AN ANTHROPOLOGICAL VIEW OF RISK PHENOMENA

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I. Introduction

1. Purpose of the Study

The benefits and risks of technological progress are bringing about changes which have repercussions in practically all spheres of human life. New risks emerge in the physical as well as in the psychological and social fields, forming some of the constraints which must be considered in making decisions related to new technologies.

One of the objectives of the Joint IAEA/IIASA Research Project on risk assessment is to develop information on societal attitudes and anticipated behaviour as inputs to the decision-making process (see Otway, 1975, and Otway, Pahner and Linnerooth, 1975).

Risk assessment is being analysed by methods relevant to the many disciplines represented by the project members. As the scientific community is increasingly conscious of the fact that in promoting new technologies, societal considerations have to be taken into account, this project enables the cultural and social anthropologist to venture into a field hitherto not explored.

The risk phenomenon implies a complex set of thoughts, fears, perceptions, preferences, values and decisions, etc. The interactions of these human manifestations should be the object of thorough research, undertaken by the behavioural scientist. Some of his tasks within the Joint Project are:

To search the anthropological and sociological literature for examples of human attitudes toward major innovations;

To study the impact of technological progress on social systems;

On the basis of material found in relevant literature, to define and analyse individual and group preferences and social values;

To define the term risk, as viewed by an anthropologist, by means of examples from traditional and modern societies;

To furnish the background material for the modelling of social parameters. The methods of systems analysis will be particularly helpful to elucidate the influence relations.

This paper aims at a definition and an analysis of the risk phenomenon including risk perception. Particular attention is given to risk as experienced in small-scale societies. Various aspects of technological progress lead to a broader understanding of man's attitude toward risk.

2. Role of the Cultural Anthropologist

In the study of human behaviour, researchers are often faced with unknown factors. They are at a loss to understand why in certain circumstances people act in one or in another way. A number of experts in the nuclear field (Reactor Safety Study, 1974), for instance, came to the conclusion that nuclear power plants are less harmful for people living in their vicinity than other technological institutions well accepted by society. Hence the strong and sometimes violent resistance to their increasingly frequent construction puzzles the involved scientists and managers.

Human attitudes are determined by the interactions of historical, political, socio-economic, cultural and biological factors, variables which do not permit identical repetitions of events and reactions.

It is particularly difficult to recognize the mechanisms leading to societal decisions where a complex group is concerned. The heterogeneous structure of modern society blurs the revision and easily conceals societal features. If valid generalizations with regard to human behaviour and preferences are sought, traditional societies offer easier opportunities for study. Small-scale social systems in most cases show the basic elements of their structure more clearly than complex modern social systems; their rules and values are believed in more uniformly, and the mechanisms which gear societal behaviour are more visible. The reactions of traditional peoples to events cannot be seen as simplified versions of our own reactions; however, by comparing modern society with a small-scale society, we can gain a clearer picture of ourselves.

Marwick (1974) holds that "alien world views, both contemporary and historical, could be important in revealing some of the general principles, especially the social influences, according to which in any society, presuppositions are made and sustained ideas are formulated and transmitted, and changes of mind and position are initiated and ultimately achieved. A grasp of these principles is basic to an understanding of the on-going development of our culture, particularly those aspects of it subject to the more accelerated growth stimulated by scientific research".

It is true that the unknown and "intangible" factors can never be fully recognized; they can, however, be reduced through patient research, taking advantage of interdisciplinary exchange of knowledge.

II. Technology and Technological Progress

As will be seen later, modern society is exposed to risks from the man-made environment on a larger scale than traditional societies, that is to risks originating from technology. The risk phenomenon cannot be considered separately; it has to be seen together with its cause, with technological progress at large. A closer examination of technology and technological progress is necessary in order to understand man's attitudes toward risk from new technologies.

1. Man and Technology

Kranzberg and Pursell (1967) define technology as "man's efforts to cope with his physical environment - both that provided by nature and that created by man's own technological deeds ... and his attempts to subdue or control that environment by means of his imagination and ingenuity in the use of available resources...".

Lock's (1975) definition of technology is applicable for modern society rather than for a small-scale society of the present or of the past. He says that "...the role of technology is taken to be the application of scientific knowledge for the generation of improvements in, and benefits from, the societal sub-systems, individually and collectively".

Technology is not new in our age; it is not the product of the Industrial Revolution of the 18th and 19th centuries. Technology was with mankind from the beginning, from the first manifestation of man's wish to master nature, to potentiate or replace his muscles, and to use the resources of his environment. Stone scrapers and spear points of early man are as much technological implements as the complicated machinery of modern societies. However, not only tools and machines can be identified with technology; it can be said to be "man's rational and ordered attempt to control nature..." including any theoretical and organizational attempt in the pursuit of that control (Kranzberg et al., 1967).

2. Technological Progress

As progress means a movement in a forward direction, technological progress is a cumulative process (Gilfillan, 1971) of advance in any field of technology; cumulative because in most cases innovations are elaborations of existing techniques or procedures, further developed or altered for more convenient and efficient use, for amelioration of the living standard or for an optimization of economy. The wish to simplify working methods contributes as much to technological progress as a shortage in labour force or resources.

The idea that throughout history technological progress was enhanced and frequently stimulated by military needs is often found in literature (Kranzberg and Pursell, 1967). Ashton (1970) defends an opposing standpoint. He asserts that "those who take the perverse view that war is a spring of technological progress may be reminded that each of the major peaks (of patent boom) came in a time of peace...". It might be argued here that much of the preparation for war is done in peacetime. Many inventions, however, which were made for military purposes will eventually be adjusted to peaceful use.

Looking back into the historical past of mankind, Gilfillan (1971) notes that governments have often played a large part in invention and thus in technological progress. This is certainly true although the emphasis has continuously changed in time together with changing values and beliefs. Leonardo da Vinci, for instance, one of the most ingenious inventors of all ages, was like many others employed by an "absolute ruler". This does not mean, however, that inventors were particularly sponsored by kings and governments. "With good reason", writes Mumford (1967), "archaic societies distrusted innovators and inventors as heartily as Philip II of Spain, who classed them, not without reason, as heretics...".

In the most recent past a different trend could be observed. During the first half of this century scientists had to struggle to convince government authorities or industrial enterprises of the merits of their inventions in order to have them taken into production. Count Zeppelin was considered by many people to be "something of a crank, a queer character who was wasting family funds with his hopeless, almost childish folly of building an airship...", writes Whitehouse (1966). Only after years of patient research and experimentation, after spectacular successes alternating with equally spectacular failures, financed by generous private donations and city lotteries he was able to sell his first airship to the German Airship Batallion, a military unit, in 1908. Since the Second World War, scientists have been increasingly employed by state institutions or private industry; their inventions are part of the output of these institutions. Whereas before technological progress was the outcome of personal initiative and effort, it has become more and more a tool of the establishment.

3.   The Notion of Technological Progress in Traditional Societies

In traditional societies the notion of technological progress is practically universal. It is frequently expressed

in myths of culture heroes, who, in the shape of animals, human beings, spirits or gods, brought new cultural features, advanced tools or techniques to the hitherto unknowing people.

The Greek goddess Athene, for example, not only planted the first olive tree in Athens, she also invented the potter's wheel. She gave instructions on how to tame horses, and how to build chariots and ships (Greek Mythology, 1963).

The Ainu in Northern Japan consider as their first ancestor the culture hero Aeoin "who first taught them how to hunt and fish, to make implements and worship their divinities..." (Murdock, 1964).

