EMERGENCIES AND RATIONALITY
THE CASE OF THREE MILE ISLAND*

R.E. Shelton
Humberside College of Higher Education
England

The accident at the Three Mile Island nuclear power plant is analyzed from the perspective of rationality theory. Contrary to the popular view that operator errors are inexplicable, the concept of practical rationality reveals the subjective meaning of the operators' actions. It is argued that rationality is a valuable notion for the practical management of emergencies and man-made disasters, and that rationality is an essential element in the development of a sociology of disasters.

Introduction

Given the nature of modern processes in petrochemicals and nuclear power production there is always a risk that an industrial accident may become a disaster. Much depends then on the ability of managers in these industries to maintain detailed control over the complete extraction, processing, distribution cycle; and over operating procedures, operating behavior, maintenance work and safety standards. It has been an implicit assumption of scientific management that such ultimate control over production is, or will soon become, a practical reality. Recent events cast doubt on the optimism of such thinking as human errors in design, in planning, or in the response to emergency itself, show that initial estimates of system reliability are unrealistically high.

Such errors are not so easy to explain. To outside observers the actions of those in the organization may appear whimsical, negligent, or, more profoundly, inexplicable. Even after the

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research team has produced a collective picture of system failure, there often remains a problem over why the errors occurred in spite of all precautions.

Rationality concepts offer a research perspective based on individual actions. Essentially, such an approach is concerned with discovering what reasons guided the behavior of an actor in the event leading to a disaster. If reasons did exist, then the method encorages us to explain their historical derivation, to analyze their logical validity, and to relate them causally to the accident itself. In the absence of such reasons, however, we must look elsewhere for explanations.

The purpose of this discussion is to evaluate the potential role that rationality concepts could play in the study of mass emergencies and disasers. Our discussion is in three sections, *Accident*, *Rationality*, and *Implications*. The first section, which was based on the report of the President's Commission (Kemeny, 1979), places the events of the accident and consequent emergency within a contemporary social context. Although most of the description considers events in the Three Mile Island (TMI) control room, it is helpful to make this connection with wider issues in order to inform later analysis of the rationality of decisions. The second section develops a set of rationality concepts which are then used to evaluate the operators' behavior. The purpose of the evaluation is to assess the usefulness of rationality concepts to researchers--not to conduct another inquiry into TMI itself. The third and final section of the paper considers the implications of the preceding analysis for disaster researchers and emergency planners. Connections are made between rationality and other methods of explanation to locate the theme in the framework of organizational theory.

It is concluded that rationality offers a powerful unifying and connective principle for researchers and managers. It is, however, an approach that has numerous theoretical and methodological flaws and limitations. In the absence of the term it would be possible to reach similar practical decisions and to avoid a number of misleading assumptions that the term connotes. But, on balance, the notion of rationality is an indispensable part of explanation and management.

The Accident

Context

The Kemeny Commission Report contains the following introduction to the Three Mile Island accident,

> "On Wednesday, March 28th 1979, 36 seconds after the hours of 4.00 a.m., several water pumps stopped working in the Unit 2 nuclear power plant on Three Mile Island, 10 miles south east of Harrisburg, Pennsylvania..." In the minutes, hours and days that followed, a series of events - compounded by equipment failures, inappropriate procedures, and human errors and ignorance - escalated into the worst crisis yet experienced by the nation's nuclear power industry". (Kemeny, 1979:101).[1]

The United States Government ordered an immediate investigation of the accident and its aftermath.

No aspect of organizational life can be studied properly unless connections are made between the actions people take, the meanings their decisions have for them, and the wider social, economic, and technological culture. Three Mile Island cannot be appreciated fully unless certain, ostensibly indirect, features of its environment are considered.

The plant was one member of a generation of facilities created in response to a perceived need of U.S. energy policy to be independent of Middle East Oil. Regarded in some government circles as a comparatively inexpensive long-term investment, and by some scientists as a clean and safe source of energy, nuclear power appeared to solve many political-economic problems at once.

To some extent such an assessment always depended on the exclusion of certain costs from the calculations. Nuclear power imposes high costs on the localities in which uranium extraction occurs, and later in the production cycle, involves investment in safe, long term waste-disposal capital. But the crucial problem in this case was the cost of safe plant operation. By many other industrial standards the safety regulations in nuclear power plants are lengthy, complex and very detailed (cf. Patterson, 1978:192ff). Three Mile Island illustrated that there still comes a catastrophic point when capital investment costs run at such high levels that there is a conflict between sales revenue and safety. Since "safety" can appear to be an indefinite and distant goal, eluding immediate attainment, it may seem reasonable to decision-makers to proceed with operations that might, with hindsight, have been better postponed until safety weaknesses had been rectified.

