harm (which no rational society requires). Because the weakest versions are unobjectionable, even banal, I will not discuss them here. To make analytic progress, let us understand the principle in the strong way to suggest that regulation is required whenever there is a potential risk to health, safety, or nature, even if the supporting evidence remains speculative and even if the economic costs of regulation are high. To avoid palpable absurdity, the idea of 'potential risk' will be understood to require a certain threshold of scientific plausibility. To support regulation, no one thinks that it is enough if someone, somewhere, urges that a risk is worth taking seriously. But under the Precautionary Principle as I shall understand it, the threshold burden is minimal, and once it is met, there is something like a presumption in favor of regulatory controls.

I believe that this understanding of the Precautionary Principle fits with the understandings of some of its most enthusiastic proponents, and that with relatively modest variations, this understanding fits with many of the legal formulations as well.

It is tempting to object that the Precautionary Principle, thus understood, is

³ Final Declaration of the First European "Seas At Risk" Conference, Annex 1, Copenhagen, 1994.

hopelessly vague. How much precaution is the right amount of precaution? By itself, the principle does not tell us. It is also tempting to object that the principle is, but should not be, cost-blind. Some precautions simply aren't worthwhile, because they cost so much and help so little. But the most serious problem lies elsewhere. The real problem is that the principle offers no guidance – not that it is wrong, but that it forbids all courses of action, including regulation. It bans the very steps that it requires.

To understand the objection, it will be useful to anchor the discussion in some concrete problems:

- Genetic modification of food has become a widespread practice.⁴ The risks of that practice are not known with precision. Some people fear that genetic modification will result in serious ecological harm and large risks to human health; others believe that genetic modification will result in more nutritious food and significant improvements in human health.
- Many people fear nuclear power, on the ground that nuclear power plants create various health and safety risks, including some possibility of catastrophe. But if a nation does not rely on nuclear power, it might well rely instead on fossil fuels, and in particular on coal-fired power plants. Such plants create risks of their own, including risks associated with global warming. China, for example, has relied on nuclear energy, in a way that reduces greenhouse gases and a range of air-pollution problems.⁵

⁴ Alan McHughen, *Pandora's Picnic Basket* (New York: Oxford University Press, 2000).

⁵ See Ling Zhong, "Note: Nuclear Energy: China's Approach Towards Addressing Global Warming," *Georgetown International Environ-*

- There is a possible conflict between the protection of marine mammals and military exercises. The United States Navy, for example, engages in many such exercises, and it is possible that marine mammals will be threatened as a result. Military activities in the oceans might well cause significant harm; but a decision to suspend those activities, in cases involving potential harm, might also endanger military preparedness, or so the government contends.⁶

In these cases, what kind of guidance does the Precautionary Principle provide? It is tempting to say, as is in fact standard, that the principle calls for strong controls. In all of these cases, there is a possibility of serious harms, and no authoritative scientific evidence demonstrates that the possibility is close to zero. Put to one side the question of whether the Precautionary Principle, understood to compel stringent regulation in these cases, is sensible. Let us ask a more fundamental question: is more

mental Law Review 12 (2000): 493. Of course, it is possible to urge that nations should reduce reliance on either coal-fired power plants or nuclear power, and move instead toward solar power. For general discussion, see Godfrey Boyle, ed., *Renewable Energy: Power for a Sustainable Future* (Oxford: Oxford University Press in association with the Open University, 1996); Allan Collinson, *Renewable Energy* (Austin, Tex.: Steck-Vaughn Library, 1991); Dan E. Arvizu, "Advanced Energy Technology and Climate Change Policy Implications," *Florida Coastal Law Journal* 2 (2001): 435. But these alternatives pose problems of their own, involving feasibility and expense.

6 See Testimony of Vice Admiral Charles W. Moore, Deputy Chief of Naval Operations for Readiness and Logistics, before the House Resources Committee, Subcommittee on Fisheries Conservation, Wildlife and Oceans, June 13, 2002.

stringent regulation really compelled by the Precautionary Principle?