In South America, in the region of the river Alto Madre de Dios, the Machiguenga tribe learned from the moon, who appeared as a young man, that the red soil which was eaten by the primitive people should be used to make vessels in which to boil yuca (maniok). Thus, he simultaneously introduced the technique of fabricating pottery, the knowledge of cooking and the cultivation of the starchy root yuca (Carrasco Hermoza, 1970).

These examples show that technological progress is thought to have brought, through the intervention of some outside agent, easier or more efficient techniques, improved tools and very often, as an accompaniment, an awareness of group identitiy as well as an advanced ethic attitude.

4. Culture Change

Much has been written on the subject of technological progress. The various aspects are discussed by sociologists, anthropologists, psychiatrists, philosophers, pedagogues, and, of course, technologists. The host of relevant literature bears witness to the fascination emanating from technology. Critics and admirers equally acknowledge the incomparable impact of technology on mankind, on social systems, on the human mind, religion, education, family and politics, etc.

Before discussing the impact of technological progress on social systems, some thoughts on culture change in general are appropriate.

A vast literature exists on culture change, a subject which has attracted anthropologists for many years. A distinction should be made between culture change in traditional societies due to cultural contacts, which always include a certain amount of technology, and technological

progress in its strictest sense induced by development projects and technical assistance. It is rather difficult to find publications giving accounts of the sociological aspects of development projects. Most reports show the technologist's point of view, and only rarely do sociologists research on the effects of such projects on social systems.

A social system is held together by the interaction of a group of people as long as a common body of knowledge, beliefs, skills, and learned behaviour manifested in their religion, economic and political practices, arts, values and attitudes, is maintained for a number of generations. As a social system is a functional whole, it follows that all components of it are interdependent. This means that an alteration of one component automatically influences other parts and thus brings about a feedback in any or all of the other components. Culture change means "any change of cultural circumstances as far as it influences the structure or the function of the respective social entity" (Behrendt, 1966).

Culture change might come from inside a group or from the outside. The term per se does not say whether the change brings about useful or harmful consequences. Outright shrinking of cultural features is possible, for instance. Moreover, the term culture change does not indicate at what pace the change takes place and whether all components are affected at the same time and speed; nor does the term indicate whether the change is irreversible and leads to a collapse of the respective social system.

The causes for culture change have been widely discussed. Most frequently, cultural contact is assumed to be mainly responsible for changes in a particular sub-system or in the whole social system of a group. However, Migdal (1974) sees a certain weakness in this theory which does not explain why peasants in two villages close to one another and structurally similar react differently to culture contact. Why do some reject change while others accept it, and why do individuals change certain patterns but not others? He thinks that historical and economic reasons create differential premises for change.

It is recognized that in traditional societies changes in material culture are easily accepted in most cases, as these changes bring about improvements and relief in daily work. People of all cultures like to facilitate procedures and labour. An iron tool is more efficient than one made of stone. The gun gives better protection by far than arch and bow.

Material changes can easily be incorporated into the
pattern of a particular culture so long as these innovations
fit reasonably into the broader traditional whole. When
they serve an obvious and well-known purpose, they are taken
over without inducing substantial change. Items alien to
tradition are either compartmentalized or embedded into the
material culture along traditional lines (Velimirovic, 1974).
In this sense technological progress by its definition
appears as culture change focused on particular technological
practices. However, each technological advance is inter-
woven with psycho-social transformations (Mumford, 1967).
Very often consequences are revealed only after years. They
become noticeable by degrees. If the changes are of some
magnitude, and moreover, if they are accompanied by new
religious beliefs or with profound political and economic
changes, they cause the emergence of new patterns in social
relationships, new values and an altered set of preferences.

5.   Benefits of Technological Progress

In the years of reconstruction following the Second
World War, the practically unanimous belief in progress,
which began to acquire strength only in the 18th century
in Europe (Kroeber, 1963), reached its peak. Technological
progress in particular was considered to be not only useful
but good. In 1955 Mead gave expression to this belief:
"...The words technological change have come to symbolize
for people all over the world a hope that is new to mankind...
the hope that the peoples of the world need be hungry no
longer...".

Technological progress meant promotion of underde-
veloped and rural areas, improved communications, and with
this a better understanding between nations. This was
thought to contribute to peace in the world. More
education brought enlightenment to peoples hitherto neglected.
Backwardness and superstitions could be abolished, good
health and happiness promoted. Increased use of ever
improving machines would free the world of drudgery.

Teilhard de Chardin (Laudadio, 1973) sees "technological
progress as an intensification of tendencies already present
throughout history. Man wants to reduce the amount of time
and energy spent on hard physical labour and increase the
amount of time and energy devoted to intellectual activity
and leisure... . As machines give man more freedom to
pursue his intellectual and spiritual interests, they become
more and more the embodiment of human knowledge and cause
an improvement in the quality of human energy... . Techno-
logical progress improves the economic welfare of society
and enriches the spirit of the individual worker...".

Belief in progress and in international responsibility for the well-being of mankind finds its supreme expression in one of the objectives of the United Nations Charter of 1945. It demands for all peoples in the world "social progress and better standards of living in larger freedom..." as a consequence of technological progress (Mead, 1955).

6.   Costs of Technological Progress

Mead sees dangers threatening traditional societies in the manifestations of technological progress as already experienced by the developed countries: "...If the abolition of hunger and want were to be bought only by industrialization, by urbanization, by mechanization, by westernization, by secularization, by mass production, would not the cost be too great? Of what use to introduce a tractor which made the yield of grain fields greater if in so doing the whole distinguishing fabric of life which had characterized a society would be ripped into shreds?" (Mead, 1955).

What actually is the impact of technological progress on social systems? How did it affect the industrialized societies? This is far too a complex matter to be dealt with exhaustively in a short paragraph; a more extensive paper on this subject is in preparation. Some of the more obvious consequences on the societal level are (besides the population explosion):

> Separation of the working sphere from the living sphere, shifting the emphasis from home and family to the working place;

> Breaking up of extended families through urbanization; loss of playmates for children; the emergence of the problem of the aged;

> A shift from the older members of society to the younger through early education and money-earning opportunities; devaluation of experience in favour of money, thus deepening the gap between the generations;

> Neglect of spiritual values in favour of technological progress and material wealth;

> Separation of urban people from nature, which has a marked influence on their peace of mind and happiness; increase of mental health problems.

Illich (1974) is a particularly severe critic of techno-logical progress. He is of the opinion that in many fields of industry services are produced which are supposed to serve

public well-being, but which in reality create far more new needs than can ever be met. A similar opinion is expressed by Lock (1975), not in the sense of a critique but in explanation of the mechanisms of technological progress (Marx, 1973). It is not clear whether the production of newer, and better, objects shapes the preferences of society, or whether public demands require the constant improvement of products and procedures. This argument is used by critics of technological progress on one side, particularly among the young generation of today, and the producers of innovations on the other side. The same thought was expressed by Freud (1959). In spite of the "...extraordinary strides in knowledge of the natural sciences and technical application of them... men are beginning to perceive that all their newly won power over space and time, this conquest of the forces of nature, this fulfillment of age-old longings, has not increased the amount of pleasure they can obtain in life, has not made them feel happier...". He argues that many of the admired advances create new needs: "...If there were no railway to make light of distances my child would never have left home and I should not need the telephone to hear his voice. If there were no vessels crossing the ocean my friend would never have embarked on his voyage and I should not need the telegraph to relieve my anxiety...". Freud does not further develop this thought.

7. Progress for Prestige

A few words should be said on progress as a means to give prestige to an individual or a group.

