



A Psychological Perspective of the Nuclear Energy Controversy

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A PSYCHOLOGICAL PERSPECTIVE OF
THE NUCLEAR ENERGY CONTROVERSY

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Preface

Among the important considerations in the development of energy systems are the constraints imposed by the risk of various technologies. Clearly, that risk involves not only the possibility of physical or biological harm to a society, but also the potential risk to the psychological well-being of people, perceiving a certain risk situation. One of the aims of the Joint IAEA/IIASA Research Project is to identify the determinants that may influence the public perception of risk from various energy systems. In particular, this paper deals with the psychological aspects of the perception of risk of nuclear power plants.

Abstract

This report concerns the following: 1) the nuclear energy debate as a focal point for a wide range of societal concerns; 2) general considerations regarding the impact of technology on society and on the individual; 3) psychological determinants in the nuclear energy controversy; 4) potential symbolic constraints posed by nuclear energy; and 5) the possible role of social-behavioural researchers in the nuclear energy debate.

A Psychological Perspective
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INTRODUCTION

In recent years there has been evidence of increasing resistance to the continued expansion of technology. Many of the industrialized nations are experiencing a period when contemporary values are being questioned. Plans for further development of large-scale technologies are being met by a variety of demands for closer examination of the potential benefits and risks to human health and well-being. Of particular interest, at the present time, is the dramatic public response to the siting of nuclear power facilities witnessed in many countries (Federal Republic of Germany, France, Japan, Sweden, and the USA). One of the goals of the Joint IAEA/IIASA Research Project is to explore such issues from a multi-disciplinary viewpoint. In this context, the social-behavioural scientist is consulted for insights regarding the impact of various technologies on psychological, social and cultural systems.

Although historically one can trace the scientific concern regarding the safety of nuclear energy to the date of its inception, it would appear that greater public interest emerged with the ecological-environmental confrontations of the late 1960s. Even more significant, as an alerting historical event, was the energy crisis of late 1973. As a result of the announced plans by many industrialized countries to accelerate nuclear energy programmes, public awareness of the aspects of nuclear energy was increased.

The contemporary concern for the social, economic, political, and psychological aspects of the nuclear energy debate has been clearly portrayed in statements by scientists and political leaders at numerous international meetings and in reporting by the mass media. The reaction to this particular technology has ranged from relative public indifference to wide-spread anxiety. In some countries the resistance has been so challenging as to stimulate serious social and political discussion. In several cases it has resulted in government decisions to halt further construction of nuclear power facilities.

This paper addresses some of these issues from the viewpoint of a behavioural scientist. The following topics are discussed:

- I) The nuclear energy debate as a focal point for a wide range of societal concerns;
- II) General considerations regarding the impact of technology on society and on the individual;
- III) Psychological determinants in the nuclear energy controversy;
- IV) Potential symbolic constraints posed by nuclear energy; and
- V) The possible role of social-behavioural researchers in the nuclear energy debate.

I. THE NUCLEAR ENERGY DEBATE AS A FOCAL POINT FOR A WIDE RANGE OF SOCIETAL CONCERNS

The energy crisis of October 1973 served as a temporal catalyst to increase public awareness of world energy resources, demands and constraints. Many of the industrialized countries, stimulated in part by a desire to achieve economic independence from mounting oil prices, accelerated their existing nuclear energy planning programmes. Until this time the nuclear industry had developed slowly but steadily. Reactor facilities were usually constructed in remote locations where the public reaction, if it occurred, was geographically limited. The coverage provided by the mass media was generally less evident than that seen today. Clearly, the issues were not of such global interest and intensity as witnessed over the past several years.

The response to nuclear energy programmes, so evident in the USA, Sweden, Japan, and Western Europe, might be understood on one level, as a generalized resistance to increasingly complex technological systems. Standards of living have improved considerably during this century, largely due to the benefits made possible through the development of new technologies. As technological systems have become larger and more complex, they have offered increasingly attractive benefits that have become an integral part of life, thereby creating demands for more progress. This process of reinforcement has led to increasingly complex and therefore potentially fragile systems.

With the expansion of technological systems, the negative side-effects, which detract from the societal benefits, received more attention. Some of these side-effects, such as new safety hazards, have been rather obvious, while others have been more subtle and therefore more difficult to predict and detect; for example, new health hazards, complicated environmental interactions, unemployment, mental health problems, and changes in basic social institutions.

Consequently, there appears to be a growing awareness that increased consumption of goods and services has not always brought

a commensurate increase in "happiness". The resulting societal response has been observed in the emergence of attitudes that regard much that is new as potentially harmful; the fundamental value of science to society is also being questioned. A variety of individual and group demands have been put forward for a closer examination of the benefits and risks of technological innovations.