The answer is that it is not. In some of these cases, it should be easy to see that in its own way, stringent regulation would actually run afoul of the Precautionary Principle. The simplest reason is that such regulation might well deprive society of significant benefits, and hence produce a large number of deaths that would otherwise not occur. In some cases, regulation eliminates the 'opportunity benefits' of a process or activity, and thus causes preventable deaths. If this is so, regulation is hardly precautionary. Consider the case of genetic modification of food. Many people object to genetic modification, with the thought that 'tampering with nature' can produce a range of adverse consequences for the environment and for human health. But many other people believe that a failure to allow genetic modification might well result in numerous deaths, and a small probability of many more. The reason is that genetic modification holds out the promise of producing food that is both cheaper and healthier – resulting, for example, in 'golden rice,' which might have large benefits in developing countries. The point is not that genetic modification will definitely have those benefits, or that the benefits of genetic modification outweigh the risks. The claim is only that if the Precautionary Principle is taken literally, it is offended by regulation as well as by nonregulation.

Regulation sometimes violates the Precautionary Principle because it would give rise to *substitute risks*, in the form of hazards that materialize, or are increased, as a result of regulation.⁷ Con-

7 See the discussion of risk-related trade-offs in John Graham and Jonathan Wiener, *Risk vs. Risk* (Cambridge, Mass.: Harvard University

sider the case of DDT, often banned or regulated in the interest of reducing risks to birds and human beings. The problem with such bans is that in poor nations, they eliminate what appears to be the most effective way of combating malaria – and thus significantly undermine public health.

Or consider the ‘drug lag,’ produced whenever the government takes a highly precautionary approach to the introduction of new medicines and drugs into the market. If a government insists on such an approach, it will protect people against harms from inadequately tested drugs; but it will also prevent people from receiving potential benefits from those very drugs. Is it ‘precautionary’ to require extensive premarketing testing, or to do the opposite? In the context of medicines to prevent AIDS, those who favor ‘precautions’ have asked governments to reduce premarketing testing, precisely in the interest of health. The United States, by the way, is more precautionary about new medicines than are most European nations – but by failing to allow such medicines on the market, the United States fails to take precautions against the illnesses that could be reduced by speedier procedures. More generally, a sensible government might want to ignore the small risks associated with low levels of radiation, on the ground that precautionary responses are likely to cause fear that outweighs any health benefits from those responses.⁸

Press, 1995); Cass R. Sunstein, “Health-Health Tradeoffs,” in Cass R. Sunstein, *Risk and Reason* (Cambridge: Cambridge University Press, 2002), 133 – 152.

8 Ibid. For some counterevidence in an important context, see Lennart Hardell et al., “Further Aspects on Cellular and Cordless

We should now be able to see the sense in which the Precautionary Principle, taken for all that it is worth, is paralyzing: it stands as an obstacle to regulation and nonregulation, and to everything in between.

In practice, the Precautionary Principle is widely thought to provide concrete guidance. How can this be? I suggest that the principle becomes operational if and only if those who apply it wear blinders – only, that is, if they focus on some aspects of the regulatory situation but downplay or disregard others. What accounts for the particular blinders that underlie applications of the Precautionary Principle? When people’s attention is selective, why is it selective in the way that it is? Much of the answer lies in a series of identifiable mechanisms. Let us begin with a popular idea about the sanctity of nature.

Sometimes the Precautionary Principle operates by incorporating the belief that nature is essentially benign and that human intervention is likely to carry risks – as in the suggestion that the Precautionary Principle calls for stringent regulation of pesticides or genetically modified organisms. Many people fear that any human intervention will create losses from the status quo and add that these losses should carry great weight, whereas the gains should be regarded with some suspicion or at least be taken as less weighty. For example, “[h]uman intervention seems to be an amplifier in judgments on food riskiness and contamination,” even though “more lives are lost to natural than to man-made dis-

Telephones and Brain Tumours,” *International Journal of Oncology* 22 (2003): 399 (discussing evidence of an association between cellular telephones and cancer).

asters in the world.”⁹ Studies show that people overestimate the carcinogenic risk from pesticides and underestimate the risks of natural carcinogens. People also believe that nature implies safety, so much that they will prefer natural water to processed water even if the two are chemically identical.¹⁰