Migdal (1974) calls the desire to achieve recognition and success in a system wider than that of the village one of the reasons for abandoning traditional patterns and commitments. The wish to please or to impress can influence the actions of people in a certain degree. The request for faster cars, for instance, for ever more advanced implements in household, office and factory is well known in modern society.

By comparison, this mechanism is visible also in small-scale societies as soon as they enter the stage of social stratification or when they have more intimate contact with the consumer goods of industrialized countries. In an egalitarian society all members own the same kind of objects, and all eat the same food. The wish to outdo their neighbours and kinsmen in quantity or beauty of their belongings does not exist, or is suppressed in order to avoid conflicts (Velimirovic, 1974). However, if a wealthy class emerges, envy will grow and nourish new desires. In the north of the island of Luzón, in the area where the

Kankanai Igorot live, houses made of corrugated iron spread rapidly, replacing the traditional type of house. By our standards they are ugly and less well adapted to the local climate than the wooden huts covered with grass. During the hot day they are hot inside, and in the cold mountain nights the inhabitants shiver from the cold. Yet the owner of such a house is recognized by his neighbours as a wealthy and progressive person (Velimirovic, H., Field Experience, Philippines, 1968-1973).

The snowmobile in Finland is highly appreciated by the Lapps; it gives status to its owner. However, it does considerable harm to the traditional system of reindeer herding for subsistence:

Many animals have to be slaughtered in order to pay for the snowmobile;

Due to mechanized herding with the snowmobile the herds are scattered over wide areas, making traditional herding impossible;

Wealth is concentrated in greater amounts than ever before; a new social stratum is created, that of the contractor, with new methods of management, deepening the gap between the older and the younger generation and between traditional herdsmen and modern entrepreneurs (Ingold, 1975).

Human factors such as the striving for prestige are recognized by behavioural scientists, but are little understood. The boundaries between a universal human attribute and the influence exerted by the value system of a given society are not clearly visible. Both seem to hold true; the universal wish to please finding its distinctive expression through tradition.

Considerations such as these are of obvious importance with respect to the formulation of societal preferences.

8.   Man's Attitude Toward Technology and Technological Innovation

In spite of an eager acceptance of items which facilitate daily life, it seems that major changes and innovations are often viewed with distrust. Kroeber (1963) says that "... a large part of mankind just is fundamentally conservative..." and that even revolutionaries "generally want particular improvements on top of a basic maintenance of the scheme of things". He ascribes this characteristic particularly to other than Western societies, for whom the idea and ideal of progress has not been axiomatic.

Hirshberg and Schoen (1974) found that in the United States resistance often remains even "after an innovation satisfies requisite technical and economic conditions", even after feasibility is demonstrated. He blames organizational and cultural factors for this resistance. Local prejudices can be involved as well as fear of loosing one's employment if new technologies replace old ones.

Gilfillan (1963) gives as causes for individual resistance to innovations those he cites from Hart and Stern, namely: ... unacquaintance, stupidity, all the factors in conservatism and selfish vested interests...".

The most difficult task for a behavioural scientist in an analysis of the relationship between technological progress and man is the evaluation of human attitudes. It is recognized that generalizations can be made only with reservations as individual and public attitudes are determined by an undefinable number of factors. On the individual level age, sex, education, profession, and level of information can play a part, to name only the most evident factors. Others are equally important, such as genetic inheritance and cultural background. On the societal level historical and political factors are in the foreground. Attitude surveys are frequently mentioned as showing group values. However, this is a complex matter and discussions bring no satisfactory solution to who makes public opinion and who expresses it. Do decision-makers and public officials represent public opinion? The individual is subject to strong influences from his material and geographical environment, from friends, superiors, pressure groups, mass media. Personal attitudes might change in time with changing influences and circum-stances. How can a uniform opinion be generated by so many diverging and labile individual minds! Attitude surveys are of only limited value. As anwers may to some extent depend on the formulation of the question, they need not represent the true thoughts of a person. On the whole it can be said that at the present state of knowledge attitude surveys are the best tool available to gain a general if momentary impression. These problems are recognized and taken into consideration by sociologists.

Out of many surveys continuously under way, two papers on research, each done independently of the other in the US in 1970 and 1972 on the subject of technology and social change, bring similar results in their conclusions in that their survey "does not reveal the kind of rampant anti-technology, antiexpert sentiment that we hear so much about from social critics and the mass media..." (Taviss, 1972). The data of La Porte and Metlay (1975) show that there is a

"...positive public response to past and present technological
development, overlaid with a set of concerns about the more
general consequences of that development...". Taviss stresses
the ambivalence toward technology. The same people who
support it as being beneficial, criticise it for particular
reasons. However, most people do not hold technology respon-
sible for their discontent with the quality of life.

La Porte and Metlay found a significant increase in the
public's distrust of all public and private institutions with
respect to decision-making. Government officials and business
leaders are felt to have an undue amount of control in the
implementation of technology. Similar findings are reported
by Taviss. Both surveys show that the public wishes a
higher degree of participation in decision-making in techno-
logical matters and that they feel "far removed from any
access to the decision process...".

Another author, Mazur (1975), holds that "...public
opinion polls have consistently shown more persons to be
in favour of each innovation than are opposed to it, and
there is slightly more opposition as the amount of eduction
decreases...". It seems that education and occupation play
a major role in the evaluation of technology, rather than
age, sex, marital status and religion. Taviss found that
the "...information level revealed a higher correlation
with attitudes than did education itself....the least know-
ledgeable groups were far more likely to agree strongly
with the criticism than the moderate or high-information
groups...". Her statement that there is greater support
for technology from the low-information group than from the
high-information group does not necessarily contradict
the previous note but is possibly an indication of a more
unbalanced mode of thinking in the less informed person.

According to the surveys described, the mass of people
do not formulate their opinions. Determined by education,
preparedness, mental agility, political conviction, etc.,
there is in each group a certain proportion of outstanding
individuals more outspoken than the rest of the group.
These are the people who actively defend the values of the
particular group. As La Porte and Metlay found,"...not
unexpectedly there was no strong concensus on what values
should be given priority.." and "...that the public considers
a wide-ranging combination of values to be important criteria
for evaluating the consequences of technical development
complicates both the activities of technologists and the
task of policy-makers, for some of those values seem clearly
to be in tension...". This confirms the weight of indi-
vidual vs. public opinion. However, they continue that
"...a relatively high degree of support was expressed for
a wider range of priorities than simply the economic value

(of employment and taxes)...". A similar tendency is recognizable from the evaluation of Taviss' research, namely that the respondents favour a greater allocation of natural resources to social than to technological programs.

It is evident that societal values depend on factors characteristic for a particular society in a particular time. They will change with circumstances, even with the emergence of a new generation.

However diverging individual opinions might be, and whatever the differences in societal values are, La Porte and Metlay concluded on the grounds of their research that technological dissent cannot be written off as either anti-rational or anti-intellectual, as is often asserted by stout believers in technology.

III. Risk Analysis

In the previous chapter, we have examined man's attitude towards technological progress. In the following chapters, we will discuss the various risks man faces, both in traditional society and in a changing techno-logical environment.

1. Present State of Research

The exponential growth of technology has generated consequences which are also growing at an exponential rate. If technologies are new, the trends and the magnitude of their effects might not be known for lack of experience. In order to gain control over the risks arising from the development of new technologies, the need for risk assess-ment was evolved within the scientific community.