The social confrontation has seemed to centre on nuclear energy as the most recently developed example of the continued proliferation of technology. Attention has also been directed to a closer scrutiny of the values and attitudes implicitly embraced by societies with large-scale technologies. Such issues as: the "rate of growth" of societies; national levels of energy consumption and "life style"; the non-transparency of bureaucracies involved in the development and maintenance of energy-expansive economies; the "ethics" of progress; the acquisition and distribution of power and wealth in developed and developing countries; the responsibility of decision-makers and leaders; their responsiveness to the dehumanizing effects of large-scale systems; and risks to man and his environment--all have emerged as important considerations in the nuclear energy debate.

Thus, the nuclear energy debate may be viewed as an important historical arena for considering a wide range of societal issues. These issues extend across national boundaries, affect large groups of people, and may influence the future health and well-being of mankind. It is therefore critical that as many perspectives as possible be provided, so that the determinants of this controversy may be understood.

In the next section, the impact of technological expansion and cultural change on the individual and society is considered.

II. GENERAL CONSIDERATIONS REGARDING THE IMPACT OF TECHNOLOGY ON SOCIETY AND ON THE INDIVIDUAL

One of the potential opportunities afforded by the nuclear energy debate is that of a "breathing period" in which to examine the available knowledge regarding the impact of technology on societies and on the individual. The sense of urgency often expressed by those committed to searching for and developing new energy options only serves to support the prevailing practice of continued technological expansion and an accelerated rate of growth. Perhaps what is provided by the nuclear energy debate is a forum to evaluate philosophies underlying the energy policies of developed and developing countries. For several decades the social and behavioural sciences have been documenting the negative, depersonalizing aspects of technological expansion. However, this information rarely reaches the recognition or awareness of those responsible for advocating energy-expansive systems. Such scientific knowledge might be

useful and critically important for developing new perspectives on the selection and planned rate of growth of various energy options.

A. Societal Responses to Technological Change

Historically, societies have strived to create an environment that provides safety and satisfaction. Individuals learn to construct and perceive their environment in such a way that their anxiety is reduced. Fear of destruction by natural forces is one of the determinants that accounts for this need to build up a world in which one may feel secure. In the industrialized nations, the promotion of science and technology has resulted in a multitude of innovations designed to reduce excessive labour and human misery thereby supporting a view of the world as a safe place in which to live.

With the gradual development of social systems, political structures and philosophies based on security-seeking (a movement toward longer life, better health and greater pleasure), there has been a tendency to overlook or underestimate the potential adverse effects of technological expansion. As the rate of introduction of new ideas and innovations has exceeded our capacity to understand, utilize and assimilate such changes, we are forced to re-examine the implicit values of science and technology.

Since the turn of the century, Western societies have witnessed a remarkable acceleration of technological progress. Numerous attempts have been made to document or quantify this acceleration. It may only be a moot point as to whether or not previous cultures or societies have experienced a greater degree of change. The important question to be examined here is: what are the effects of such cultural acceleration on the individual and society?

The effects have been intuitively known for centuries. Hippocrates first noted: "It is change that is chiefly responsible for diseases, especially the greatest changes, the violent alternation in the seasons and in other things". The individual, and society at large, are capable of absorbing only a finite limit of change per unit time before the organism or system begins to experience difficulty. Recently, medical researchers have scientifically confirmed this hypothesis (Holmes, 1970; Gunderson, et al, 1974). It has been demonstrated that a clustering of significant changes in an individual's life are highly correlated with a major change in health status. The illnesses (accidents, injuries, physical diseases, and emotional disorders) in one's lifetime appear not to be randomly distributed, but occur when there is an abrupt change in established patterns of living. Such alternations might include: a) independent choices for change made by the individual; b) fortuitous occurrences in one's life (for example,

death of a family member); and c) those changes imposed on the individual by the cultural-historical moment of which one is a part.

The research of Rene Dubos (1965) has extended these observations to the larger, societal context. A relationship has been established between abrupt socio-cultural changes that followed the major technological revolutions (for example, agricultural and industrial revolutions), and the onset of the major epidemics and pestilences that plagued mankind. "The cruel irony of fate is that disease comes to the forefront precisely at that time when abundance replaces poverty."

An interesting historical example that serves to dramatize the effects of sudden alterations in cultural patterns is provided in a now classical, anthropological study by Rivers (see Montagu, 1974). He described the impact on a traditional society in Melanesia of major changes in the cultural matrix. In surveys conducted between 1908 and 1914, he documented the devastating effects of the incorporation of European technology on this less-developed cultural system. The European influence on native customs and the way of life (modification of clothing and housing standards, changes in legal and administrative structure) was abrupt and complete. The aboriginal society was simply not prepared to deal with such a rapid and catastrophic change in its life style, and gradually abandoned its desire to survive. This was reflected in a marked increase in mortality rate, a decrease in fertility rate (impotence in male members of the population), and a pervasive "giving up syndrome". As stated by Rivers:

I have pointed out that if these and similar institutions had been studied before they were destroyed or discouraged it would have been found possible to discriminate between those features which were noxious and needed repression or amendment, and those which were beneficial to the welfare of the community. Even when their destruction was deemed necessary, something could have been done to replace the social sanctions of which the people were thus deprived. The point I wish to emphasize is that through this un-intelligent and indiscriminating action toward native institutions, the people were deprived of nearly all that gave interest to their lives.

