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## 1. INTRODUCTION

The very attention given to this conference by an international array of experts testifies to the perceived importance of the conflict about the transport of irradiated fuel through residential areas. Solon has noted that "transportation is the most vulnerable part of the entire fuel cycle from the point of view of accident or sabotage" (1). It is also the most vulnerable to public hostility, in that transport from reactors to reprocessing is regarded as a main artery of the fuel cycle. Whereas immediate conflicts over reactors or other plant are at least localized, the transport of spent fuel is somewhat like a highly mobile siting issue. The analogy is emphasized by reminding ourselves that a single typical skip in transport might have 0.5 - 1.5 million curies of radioactivity - as one critic put it, like "iodine-free reactors, unguarded and mobile" (2). The dislocation between meanings which different social groups give to the issue is reflected in the natural language they use to express their experience of it. Spent nuclear fuel is widely and unambiguously treated as "nuclear waste" in popular perception, yet it is seen as a valuable resource to the industry. Indeed, one suspects that the common term "spent" fuel has been expunged because of its negative connotations.

The importance to the State as sponsor of nuclear energy of keeping the arteries open has been underlined by the conflicts between local and central government over the right to control nuclear fuel shipments through urban districts. When Ipswich Council attempted in 1980 to create a bye-law to ban such shipments, the Government refused to allow the bye-law any legal status. Various other local authority resolutions banning "nuclear waste" from their territory have been similarly neutralised, highlighting the general issue of principle about the central restriction of local democracy. This is one of the most potent dimensions of the issue of irradiated fuel transport.

In this general controversy there has been virtually no distinction recognized either between nuclear waste and recyclable nuclear fuel, or between civil and military shipments. Opposition to civil shipments has been closely intertwined with the broader reemergence of opposition to nuclear weapons generally. The real confusion and official prevarication over possible military uses of plutonium from civil reactor fuels has only added to this embroilment.

As an exercise in risk-interpretation, cursory oversight shows that the issue of irradiated fuel transport is far from self-contained, even to within the broader reaches of the full nuclear fuel cycle. Like the long-standing controversy over flouridation of water supplies but more so, one sees a linkage of apparent conflict between "objective" and "perceived" risks of an action with an underlying conflict about the legitimate scope of centralized authority.

In this paper I want to take up the general issue of how to interpret the gaping conflict between the apparently "objective" and "perceived" risks of transport of irradiated fuel and of nuclear power in general. In the view I will advance the "objective risk" framing of an issue is not so much an attempt to identify and rank the risks as to establish a particular framing of the problem to which public attention should be given, and thus of the problems to which public attention should

not be given. My overall aim will be to argue that most approaches to this question - which arises in a wide range of policy issues - are too rooted in the specifics of the technology giving rise to the physical risks, and too psychologistic - they pay inadequate attention to institutional relationships and processes which when properly treated imply a radically different view of the problems involved.

## 2. RISK DEFINITIONS - MINDS VERSUS SOCIAL MATTERS

Others have drawn attention to the problems in defining precisely what the risks are to the public and transport workers; they have also given examples of the inconsistencies and ambiguities in testing and regulatory practices which are assumed to foster public hostility (3). I do not know whether there is any large-scale public hostility to nuclear fuel transport as such. This conference has defined (urban) transportation as one separate risk setting for nuclear energy and much effort has been devoted to calculating the discrete risks for this specific setting. Much effort of a different kind has also been devoted to identifying perceptions of risk in similar discrete categories (4). Each shares the assumption that public reactions are related to these categories of risk - transport, reactor accident, disposal, etc. - and evaluations of their rationality or otherwise is implicitly based on their relation to an identified physical risk factor which gives shape to that category. It is important to note, and it should give us pause to consider how meaningful are our basic categories for social decision-making, that these basic classifications arise from technological and/or regulatory categories which may have little to do with the ways in which real people experience events and processes. A corresponding set of assumptions about these risk conflicts involves an approach which has been enshrined in the influential but, I believe, fundamentally misleading framework of "decision analysis" (5). The relevant aspect of this approach here is that it defines risk decisions according to some taken for granted framework, or problem setting, e.g., whether or not to wear seatbelts, or to take out insurance against floods, and

then evaluates people's perceptions according to how far they help optimise their position with respect to that one problem. This also leads naturally to the "objective-perceived" risk dichotomy.