In the past, risk assessment was a matter for insurance specialists or welfare experts, or for psychologists and decision-theorists analysing, for instance, risk-taking in gambling. Lately, with increasing health hazards from the polluted environment, public health specialists have become aware of the new risks facing mankind in particular circum-stances. Risk analysis is now gaining acceptance in a large number of industries for operational and strategic planning (Canada, 1973). A computer search made early this year showed that most of the publications on risk came from the managerial field.

Comprehensive research on risk assessment in connection with new technologies has only recently been taken on the agenda of researchers. The approach is new, and from the

literature available so far it might be assumed that a long road lies ahead of the scientist engaged in this field before any conclusive theories or operational methods for the proper assessment of risk are developed.

To the sociologist it is striking to see that much attention in this research is focussed on the theory, method and praxis of risk assessment, rather than on communication and societal responses (Comparative Risk Assessment, Woods Hole, 1975). In his comprehensive "Anatomy of Risk" Rowe (1975) emphasizes the need for data on societal behaviour. Other authors stress the same need, and the lack of knowledge about societal attitudes in connection with risk assessment.

These facts show the dilemma in which behavioural scientists find themselves. It is recognized that in ongoing research, aspects have to be taken into consideration which at the present stage of knowledge are "intangibles". Methods need to be developed for gaining clearer insights into individual and societal risk behaviour with respect to technological risks.

The working hypothesis of this paper is that a pragmatic approach might lead to some understanding through:

Field research and the analysis of case studies;

An analysis of various research results, particularly of civic action reports;

Comparative analysis of risk behaviour in small-scale societies from available literature;

An analysis of historical case studies of major innovations, taken from the literature.

Points 2 and 4 will be part of the future research work of the Joint Project. Point 1 would be useful if a questionnaire could be elaborated, taking into account the lack of knowledge recognized here, testing more than one group, and possibly allowing cross-cultural comparisons. Point 3 will be discussed in this paper.

2. Definition of the Term "Risk"

How can "risk" be defined? What are its characteristics, and what are people's percpetions of and attitudes toward risk?

Otway et al. (1975) consider risk as a probabilistic term; however, a deterministic connotation is suggested by the consideration of preferences for various consequences (Winkler, 1973), that is for the expected benefits. In

other words, a risk is taken if it is judged that potentially it could bring a desired benefit which is worth the price in property, social security, health or even life. The goal could be a material benefit, pleasure, prestige or the maintenance of a satisfactory status quo.

The risks a modern society has to face are caused mainly by the effects of new technologies on man's environment or behaviour. If the new hazards are compared with those of the recent past, for example at the beginning of this century, it is obvious that they have completely changed. Not only do they expose man to an involuntary risk in which, in most cases, he is helpless since he can neither escape the hazards nor fight them efficiently; but, significantly, they have reached global proportions in space and in magnitude. This has never been the case before.

3. Risk Assessment

Risk assessment as a method of examining all possible aspects of risk is seen by Otway et al. (1975) to consist of risk estimation and risk evaluation. Informally it is carried out by the person, or persons, confronted with a risk situation. For decision-makers in the public or private sector it is a necessary procedure as they impose a risk or risks on other persons.

Otway describes risk estimation as "the identification of the second (and higher) order consequences of a decision and the subsequent estimation of the magnitude of the associated risks", and risk evaluation as the "complex process of anticipating the societal response to risk; it is based upon an understanding of the relevant societal attitudes and preferences. This could be termed the 'acceptability of risk'" (Otway et al., 1975).

IV. Risk in Traditional Societies

An analysis of risk situations and risk behaviour in traditional societies will give a baseline for comparison with modern social systems. For easier classification, the distinction should be made between natural hazards and man-made risks, and between involuntary and voluntary risk taking.

1. Natural Hazards

Natural hazards play different roles in different parts of the world, according to topographic and climatic factors on one hand, and socio-economic and political factors on the other. The state of technological development and the ad-

vancement of the infrastructure are also important factors.
It was observed that very often natural disasters bring
more destruction in overcrowded areas with poor quality
of housing materials and poorly organized public services.
On the whole, natural hazards are more serious for tra-
ditional man whose possibilities for protection are scant
compared with those of modern urban man.

The destruction caused by natural disasters threatens
the health and life of traditional people, their material
possessions, animals and crops. Their social systems
suffer last, and only as a consequence of extreme and pro-
longed stress. A wide range of resilience mechanisms will
be mobilized to protect social unity (Velimirovic, 1974).
Disaster studies show that societies in transition are
especially vulnerable to natural disasters. Mechanisms
inherent in a traditional society have vanished or are
mutilated, but the highly developed infrastructure which
absorbs a great deal of disturbance in an industrialized
society has not yet been effectively developed (Kates et
al., 1973).

2.   Involuntary Risks

Natural hazards are in most cases involuntary risks.
This term might appear to be a "controversio in adjecto".
An involuntary risk, that is a situation of uncertainty
which leaves no alternatives for a person, might be termed
"threat" or "menace" as well. Typhoons, floods and droughts,
earthquakes, lightning and volcanic eruptions can be con-
sidered involuntary risks, i.e., phenomena which leave
aboriginal man helpless and defenseless.

The inhabitants of wide areas in Persia and Pakistan
or on the west coast of South America, where violent earth-
quakes are not infrequent, do not have the choice of residence.
In the Philippines, for instance, every year during the
rainy season vast areas are hit by an unpredictable number
of devastating typhoons, killing people and causing havoc
to land and animals. Most of the inhabitants in these
areas are poor. They do not have the means to choose, and
with their poverty goes a lack of knowledge. They might
not even know that there are areas, out of their reach,
which do not experience disasters of this magnitude. In
such cases it seems appropriate to say that people are ex-
posed to environmental threats with no possibility of
escape.

3.   Frequency of Occurrence

In this context the frequency factor should be taken into account (Burton et al., 1968). If a disaster occurs frequently, people will react differently than when they are not well acquainted with it, or know about its occurrence from hear-say only. Before they experience it, they are more careless and more confident; when faced with the disaster they are less sure about the remedy procedures.

The author lived in a Philippine settlement on Luzón when a typhoon of outstanding magnitude (Velimirovic et al., 1972) hit this part of the island. As stated above, the population of this area is experienced in this kind of disaster. In that particular year (1970) typhoons swept over the Central and/or Northern Philippines virtually every ten days. The coming of a typhoon is announced some days in advance on the radio. Heavy rains and strong winds herald it before the core of the typhoon hits the area.

In preparation for the 1970 typhoon, the roofs were fastened to trees with ropes, the wooden sliding doors and windows of the bamboo huts were reinforced, the fishing boats were put on shore and in a safe place. People gathered in the strongest hut; only the men went out from time to time on guard. Everything was done in an atmosphere of equanimity and cheerfulness.

At the height of the typhoon some women played cards, laughing and joking. An old grandmother placed a basket full of coffee beans on the bamboo floor, those not engaged in games helped to peel coffee, distracting their attention from the frightful spectacle of nature.

It should be added that most of the coconut and banana trees, some of the main sources of income and subsistence of these very poor fisher-farmers, were badly damaged, uprooted or destroyed. Coconuts and coffee cherries were scattered all over, partly beyond recovery. Certainly, the behaviour of the group described corresponds to their code of self-restraint; however, no subdued fear could be detected, and it was evident that such occurrences were frequent. Work in the devastated gardens was resumed immediately after the strongest storm had subsided.