In extending these conclusions, it can be seen that there is a point at which the integration of an individual, a society or a culture is threatened by too abrupt or too protracted an alteration in social, political, or economic stability. Clearly, such changes may open up new avenues of human opportunity, creativity, and expression, but they also carry with them inherent risks to the physical and emotional well-being of those undergoing the changes. Indeed, man seems constantly to seek change for biological and spiritual reasons; but a reasonable balance, an equilibrium of forces, is required to sustain values critical for human life.

B. Individual Responses to Technological Change

To the observer of behaviour it is clear that the continual bombardment of an individual with new stimuli, the disruption in some form of predictable day-to-day stability, and the "disaggregation" of long-held social and moral conventions may serve to disorient the individual in time and space. The eventual effect of such "psycho-historical dislocation" is to increase the anxiety level of the individual and to initiate various patterns of accommodation. These responses may range from conscious, purposeful efforts to deal with a changing world to unconscious processes of which the individual is largely unaware.

It is important to realize that these are expected human responses to a rapidly changing social milieu, adaptations to the stresses of an uncertain world. Anxiety serves an important and useful function for the human being. When its intensity and character are appropriate to the situation, it increases the individual's readiness for prompt and vigorous action. A physically and emotionally active response serves to alert the individual to aspects of his life situation that may be potentially threatening. In terms of the survival potential afforded the individual or collectively a society, it is clear that some level of visible activity is more desirable than denial of the threat, apathetic withdrawal, or emotional constriction.

The aggregation of concerned individuals into groups provides a framework for identifying the nature of a *perceived* threat. Such groups may struggle to understand and give meaning to their collective perceptions of a given situation. In this manner, public interest groups may "break through" the prevailing, unconscious denial and apathy that envelops possibly menacing societal institutions or conventions. Their activity is an appropriate expression of anxiety for the potential perils of man-made developments (governments, technologies, and so forth). Their behaviour, often interpreted as political, may be more simply and importantly an attempt to bring greater clarity to an obscure, complex, and inadequately conceptualized and therefore anxiety-provoking condition.

Little attention has been paid to how nuclear energy is perceived in the public mind. In the next section some possible psychological determinants of the nuclear energy controversy will be discussed.

III. PSYCHOLOGICAL DETERMINANTS OF THE NUCLEAR ENERGY DEBATE

Although the nuclear energy debate may be understood as a focus for a wide range of societal concerns, the apparent *universality* of responses and the *intensity* of emotions observed require further consideration. The controversy provides a wealth of available data on social and behavioural responses.

It is thus a unique case study for the investigator seeking to understand other determinants of the debate. However, one may be surprised by the paucity of frameworks for understanding the psychological determinants in the controversy.

A social psychiatrist, examining the diversity of responses, strives to identify those elements that may represent characteristics unique to a particular society or nation, and also to elucidate those elements that extend across societal/cultural boundaries and are shared by the larger group of individuals.

It is proposed that a substantial part of the public concern regarding potential perils of nuclear energy relates directly to how they are perceived. This *perception* is coloured by several possible factors, each of which will be discussed in further detail:

- A. Pre-existing associations related to anxiety of nuclear war;
- B. Conscious and unconscious fears of death related to nuclear energy;
- C. Conscious and unconscious fears of radiation.

A. Pre-Existing Associations Related to Anxiety of Nuclear War

In tracing the historical roots of nuclear energy, one must attempt to establish how nuclear energy was first conceptualized in the public mind. For the scientific and intellectual community, the concept of nuclear physics began with the discovery of the X-ray by Roentgen in 1895. There followed the rapid expansion of knowledge gained from discoveries about the nature of the atom from the late 1800s to the 1940s. Eventually, these discoveries culminated in the active role played by scientists of the USA in harnessing this new form of energy. The development of the atom bomb during World War II was the result of their efforts. In spite of the historical significance of the bombing of Hiroshima and Nagasaki, it was probably not until several years later that the public in the USA, Europe and the rest of the world became fully aware of the immensity and enormity of this historical event.

With the gradual extension of the arms race between the USA and the USSR, and the subsequent development of the hydrogen bomb, MIRVS, and so forth, the public has become increasingly aware of this new force in human experience. There can be little doubt that the continued proliferation of weapons systems by the USA and the USSR, extended now to other national powers, has influenced our common perceptions of the safety of the world in which we live.

It is surprising to note, however, that on reviewing thirty years of available literature in the social and behavioural

sciences, one fails to uncover more than a few definitive, salient studies of the commonly held ideas, attitudes, beliefs, fantasies, and fears regarding nuclear energy, either as it pertains to power production or to its military use. The influence of such conscious and unconscious factors on the individual's perception of the environment and the future, on contemporary life styles, and on the changing character of social-political systems may be greater than previously realized.