In 1978, the year before the accident, the plant had been under repair for 195 of 274 operating days. Many problems concerned valves: on April 23rd, the main steam relief valves

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1 The present account of events has been compiled largely from the staff reports to the Presidential Commission under the Chairmanship of J.G. Kemeny.

failed; on September 20th and 25th, feedwater valves failed; on October 13th the electromatic valve on the pressurizer failed. As it became increasingly urgent to go inte commercial operation, an inspection by the watchdog Nuclear Regulatory Commission found thirteen areas of improperly or inadequately completed operating procedures. Still the plant opened in time for the New Year and had managed 40 days of operation by 28th March 1979 when the accident occurred.

Outline of the Accident at Three Mile Island

Three Mile Island is a pressurized water reactor. Heat from nuclear reaction is transferred to pressurized water which circulates continuously in a closed system. The high pressure prevents this water from boiling. Water in a low pressure system next to this is allowed to boil and the steam which results powers a generator. Meanwhile the water in the pressurized system, the so-called primary coolant system, is being pumped back to the reactor.

Each loop in the coolant system contains a pressurized vessel in which a certain amount of water is evaporated or condensed to maintain coolant pressure and control the system in general. It can be pictured as a pressure cooker. It is intended to remain half-filled with water. The other half is an air bubble under pressure. The main task is to adjust pressure here so that the water in the core does not boil and turn to steam. The correct pressure for this is 2,155 pounds per square inch. If pressure is too high a valve is meant to open: and if pressure is too low the valve closes so that the bubble expands. In this way equilibrium can be maintained.

The pressurizer relief valve presented two problems for the control room. It was an unreliable piece of equipment and had failed completely, or leaked, on many occasions. The operating company, Metropolitan Edison, had installed a light in the control room to show that the valve was either open or closed. But this presented the operators with another problem, because the light actually indicated electricity supply to the opening mechanism, not the position of the valve. Operators could only infer that it was open or closed.

The accident began when a maintenance crew, who were cleaning the secondary system which takes steam to the generators, accidentally caused a leak of water into an air system which controlled the plant's instruments. This had the effect of automatically closing valves on the pumps which send water to the turbines. The valve failure initiated an automatic shut down of the reactor and water flow ceased. Pressure in the pipes rose and the pressurizer valve opened as it was meant

to do. *But when the pressure fell, the valve did not close as it should, though the light in the control room indicated that it had.* Steam escaped rapidly, so that pressure fell to 1,640 p.s.i. and the water began to boil. As the steam generators now started to boil dry, an automatic emergency coolant system started.

The first mistake of the plant operators was to fail to close the valve, in spite of numerous warning signs that they should do so. Indicator lights suggested that the bubble inside the pressurizer was diminishing and water was filling the tank. This is called going solid. Because going solid can damage the reactor, operators are trained to avoid it at all costs. *So when the operators saw the signs of a saturated tank, they shut off the emergency system.* This was their second mistake and much the more serious of the two. The reactor was now not being cooled by water and was boiling dry. In the reactor, the cladding around the fuel began to decay causing increased levels of radioactivity in the coolant water. Eventually, two hours into the accident, someone identified the problem and the pressurizer valve was closed.

They were still not out of trouble, as radiation levels increased and contaminated water overflowed in the reactor building and into an auxiliary building. Hydrogen gas began to form in the core; it was potentially liable to explode. Temperatures were very high, off the scale of measuring devices; *but the operators had two measures of temperature and they believed that the higher one was a faulty recording. In this was they could hold a quite erratic view of events, failing to diagnose that the core was uncovered -- which is a very serious occurrence.*

Behavior in the Control Room

The control room of Three Mile Island was a badly designed work place. It contained a large and confusing control panel, many of the dials on which had been obscured by labels, tags and messages. Some plant functions were monitored on back panels out of sight of the operators. The form of information presented by the equipment in the control room required considerable integration and interpretation by the operators. Whilst *these operators were comparatively above average in ability, they were high school graduates who did not possess deep theoretical understanding of the process they were controlling. Their actions were based on procedural learning rather than diagnostic ability.* Viewed from the perspective of the operators' intentions, their actions take on a more comprehensible form.