R. Firth (1959) came to the island of Tikopia in the Pacific shortly after a strong typhoon had hit the island. In this area typhoons occur occasionally at intervals of about 20 years. Thus, young people under the age of twenty might have heard about it, and adults might faintly remember a previous typhoon and the measures taken on that occasion. Firth relates that the people of Tikopia had hardly overcome

the shock of this disaster when a second typhoon swept over
the island a year later, leaving the population in a state
of desperation. This second shock resulted in a severe
famine, accompanied by a number of social disturbances,
until the rulers of the island started to adapt the tra-
ditional pattern of social behaviour to the new situation.

These two short descriptions show that the senses
become accustomed to actual danger by continual exposure to
hazard; in other words, the effect of the event is attenuated
by habit.

The same is true of modern people. Readers might still
remember the eruption of the Helgafell Volcano on Heimaey,
Westman Islands (Iceland), in January 1973. During the
eruption all but 200 persons had to be evacuated from the
Westman Islands. Eyewitnesses agree that the people showed
most remarkable restraint, calm and patience during the
disaster and the evacuation procedures (The Volcanic
Eruption on Heimaey, 1973). This is explained by a reporter
as being due to the past experience of the islanders. The
last eruption in the island groups had taken place ten
years before the Helgafell outbreak, so that it was still
remembered by the adult population. Furthermore, the hard
life of fishermen under difficult working conditions in
stormy seas, and the common threat of loss of life, had
taught them throughout centuries to face uncertainty and
danger calmly.

4.   Health Hazards

Small-scale societies are more exposed to health hazards
from their natural environment than modern societies. This
particularly concerns people living in the tropics. If the
outbreak of a disease is probable according to statistical
frequency of occurrence, and if at the same time exposure
to the health threat might bring a benefit, it can be con-
sidered a risk to health.

In West Africa in the Volta River Basin (Onchocerciasis
Control in the Volta River Basin) a small mosquito (Simulium
damnosum) is the carrier for a parasitic worm (Onchocerca
volvulus). This parasite in its larval stage is transferred
to human beings through the bites of the carrier mosquitoes.
If a person is bitten frequently a parasitic disease de-
velops which not only produces unpleasant skin conditions,
swollen glands and nodules, particularly on the head and
eyes, but which eventually leads to blindness (at the age
of about 35 when people are in their most productive years).

The inhabitants of the fertile river beds are well aware that living near the rivers is responsible for the disease. The disabling consequences of the illness are so feared that whole villages move away from the river to the dry savanna, away from the flight radius of the mosquitoes. However, because of the lack of water, living conditions in the savanna are difficult. Population pressure might locally lead to overexploitation of poor soil. (On a small scale, and in certain areas, this might have been one of the causes contributing to the severe famine experienced in wide areas of Africa.) Eventually the farmers or their children return to the fertile river valleys where they will be exposed to the risk again, only to be driven away after the consequences of the disease make themselves apparent.

Another example shows the kind of risk a traditional society is exposed to through its environment (Velimirovic, B., 1969). In the irrigation ditches of the Nile delta in Egypt, in the Sudan, in irrigation systems in Tanzania and on some islands of the Philippines (Leyte, Samar, S. Mindoro, for example), as well as in some other parts of the world (Brazil, China), small snails which live around aquatic plants are infected by parasites which use the snails as hosts during their developing phase. When they are in the stage of worms (called Cercaria), the parasites leave the snails, float freely in the water, and eventually intrude into human bodies. During their reproductive cycle the different species of the parasite (Schistosoma haematobium and Schistosoma mansoni in Egypt and Tanzania, Schistosoma japonicum in China and the Philippines) affect specific parts of the human body, particularly the veins of the uro-genital and gastro-intestinal tracts. The illness which they cause is disabling and may be fatal if the parasites are concentrated in the liver, thus provoking a form of cirrhosis.

Children are easily infected because they play and bathe in the water. For at least 30 years the people living in the infected areas have known the cause of their disease. Yet, the ditches must be cleared of vegetation if they are to function well. Thus the agricultural population which is in constant contact with the water has the most severe infections. In the process of food production the peasants must take the risk, always with the hope "it will not happen to me".

5. Voluntary Risks

A natural hazard is a voluntary risk if people have the option to decide whether they are willing to cope with the impending dangers or uncertainties in order to gain benefits; for example, when a person living in an area where the incidence of natural disasters is high decides nevertheless to remain at home on his own land.

People often choose - if they have a choice - to live in places which are exposed to the recurrent incidence of natural disasters (Kates et al., 1973). Volcanic soil is particularly fertile for cultivation. Men prosper in such areas, but they have to accept the risk of occasional loss.

On the island of Luzón in the Philippines, a small volcanic island in the middle of the big Taál lake (itself a pre-historic crater lake) was continuously inhabited by fisher-farmers in spite of known eruptions in the past. It is said (Carrol et al., 1966) that in four centuries Taál Volcano has erupted some twenty times. During an eruption in 1911 1,335 persons were killed and 199 horribly burnt and injured, and 142 square miles of fertile land were devastated; yet the island was not definitively abandoned. During the following major eruption in 1965, between 200 and 300 people were killed within 75 minutes and 1,300 families were left homeless. Three years later, in 1968, Taál erupted again, and again around 1,000 people were killed and animals and settlements were buried under the ashes. Under government pressure the island population was evacuated each time the volcano showed signs of imminent eruption, yet returned as soon as the immediate danger was over.

The inhabitants of the Westman Islands of Iceland described above, who were evacuated after the eruption of the Helgafell Volcano on Heimaey, returned to their island when the volcano had calmed down. They did not consider giving up their homes and the source of their income, a well-developed fishing industry (The Volcanic Eruption on Heimaey, 1973).

On the island of Tristan da Cunha in the southern Atlantic, a severe volcanic outbreak in 1961 forced the inhabitants to flee to England. The main landing beaches and a lobster freezing-plant, the island's only cash industry, were destroyed (Blair, 1964). However, most islanders decided to return to Tristan da Cunha after 18 months of exposure to the temptations of a West European metropolis. They decidedly preferred the harsh island life of egalitarian community ideals (Munch, 1975) characteristic for Tristan da Cunha.

Since early historical times people have known the risks of living in the neighbourhood of rivers subject to periodical flooding; however, they recognized the benefits of the alluvial soil for agriculture, accepted the risks, and, as time went by, adjusted by constructing irrigation systems minimizing the potential dangers.

6. Man-Made Risks

Man-made risks can be divided into:

a) Voluntary risks
b) Involuntary risks
c) Crime.

a) Voluntary risks

Man-made risks which are voluntary can be described best by the motivation for their acceptance. In traditional societies a person will voluntarily take a risk in order to obtain benefit in the following sectors:

      i) Economy
    ii) Sex
  iii) Social prestige

i) Economy

The daily fight for subsistence forces traditional societies in many parts of the world to use dangerous practices, according to the nature of their environment, in order to catch or produce food, or materials which might be traded or sold to obtain the necessary food. Examples are fishing in dangerous seas and diving for pearls and sponges. In Northern Luzón sweet potatoes are cultivated by Igorot women on extremely steep mountain slopes, too steep to be used as grazing grounds for water buffalo or for planting rice.

The Bemba in Northern Rhodesia (Richards, 1969) practice a particular technique of slash-and-burn agriculture: they plant the seeds in "burnt gardens". The young men of the village climb high trees in order to cut branches and throw them to the ground. When these are dry they are burnt and the ashes are used as fertilizer for the new garden plots. Climbing and working on the trees requires skill and agility. The older men who lack these qualities do not take the risk of participating in these practices.

