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**MANAGING TECHNOLOGICAL RISK: A BIOETHICAL INQUIRY**

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## MANAGING TECHNOLOGICAL HAZARDS: A BIOETHICAL INQUIRY\*

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In recent years several anthologies have appeared assessing "lessons learned" from some twenty-five years of effort in "managing technological hazards."<sup>1</sup> The more discerning will detect a new mood and refreshing attitude toward the human future and proposals for possible goals.

Among respected leaders in the environmental crusade of the sixties, Robert M. White invites us to recall that the "new environmental ethic" which emerged during the 1970's contrasted sharply with the pre-World War II "ethic of utility" which pursued a goal of "the greatest good for the greatest number."

"The new ethic embraced the philosophy that we must learn to live more closely in harmony with the natural environment and that our activities must foster that harmony."<sup>2</sup>

White reminds us that this new ethic has been aggressively institutionalized, driven by the conviction that government regulation and strict enforcement could compel human beings to adopt activities more closely in harmony with the natural environment. New laws simply assumed that the values and social benefits of protecting the environment and human health took priority over economic costs which industry could easily accommodate. However, two decades of vigorous economic growth in the 60's and 70's have given way to economic constraints of the mid-1980's. It is now clearly recognized, says White, that environmental protection is not costless to society. Moreover years of stringent government regulation have obviously failed to protect

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the public from "hazard spectaculars such as Three Mile Island, Love Canal, and Bhopal." Acknowledging the fact that "the world is fraught with irreducible risks," White concedes that we may have to forego reducing some risks--even set priorities in the management of a vast array of hazards--as morally necessary if we are to protect human rights to fairness and distributive equity.

These concessions indicate a significant shift in perspective. Yet they seem tempered by a residual reluctance to concede that learning to live "in closer harmony with the natural environment" may create more problems for practical living, not to mention ethical reflection, than it solves. Several ethicists have attempted to regard a stable "balance of nature" as a sound foundation for deriving a new ethic for protecting the environment from presumed hazards of modern technology. Consider the following exhortations. Ian McHarg writes, "We must learn that nature includes an intrinsic value system."<sup>3</sup> Thomas Colwell offers a more expansive moral prescription:

"The balance of Nature provides an objective normative model which can be utilized as the ground of human value. . . . Nor does the balance of Nature serve as the source of all our values. It is only the ground of whatever other values we may develop. But these other values must be consistent with it. The balance of Nature is, in other words, a kind of ultimate value. . . . Human values are founded in objectively determinable ecological relations with Nature. The ends which we propose must be such as to be compatible with the ecosystems of Nature."<sup>4</sup>

These prescriptions interpret and amplify Aldo Leopold's seminal essay, "The Land Ethic," containing his celebrated statement: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."<sup>5</sup>

Environmental ethics has not developed into a monolithic mindset. One school of interpreters maintains that "rights" should be extended to include their attribution not only to sentient fauna and flora, but also to rocks and rivers, as a means of entailing human obligations not to "harm" them.<sup>6</sup> Others insist upon a wholistic interpretation of the total ecosystem as possessor of inherent moral worth. The Ecosystemic School derives the "good" of nature and its moral oughts for human beings from a normative "balance of nature" to be preserved by a correlative self-sustainable society, by species diversity, and other imperatives.<sup>7</sup> Both the Extended-Rights school and the wholistic Ecosystemic school are predicated on the normative principle that "Nature knows best."<sup>8</sup> Protecting a pristine environmental quality is the paramount moral mandate. Both schools tacitly assume that the state of nature is fundamentally benign and benevolent and should be protected from detrimental encroachments inflicted by technological man. They foster the widespread popular belief that human transactions with nature, by definition, cause resource dissipation and degradation of a pre-existing pristine condition. By implication biohazards threatening public health in the modern world are caused primarily, if not exclusively, by industrial sources of pollution and toxic wastes. The risks selected for paramount concern are technological risks.

In contrast to environmental ethics, bioethics attempts to transcend the misleading dichotomies which have tended to pit "technological man"

against a "natural environment," rights vs. utility, risk vs. benefit, growth vs. development, large/hard centralization vs. small/soft decentralization, and so forth. Such dichotomies are not only needlessly polarizing; they also distract attention away from the vital interdependence between a life-sustaining biosphere and a life-preserving material well-being of individuals who presently comprise our common humanity. Bioethics seeks principles as a guide to setting priorities which can be implemented by public policies with achievable goals. Bioethics seeks the means to provide basic material well-being for living persons as the sine qua non of protecting a preferred, agreed-upon environmental quality. To that end, bioethics must develop a far more complex and comprehensive conceptual framework than is envisioned by current versions of "environmental ethics."