The operators failed in four diagnostic areas. (1) They failed to recognize that they were dealing with a loss of coolant accident, instead believing that there had been a break in a steam line because there had been no radiation alarms. Some of the symptoms which they might have used to determine the true state of affairs were the drop in reactor coolant pressure, the high levels of water in the reactor building, the reactor building temperature alarms and increasing radiation levels. (2) They failed to regognize that the pressurizer valve was open. Instruments said it was closed. A computer printed a warning about a high temperature near the valve, which could have been interpreted as an open valve, but it came far too late to be useful. Eventually this valve was closed when operators checked a safety valve behind it and found that this had also been left open. (3) They failed to recognize that the plant was filling with steam. Essentially this was because they thought there was no leak in the coolant system and that emergency actions had overfilled the pressurizer with water. (4) They failed to recognize the need to remove heat from the system. Temperatures rose in the reactor as water levels dropped. A computer printed out a line of question marks to show that this was happening, but no-one knew what this meant. A technician reported very high temperatures in the core--actually the fuel was melting--but the operators saw this as an error in the recording equipment. They failed to see that high temperatures and low pressure in the system must imply an uncovered reactor core.

Scientific analysis might study the psychological background to such human factors problems and consider impersonal constraints such as information processing capacity and perception; but here we consider the intentions the operators had in mind, the reasons for their actions, and ask whether or not, at a practical level, they behaved rationally.

Rationality

The notion of rationality is frequently used to convey a traditional model of decision-making processes in organizations. A recent analysis and criticism of this model described it as follows:

> "In conventional terms, the task of making a decision can be decomposed inte five subtasks: (1) identifying the relevant goals; (2) searching for alternative courses of action; (3) predicting the consequences of following each alternative; (4) evaluating each alternative in terms of its consequences for goal achievment; and (5) selecting the best alternative for achieving the goal." (Anderson, 1983:201-202).

Such rationality has been criticized on empirical and analytical grounds by many writers (notably Simon, 1976, and Weick, 1979). Individuals are unable to consider many alternatives in detail and, in any case, organizations' social and political processes, with their complicated power relationships, do not, and could not, work in the manner implied by such an account (Burrell and Morgon, 1979; Dahl and Lindblom, 1953; Lindblom, 1959; Nicolaides, 1960; Silverman, 1976).

This mechanistic view of rationality is inappropriate, but it is also unnecessary. In its place we can use a concept of practical rational action which does recognize social psychological evidence and retains the fundamental view of purposeful behavior necessary to organizational management. Following the work of Benn and Mortimore (1976) rationality can be regarded as a formal or practical concept.

Formal Rationality

Formal rationality is concerned with the logical status of our aims, beliefs, or actions. In organizations, aims are implicitly or explicitly given in the structure of rules and tasks. More generally they are available in the national culture or local subculture for individuals to make sense of, or rationalize, their behavior. Anderson (1983:211-212) gives an example of Robert Kennedy's intervention in the Cuban missile crisis debate in which United States moral traditions were brought into the argument against a surprise air attack on Cuba. Formal rationality constists in holding a belief on the basis of evidence, inference or experience, in maintaining logical consistency between beliefs; and in adopting a critical attitude to beliefs by altering them when faced with disconfirming evidence (Lukes, 1977:194-213).

Practical Rationality

Since people in organizations are concerned with practical action, it is reasonable to adapt the requirements of formal rationality to their situation. Practical rationality behavior is defined as an action taken for a good reason in the light of the person's aims, beliefs and abailities at the time. This does not suspend all evaluative standards since there is the "good reason" requirement in the definition; but neither does it ignore the subjectively meaningful aspects of practical behavior. Mortimore (1976:93-110) uses "good and sufficient reason" to argue that the rational actor need not choose the best option, but should see the "best" as only one way to meet the "good and sufficient" criterion. In this view, making decisions without

deliberation on the basis of know-how is perfectly rational, and so is acting on technical rules which apparently apply to a specific case.

Practical Rationality and the TMI Control Room

The evidence of the accident reports clearly showed numerous irrationalities at the formal level including the four crucial diagnostic errors described earlier. But it is misleading to drop all reference and regard for rationality concepts since, as a social action theorist would recognize and expect, actions that may seem erratic, random and bizarre, can sometimes be explained by reference to their subjective meaning for the individuals concerned, i.e., practically rational.