A belief in the benevolence of nature plays a major role in the operation of the Precautionary Principle, especially among those who see nature as harmonious or in balance. In fact, many of those who endorse the principle seem to be especially concerned about new technologies. Most people believe that natural chemicals are safer than man-made chemicals.¹¹ (Most toxicologists disagree.) On this view, the principle calls for caution when people are intervening in the natural world. Here of course we can find some sense: nature often consists of systems, and interventions into systems can cause serious problems. But there is a large problem with this understanding of the Precautionary Principle. What is natural may not be safe at all.¹²

Consider in this light the familiar idea that there is a ‘balance of nature.’ According to one account, this idea is

9 Paul Rozin and Carol Nemeroff, “Sympathetic Magical Thinking: The Contagion and Similarity ‘Heuristics,’” in *Heuristics and Biases: The Psychology of Intuitive Judgment*, ed. Thomas Gilovich, Dale Griffin, and Daniel Kahneman (Cambridge: Cambridge University Press, 2002).

10 Ibid.

11 See Paul Slovic, *The Perception of Risk* (London: Earthscan Publications, 2000), 291.

12 See James P. Collman, *Naturally Dangerous* (Sausalito, Calif.: University Science Books, 2001).

“not true.”¹³ A scientific revolution has shown that nature “is characterized by change, not constancy,” and that “natural ecological systems are dynamic,” with desirable changes including many “induced through human action.”¹⁴ In any case, nature is often a realm of destruction, illness, killing, and death. Hence the claim cannot be that human activity is necessarily or systematically more destructive than what nature does. Nor is it clear that natural products are comparatively safe.¹⁵ Organic foods, favored by many people on grounds of safety and health and creating annual revenues of \$4.5 billion in the United States alone, are, according to one account, “actually riskier to consume than food grown with synthetic chemicals.”¹⁶ If the Precautionary Principle is seen to raise doubts about pesticides, but not about organic foods, it is probably because the health risks that come with departures from ‘nature’ register as especially troublesome.

Some of the most serious risks we face are a product of nature. Nothing is more natural than exposure to sunlight, which people rarely fear. But such exposure is associated with skin cancer and other harms, producing serious health problems that (unfortunately) have not been the occasion for invoking the Precautionary Principle. Tobacco smoking kills 400,000 Americans each year, even though tobacco is a product of nature. To say all this is not to resolve specific issues, which depend on complex ques-

13 See Daniel B. Botkin, “Adjusting Law to Nature’s Discordant Harmonies,” *Duke Environmental Law & Policy Forum* 7 (1996): 25, 27.

14 Ibid., 33.

15 See Collman, *Naturally Dangerous*.

16 Ibid., 31.

tions of value and fact. But the false belief in the benevolence of nature helps to explain why the Precautionary Principle is thought, quite incorrectly, to provide a great deal of analytical help.

People tend to be loss-averse, which means that a loss from the status quo is seen as more undesirable than a gain is seen as desirable.¹⁷ When we anticipate a loss of what we now have, we can become genuinely afraid, in a way that greatly exceeds our feelings of pleasure when we anticipate some supplement to what we now have. So far, perhaps, so good. The problem comes when individual and social decisions downplay potential gains from the status quo, and fixate on potential losses, in such a way as to produce overall increases in risks and overall decreases in well-being.

In the context of risk regulation, there is a clear implication: people will be closely attuned to the losses produced by any newly introduced risk, or by any aggravation of existing risks, but far less concerned with the benefits that are foregone as a result of regulation. Loss aversion often helps to explain what makes the Precautionary Principle operational. The opportunity costs of regulation often register little or not at all, whereas the out-of-pocket costs of the activity or substance in question are en-

17 See Richard H. Thaler, "The Psychology of Choice and The Assumptions of Economics," in *Quasi-rational Economics* (New York: Russell Sage Foundation, 1991), 137, 143 (arguing that "losses loom larger than gains"); Daniel Kahneman, Jack L. Knetsch, and Richard H. Thaler, "Experimental Tests of the Endowment Effect and the Coase Theorem," *Journal of Political Economy* 98 (6) (1990): 1325, 1328; Colin Camerer, "Individual Decision Making," in *The Handbook of Experimental Economics*, ed. John H. Kagel and Alvin E. Roth (Princeton, N.J.: Princeton University Press, 1995), 587, 665–670.

tirely visible. In fact this is a form of status-quo bias. The status quo marks the baseline against which gains and losses are measured, and a loss from the status quo seems much worse than a gain from the status quo seems good.