Certain hunting methods represent the same kind of risks, such as the buffalo hunt of some Plains Indian tribes before they became equestrian hunters, or the fight with wild animals preying on herds.

ii) Sex

Some societies - such as the Cubeo (Goldman, 1963) or the Yanonámi (Becher, 1971-1973) of the Amazon Basin, or the Murngin of North-West Australia (Warner, 1958) - are bound by strict traditions to particular marriage regulations. As a consequence the choice of sex partners is restricted.

It is quite frequent that under such conditions men are looking for sexual adventures and women are not strongly opposed to proposals of this kind, in spite of occasional severe punishment. Stealing a wife might fall under the same heading. Among the Eskimo of Northern Alaska (Spencer, 1959) murder is common in retaliation for wife stealing. Such exploits, while risky, bring about a certain admiration by less successful suitors.

iii) Social prestige

At this point the borderlines between the prestige and the sex categories are flexible. In traditional societies social prestige is one of the main goals, not only through conforming to the norm but, in many cases, through the use of dangerous practices such as warfare, headhunting (in the past), horse and cattle theft, and bravery in sportive performances.

The prestige-bringing purpose of warfare was particularly obvious in the Plains Indians' tribal wars where the aim was not necessarily to kill a person but to touch the enemy under dangerous conditions, and to take his scalp as proof of one's prowess (Ewers, 1955).

It is interesting to note that primitive warfare tries to minimize risk (Hirschberg, 1965). Ambushes are preferred to man-to-man fights; night and early morning are chosen for an attack rather than the active time of day. In some societies warfare for cannibalistic reasons not only contributed to a person's social prestige, but he was thought to gain strength from the incorporation of inimical substance. The warrior knew that he might be the victim at any time.

There is no evidence that in traditional societies war is considered as an involuntary risk, a punishment imposed by supernatural powers, as in the Christian belief of past centuries where war was thought to be one of the God-sent plagues. Indirectly, however - in some head-hunting societies, for instance - an ancestor spirit could ask his descendant for an enemy head as sacrifice in order to cure an ill kinsman. In such cases the warrior felt the obligation to engage in warfare.

In some parts of the world head-hunting served the same purpose, to bring social prestige to the victor. Sometimes it was thought to bring prestige particularly in the relationship with women. A young Ilongot of Luzón of marriagable age had to present a certain record in order to be accepted by his mate (Wilson, 1967). It was understood that in this kind of warfare the outcome was necessarily uncertain. The risk was mutual, the price was high but so was the satisfaction of the respected person. Here again, the borderlines between the two categories are flexible; the goal can be understood in terms of both sex satisfaction and social prestige.

To gain prestige, not only are risks to health or life taken, but also economic risks, as seen in feasts of merit. Some Indian groups of the North-West Coast of North America - the Kwakiutl, Tsimshian, Tlingit, Haida and others - used to hold big feasts called "potlach". The social rank of a person was measured according to his wealth in particular material goods. These goods were distributed at a potlach on the occasion of special events such as birth, initiation, marriage or death. The person who received the gift had to recompense the giver with 100% or more at some other potlach. The highest rank was given to him who could outdo the others in the amount of gifts distributed or goods destroyed for the sake of boasting (Hirschberg, 1965).

In South-East Asia and in the northern mountains of the Philippines another kind of feast of merit is known (Velimirovic, 1972). Though discouraged by government efforts these take place among certain mountain tribes of Northern Luzón even today, but on a minor scale and pre-ferably combined with memorial and curing ceremonies. Here the person who wants to gain status in his community is obliged to give a series of feasts of merit (called "cañao" by the Igorot) on which a fixed, and at each successive feast increasing, number of pigs and water buffaloes are slaughtered. The meat is eaten by family members, friends and villagers at a banquet lasting several days, accompanied by ritual dancing and drinking. During the ceremony of the highest grade thirteen pigs and six water buffaloes are sacrificed and distributed at once.

Gift giving in order to gain prestige is practically universal. Outstanding persons wishing to enhance their social status or striving for prestige and rank distribute their possessions to competitors or to poorer members of their groups, at the risk of being left poor themselves, but hoping to be compensated in the future according to their higher status.

b) Involuntary risks

Man-made involuntary risks in a traditional society can be brought about either by members of the traditional group or from the outside. The following distinctions can be made:

    i) Random risk
   ii) Risk imposed by trial
  iii) Risk brought about by a stronger group.

i) Random risk

Whereas the warrior who went out to kill for prestige was voluntarily taking the risk of being killed himself, a member of the same cultural group - maybe of the neighbouring and therefore enemy village - was in a situation of involuntary risk when he went alone on a path where he might be ambushed to have his head taken. Women and children working in the fields without male protection were exposed to the same risk.

ii) Risk imposed by trial

In many traditional societies the innocence or guilt of a person was judged by the outcome of a test of clearly dangerous dimensions called "ordeal". In medieval Germany it was called "Gottesurteil", the judgement of God. The methods were, for example, poison taking, being thrown in deep water, or holding an arm in boiling water. A person subject to suspicion was exposed to such a risk, either by a verdict or under the pressure of public opinion.

The Efik of Calabar province in Nigeria possessed several forms of divination for ordeal. One of them, "medicine-broom divination", is described as follows (Simmons, 1969): "...The diviner applies magic-medicine to two six-inch brooms made from the striated husk of the oil palm tree. The suspect holds one broom in each hand and places the ends of the brooms against his neck. The brooms are believed to squeeze the neck of a guilty person...".

Another method is described where, under the weight of accusation, an individual believed to have used witchcraft usually demanded: "...his right to undergo the Calabar bean ordeal in order to establish his innocence. The suspect ate eight poisonous Calabar beans, and then drank an infusion of several ground Calabar beans and water. If the suspect possessed witchcraft, his mouth shook and mucus came from his nose, but if innocent of witchcraft he lifted his right hand and then regurgitated...".

The ordeal is defined as "...a form of divination in which the accused risks bodily injury..."; however, it must not necessarily do him bodily harm. The risk lies in the uncertainty whether the test will prove guilt or innocence. If the accused is found guilty, the punishment would bring the injury.

iii) Risks brought about by a stronger group

If two cultural groups of different strength meet, it is most frequently the weaker group who is under pressure to accept cultural elements of the stronger group. Acceptance

of new ways may constitute a risk. Turning away from old
traditions could mean wealth, material superiority, education,
pleasure and prestige; however, the risk appears in the re-
lationship with supernatural powers, gods, and ancestor
spirits. In a way common beliefs and religious practices
have strong unifying functions in aboriginal societies.
Myths, prayers, sacrifices restore or strengthen the cohesion
of the group. Gods or spirits watch over continuity in
religious customs and life style. The tribal conscience
fears their punishment and their revenge which will be
seen in illness, death, accidents, loss of wealth, and mis-
fortune. Here one must seek some of the reasons for
resistance to progress: in the conflict between elders
and the young people who received their education in
government or mission schools.

c) Crime

Crime is not per se a motivation to take a risk but
a means to attain a desired goal involving a major risk
through a deed thought to be criminal by the group.

In some traditional societies where certain crimes
were customarily punished with the death sentence,it was
clearly a risk to commit such crimes as sorcery, murder,
theft of food during famines and, sometimes, adultery.
If he was discovered, the offender had to undergo formal
trial and was consequently sentenced to death by various
means.

The Kankanai-Igorot (Velimirovic, 1972) relate that
in the past, when a sorcerer was discovered, he was sentenced
to death by the council of elders. After an especially
good meal with plenty of alcoholic drinks he was obliged
to commit suicide by whatever way he chose.