There has emerged in recent years increasing interest in the prevalence of fears of nuclear war and how they may influence the collective, psychological framework. This appreciation was stimulated by the now classic work of Robert Jay Lifton, *Death in Life - Survivors of Hiroshima* (1968). His interviews of the "hibakusha" (explosion-affected persons), employing what he termed a modified, psychoanalytic interview technique, revealed the many consequences of this psycho-historical calamity. There were the obvious, initial, traumatic sequelae of the explosion. Later, there was the more insidious and feared "A-bomb disease", resulting from the effects of the invisible radiation. Then, the intense sense of loss, abandonment and guilt experienced by the survivors. Perhaps what was most important was the profound effect of the bombing on religious beliefs, social institutions and the collective psychology. The reactions of the people included massive apathy, withdrawal and a pervasive feeling of hopelessness.

Of particular interest was the inability of the survivors at Hiroshima and Nagasaki to "make sense of" their tragedy. The existing belief system, social consciousness and collective psychological structure did not provide for an assimilation of the experience. Their struggles to give symbolic meaning to their tragedy resulted in a realization that they had experienced a form of death and devastation that was in all senses absurd and incomprehensible.

It is worth noting that this study was undertaken in 1967, seventeen years after the explosions. Until that time there had been no systematic, scholarly attempts to study the social and psychological consequences of the bombing. Most reports had been fragmentary, technically-oriented and had tended to ignore the human misery and suffering. This observation perhaps attests to the degree of denial and historical distance required to examine the penetrating influence and meaning of this holocaust.

The importance of these insights for contemporary societies has been considered in a somewhat speculative fashion by Koestler (1976):

The crisis of our time can be summed up in a single sentence. From the dawn of consciousness until the middle of our century man had to live with the prospect of his death as an individual; since Hiroshima, mankind as a whole has to live with the prospect of its extinction as a biological species.

This is a radically new prospect; but though the novelty of it will wear off, the prospect will not; it has become a basic and permanent feature of the human condition.

There are periods of incubation before a new idea takes hold of the mind; the Copernican doctrine which so radically downgraded man's status in the universe took nearly a century until it got hold on European consciousness. The new downgrading of our species to the status of mortality is even more difficult to digest.

But there are signs that in a devious, roundabout way the process of mental assimilation has already started. It is as if the explosions had produced a kind of psychoactive fall-out, particularly in the younger generation, creating such bizarre phenomena as hippies, drop-outs, flower people and barefoot crusaders without a cross. They seem to be products of a kind of mental radiation sickness which causes an intense and distressing experience of meaninglessness, of an existential vacuum, which the traditional values of their elders are unable to fill.

In spite of the dramatic rhetoric, there are several important points raised by Koestler. The enormity and potential destructiveness of nuclear weapons as well as our helplessness and vulnerability to their consequences is difficult to deny. It may be that the mere contemplation of the potential horrors of an atomic war engenders such anxiety as to cause people to deny the possibility that such a disaster could occur. The fears of nuclear war, which were so prevalent in the early 1950s and again emerged at the time of the Cuban missile crisis in 1962, have largely passed from view. When such pervasive fears disappear it does not mean that they may not re-appear at a later date. Our attempts to deny such a universal image of death or to avoid the lingering threat of impending disaster are bound to be only temporary and tenuous at best.

Thus the energy crisis of 1973 served also as a temporal catalyst to increase public awareness of nuclear energy. In addition, it provided for a re-emergence of the fears of nuclear war and nuclear weapons that may be less directly evident. Plans to expand the nuclear industry and to site facilities near populated regions have stimulated public awareness and resulted in increasingly active public resistance. The nuclear power plant provides a more readily accessible and visible focus for the expression of a wide variety of diffuse fears and dormant anxiety. Indeed, it may be that the unique scientific "coupling" of nuclear power production and nuclear weapons provokes anxiety and accounts for the intensity of emotions now observed at an international level.

It is proposed that a significant part of the public concern regarding the potential perils of nuclear power plants may represent anxiety "displaced" from the fear of nuclear war. In conventional psychiatric terminology, displacement is a psycho-

logical process known to lessen anxiety in the individual. As an unconscious mental process, displacement is defined conceptually as a shifting of emotions from one object to another object. There is, then, the symbolic representation of the original fear-provoking stimulus by another object which evokes less anxiety. Thus, the intensity of emotions manifested toward the nuclear power plant might be understood partly as a displacement of unconscious fears of nuclear weapons and nuclear war.

It must be realized, however, that such a reductionistic appraisal of the nuclear power plant controversy may tend to neglect the intrinsic hazards of nuclear power plants, to make less visible the threats that nuclear energy and nuclear warfare have in common, and to intellectually diffuse the ideological basis for the controversy. The resistance to nuclear power plants is a reaction against the threat they pose to human life and well-being for contemporary and future societies. Contemporary social responsiveness to nuclear energy (and to all other technologies) may be viewed as breaking through the "psychic numbing" that clouds confrontation with all these aspects of our man-made environment that pose the threat of death. As noted by Norman Moss (1968), regarding the social responses to nuclear weapons in the 1950s:

For a little while, when the bomb was new, a great many people felt there was something simple that they could say about it, something positive and right that they could do... .