The risk, and social response to it, is assumed to be generated by some given "intrusion" into a situation; the risk decision and associated options are defined according to that factor. Risk perceptions are then given their multiple attributes also in relation to that factor. Thus, for example, perceptions of some aspect of the array of physical nuclear risks are understood in terms of their deviation from the so-called "objective" risk,by sub-theories, such as the extra load given to involuntariness; emotional association with images of Hiroshima; the imperceptible nature of radiation; the perceived benefits relating to that factor, etc. (6). Even when these are defended as "rational" biassing factors, or at least neutrally described, they remain cognitive-emotional categories defined in relation to the physical risk generator.

More progressive decision analysis or psychological approaches have introduced qualifications: (i) that the experts' assessments of the "objective" risks can be systematically biassed (7). However, this insight has so far only obscured the deeper point that the ensuing expert arguments and uncertainties over the "objective" risk only consolidate as natural the common basic framing which identified the targets of the risk-identification process in the first place; (ii) they have acknowledged the sociologists' criticism that "risks" as defined by regulatory bureaucracies searching for an artificially precise uni-dimensional scale in which to set an acceptable level may be a meaningless category (8). They note that "from a decision making perspective, it makes no sense to speak about acceptable risks. One adopts (or accepts) <u>options</u>, not risks. The option may entail some level of risk, but there is no way in which that risk can be separated from its other features" (9).

However, this sense of enlightenment is tempered by the more fundamental problem this approach does not address, namely that it persists in defining "options" ( and implicitly evaluating rationalities of perception and response-optimisation)

in terms of a decision problem assumed to be common to all actors. They are all assumed to adopt a deliberate, active response by selecting amongst options defined in relation to that factor which (amongst other things) embodies some risks.

The approach which I shall propose as a way of interpreting risk conflicts generally, and that over irradiated fuel transportation in particular, takes a different starting point. The essence of this alternative approach is that the most general problem confronting people and organisations, is to maintain a sense of order and security: this means a concern to maintain social credibility, some autonomy, and trust in surrounding actors. This general problem pervades all our social dealings and all our more specific problems to a greater or lesser extent (10). Every "problem" is actually a mosaic of several interpenetrating problems of different levels of visibility and precision. The interpenetrations and levels will differ for different actors, who concretely experience an issue in very different ways. Nuclear fuel transport is a different issue for a railway worker that it is for a nuclear engineer or say a shoe-factory worker who may never have heard of irradiated nuclear fuel. This is not merely a point about cognition. How a railway worker relates in real life to a nuclear fuel consignment as a "problem" may have direct empirical implications for other consignments and work relations he has to handle routinely; how a nuclear engineer relates to it embodies a different set of consequences for his or her professional status, social credibility. Others who have no active interest will have an "attitude" that is only the accidental by-product of other commitments which have an incidental impact on the "problem". However, even these can be constraints, since these incidental commitments, e.g., to the passive idea that the local marshalling yard is a benign environment, can be the source of sudden active interest if attention patterns are somehow changed. What we call an issue is in reality a common context defined by some influential interest group as a "problem" to be "managed". But that common setting is the crossroads for multiple experiences and issues.