Interpretation of the accident reveals a number of practically rational, "good reason", actions--though it also shows up some inexplicable.

When the first feedwater pump failure occurred the operators began to use emergency procedure for a turbine trip. But as temperatures increased the reactor stopped (scrammed) as well. When they observed this, the operators began a different and quite appropriate emergency procedure, with the reasonable intention of stabilizing the plant at a specific temperature and pressure. If they could succeed in this, then the heat, which was still being produced by the reactor after close down, would be removed. As part of this procedure, they checked that the auxiliary water pumps had started, which would maintain necessary coolant levels. But these pumps were, in fact, out of action after a maintenance crew, contrary to regulations, had left two valves closed "by mistake". The control room operators now failed to see the two lights, one of which was covered by a tag, which would have told them this. No explanation has been forthcoming as to why the operators did not look at these lights.

The operators hoped to control the plant through the changes they could make to the level of the pressurizer. They first needed to achieve a certain normal level of water in the pressurizer. Their understanding of events up to that point of the reactor scram, was that the pressurizer would be emptying as temperatures fell and the water cooled. But they observed that in practice it was filling with too much water. Failing to make use of signs that the pressurizer valve was open, that steam bubbles were blocking the cooling system, forcing much needed water out of the open valve, and that the pressurizer itself was filling with steam, the operators began to close the automatic emergency cooling system which was all that stood between them and a plant disaster. The system now began to boil dry.

These actions then were practically rational in that, given the beliefs they held at the time, the operators were choosing appropriate means to achieve the result they desired. Their failing lay in not taking all relevant factors into account. Soon they began to distrust their instruments, but persisted in holding to their interpretation of events based on the non recognition of the open pressurizer valve.

When it was noticed that the valves in the emergency cooling system were closed, the operators immediately opened them. For a time, temperature and pressure in the reactor appeared to stabilize. But unseen deterioration was still occurring. As coolant levels decreased, steam and heat increased. The operators intended that natural circulation of water at different temperatures would keep the reactor cool. This was being prevented by steam bubbles in the cooling pipes. The fuel began to disintegrate in the heat, releasing radioactivity into the coolant water. But the operators refused to believe that temperatures were so high, firstly by assuming that the measuring equipment was wrong, and secondly by failing to correctly interpret that super-heated steam in the reactor was evidence of an uncovered reactor core. It was only when the observed high radiation levels in a sample of coolant water, and when radiation alarms began to sound in large numbers, that the plant staff called a site emergency, effectively resigning independent control over events.

This unhappy catalogue of errors illustrates the discontinuity between an organization and the individuals within it. Operators were not able to understand what was happening for three main reasons. Firstly, they had not been given training which would have prepared them for the interpretive requirements of controlling the plant. Secondly, the control room did not present them with information in a form that matched their decisional needs; data were scattered and misleading, and were not available when they were needed. Thirdly, the emergency procedures the operators had been taught to use were not matched to the data system and the operators' training; essentially,the operators had to know what was wrong before they could find a procedure to put it right; but they had no way of translating symptoms into diagnosis.

The evaluation of operator rationality during the accident must recognize several structural limitations to the scope for rational action. In order to process information effectively, the decision maker needs to be able to relate data in accordance with a framework of understanding he/she has derived from theory. It is possible for someone to perform many routine actions simply by virtue of possessing a procedure; but non-routine

events, by definition, leave such an automaton helpless in the face of novelty. The training received by control room operators was divided between two organizations poorly co-ordinated with one another. Babcock and Wilcox and Metropolitan Edison. At Babcock and Wilcox, where operators were taught the principles of plant operation, there was little chance for them to develop a theoretical appreciation of the plant they controlled. As the Kemeny Commission noted,

> "Operators were not provided with a fundamental, comprehensive, understanding of their reactor plant design and operation which would enable them to recognize the significance of a set of circumstances not explicitly predicted by the operating procedures and which would lead to place the plant in a safe condition."

In failing to recognize a loss of coolant accident, many symptoms were missed which would have provided more expert staff with a correct interpretation--reactor temperature alarms, rapid and continuing decrease in reactor coolant pressure, and increasing levels of radiation. But the relevant procedure for a loss of coolant accident was included in training only once during the year preceding the March crisis, and then it was not given much attention.