The ban-the-bomb movement posed the question of the bomb, not in terms of politics, but in terms of conscience. Its questions were sometimes over-simplified and distorted. But its voice [was] a nagging reminder of what is being talked about when nuclear strategy or politics are discussed: The trafficking in pain and death, or *the threat of it*, on a new order of magnitude. Others may find it easy to regard these things abstractly, or remote from imagination, not the ban-the-bomb people. They are a pressure group for the consequences.

If the debate continues on this ideological, moral level, then the "devious process of mental assimilation" that Koestler refers to may be directly confronted. The subtle and insidious effects of living under the threat of nuclear war can be identified and distinguished from the threats of nuclear power plants. Perhaps then, and only then, can a reasonable dialogue proceed between the public and the promoters of nuclear power production.

The close linking of these fears of nuclear power plants and nuclear weapons has been previously noted. As once described by Laura Fermi in Grodzins and Rabinowitch, (1965):

Bombs or reactors? My mind is pervaded by a vague sense of mystification over the lack of differentiation between the peaceful and military atom that I have often detected in people's thinking.

It is interesting to note that people are surprised or "mystified" by the "lack of differentiation", when indeed these two forms of development of nuclear energy do share the prospect of death and exposure to radiation. It may be that this *merging of a mutually shared threat* is what people are responding to--they may not be fully aware of what is upsetting them, they may not have a fully conceptualized knowledge of the threat, and they may lack the conceptual framework within which to articulate their concerns.

The controversy may thus be understood as an important and critical process that has been continuously emerging. It is an on-going struggle to understand the ambiguous and ambivalent aspects of nuclear energy as they have developed over the past thirty years. Nuclear energy is ambiguous by its very nature; owing to the difficulty of conceptualizing the atom, radiation, waste management, and so forth. Its ambivalence is reflected in its capability of being used for positive or negative ends, for peaceful or military ends. Such ambiguous and ambivalent elements in an industry as complex as nuclear are bound to generate anxiety in the scientific and public communities. The controversy serves as an arena for bringing into clearer focus many less readily identifiable issues relating to nuclear energy in all its forms.

In the next section, the role of conscious and unconscious fears of death relating to nuclear energy will be considered.

B. Conscious and Unconscious Fears of Death Related to Nuclear Energy

Another factor influencing the perception of nuclear energy and public response is the underlying concern regarding potential risks to society and the environment. In the nuclear industry (as well as in other large-scale technological systems), there has evolved an increasingly sophisticated methodology for quantifying the physical and biological risks posed by these various industries. The risk-benefit model has invariably sought to present the estimated probability of an undesired consequence of a particular industry as some measure of the "risk of fatality", "loss of life expectancy", or "risk of exposure". Most recently, such an assessment of the nuclear industry culminated in *Reactor Safety Study: An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants* (1974). The consequences of the most devastating reactor accident (a core melt-down) were estimated using a large volume of data on nuclear power plant operations that have accumulated since this initial report was prepared in 1957. The severity of such an accident was presented in two models:

Acute death (estimated to be 92 persons);

Population radiation exposure (estimated to be 200 acute illnesses).

In addition, data were presented that compared the number of fatalities per year and the estimated risk of fatality from a variety of other causes (for example, automobile, and air travel, fires, natural hazards). Ostensibly, this practice of comparing risk estimates is intended to assuage public concern about nuclear safety. The data provided for a ranking of the estimated fatalities from a nuclear power plant accident several orders of magnitude below natural hazards and other "accepted" risks.

One wonders that such a rational probabilistic assessment of risk in an issue as apparently anxiety-provoking as the nuclear energy debate does not necessarily reduce public concern. It may even serve to polarize positions to a greater extent. As developed in Otway and Pahner (1976), the risk-benefit methodology fails to consider conceptual differences in how risks are perceived by the public and by those compiling such statistics. There is a tendency to "technologize" the probability of death without considering that it is the *consequence* or *mode* of death with which people are most concerned. Society may finally be responding to the fact that there are numerous man-made industries that have a potential for killing or for exposing large groups of people to a particular threat. Risk-benefit methodology also fails to consider the possible influence that a perceived threat may have on the psychological well-being of persons, irrespective of how low the risk is estimated.