It is a common limitation of policy approaches, and of policy research that interests impinging on an "issue" as defined from the policy management position are defined by their relation to that issue (if they are even recognized at all) rather than the other way about (11). This lack of sociological perspective contributes to unrealistic policy formulation in ignorance of problems in later implementation and practical social viability. From this "verstehen" perspective (12) social institutions, be they formal ones or informal ones like friendship networks, are the origins of meanings, problem-definitions and perceptions: "risks" are part of a structure of meaning based in the security of those institutional settings in which people find themselves. Such settings interconnect the personal scale and the scale for example of organisations or political cultures. These cultural patterns are being constantly reproduced by people through routine social interaction, in their constant cultivation of a sense of security and autonomy. Institutions

Institutions are about the maintenance of social order and trust, whatever their more specific agenda. A sense of threat, crystallized onto discretely identified "risks" may then arise when these institutional processes break down or change into unfamiliar modes for whatever reason. A significant risk may be identified in the form of some external physical factor as the symbol of this breakdown. Conversely, the presence of some otherwise "significant" physical risk factor may occasion no sense of threat or risk if those institutional processes are operating more or less satisfactorily. Thus Rayner's fieldwork in hospitals specializing in radiological work, with regular use (and abuse) of radioactive materials, showed a virtually complete lack of concern for the heated controversy in society at large, about the effects of low doses of radiation (13). Risks were expressly recognized, so it was not a case of psychological suppression. But these risks were defined according to social relations in the institutional setting, for example, whether a plumber trusted technicians not to throw radioactive materials down the ordinary drains rather than the special "active" materials drains.

In a complex industrial society, characterised by high levels of differentiation, even fragmentation, these patterns of familiar cultural experience and commitment may vary a lot. Anthropologists who have studied risk controversies have identified a few basic systematic patterns, each with its own characteristic, underlying diverse settings and interactions. This is not the place for an exposition of this body of work, which has anyway been clearly described elsewhere (14). The main thrust is that social interactions can be distilled into basic styles demarcated by othogonal axes indexing degree of "grid" (roughly, how much an individual is constrained by others) and "group" (how strongly an individual's significant relations are socially bounded from others). These styles dictate forms of social experience, e.g., of control, cause-effect, unity, etc., which parallel experience of nature and the physical environment (15). Different rationalities derive from these different social roots. The point is that despite the normal crop of questions for further development, this cultural approach to the interpretation of risk conflicts offers a much richer and less loaded understanding of conflicting perceptions and their roots than do the essentially psychologistic ones which dominate present thinking on the issue. One can see how the definition of meaning of a physical risk issue will vary irreducibly between groups reflecting these different kinds of social experience. It is not a case of identifying cognitive factors causing deviation from some "objective" risk, but of understanding fundamentally different problem configurations, organically rooted in different empirical social experiences and agenda.

## 3. PERCEIVED RISKS - FROM EMOTIONAL SYMBOLISM TO EMPIRICAL SUBSTANCE

One of the associated tenets of the objective-perceived risks approach is that uncertainties in the scientific understanding of the objective risks are the origin of conflicting perceived risks - what regulators or industry representatives regard as marginal scientific differences over risks are believed to allow strong emotional forces enough room for extreme

polarisation of perceived risks. What is thought at any point in time to be a scientifically given amount of uncertainty is thus a resource for emotional licence: this not only polarises social perceptions but tends to pull scientific debate away from an otherwise natural consensus point. Some irreducible uncertainties are recognized especially in evaluation of dose-effect questions involving latent periods, chronic doses, statistical effects and multiple causes. But even apart from this category of scientific uncertainties, research has shown how even in areas with no external implications or interest scientists themselves are inconsistent about the extent or significance of uncertainty in their own specialty (16). In other cases they have been shown to relate their evaluations of the scale and significance of scientific uncertainty to underlying behavioural judgements. Campbell discovered that scientists' judgements of the scale of uncertainty in the environmental questions surrounding the proposed Mackenzie Valley pipeline in northern Canada, were systematically influenced by their tacit behavioural judgements about some key social questions such as whether the oil industry could really be regulated to build only at the correct times of the year, and whether one pipeline would lead to a whole "corridor" of associated developments (17).