In search of this conceptual framework, this brief paper proposes to examine a puzzling anomaly as a key to understanding the cultural climate of opinion which currently sustains a cluster of beliefs about unprecedented threats of risk from "technological hazards." Three questions will be explored:

- (1) For what reasons have technological risks been selected as requiring special concern and management?
- (2) What scientific evidence and reasoning validates or invalidates this particular process of risk selection?
- (3) How might a conceptual framework for bioethical inquiry be developed to encourage a more comprehensive public awareness and consensus on this risk selection process?

## I. TECHNOLOGICAL RISK SELECTION: SURROGATE FOR SOCIAL CRITICISM?

Citizens in modern technological societies enjoy a standard of living, political freedoms and social amenities unparalleled in history. Yet they harbor strongly negative attitudes toward the quality of their lives and their environment. What can account for this puzzling anomaly? In less than a generation, a cultural sea-change has transformed relatively affluent citizens into fear-ridden critics who protest against technological hazards, environmental pollution, and personal contamination caused by "corporate cancer." Science and technology as recently as two decades ago were considered preëminent sources of safety and reliable instruments of human control over hostile nature. Why have they become the object of skepticism and doubt? Douglas and Wildavsky ask, "Of what are Americans fearful?" The answer is ironic: "Nothing much, really, except the food they eat, the water they drink, the air they breathe, the land they live on, and the energy they use."<sup>9</sup>

Sociologists and psychologists customarily attribute differing perceptions of risk to different personality traits. However, Douglas and Wildavsky maintain that dangers or risks are selected for attention dependent upon the strength and direction of social criticism and cultural bias. People pay attention to certain risks, not arbitrarily but purposefully, that is, to reënforce and conform to a specific way of life already selected on other grounds. When people disagree about "perceived" vs. "actual" risks they may be disposed to take or to avoid, the disagreement signals divergent agendas for changing or preserving preferred forms of social organization.

We cannot account for current disputes over the discrepancy between "actual" vs. "perceived" risks if we cling to the view that real knowledge of an external world should be allocated to experts in the physical sciences, while mistaken perceptions pertain to the realm of personal psychology. According to this faulty division, dangers are assumed to be inherent in a physical state of affairs, and the risks they pose are objectively ascertainable by experts. Subjective personality traits--i.e. an individual is either a risk-taker or a risk-avoider--cannot account for a bias toward risk as a whole. A subjectivist view is nullified by two questions: Why is it that experts disagree? Why does one and the same individual fear environmental dangers to the exclusion of those more immediately life-threatening?

Only a cultural theory of risk selection as a product of cultural bias and social criticism can account for the anomalies we encounter in affluent technological societies. Douglas and Wildavsky observe, "Only a cultural approach can integrate moral judgments about how to live with empirical judgments about what the world is like." The risks we select to control or mitigate, individually and collectively, are integral to the choices we make with respect to the best way to organize social relations, to protect shared values, and to devise institutional mechanisms for formulating public policy.

In the current dispute about technological hazards and perceived threats to environmental protection, partisans accuse each other of serving the vested interests of preferred social institutions. Whether one represents the "industrial establishment" or the "danger establishment," each side accuses the other of irrational bias, of misperceptions of real risks, of subversion of the public interest. For a cultural theory of risk selection,

the primary task is to discover the fountainhead of cultural biases which place these mutual critics in irreconcilable opposition to one another.

If public attention is a reliable indicator, the most dominant, dreaded, all-pervasive threat to public health and safety over the past twenty-five years appears to be cancer. The cause of this ubiquitous threat was singled out in the early 1960's when, coincidentally, the environmental movement took cultural root. Carcinogens, it is widely believed, do not exist as "natural" phenomena in our world. Instead they are considered to be artificial inventions of technological man, produced in the form of synthetic chemicals during and after World War II, and directly responsible for no less than 90% of all cancer deaths.

The emergence of this widely-shared belief has been chronicled with careful documentation by Edith Efron.<sup>10</sup> She traces its evolution through the pages of influential books by Rachel Carson,<sup>11</sup> Barry Commoner,<sup>12</sup> and Samuel Epstein.<sup>13</sup> Less well known as mentor and "primary instructor" of popular beliefs about carcinogens is Umberto Saffiotti of the National Cancer Institute. In a 1976 paper delivered at a cancer conference, now regarded as a classic, Saffiotti set forth ideas based on his fundamental assumption, namely that industrial chemicals are the primary source of cancer in modern technological societies.

"I consider cancer as a social disease, largely caused by external agents which are derived from our technology, conditioned by our societal lifestyle and whose control is dependent on societal actions and policies."<sup>14</sup>

Since Saffiotti knew at the time he delivered his paper that most industrial substances had never been tested for carcinogenicity, the personal pronoun "I consider" signaled a personal belief and not a scientific conclusion.



derived from a disciplined study of the data. Indeed, at that time, he was engaged in a campaign for passage of the Toxic Substances Control Act which had as its objective a program making it possible to acquire such data.

