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Safety: a new element of politics and science

For a very long time we have been led to believe that the discoveries of science would be automatically applied for the benefit of humanity. By means of some 'hidden hand', the scientific discoveries made by independent researchers are converted into developments in technology and medicine that advance human welfare. We now know that scientific advance is not spontaneous, but is directed by externally set priorities. Questions of the purposes and assumptions driving science, and the power behind them, have to be addressed more openly and urgently.

The motto 'knowledge is power' goes back a long way, especially in connection with science. But now we must ask, who has the power that derives from science, and for whose benefit is it used? The converse is that 'ignorance is impotence'. To that we ask, who is kept in ignorance, how and, again, to whose benefit?

Neither of these questions is simple, nor are the answers straightforward. There is no need to suppose a conspiracy to control power or create ignorance. And we can assume that individual scientists are at least as moral and idealistic as the ordinary run of humanity. But the contract between science and society is managed by large, established institutions, whose imperatives involve power and profit in the increasingly important arenas that they themselves are creating. Unless we look at science-in-society in those terms, we are inhabiting a fantasy world of universal good intentions. We must acknowledge that science has become a means of production rather than an adventure, and that the great mass of researchers are just workers rather than explorers. Such developments bring politics directly into the governance of science. But there is another new feature that makes science, in one crucial aspect at least, essentially political.

The traditional goals of science, knowledge and power are now being enriched by a third: safety (Ravetz 2003). As science has enabled ever greater control over the age-old dangers of disease, famine and calamities, it has produced new threats, some potentially catastrophic and others insidious. The state of personal and societal safety, which in recent generations we have come to take for granted as a right, is now threatened by the unexpected consequences of advances in our science-based technology. Not

just the application of science but our scientific knowledge itself is now the subject of debate and concern in relation to safety and survival.

The preservation of safety is not merely a new function for science; it is one that injects politics directly into the contract between science and society. For those institutions that use science to protect the public are in a position of trust. When they fail in that task, they, and also the science and scientists that they have deployed, are seen to have betrayed that trust. In this way, science in its functions of assuring safety (we may call it regulatory or precautionary science, or just safety science) is exposed to moral protest and outrage as it never was before. This explains the sudden emergence of public mistrust of science at the turn of the millennium. There is a sense among the public that science has failed to provide protection from new dangers, many of them generated by science itself. And worse, science (as an institution related to government and commerce) has failed to acknowledge its responsibility either for their creation or for its failure to protect.

One way in which official science has secured and maintained a protected position in relation to safety has been through nomenclature and concepts. A particular discourse, ostensibly based on science, has been established to the exclusion of others based on personal experience. Thus there has been an effective creation of ignorance, as other perspectives on the issue have been inhibited from development and expression. Over the last half-century, in the industrial sphere the traditional concept of 'safety', dependent on straightforward science, craft skills and professional judgements, was supplanted by 'risk'. To some extent this was inevitable, as novel and complex industrial installations required ever more sophisticated methods for the analysis of their hazards. Civil nuclear power was the leading example of this tendency; the routes to disaster are so numerous that refined mathematical analysis provides the only hope of an assessment of their risks. But then the official discourse became dominated by 'risk', with its connotations of being a precise, quantitative measure. Older ideas of 'danger' and 'safety' were generally displaced, and relegated to untutored popular discourse. Thus the choice between the two sets of terms, with their associated concepts, involves the politics of technology and its regulation. This is at the core of the struggle for the survival of modern civilization against all its destructive tendencies. Key words have power; their absence produces impotence.

Not 'risk' but 'safety'

I therefore suggest that we carry the campaign into the terrain of nomenclature and concepts. 'Risk' is a technical term, which as commonly used presents a reduced, artificially bounded and simplified picture of the

problem: probability and cost. There is a precise definition of risk: the product of the probability of an occurrence of harm, multiplied by the cost of that harm should it occur. The precision is only in the concept; in any real example, the difficulties of measurement and quantification, on top of those of defining the situation for analysis, make risk analysis a highly imprecise affair. For any real hazard involves a complex syndrome of possibilities, together with potential steps for prevention, containment, mitigation, remediation and compensation; and each of these has its own socio-technical system incorporating a variety of traditions and values.

The true complexity that is ordinarily described as 'risk' would be better characterized by the traditional terms 'safety' and 'danger'. We can approach 'safety' through the apparent paradox that there is no such thing as a zero risk. This maxim is thrown at those objecting to some proposal that they consider dangerous, as if they were demanding an unattainable perfection. Of course that is not so. To understand 'safety', we can ask, why it is safe to cross a busy road at one point and dangerous at another? The traffic is there, and the risk of an accident is non-zero at both places. But in one place the risk-reduction system is functioning with competence and integrity, and in another it is not. So being 'safe' amounts to saying that it's OK to be there. Thus, in contrast to the clinical concept of 'risk', 'safety' is a complex attribute. It is analogous to 'quality', since it is after all an aspect of quality. Both concepts are pragmatic, recursive and moral.

'Safety' cannot be reduced to a certified expertise in techniques of quantitative puzzle-solving. It is essentially post-normal (Ravetz 1993, 1999), as it involves complex and hence non-quantifiable uncertainties, along with strong value commitments. Therefore, problems of safety require an extended peer community and mutual learning through dialogue. This has implications for citizenship as well as for science. Social scientists have noted that in discussion of genetically modified (GM) food and crop risks, for example, ordinary people rarely use the term 'risk' unless prompted to do so, instead using the less colonized terms 'harm', 'danger' or, more typically, and significantly, 'unknown consequences' (Marris et al. 2001). Also, safety is the concept that is appropriate for real regulation; thus in the UK we still do not have the 'Health and Acceptable-Risk Executive', but rather the Health and Safety Executive (HSE).

The methodology of safety science

Changing our conceptual focus from 'risk' to 'safety' enables us to gain clarity on the post-normal character of the problems. A full appreciation of a 'safety' problem necessarily involves its complex character. To take a familiar example, a dangerous road crossing involves a variety of road users