The operators had been trained to work according to procedures (Malone, 1980:13):

> "operators were conditioned to avoid having a solid pressurizer; therefore they attended almost completely to pressurizer level and neglected reactor coolant system pressure. This conditioning was derived directly from Three Mile Island 2 Technical Specifications."

Furthermore, the training they received made it difficult for the operators to select the correct procedure to suit circumstances. Procedures were labelled by the type of problem, e.g., "large loss of coolant accident", but the operators had a set of symptoms to deal with, not a problem label.

In summary, for an operator to act rationally, he requires more than an accurate procedure. He needs training which will enable him to diagnoze the problem he is attempting to solve. Where such training is absent, it is incorrect to evaluate their actions by stronger criteria than is consistent with their training. Training appears to have had a negative influence in directing actions along totally inappropriate paths.

Interpretation

The TMI accident is an important issue in itself, but it is

of additional significance in its illustration of the rationality concept in the study of mass emergencies and disasters. Firstly, responses to major emergencies in the United States and the United Kingdom already involve the co-ordination of knowledge in diverse sciences, including applied social sciences. But in sub-systems of emergency response there is a tendency for rationality to be neglected. These areas are: "operator" training in the subject organization in which the accident took place; the training of emergency response teams; and in the preparation of the general public, both in the evacuation areas and those elsewhere who will be informed about the accident by the media. This area of application is termed Action Rationality for the following discussion.

Secondly, it is interesting to analyze the paradigms and styles adopted by sociologically based writers on emergencies, and to consider how rationality might be used by them. This area of application examines the possible contribution of rationality to the methodology of sociologists of emergencies and disasters. It is termed Rationalist Methodology for the purposes of the discussion which follows "Action Rationality".

Action Rationality

The accident at TMI offers numerous leads for those concerned with organizational behavior in emergencies.

(a) Intentional Rationality. Non-routine circumstances invariably require operators to go beyond procedures. Procedures designed for normal circumstances and foreseeable crises often fail to cover emergency conditions in full. Operators will behave reasonably according to their own beliefs, abilities and resources. To improve emergency behavior it is necessary to base the operator's knowledge on sufficient theoretical foundations to enable him/her to achieve an effective diagnosis and action, or to make an immediate and effective referral to someone who does possess that understanding.

(b) Human Factors Rationality. Systems are often designed haphazardly and achieve low levels of integration between the requirements of technical specifications and decision or diagnostic information needs of operators. Study of the decision and diagnostic actions of operators as practically rational actors will aid the development of effective interfaces between technology and people (cf. Malone, 1980).

(c) Team Rationality. Emergencies tend to demand the creation of new coalitions of organizational staff, often, as in the case of TMI, reaching across organizational boundaries. It is a basic proposition of systems theory that each problem possesses a distinctive boundary, but too often the complexity of the

boundaries which arise in practice create new problems of their own, as happened at TMI in the interrelation of the plant, the Nuclear Regulatory Commission and the Pennsylvania Emergency Management Agency. Each component element in such plural coalitions tends to adopt its own rationale, shared premises and decision logic. The demands of crisis situations are not conducive to the early resolution of the conflicts between teams, with the result that mistakes are made and important decision factors are overlooked. An example in TMI was the misinterpretation by the Nuclear Regulatory Commission (NRC) of a planned radiation release on March 30th, 1979 when they wrongly supposed there to be a danger of widespread contamination. Training needs to be extended to such temporary sub-systems and at an appropriate level of abstraction--i.e., one dealing with practical actions. The singularity and simplicity of planning documents is giving way to multiplicity and complexity. But this sophistication must be matched by extensions to organizational training so that plans can be implemented effectively.

(d) Rationality and Community. It has been recognized for some time amongst disaster researchers that the public do not often respond to a threat with blind panic (Wenger, Faupel and James, 1980). Instead, altruistic and organized behavior is the norm. However, there remains a tendency amongst bureaucrats to deprive the public of information, give the public false information and to exclude the public from decisions. Within the organization experiencing the accident, or amongst those agencies such as Red Cross, or the National Guard, who cope with the aftermath, there are tendencies to take on a professionalized attitude to the public, "for their own good". Often this is very desirable in itsel since it is in this way alone possible to deal with large scale emergencies.

But it is a necessary condition of effective response that the public are able to base their decisions on reliable information about the hazard, and the roles of the various agencies in relation to the public during the crisis. This is notwithstanding the requirements of local political democracy for the involvement of lay people in socio-technical and ethical decisions (cf. Shrader-Frechette, 1980).