On the island of Tikopia in the Pacific Ocean (Firth,
1959) a person who continuously disturbed peace and unity
in the community was finally sent in a fragile boat to sea
where he would eventually perish.

In Inka Peru (Murdock, 1964) adultery was punished with
death. Stones were thrown at both adulterers until they
died, or they were pushed into the sea bound together with
a rope. Also in pre-Columbian Mexico (Bray, 1968) adultery
was punished with death through stoning or strangulation.

Among the Bemba of Rhodesia (Richards, 1969), the food
thief during a severe famine was beaten to death.

It is evident that in those circumstances people were
reluctant to take a risk which could bring them dishonourable
and violent death.

V.   Risk Perception

"Risk perception" is the content of what a person thinks about risk. It reflects the personal judgement of an individual or the joint judgement of a group. Otway et al. (1975) maintain that "risk perception is important since the response to risk depends upon how situations are perceived...".

A distinction may be made between objective risk and subjective risk understanding as suggested by Haefele (1974). However, even if the attempt at objectivity is made, people's responses to events are always biased by personal and group factors, many of them unknown to the researcher. As Fishburn (1964) has pointed out, "all measurements of probability rely upon human judgement to some extent".

For known technologies the reality of a risk consequence will range within determinable limits. It might not be predictable in all details, but on the basis of objective data from past experience the reality can be expressed through appropriate methods.

In the nuclear field, risks might be of hypothetically almost infinite magnitude. Their exact testing in the laboratory is not feasible. Therefore, real risks remain, called by Haefele "residual risks". On the level of "hypotheticality" they have to be considered as unknown variables,"embedded" in the known risks (Haefele, 1973).

The perceived reality of a risk has as many faces as there are people involved in the particular event. The way in which a person perceives reality is subject to an indeterminate number of influences from within and outside the person. Age, sex, ethnic background, mental structure are decisive, as are experience, frequency of exposure to an event, knowledge and the availability of information, etc. According to a person's knowledge and the ability to think logically, perceived reality will differ from reality by degrees. Equally, the measures to avert risk or to mitigate unfavourable risk consequences will differ by degrees, related to the respective risk perception. Expert measures will come closest to the needs of the reality; lay measures might show marked differences. This is best explained by some examples from small-scale societies.

1.   Risk Perception in Traditional Societies

In traditional societies considerations of this kind are unknown, and the faculty of abstract thinking is frequently unschooled. A definition on this level not being available, risk perception is most clearly expressed in:

a) Measures of risk aversion
b) Risk awareness expressed in symbols or in myths.

a) <u>Measures of risk aversion</u>

In this category are included all measures which in some way prevent a risk or minimize its consequences. Moving away from a hazard zone is a measure of risk aversion, as is fastening a roof during a typhoon, or installing safeguards such as double outriggers in a seafaring boat used by the inhabitants of islands in the Pacific. The construction of stockades around a settlement as practiced by some American Indians is averting the risk of attack by trespassing enemies. Avoiding sorcery or punishable crime is a kind of risk aversion as a consequence of risk perception.

A ritual which shows particularly well the subjectivity of risk perception is the ceremony of dawās, practiced by some Igorot groups in the northern island of Luzón. An Igorot who assists in the recovery of a severely wounded or dead person has to undergo a sacrificial ritual in order to avert the risk of misfortune through contact with the impure. During a bus accident in the dangerous mountainous Igorot area, people living near the site of the accident abstained from giving help because a sacrifice at the required ceremony would surpass their financial possibilities (Velimirovic, 1972).

b) <u>Risk awareness expressed in symbols or in myths</u>

Radcliffe-Brown (1964) relates that the Andaman Islanders (off Burma) give the term lau or čauga equally to spirits and to foreigners of another skin color than their own. As he states that, for the Andamanese, the spirits are the chief source of danger, a subconscious awareness of the risk of contact with people different from themselves can be recognized in these terms.

In his book "Progress to Nowhere" Lommel (1969) describes the changes to which the Unambal society of North-West Australia is subject under the pressure of white domination. Their traditional patterns and values are irreversibly destroyed by a process the government authorities equate with progress. In an early stage of contact with Western society a conscious awareness of the risks to their society was observed; however, the impact of technological progress on a tribal society could be neither averted nor resisted for long. The unknown features of Western civilization are merged into a new whole, ranking with the traditional mythical beings of these Australians.

Frightful and destructive powers are believed to emanate
from it. Any contact, even in a dream, brings illness
and misfortune. Only the initiates of the new myth can
overcome its dangers; only they know how to use its
threatening forces. Risk perception or, in this case,
risk awareness is not clearly defined but is strongly
felt and integrated into traditional beliefs.

The following myth is transmitted from classical Greece.
The god Asclepius earned immense renown with his miraculous
cures. He even succeeded in restoring the dead to life
through various practices. Hades, king of the realm of
the dead, who felt that he was being wronged, went to Zeus
to complain. Asclepius was found guilty of thwarting the
order of nature. In punishment Zeus struck him dead with
a thunderbolt (Greek Mythology, 1963). This truly pro-
phetic myth expresses the awareness of a risk felt by
Greeks in Antiquity when the laws of nature were neglected
or broken by man.

An undetermined number of taboos - prescriptions and
prohibitions - in practically all traditional societies
give proof of the awareness of dangers and risks in the
physical and psychic environment of men, in interpersonal
and intersocial relationships. These examples make it
clear that "risk perception" is reduced to "risk aware-
ness" if the process is taking place on an unconscious
level. It follows that for risk perception an actual
basis of information of whatever level is a prerequisite.

2. An Example of Risk Perception in the European Past

In the course of history we encounter risk perception
of a somewhat more concrete kind. Mumford (1967) describes
how disturbed Leonardo da Vinci was by his own mechanical
fantasies. His dreams expressed his "consciousness of the
spectacle of the human savagery and the murderous malice
that some of his own proposed military instruments were de-
signed to serve. These horrors mingled in his dreams with
prospective marvels, as in the following prophecy: 'It
shall seem to men that they see new destructions in the sky,
and the flames descending therefrom shall seem to have taken
flight and to flee away in terror; they shall hear creatures
of every kind speaking human language; they shall run in a
moment, in person, to diverse parts of the world without
movement; amidst the darkness, they shall see the most
radiant splendors. O marvel of mankind! What frenzy has
thus impelled you!'". Mumford maintains that da Vinci
retained an intellectual freedom and a moral discipline
that could be achieved only rarely after the eighteenth
century. "Although he invented the submarine, he deliberately

suppressed this invention 'on account of the evil nature of man, who would practice assassination at the bottom of the sea'".

It is obvious that Leonardo da Vinci recognized the probable implications of technological progress, the risk involved if it were to serve an evil purpose. The religious beliefs and the limited technological knowledge of his time made his risk perception appear as fantastic dreams revealing his anxieties about things unknown.

3. Risk Perception in Modern Societies

This notion comprises the complex set of interactions characteristic for human values, attitudes, thoughts, individual or group opinion, preferences and the like. Only very broad generalizations seem to be possible by a categorization along the determinants already stated. Individual features such as mental structure, character, temperament, etc., can hardly be considered. The help of psychiatry or psychology is needed here.

Part of these intangibles in risk perception manifest themselves in the mass media, in votes, in the objectives of civic action groups or in the creeds of political parties joined by people with similar goals and preferences.

In modern societies there are no myths which try to integrate risk perception into daily life. And yet it can be traced in anxieties discovered by psychiatrists, in settled prejudices inaccessible to correction, in violent demonstrations, etc.