Whereas less audacious colleagues were content to express similar ideas in private, observes Efron, Saffiotti "proposed, in effect, that his personal belief be endowed with the status of a toxicological axiom."<sup>15</sup> Categorizing data as positive, negative, and inconclusive, Saffiotti boldly defined the toxicological policy he wished to see applied to inconclusive data falling into a "gray area":

"The most 'prudent' policy is to consider all agents, for which the evidence is not clearly negative under accepted minimum conditions of observation, as if they were positive. . . .

In other words, for a prudent toxicological policy a chemical should be considered guilty until proven innocent."<sup>16</sup>

Implicit in this policy is its correlative assumption: it must be assumed that no amount of any carcinogen is safe, since no one knows the amount of it required to trigger the growth of a malignancy. In short there is no threshold dose below which exposure to a carcinogen is "safe." Even one molecule of any carcinogen is a potential biohazard.

Although Saffiotti's policy and its correlative assumptions could not claim validity as the result of scientific conclusions from available evidence, they are clearly the logical culmination of seminal ideas planted more than a decade before, and forming the intellectual inheritance of "official regulatory science." Among these seminal ideas, by far the most pervasive and significant is the presupposition that nature is noncarcinogenic, and that carcinogenic chemicals are synthetic compounds invented by the

chemical industry and proliferated by all basic industries comprising our modern societies.

The non-natural causation of cancer was given widespread popular currency in 1962 by Rachel Carson. Her influential vision of man's role in creating a cancerous universe is described by Efron: "The major damage, she said, had been done since the early 1940s, the period of World War II, when the world, she said, had become contaminated by an 'unnatural' production of radiation, and by great numbers of 'sinister' chemicals, which, in partnership, were altering the very nature of the biosphere."<sup>17</sup> The term "sinister" was not Carson's arbitrary choice. As Efron explains, ". . .they were 'synthetic' artifacts of human intelligence; they had been manufactured in test tubes and were substances which had no natural equivalents and to which no life could adjust."<sup>18</sup> Efron continues:

"By producing 'unnatural' substances in huge quantities, she said, man had turned the world in which he lived into 'a sea of carcinogens' that was now taking almost one of every four lives. Man was absorbing them into his body through the air and the water and, particularly in the form of pesticides, in his food. . . ."<sup>19</sup>

Evolution has directed and shaped the adaptation of life through eons of changing environments, with the result that our natural environment has reached a balanced equilibrium devoid of carcinogens--except where contaminated by man's pollution.

Carson's seminal ideas are clearly echoed by John Quarles in his congressional testimony while serving as Deputy Administrator of the EPA:

"Since Darwin man has recognized the ability of living things to adapt to their environments. The great diversity of life in

our biosphere reflects the successful resistance of man and other species to the myriad of chemicals found in nature. However, the advent of chemical technology in the past decades has introduced billions of pounds of new chemicals that are often alien to the environment, persistent, and unknown in their interactions with living things."<sup>20</sup>

Following the passage of the Toxic Substances Control Act, a commentator on the law shows how entrenched the idea of unnatural chemical carcinogenicity had become:

"Any chemical molecule not found in nature may be said to have the potential to harm biological organisms from bacteria to man. This is because living organisms' internal defense and waste removal systems are not likely to be prepared to cope with substances of a kind that they and their evolutionary precursors never had to contend with in the natural universe."<sup>21</sup>

From this brief review of influential thinkers who have shaped a cultural climate of opinion during the past 25 years, the cultural anomaly we are experiencing becomes more understandable. With Nature exonerated and technological man held culpable, the magnitude of risks entailed by technological hazards appears overwhelming and yet, paradoxically, reassuring. What man has wrought, man can undo or eliminate. Cancer prevention in concert with cancer elimination has provided a powerful symbol for rallying political action. When partisans of the "danger establishment" hold the "industrial establishment" guilty-until-proven-innocent of having caused an unnatural

"social disease" rebaptized as "corporate cancer" by Ralph Nader,<sup>22</sup> it should be clear that an entire socio-economic system has been virtually arraigned and convicted. Demands made for institutionalizing an environmental ethic as an antidote to an ethic of utility have implied a repudiation of the cultural values of an industrialized society.

The selection of risks from technological hazards as objects for paramount ethical concern and stringent regulatory control is the direct result of a social process shaped by several deeply entrenched beliefs: Nature is noncarcinogenic, benign and benevolent; industrial society is malignant and malicious. Mankind At the Turning Point, the second report of the Club of Rome, introduced its prologue with an epigram borrowed from Alan Gregg: "The world has cancer and the cancer is Man."<sup>23</sup> This provocative claim invites us to explore the scientific evidence which might serve to validate or invalidate the selection of risks from technological hazards as worthy of paramount concern.