There has been limited empirical research on how various technologies are perceived. One recent pilot study has compared the risk perception of various technological or public facilities (Maderthaner et al, 1976)--gasworks, district heating plant, oil refinery, psychiatric hospital, nuclear reactor, prison, and airport. Respondents were asked to rate the risk of living near each of the facilities. Three groups were sampled: those living near the fossil-fuelled district heating plant; those living near the nuclear reactor; and a control group. All groups rated the nuclear reactor as the highest risk. However, those of the nuclear facility sample who lived nearest the reactor (less than 500 metres) viewed it as a statistically significant lower risk. In this case it can be seen that despite the estimated low probability of death or exposure to radiation, people still perceive the nuclear power plant as threatening. It is interesting to note that those who live nearest the nuclear power plant viewed it as a significantly lower threat. It may be that they possess greater knowledge of reactors, that they have become accustomed to living with the threat or that their constant visualization of the apparently innocuous building, workers, comings and goings, and so forth, has desensitized them to considering the risks. Another possibility, yet to be

investigated, is that the threat of death and the exposure to radiation that they face is so great that they unconsciously deny the existence of any risk.

One critical factor in determining these unique perceptions of the nuclear power plant is the imagery evoked in contemplating the risk that it presents. The nuclear power plant represents a symbolic threat of death which is, as yet, primitively organized. Just as the survivors of Hiroshima and Nagasaki were unable to "make sense of" their tragic experience those confronted with the reality of a nuclear power plant may not fully understand the nature of the threat of death to which they are exposed. Further research is needed to establish what the many determinants are for the particular intensity of emotions exhibited in regard to nuclear power plants, but clearly death symbolism is involved in this struggle. A symbolic threat of death that is unimaginable, unthinkable or unacceptable on a conscious or unconscious level, generates perhaps another "image of ultimate horror". It is a unique and universal symbol of a particular mode of death to which people are responding in many countries.

An empirical review of available literature, press reports, public demonstrations at reactor facilities and interviews with observers at public meetings and protests reveals that the theme of death frequently arises. At numerous construction sites in the Federal Republic of Germany, France and Switzerland, persons involved in the demonstrations carry placards or banners depicting the skull and cross-bones. Often there are crudely organized skits which attempt to portray the perceived threat of death posed by nuclear power facilities.

An earlier study of the nuclear energy controversy in Western Europe also documented the frequent preoccupation with the threat of death (Guedeney and Mendel, 1973). It was noted that questions raised at public hearings were often related to the fear that the nuclear facility would explode like an atomic bomb. Great concern was expressed about the possibility that the facility would kill or irradiate large groups of people. In all these cases there is a prevalent fear of death, often verbalized in a grotesque and primitive manner.

In the USA, the nuclear energy controversy evolves around a number of issues. The first subject was the routine release of radioactivity by nuclear facilities. This was followed by considerations of the safety precautions taken by the industry. In the past several years, the problem of waste management has been strongly contested. In most recent times, the concern for plutonium and its possible diversion for nefarious purposes has emerged. Additionally, the economic feasibility of nuclear energy has been challenged over the past year. Rarely have the psychological determinants of the debate in the USA been considered. It is interesting to note the comments of a recently resigned General Electric engineer which touch again on the theme of death. He was remarking on his experience of

having looked down into a pool of water glowing with the intense blue radiation which is emitted. He was quoted as saying (*International Herald Tribune*, 1976):

I looked through that 10 or 15 feet of water, the life saving shield between me and that fuel, and I knew that if any one of those elements were to come up and hit me in the eye, that I was dead just like that. Or if the water was gone, I was dead just like that. And I got the feeling right there of the very precarious balance we have between radioactive materials in a safe state and radioactive material in an unsafe state and the dangers to life that are close.

Since the resignation of the three engineers at General Electric, there have been numerous speculations on their motivations and on the credibility of their statements. The point being made here, however, relates directly to the reference to death and its symbolic representation. It is at this level that the risk of nuclear power plants may be perceived by many people, and it significantly influences the character of the debate.

The gradual "politicization" of the nuclear energy controversy has perhaps facilitated the consolidation of dissent and resistance; at the same time it may also be diffusing direct confrontation with the threat of death both as it exists and as it is perceived.

In the next section, the conscious and unconscious fears of radiation will be considered.

C. Conscious and Unconscious Fears of Radiation

Needless to say the anxiety regarding radiation release is closely related to the fear of death, because it is through radiation that death would occur in the event of a nuclear power plant accident. To die by radiation exposure may be one of man's greatest fears. The only scientific account of how such fears affect large groups of people is again provided in Lifton's study of the survivors at Hiroshima. The rumours that circulated after the bombing give substantial evidence of the pervasive anxiety that exposure to radiation (or the threat of exposure) generates in individuals. People expressed fears that Hiroshima would be uninhabitable for 75 years--a direct expression of the fear that there was a "deadly and protracted contamination from a mysterious poison" (Grosser, 1971). There were also rumours that all forms of plant life would fail to grow. Perhaps most frightening of all was the belief (and later realization) that the invisible radiation exerted a deadly influence on those exposed, and that the effects might manifest themselves *at any time*. There were no means of knowing who had been exposed or to what degree and whether or not one would die. The forms of physical death from radiation were also particularly devastating and

grotesque--(nausea, vomiting, bleeding, loss of hair, infections resulting from depleted white cells) all manifestations of the consequences of leukemia.