Guedenay's (1973) Freudian interpretation of nuclear anxiety might seem unfamiliar and far-fetched to a non-Freudian; however, her observation - that the risk perception of a non-professional person regarding nuclear power plants is in most cases linked to the horror of the bomb - merits attention, as Pahner (1975) is demonstrating in his present work. This linkage is reinforced by insufficient information and by the occasional bomb tests of the present time. Even if reassuring reports such as WASH-1400 (Reactor Safety Study, 1974) can temporarily diminish objections, people will periodically be reminded of the relationship between the peaceful use of nuclear power and the atomic bomb. As long as bomb tests are undertaken, their risk perception will stay linked to the joint source of energy, the atom. However, a certain inertia seems to be universal: as long as the need for a decision is remote, men's imagination fails to see the possible implications. Only when they are personally involved are people forced by circumstances to take a stand.

VI. Risk Acceptance

Risk perception leads to risk acceptance or risk avoidance. Risk acceptance is as complex and intangible as risk perception, since it is generated on the same subjective level of irreducible human thought. It seems that the individual differences of mentality and temperament are decisive factors in determining a person's acceptance of a risk.

Veis (1954) maintains that the urge of self-protection is of different strength in different people. Some persons, especially the young, like the challenge; they expose themselves to risks and dangers whereas others strive for security. The load of responsibility is differently felt, as is the effect of the physical and social environment.

Kahn (1960) examines as possible determining variables: body built, body weight, marital status, years of school attendance, number of children - i.e., the morphological, physiological, physical, and social variables. He found greater tendency for risk acceptance in people of leptosom (athletic) constitution.

It is recognized that high-ranking personalities in society can serve as an example to others in accepting risks. Kroeber (1963) relates that in Hawaii, in the first quarter of the 19th century, the king and some influential members of the Hawaiian aristocracy, including the high priest, demonstratively abolished their traditional gods together with the heavy burden of taboos. Many times they had observed Christians violating Hawaiian taboos without being punished by their gods. Now the people found that their gods were mute and blind toward religious rebellion of the ruling class. They consequently followed the example with only little hesitation, themselves taking up the risk of giving offence to their gods.

Munch (1975) writes that frequently "marginal elements", i.e., members of a particular group who are not well integrated, can serve as important media of change, since they are usually persons who have less interest in the maintenance of traditional patterns and values. Feeling that they have less to lose, they are more receptive to new alternatives. Seeing that the risk consequences are smaller than expected, other people more easily follow the example.

To accept a risk voluntarily, information is needed to motivate a decision. The unknown intimidates a person; he will prefer the security of the status quo. It is obvious that a voluntary risk is more easily accepted, even with

greater risk consequences, than an imposed one. Whether
it is possible to quantify this relationship, and more,
to generalize the quantification, as proposed by Starr (1969),
is questionable. Factors from the respective social environ-
ment, most of them intangible, are determinant, and there
are no methods yet to measure them (Otway and Cohen, 1975).

VII. Extensions to Modern Societies

As stated above, the study of traditional societies can
enhance our understanding of human behaviour beyond the
cultural level. An attempt is made here to extend to modern
societies some of the assumptions on risk phenomena resulting
from this research.

The discussion of various aspects of the relationship
between technology and men proves helpful in research on risk
behaviour. As major technological innovations are frequently
associated with risks, people's attitudes towards innovations
in general can be revealing with preference to risk acceptance.

1. Comparison of Risk Behaviour in Modern and Traditional Societies

Modern as well as traditional societies are exposed to
man-made risks. Here the voluntary risks reveal preferences
of the same order, yet shaped by different cultural patterns.

Everywhere, in all societies, man is prepared to take
a risk if the uncertain outcome of an event promises benefit
worth the price. The points of gravity of man's preferences
are strongly related to the fulfillment of his basic needs:
food, shelter, sex - well-being for himself and for his
family. If the pursuit of these aims meets obstacles he
will augment his efforts; he will take a risk.

Economic gain and sex seem to be strong motivations,
yet societal considerations are reflected in the attitudes
of traditional and modern man. They both wish recognition
among equals, or acknowledgement of their superiority.
Personal or national, military or professional prestige
is meaningful to them: surplus goods or surplus strength
are invested to increase or regain it. Societal or legal
sanctions may determine actions, whereas ethical or re-
ligious considerations might moderate deviations from the
norm.

Involuntary risks, however, show a different picture:
modern man is exposed to risks from his natural environ-
ment on a lower scale than traditional man. A shift has
taken place from risks through the natural environment
toward risks through the man-made environment: risks re-
sulting from activities and decisions of others, often
anonymous decision-makers.

With increasing technological progress man has, to a certain extent, gained power over nature's destructive forces. At the same time he has become increasingly entangled in the consequences of his progress: accidents, pollution, environmental hazards whose consequences are unknown so far, and economic transactions on a higher level.

2.   Some Generalizations Beyond the Cultural Level

Some broad principles can be tentatively derived from the examined material. Further research will test their validity. It is not asserted that they are new, but they deserve to be summarized.

- Mankind is basically conservative. With regard to risk this has a dual effect:

    1) People try to avoid a risk for fear of the new and unknown;

    2) People submit to a risk in order to maintain the status quo.

- The conservative mind of people does not exclude the universal wish to minimize physical effort. In traditional and modern societies a positive attitude toward technological progress seems to prevail once the contacts with progress are established.

- If, due to technological progress, changes go on in the fundamental sectors of social structure, they cause the emergence of new patterns in culture and in social relationships.

- The degree of transformation or destruction a traditional society experiences through technological progress is a function of the speed and the intensity of its impact. The threshold of resilience is not universally measureable.

- Traditional and modern people frequently derive prestige from technological progress. They are willing to take risks for social gratification.

- People's concern with a matter is related to their distance from it in space and in time.

- There is a relationship between risk perception and the frequency of exposure to a risk situation.

- Small-scale societies are exposed to risks from their natural environment more than modern societies; conversely modern societies are more exposed to risks from the man-made environment.

- There can be a substantial difference between the reality of a risk and the perceived reality.

- The perceived reality of a risk will differ from the reality by degrees according to decisive individual and socio-cultural factors.

- Risk acceptance is determined to a large extent by a wide range of individual factors.

- Risk perception is reduced to risk awareness if the process takes place on an unconscious level.

- Societal values depend on the cultural pattern of a group. Stronger concensus on values prevails in traditional societies.

- Voluntary risk is more easily accepted than involuntary risk.

- Involuntary risk is more easily tolerated if the person exposed has some control over the outcome of the risky event.

- Outstanding and "marginal" persons (Munch, 1975) are influential agents in risk acceptance.

- The risks from major technological innovations may be of global proportions for extended time periods.

VIII. Summary

A comparison of small-scale traditional societies with modern societies, and an analysis of man's attitudes toward technology and technological progress, are used as tools to gain insights into the mechanisms of societal behaviour toward risk phenomena.

Technological progress is seen as cultural change focussed on particular technological practices. Its impact on society is discussed.

Socio-cultural factors play an important part in people's acceptance of risks induced by technological progress, as they determine societal values and preferences. At the same time the unknown factors in individual thinking are stressed as they preclude a deeper understanding of human reactions.

Much weight is laid on a risk analysis based on anthropological material from traditional societies.

A number of generalizations emerge which are applicable to mankind at large. They do not solve the problems posed by man's behaviour, sometimes described as "irrational" by decision-makers. However, they point to areas in which further research might bring behavioural scientists closer to a definition of the "intangibles", and to a comprehension of the unknown human factors.

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