In the Windscale Inquiry in Britain, similar dislocations in the basic meaning of the issue - the problem to be addressed - were created by different empirical predictions of the social behaviour of key interests. Thus the authorities, including Mr. Justice Parker the inspector, took the question as the immediate "factual" one, of the identifiable "objective" risks and benefits of a single new plant for oxide fuel reprocessing, THORP. The regulatory establishment or those culturally associated with it, could understand and trust the social system which would make subsequent decisions about proposed follow-on decisions as essentially separate issues to be divorced from the present one. However, to those outside this esoteric cultural milieu, the present decision had rationally to be evaluated in terms not only of any risks identifiable sui generis, but also in terms of the further power and autonomy it gave to that elite, historically remote decision making culture.

Given the uncertainties anyway surrounding the immediate "factual" dimension, the institutional behaviour and trust dimension naturally came more into prominence (though reciprocal influence also affects the level of perceived factual uncertainty). If concrete past empirical experience indicated that the authorities had acted by assuming that every single step was only a stage in the continuous growth of nuclear power it was rational of people to formulate an open-ended problem, and to condense all possible consequences of all possible future follow on developments onto the single THORP decision. Instead of recognizing and negotiating with this rational product of concrete social relations to the technology and its controlling institutions however, Parker abruptly dismissed the extensive definition as emotive nonsense - one more example of the perceptional bias from objectivity brought about by the usual catalogue of factors - psychological dread, hysterical media, etc. - carried by this traditional approach. As I have commented in a lengthier discussion of this issue (19), historical causation and the bounding of issues into "decision problems" will inevitably be objectively different from different positions in the web of social causation. Objectively different behavioural experiences and predictions will prevail; democratic processes would allow for some accomodation between these in the usual negotiation and formulation of a public issue. Imposition by fiat of the narrower definition of the problem and thus of the framework of the "objective risk" discovery question, was simply an authoritarian way of disagreeing with and obliterating rational empirically grounded behavioural predictions. The "objective perceived" risk approach in its general form is identical.

This is not in any way an evaluation of the specific contents of those experiences and inarticulate rationalities hidden by the pejorative language of "perceived risk" defined in relation to an imposed problem as psychological categories. For example, one does not have to support or deny the argument that the growth of civil nuclear power may increase the chances of nuclear war by horizontal weapons proliferation, to see that the supposedly psychological factor in nuclear risk perception - association

with Hiroshima - embodies an empirically grounded behavioural judgement. The judgement is about whether human institutions can realistically control the spread of nuclear weapons under conditions of extreme international competition in civil nuclear commerce, with ambiguous connections between the two sectors. Whatever the answer, this is not a merely psychological factor, but is rooted in social relations of the technology.

One behavioural prediction - that the institutions cannot control the problem - is dressed in such a way as to be presented as an emotive psychological reaction: the opposite prediction no more justified by any empirical evidence nor greater behavioural expertise, is buried in the public language controlled by the decision making elite as a taken-for-granted, natural setting for defining other, "objective" risks.

## THE SOCIAL CONDITIONS OF RISK - TECHNOLOGY AS SOCIAL PROCESS

The preceding argument has included the point that the objective perceived risk dichotomy is false, for one reason because "perceived risks" embody relevant empirical behavioural experience and predictions which reflect a different domain of objective risks; the further reason is that in addition to any physical uncertainties, "objective" risk definitions often themselves embody tacit behavioural assumptions. As I have argued elsewhere in relation to three examples, nuclear power, computer software systems and the safety of pesticides (20), the structure of control often places in key positions the very people-scientists - least fitted even to recognize that they have incorporated social judgements in their "objective" statements, let alone to make realistic ones. The conflict over 2,4,5 - T between the expert Pesticides Advisory Committee and the National Union of Agricultural and Allied Workers for example, has been a conflict about the relative significance of certain social conditions of production and use of the pesticide. The PAC took it that the prescribed conditions of use were fulfilled when they asserted the safety of 2,4,5 - T. Yet these behavioural predictions were woefully unrealistic in the empirical knowledge of the NUAAW, thus calling into question the whole universe of reassurance

cultivated by the PAC in initially ignoring the key social conditions as a trivial matter of implementation.