If loss aversion is at work, we would predict that the Precautionary Principle would place a spotlight on the losses introduced by some risk and downplay the benefits foregone as a result of controls on that risk. Recall the emphasis, in the United States, on the risks of insufficient testing of medicines as compared with the risks of delaying the availability of those medicines. If the 'opportunity benefits' are offscreen, the Precautionary Principle will appear to give guidance notwithstanding the objections I have made. At the same time, the neglected opportunity benefits sometimes present a devastating problem with the use of the Precautionary Principle. In the context of genetic engineering of food, this is very much the situation. We can find the same problem when the Precautionary Principle is invoked to support bans on nonreproductive cloning. For many people, the possible harms of cloning register more strongly than the potential therapeutic benefits that would be rendered unattainable by a ban on the practice.

Loss aversion is closely associated with another cognitive finding: people are far more willing to tolerate familiar risks than unfamiliar ones, even if they are statistically equivalent.¹⁸ For example, the risks associated with driving do not occasion a great deal of concern, even though in the United States alone, tens of thousands of people die from motor vehicle accidents each year. The relevant risks are simply seen as part of life. By contrast, many people are quite

18 See Slovic, *The Perception of Risk*, 140–143.

concerned about risks that appear newer, such as the risks associated with genetically modified foods, recently introduced chemicals, and terrorism. Part of the reason for the difference may be a belief that with new risks, we are in the domain of uncertainty (meaning that we cannot assign probabilities to bad outcomes) rather than risk (where probabilities can be assigned), and perhaps it makes sense to be cautious when we are not able to measure probabilities. But the individual and social propensity to focus on new risks outruns that sensible propensity. It makes the Precautionary Principle operational by emphasizing, for no good reason, a mere subset of the hazards actually involved.

It is well-established that in thinking about risks, people rely on certain heuristics, or rules of thumb, which serve to simplify their inquiry.¹⁹ Should we be fearful of nuclear power, terrorism, abduction of young children, or pesticides? The availability heuristic is particularly important for purposes of understanding people's fear and their interest in precautions.²⁰ When people use the availability heuristic, they assess the magnitude of risks by asking whether examples can readily come to mind. If people can easily think of such examples, they are far more likely to be frightened than if they cannot. In fact, the belief in the benevolence of nature often stems from the availability heuristic, as people recall cases in which 'tampering' resulted in serious social harm.

19 See Daniel Kahneman, Paul Slovic, and Amos Tversky, *Judgment Under Uncertainty: Heuristics and Biases* (Cambridge: Cambridge University Press, 1982).

20 See Amos Tversky and Daniel Kahneman, "Judgment Under Uncertainty: Heuristics and Biases," in *ibid.*, 3, 11 – 14.

Furthermore, "a class whose instances are easily retrieved will appear more numerous than a class of equal frequency whose instances are less retrievable."²¹ Consider a simple study showing people a list of well-known people of both sexes, and asking them whether the list contains more names of women or more names of men. In lists in which the men were especially famous, people thought that there were more names of men, whereas in lists in which the women were more famous, people thought that there were more names of women.²²

This is a point about how *familiarity* can affect the availability of instances. A risk that is familiar, like that associated with smoking, will be seen as more serious than a risk that is less familiar, like that associated with sunbathing. But *salience* is important as well. "For example, the impact of seeing a house burning on the subjective probability of such accidents is probably greater than the impact of reading about a fire in the local paper."²³ So too, recent events will have a greater impact than earlier ones. The point helps explain much risk-related behavior, including decisions to take precautions. Whether people will buy insurance for natural disasters is greatly affected by recent experiences.²⁴ If floods have not occurred in the immediate past, people who live on flood plains are far less likely to purchase insurance. In the aftermath of an earthquake, insurance for earthquakes rises sharply – but it declines steadily from that point, as vivid memories recede. Note that the use of the availability heuristic, in these con-

21 *Ibid.*, 11.