It is unlikely that these consequences of exposure to radiation are unknown by individuals in contemporary societies. They are not likely to be appeased by estimates of the low probabilities of exposure to radiation, but they are likely to respond to the perceived consequences in the event of an accident.

There are several other examples that can be cited to support the contention that such conscious and unconscious fears of radiation exposure are operative in the nuclear energy debate. Guedeney (1973) remarks that a survey of health records of workers in nuclear facilities demonstrates a higher incidence of psychosomatic symptoms after the period of time they spend directly in the reactor building. As is usually the case, workers at the installation are rotated regularly to minimize their exposure. Although one would expect that these workers were adequately informed and knowledgeable about radiation, its effects and dangers, they still harbour unconscious fears reflected in their behaviour.

It is interesting to note, too, the significant participation of women in the nuclear energy debate. Although it would be easy to discount their involvement on the grounds of the contemporary social activity of women, there may be a more important determinant. In Sweden and in the USA, groups of mothers and young women have actively voiced their opposition to nuclear energy based on their perception of the threat to future generations. Their arguments focus largely on the potential effects of radiation exposure on genetic material. There have been scientific disclaimers of the early reports of increased infant mortality rates from routine releases. However, the resistance again may be on the level of perception of the possible consequences in the event of an accident, not on the low probability of an accident or on the "insignificance" of routine releases of radiation.

In conclusion, it is clear that the nuclear energy debate is greatly influenced by these various determinants. The previous associations that people have regarding nuclear war and their fears regarding the actual and symbolic threat of death and exposure to radiation posed by nuclear power plants all colour their social response and contribute to the character of the debate in different countries.

The possible constraints that these fears and perceptions place on the psychological well-being of the individual, and the influence they may exert at the societal level, will be discussed in the following section.

IV. POTENTIAL SYMBOLIC CONSTRAINTS POSED BY NUCLEAR ENERGY

Having attempted to support the hypothesis that nuclear energy presents an actual and symbolic psychological burden to large groups of people, the question remains: In what way is this information important or relevant to an understanding of the nuclear energy debate? It must be re-emphasized that a particular risk situation, even though estimated to be several orders of magnitude below apparently "accepted" technological risks to physical, biological health, may nevertheless impose a considerable psychological burden and, therefore, a different kind of risk. Most people are not weighting the risk probabilistically; they perceive the nuclear power plant as a previously unrecognized form of death threat--a threat that evokes a particular, unique and grotesque imagery of the mode of death.

It is proposed that this imagery--as represented in the ever-existent threat of annihilation from nuclear weapons, closely linked to the power-productive aspects of nuclear energy (now made more real by reprocessing, plutonium enrichment, proliferation and threats of sabotage)--puts a severe symbolic constraint on the individual's capacity to face the future. Youth worldwide seem particularly sensitive to living "in the shadow of the bomb". Increasingly, it is evident that the wide-spread aura of meaninglessness, disillusionment and alienation manifested in contemporary societies may stem from the effect of such threats on collective, psychological structure. It may have been possible for previous generations to effectively repress or deny the existence of such threats, but they may now be exerting their effects to a considerable extent.

The purposelessness of a "nuclear death" may disrupt the faith that people must be able to sustain in the human endeavour. A loss of faith in the structure that supports the meaning of life is a loss of faith in the structure that supports the meaning of existence.

As noted by Montagu (1974):

We can demonstrate that there are certain values for human life which are not matters of opinion but which are biologically determined. If we do violence to these inbuilt values, we disorder our lives, as persons, as groups, as nations and as a world of human beings.

One such universal human value that may need to be sustained and even nurtured is the belief in one's own immortality. It is perhaps necessary for societies to support the belief that the individual lives on beyond the grave. This belief has been historically sustained by living on in one's children, through one's creative works (art, music, poetry, and so forth), through interaction with other persons and living on in their memory or through belief in a life after death.

Again, Lifton (1970) has provided a critical insight into this issue:

I believe it is [more] correct to say that our own death-- or at least our own dying--is not entirely unimagineable but can be imagined only with a considerable degree of distance, blurring and denial; that we are not absolutely convinced of our own immortality, but rather have a need to maintain a *sense of immortality* in the face of inevitable biological death; and this represents not only the inability of the individual unconscious to recognize the possibility of its own demise, but also a compelling universal urge to maintain an inner sense of continuous symbolic relationship, over time and space, to the various elements of life The psychic response to a threat of death, actual or symbolic, is likely to be either that of stillness and cessation of movement or else of frenetic compensatory activity... .

To challenge such beliefs by continually developing technological systems that regard such beliefs with indifference may be destructive to the best interests of all societies and to the individual. The moral order of societies has always been founded on myths (traditional cultural beliefs). The impact of science and of technological change on these myths results in a form of moral disintegration. Any controversy or debate that focuses attention on the life-supporting nature of myths may serve to re-establish important human values. Campbell (1972) has cited the importance of *scientifically* arriving at such an understanding of the importance of these societal and individual myths so that in the criticism of their archaic features, their need is not misrepresented or disqualified.