Parallel examples are not hard to find in the nuclear issue, whether relating to risk, downright viability, or both. As a typical example, we could examine Sir Alan Cottrell's view of the safety of PWR pressure vessels, and Sir Walter Marshall's interpretation of that view (21). Although Cottrell expresses himself reassured by later work of the Marshall Committee on this problem since its strongly criticized first Report in 1976, the conditions which Cottrell attaches to this view - about the extreme vigour of construction and inspection needed for safety - are arguably unattainable, according to one's behavioural predictions. By being underemphasized these behavioural judgements are tacitly incorporated into the scope of authority of the expert's pronouncement, yet there is no reason why this scope should cover such behavioural predictions. Thus what is widely quoted as the top expert's endorsement of the safety of PWR pressure vessels could just as easily be interpreted as the opposite.

The nuclear fuel cycle taken as a whole is replete with such dependencies upon behavioural disciplines previously taken for granted or at least optimistically assessed. This is no different in principle from other technologies, except for the greater elaborateness of nuclear technology and its image of exemption from such mundane realities. It is a complex <u>social</u> process. If even loyal professional insiders can get it wrong, then it must be widely evident that there are large opportunities for error by those who play a key role but who are not even trained and socialized into the nuclear industry - such as ordinary railway personnel with only occasional intersection of their concerns with the nuclear industry.

These are areas of experience which ordinary people can understand and relate to, more realistically perhaps than technical experts, and the more the latter are shown to have neglected these dimensions, the less trustworthy they are naturally seen to be. Once the precarious conditions of public trust in the responsible institutions have been breached, then it becomes natural for judgement of risk to be based on the worst possible

physical case, since there is no longer any credence given to the institutional behaviour that might restrict that physical possibility to an extremely low probability. In these circumstances if spent fuel skips containing millions of curies of activity are going through residential areas it is little use arguing about how well the skips are tested and how long it would take for fuel vapourisation. It is not that technical conflict over these questions creates social mistrust in the authorities, but more the latter creates the former.

Ironically the reaction to the growing realization of the importance of unrecognized thus relatively unregulated behavioural areas in risk management leads to programmes for greater behavioural control which can itself evoke a negative reaction (22). This is part of a general syndrome to which the nuclear fuel cycle may be particularly vulnerable, but by no means uniquely so. All areas of public life depend on much greater informal trust and accomodation between groups and individuals than is usually recognized. As the general conditions of trust in collective institutions break down, for example by the further spread of contractual relationships as is widely recognized, these collective interactions to which we are committed need to be regulated by formal "coercive" means to replace the dissolving informal accomodations. Yet once this process starts it reveals a virtually inexhaustible and impossibly large field of interactions to "externally" regulate (23). The dimensions of this process are indicated in the contrasting approaches to regulation in Britain and the USA. In the USA, mistrust is institutionalized in the political culture even in the constitution. Tranditional, informalised political authority is always highly problematic, so that institutions have to resort to formalised approaches - legal procedures,elaborate reference to "scientific" criteria and facts - to a degree which British authorities regard as neurotic. They tend to take for granted the authority of traditional institutions who are therefore freer to exercise informal discretion in interpreting statutes and regulatory criteria from case to case. If this substratum of authority in the political culture is undermined however, then reasons for decisions are demanded in public, and formal responses may have to be given. At this point the lack of unambiguous technical rationale for

decisions (as exposed for example by the cross-examination of energy or traffic forecasts) may become acutely problematic. The importance for policy viability of sustaining public trust in decision making institutions in far greater in Britian than it is in the USA, and thus places more of a long term burden upon the former.