22 *Ibid.*

23 *Ibid.*

24 Slovic, *The Perception of Risk*, 40.

texts, is hardly irrational. Both insurance and precautionary measures can be expensive, and what has happened before seems, much of the time, to be the best available guide to what will happen again. The problem is that the availability heuristic can lead to serious errors, in terms of both excessive fear and neglect.

The availability heuristic helps to explain the operation of the Precautionary Principle for a simple reason: sometimes a certain risk, said to call for precautions, is cognitively available, whereas other risks, including the risks associated with regulation itself, are not. For example, it is easy to see that arsenic is potentially dangerous; arsenic is well known as a poison, forming the first word of a well-known movie about poisoning, *Arsenic and Old Lace*. By contrast, there is a relatively complex mental operation in the judgment that arsenic regulation might lead people to use less safe alternatives. In many cases where the Precautionary Principle seems to offer guidance, the reason is that some of the relevant risks are available while others are barely visible. And when people seek to protect nature against human intervention, it is often because the dangers of intervention are visible and familiar while the dangers of nonintervention are not.

I have not suggested any particular substitute for the Precautionary Principle. But none of the arguments here supports the views of Aaron Wildavsky, an acute and influential political scientist with a special interest in risk regulation, who also rejects the Precautionary Principle.²⁵ In Wildavsky's view, the notion of 'precaution' should be abandoned and

replaced with a principle of 'resilience,' based on an understanding that nature, and society, are quite able to incorporate even strong shocks, and that the ultimate dangers are therefore smaller than we are likely to fear. It would follow from Wildavsky's 'resilience' principle that people should be less concerned than they now are with the risks associated with (for example) arsenic, global warming, and the destruction of the ozone layer.

Unfortunately, the principle of 'resilience' is no better than that of 'precaution.' Some systems, natural and social, are resilient, but many are not. Whether an ecosystem, or a society, is 'resilient' cannot be decided in the abstract. In any case resilience is a matter of degree. Everything depends on the facts. The resilience principle should be understood as a heuristic, one that favors inaction in the face of possibly damaging technological change. Like most heuristics, the resilience principle will work well in many circumstances, but it can also lead to systematic and even deadly errors.

A better approach would be to acknowledge that a wide variety of adverse effects may come from inaction, regulation, and everything between. Such an approach would attempt to consider all of those adverse effects, not simply a subset. When existing knowledge does not allow clear assessments of the full range of adverse effects, such an approach would develop simplifying devices, helping to show the appropriate course of action in the face of uncertainty. When societies face risks of catastrophe, even risks whose likelihood cannot be calculated, it is appropriate to act, not to stand by and merely to hope. A sensible approach would attempt to counteract, rather than to embody, the various cognitive

25 See Aaron Wildavsky, *But Is It True?* (Cambridge, Mass.: Harvard University Press, 1995), 433.

limitations that people face in thinking about risks. An effort to produce a fair accounting of the universe of dangers should also help to diminish the danger of interest-group manipulation.

To be sure, public alarm, even if ill-informed, is itself a harm, and it is likely to lead to additional harms, perhaps in the form of large-scale 'ripple effects.'²⁶ A sensible approach to risk will attempt to reduce public fear even if it is baseless. My goal here has been not to deny that point, but to explain the otherwise puzzling appeal of the Precautionary Principle and to isolate the strategies that help make it operational. At the individual level, these strategies are hardly senseless, especially for people who lack much information or who do the best they can by focusing on only one aspect of the situation at hand. But for governments, the Precautionary Principle is not sensible, for the simple reason that once the viewscreen is widened, it becomes clear that the principle provides no guidance at all. Rational nations should certainly take precautions. But they should not adopt the Precautionary Principle.

²⁶ See the discussion of the social amplification of risk in Slovic, *The Perception of Risk*.