It is argued here that the nuclear power plant is an actual and symbolic threat of death on a scale not previously known and in a manner not previously envisioned. It poses a considerable strain on the individual's perception of his life, its meaning and its future. The potential effect of living under such a psychological burden may be such as to critically undermine creative processes in the individual and in societies.

In the next section the possible role of the behavioural scientist in the nuclear energy controversy will be considered.

V. ROLE OF THE BEHAVIOURAL SCIENTIST IN THE NUCLEAR ENERGY CONTROVERSY

Anticipation or Aftermath?

Unfortunately, it seems that all too often the social-behavioural scientist enters the study of the interface of society and technology in the aftermath of tragedy. This may be partly the result of rapid developments in the engineering, aerospace and bio-medical sciences that have greatly out-distanced the social institutions and moral-ethical systems

which help us to properly evaluate such advances in our lives. In other cases it may simply be that large-scale technologies incorporate within them a certain inhuman, impersonal and indifferent attitude which is only realized too late.

An interesting case in point: on 26 February 1972, the Appalachian coal-mining area of Buffalo Creek Valley, in southwestern West Virginia, was the scene of that state's worst flood--a man-made flood caused by the collapse of a slag dam. In three hours a black wave of sludge and water travelled seventeen miles leaving behind 125 dead men, women and children; 1,000 injured; 4,000 homeless with 550 homes completely demolished and nearly 1,000 other homes extensively damaged. For some time prior to the flood there had been repeated efforts by the inhabitants of the valley to require the coal company repair the dam, but to no avail. Approximately two years after the flood, 625 families settled a US \$65 million damage suit out of court for US \$13.5 million. The reason the decision represents a landmark case is that one of the major points of contention in the trial was the extensive psychological trauma resulting from the flood. A team of psychiatrists, psychologists and social workers from the University of Cincinnati as well as researchers from Yale University studied the survivors extensively. Interviews with large numbers of individuals revealed significant levels of depression, a marked increase in divorce and criminal adolescent behaviour (Panel of Buffalo Creek Disaster, 1975). The effects on the children, as demonstrated in interviews and psychological testing, were devastating. One of the major sources of depression, when all of the data were analyzed, was the overwhelming sense of rage and impotence that individuals felt toward a faceless, and callous industry--an industry that had been unwilling to attend to their initial pleas about the dam and later refused to assist in the recovery.

The history of man's interaction with his technologies is replete with similar examples of ignorance, negligence, indifference or arrogant disregard. It may be one of the unfortunate consequences of modern, large-scale technologies that they foster, in their complexity, a lack of consideration for human values and needs. Such an inherent hazard may need to be constantly understood, interpreted and guarded against. The concomitant ex-post philosophy that has evolved in compensating survivors or victims of technological accidents may need to be revised in favour of an ex-ante philosophy where the decision to modify or abandon a particular system would be based on the possibility or probability of physical or psychological harm, not on the actuality. Häfele (1973) has outlined three thresholds over which large and complex technological developments must pass. The first of these is scientific feasibility; the second is technological and industrial feasibility; and the third, economic and commercial feasibility. Increasingly it would appear that social-psychological feasibility will play an important role in decisions regarding the selection of large-scale technological systems. Yablonsky (1972) developed the notion that:

The central, potentially apocalyptic crisis of the twenty-first century may not be found in the highly publicized surface conflicts between East and West, "social" minority and majority groups, or left and right political factions. The crisis may fundamentally exist in the historical encounter in social systems between the counterpoints of humanistic and social machine forces. If people do not revive, maintain and nurture their humanism, they may be doomed to an escalation (and covert acceptance) of physical death or of the spiritual and creative death involved in a robotic existence in a social machine society.

The task of the social-behavioural scientist is to provide continuing information and insights regarding the impact of technology on man's health and well-being. It may even be that he will have to assume a more active role in confronting those aspects of the technological environment that threaten individual and societal well-being.

CONCLUSIONS

This report presented some new perspectives on the nuclear energy controversy. It represents part of the continuing effort of the Joint IAEA/IIASA Research Project to gain a deeper understanding of technological risks at all levels ranging from the physical and biological to the influence on collective psychological framework and societal structures.

The nuclear energy debate has been viewed here as an important arena for a wide range of contemporary societal concerns. Brief mention was made of the literature in the medical sciences that demonstrates the impact of technological change on health and illness patterns. In addition, an effort has been made to provide some psychological insights on the nuclear energy controversy. Its *intensity* and *universality* suggest that a number of conscious and unconscious fears influence the character of the debate. These fears relate to the perception of the nuclear power plant as an actual and symbolic threat of death and exposure to radiation. The close linking of the power-production capacity of nuclear energy with nuclear weapons and the mutual risk they both pose was discussed. Finally, some consideration was given to the possible symbolic constraints that nuclear energy options place on the individual's and societies' capacity to face the future. It is hoped that such insights will generate further research into these often neglected areas. In this way we may gain better access to the important decisions and selections that will be made regarding energy systems.

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