## CONCLUSIONS

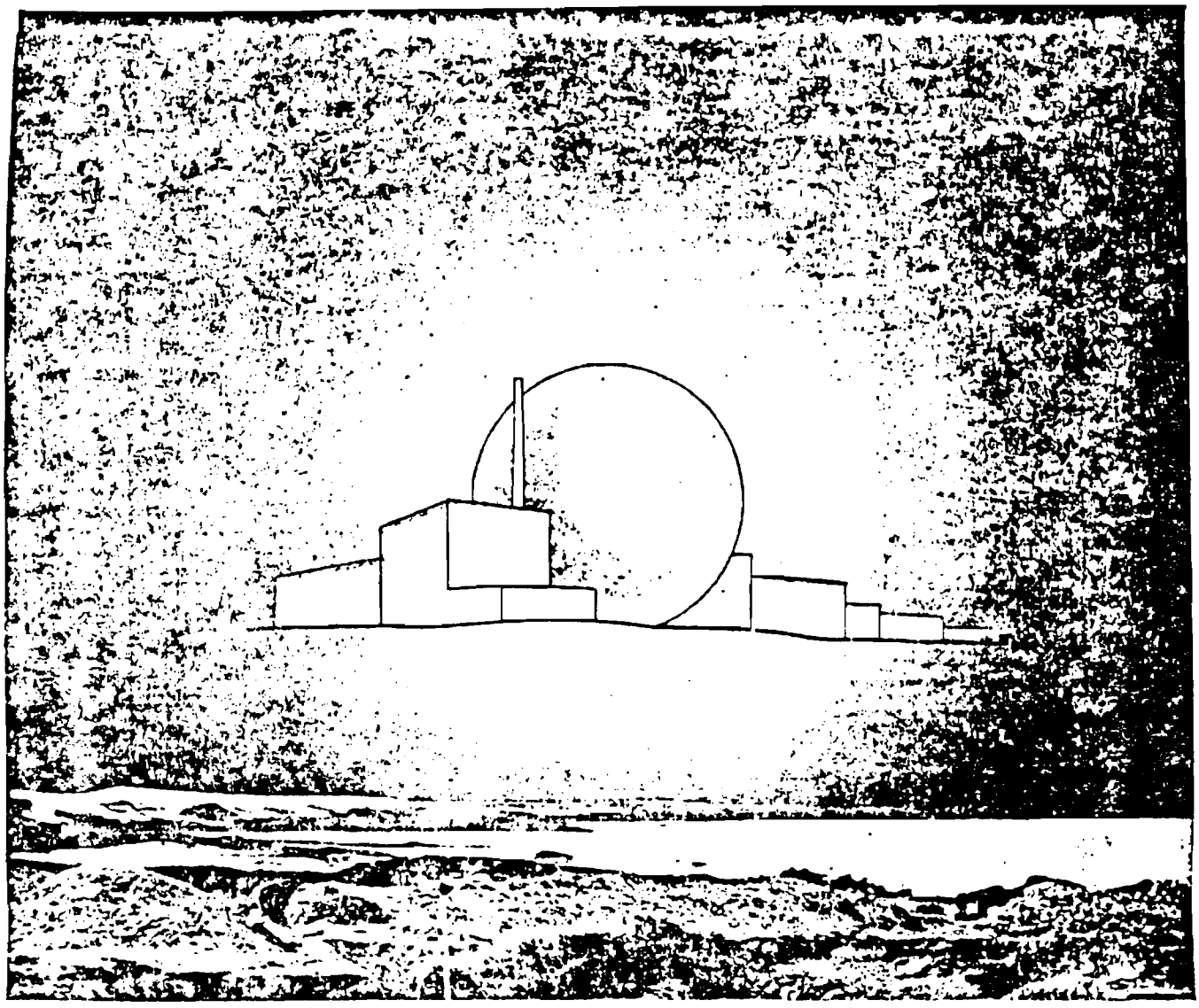
It is usual to assume that concern about the risk from some activity corresponds amongst other things with its degree of regulability. Yet despite the discovery of areas of intrinsic difficulty in regulation in the nuclear fuel cycle, in comparison with many other risky activities it is inherently easy to regulate. Compared to hazardous chemicals transport and disposal for example, where the number and variety of producers, transporters, and other handlers is vast and largely unknown, nuclear fuel transport is highly centralized, completely known (at least to the regulators) and small scale. The proportional resources devoted to the nuclear case are colossal compared to hazardous materials transport. In the USA for example, (24) over 200,000 million ton-miles of hazardous materials, in nearly 1.5 million vehicles are "regulated" by about 250 inspectors. Yet despite the furore over the USA EPA's Superfund for hazardous waste dumps, hazardous waste transport has not yet evoked the same level of general hostility and concern as nuclear fuel transport.