In summary, the concept of rationality offers a number of productive leads for organizational planners aiming to cope with foreseeable disasters. It provides a core concept of rational action upon which training and organization of operators, teams, and the community can be based. Discussion now turns to the consideration of the role of the concept of research.

Rationalist Methodology

On the basis of Astley and Van de Ven's (1983:246-273) recent classification of the diverse schools of organizational thought, we can locate rationality as a "strategic choice theory". This view emphasizes the voluntaristic nature of behavior within organizations. It is in contrast to the system-structural orientation which focusses upon deterministic contingencies in the organization's environment. Some writers have adopted a pluralistic style containing insight drawn from both schools. To take one example (Turner, 1983), accidents may be studied using "grounded theory", a concept developed by Glaser and Strauss (1967) for the analysis of quantitative research data. In grounded theory, the researcher derives theory directly from phenomena by discussion of the concepts people use to discuss features of the data. Such methods of analysis often produce material of apparent relevance to those involved in the events themselves.

Turner analyzed three disasters (for the purposes of this argument); they were the Aberfan, Wales, waste-tip disaster 1966; the Hixon, England, traincrach 1968; and the Douglas, Isle of Man, England, fire of 1973. Seven major causal components were identified, and they can be closely matched to the reported events at Three Mile Island.

"1. *Rigidities in perception and belief in organizational settings*. Within several of the organizations concerned, understanding ... was limited by the existence of pervasive sets of beliefs ... built into the structure of the organization concerned ..." (Turner, 1983:333).

At Three Mile Island the belief that events could be handled by procedures, obscured the true demands on operators in crisis for which no procedures had been designed.

"2. *The decoy problem*. In a number of instances where some hazard or problem was perceived, action taken to deal with that problem distracted attention from the issue which eventually caused the trouble." (Turner, 1983:333).

At Three Mile Island, operators focussed on pressurizer levels and neglected other indications that would have aided accurate diagnosis of the situation.

"3. *Organizational exclusivity: disregard of non-members*. In some of the cases analyzed, individuals outside the organizations concerned had perceived the danger, and had complained, only to meet with a high-handed or dismissive response." (Turner, 1983:333).

At Three Mile Island management received several warnings about failures of pilot operated release valves and other matters but did not act on them in time to avoid the accident.

"4. Informational difficulties ... wrong or misleading information was transmitted, information was distorted in transmission, was buried in a mass of irrelevant information, and was suspected because of distrust of the person conveying it." (Turner, 1983:333).

At Three Mile Island all of these dysfunctions occurred--the misleading control panel, the distortions of messages sent from plant to NRC or from PEMA to NRC are examples.

"5. Strangers on complex sites ..." Here Turner is referring to noteworthy data provided by the public or outsiders who had avoided the socialization process. It was an outsider who made a crucial diagnostic intervention some hours after TMI's accident had begun.

6. "Failure to comply with regulations already in existence" ... The Presidential Commission found numerous failures to comply with NRC regulations and indeed whole areas of operation which were known to staff of TMI to be unsafe.

7. "Minimizing emergent danger ... Repeatedly individuals underestimated possible hazards, minimized emerging danger, disagreed with others about emerging danger, and failed to call for help in situations which would, *to the outsider* (my emphasis) seem to have demanded such a response."

At TMI, the danger of uncovering the core was unrealized for some time. Later, there were to be inter-group conflicts over the likelihood of a hydrogen gas bubble explosion, and over the need for local evacuation.

This classification of Turner's is drawn from grounded theory and is recognizably valid as a depiction of events at TMI. Since Turner uses grounded theory and not rationality to arrive at his classification, however, it might be argued that the latter term is redundant. Clearly it is possible to achieve scientific and practical understanding without using the rationality concept. But the argument for adopting such a framework is persuasive.

What is "revealed" by the the apparent behaviorism and neutrality of grounded theory is a disguised version of rational action theory. Much depends on the implied existence of a subjective actor with a meaningful though distorted view of the working of an organization with others who are similarly placed. References to the disregard of non-members can be seen as parallels to the rationality notion that groups develop their own distinctive logics and define themselves as specialists in the use of them to the exclusion of strangers. Underlying explanations for information distortion, minimizing dangers, and operating unsafe plans can be constructed to show how intentionally rational work behavior, seen from the inside, can

be appallingly erratic to outsiders (e.g., Zimmerman, 1974:221-238).