Indeed one could say that over the full range of activities, unregulability strictly defined is normal, and nuclear is one of the more regulable ones. As argued earlier the question is why so many risky activities, badly controlled are more or less accepted without much sense of risk; put this way the question highlights the positive role played by institutions in constantly reproducing and repairing social trust and reassurance. Risk is defined not so much by the penetration of some identifiable risk-generating factor, but by the mere absence of those familiar and traditional institutional supports which can be so strong as to allow people to live happily in the presence of "objectively" large risks. A "problem" such as the objective risk of some activity, central to a given decision maker (or decision analyst) may be an incidental item in a very different world of meaning to some other person or group involved.

Unlike abstract policy formulations, real political issues are never unicentric and self-contained. One of the basic tensions in politics is the regular tendency for specialist, single-interest, professional groups to distort the negative and flexible political interpretations of issues with their own artificially self-contained meanings of key prescriptive terms, such as "risk" or (as in the race-IQ controversy) "intelligence" (25). Intentionally or not this uncritically imposes single meanings whose artificial precision and objectivity conceals their questionable social relevance. It expresses a political bias by obliterating a whole set of normative questions to do with social relationships, historical commitments and their entailments, etc.

The conflict about the risks of urban transport of irradiated fuel is only the symptom of a deeper issue. Perhaps technical fixes could be found which could avoid the symptoms, for example by shipping all fuel to Windscale by sea and avoiding virtually all land transport. But this would only shift the expression of the symptoms to some other point. After more than a quarter of a century, nuclear technology including its institutions, is still not integrated into popular culture - largely through the unanticipated consequences of its own previous means of gaining authority. Figure 1 shows the kind of magical superhuman imagery cultivated even in sober reviews of the nuclear programme in the 1950's (26). We should not be surprised if there is tension when inevitably, the magical expectations confront the mundane realities, for example of spent nuclear fuel skips lying apparently neglected in railway sidings routinely accessible to children.

Nuclear power was launched and is still driven by a kind of apocalyptic, synoptic vision and commitment which accomodates very badly with the realities of its implementation, which are much more akin to the policy model of disjointed incrementalism - "a series of (relatively) incremental, remedial choices among a narrow range of options, reconciling only a narrow range of interests. The strategy works to the extent that interests and alternatives ignored at one step can assert themselves and demand attention at a subsequent step" (27).



# DOUNREAY—

## *to mankind will be the reward...*

Millions of people, with only a glimmering of what the Atomic Age can mean to mankind, stand amazed at the fantastic prospect of heat, light and power issuing from a source that cannot even be seen. These people of the world, for whom the atom will be harnessed for service, gather their news of this great new power, day by day, from newspapers, radio and television.

These men and women can feel a sense of pride in the achievement of harnessing this power for peace. We who are building the atomic station at Dounreay, and have learned the stature of the project, are honoured to have been entrusted with this major work—this heralding sign of the new age in Scotland's industrial life.

Figure 1: Atomic Symbolism 1956

The perceived risks of irradiated nuclear fuel transport are only a response to the objective reality of the integration of this activity with the rest of that impatient, culturally alien commitment. No guarantee should be expected that yesterday's practices have not already set in train today's and tomorrow's responses; nor that the results of their now demanding attention will not be paralysingly disjointed. The only feasible route is to recognize the social realities undelying people's cognitions, and take the risks of first, respecting them for what they are; and second, negotiating with them.

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