Rationality thus provides a necessary explanatory concept of action that is useful in the description and in the evaluation of behavior. It would be better to recognize that it is implicit in such social explanation in the first place than produce apparently theoretical frameworks carrying no logical substructure of their own. Most actors refer to the intentional rationality of their personal actions, but it is important to extend a reflexive compliment to other people and to avoid reifying their actions in impersonal abstractions.

Apart from its explanatory value, rationality encourages the formulation of hypotheses at various levels across several disciplines. The text of an accident can be interpreted to show how it was possible for actors to respond inappropriately, perhaps showing their mistaken beliefs, or their use of incorrect rules or procedures, but in the end maintaining a view of the world that is consistent with reasonable behavior. The same practically rational action can be used in economics, law, or philosophy as a condition of explanation, without implications of calculative utilitarianism. In psychology, it offers a contribution to motivation or attitude theory. In anthropology, rationality again offers a theoretical framework for the interpretation of belief systems in other cultures. A concept of action which can be applied so generally is of great value.

For the disaster-research community, rationality theory provides a connective and unifying link with traditional disciplines. Through this link it will be possible to extend and to elaborate work done in other disciplines and contribute to them.

The major contribution of rationality theory to the study of accidents and disasters is to model-building assumptions. An understanding of the subjective actions of people in disaster zones and disaser sub cultures could inform the planning process in sufficiently detailed form to improve predictive accuracy and to make relief aid more specific to needs. Inaccurate or over-simplified assumptions about individual reasoning and group action can be replaced in this way by more authentic and detailed plans which relate probable community responses to features of the threatening situation. But rationality does have limitations for social scientific theorizing. Abelson (1976) gives three basic problems with the concept.

First, rationality appears presumptive in its assumptions about cognitive abilities. The individual is supposed to have

goals and in order to reach them successfully he processes large amounts of information. But the history of psychology shows the gradual realisation of the limitations of human information processing. Rather than build models of behavior which presume a calculative or deliberative personality, it would be better to deal with actual psychological processes in the first place. This problem has been obiated by defining a practical rationality of action.

Then Abelson suggests that rationality is pre-emptive in its "search for the idealisation that isn't there", which is "a less productive research strategy than finding out what is there" (Abelson, 1976:61). There are two particular cases of this. First, if we search for rationality we tend to find it, even if we must alter our definitions to do so. Secondly, the concept overrides a number of competing and potentially informative alternatives. But Abelson recognizes that an assumption of rationality has been productive in his own subject area dispite the problems it involves. The theory of cognitive attitude consistency for example, is derived from just such an assumption made with recognition of the individual's distorted view of reality. As to these points themselves, the assumption of rationality is more than that: it is still possible to conclude that the phenomena have not been explained by its use. Also, the fact that it overrides other explanations is a necessary element in any methodology; what must be justified is the usefulness of doing so.

Finally, Abelson regards rationality as prescriptive--"if the observed behavior is not rational, it should be," it appears to imply. There will be a tendency for social scientists to be biased towards rationality by virtue of their training and purposes. Many accounts of social life have been over-rationalized in this way, not least the literature on management and organizations. The concept has several weaknesses. It appears almost infinitely malleable. There always exists some level at which the operators could be regarded as rational, but, on those occasions where even this fails, the analysis must simply fall silent. If a reason cannot be found, further hypotheses may be hard to generate from this theory.

Certainly rationality is a limited concept. It cannot alone predict what is likely to happen in the future, but must await events until it can be used in evaluation. It is not a measurable notion which might allow fine discrimination or comparison to be undertaken by researchers. And it focusses on individuals at the expense of social systematic, historical, or structural perspectives.

Conclusions

Analysis of the accident at Three Mile Island nuclear power plant in 1979 illustrated the role of a practical rationality concept in the understanding of organizational behavior in emergencies. By using this concept it is possible to explain key aspects of man-made disasters, whilst preserving an underlying account of reasonable behavior which can apply across a variety of subject fields. The concept has been shown to offer practical leads to managers of organizations to reinforce the capabilities those organizations possess for rational response. Similar recommendations have been extended to emergency planning organizations concerned with community response. Finally, the concept has been evaluated for its explanatory proposals are more qualified by recognized limitations, but it is suggested that certain dangers inherent in impersonal social theories may be avoided by use of the notion of practical rationality.

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