## II. TECHNOLOGICAL RISK SELECTION: SCIENTIFIC EVIDENCE AND IRONY

For reasons which defy a defensible explanation, overwhelming evidence of the existence, magnitude, and ubiquity of natural carcinogens has only recently been given the scientific attention it deserves. As Efron wryly remarks:

"The strange truth is that within three years of the passage of the Toxic Substances Control Act, conceived to protect the earth from Faustian man, the earth itself had been reported to be carcinogenic beyond anyone's wildest imaginings."<sup>24</sup>

In 1979, a cancer researcher at the University of Wisconsin, James A. Miller compared the types of carcinogens produced by nature with those produced by men. He wrote:

"A wider variety of carcinogens occurs in our natural environment; the term 'naturally occurring' is used here in its broadest sense. The great majority of these agents have undoubtedly been present throughout evolution, some may even have facilitated the speciation of living systems."<sup>25</sup>

In 1983, a storm of protest greeted Bruce Ames' revealing and provocative article in Science, "Dietary Carcinogens and Anticarcinogens."<sup>26</sup> If any doubt remained, he made it clear that we are virtually immersed in a sea of toxic substances inherent in Nature; the human diet contains a plethora of natural mutagens and carcinogens. His findings suggest that preoccupation with relatively small amounts of man-made effluents from various industrial processes has diverted research attention away from the most health-effective and cost-effective ways to reduce the burden of cancer through dietary and lifestyle changes. Such recommendations stand in sharp contrast to the Saffiotti-Epstein school of thought which holds that cancer is basically a political problem, induced by the irresponsible policies and practices of corporate capitalism.

In light of popular beliefs about unprecedented threats from exposure to radiation derived from nuclear technologies, recent publications about the ubiquity and magnitude of terrestrial radiation are a revelation.

D. J. Bennison and colleagues write:

"Terrestrial radiation is emitted from radioactive nuclides present in varying amounts in all soils and rocks, the atmosphere and the

hydrosphere, and from those radionuclides that, transferred to man through food chains or by inhalation, are deposited in his tissues. . . . Even now, despite the widening use of radiation-producing devices, the widespread radioactive contamination from nuclear weapon tests and the increasing applications of nuclear energy and radioisotopes, natural sources are the main contributors to the radiation exposure of most of the human population and are likely to remain so in the foreseeable future."<sup>27</sup>

Despite such overwhelming scientific evidence, radiation exposures from man-made technologies--whether for medical diagnosis or electricity generation--have been singled out as a unique cause of the dread disease of cancer as well as genetic mutations affecting distant future generations. Its effects are called "insidious" because they are believed to be latent and delayed in their manifestation. The scientific status of evidence from which these beliefs are derived is a matter of profound public misunderstanding.

### 1. Hypothetical Harm

Over twenty-five years have been spent in developing radiation protection philosophy and standards, years dominated by a conservative assumption: namely that every radiation dose greater than zero entails some possibility of somatic and/or genetic harm. A linear, zero-threshold hypothesis has guided the development of radiation standards. This hypothesis has been interpreted in such a way that the public believes there is no safe dose of radiation. It is ethically significant to realize that, despite a vast array of data in radiology, there is no conclusive evidence to prove the existence or absence of a threshold. Moral condemnations based on the linear hypothesis take it to

to be an unassailable scientific conclusion; but in fact, it is only an inconclusive theory, an extrapolated hypothesis, an ultra-conservative and protective rule of prudence.

We could not exist if the linear hypothesis were applied and enforced upon our lifestyle exposures to natural radiation. The absence of scientific evidence of harm from exposure to low-levels of natural and man-made radiation is not due to incompetence or oversight or lack of attempts to ferret them out. Lauriston Taylor has described the situation in this way:

"No one has been identifiably injured by radiation while working within the first numerical standards set by the NCRP and then the ICRP in 1934.

Let us stop arguing about the people who are being injured by exposure to radiation at the levels far below those where any effects can be found. The fact is, the effects are not found despite over forty years of trying to find them. The theories about people being injured have still not led to the demonstration of injury and, though considered as facts by some, must only be looked upon as figments of the imagination."<sup>28</sup>

## 2. Hormesis

It has been scientifically established that there are net beneficial effects from exposure to low levels of several toxic substances, e.g. copper, selenium, fluoride. Professional ethics and logic compel one to ask if competent members of the scientific community should not examine radiobiological data through the lens of an hypothesis counter to, but equally worthy of attention given, the linear, zero-threshold hypothesis. T. D. Luckey has presented a strong case of evidence supporting the possibility that

exposure to low-level radiation might have net positive effects, and indeed, it may be essential for the continued well-being of living organisms which have evolved in relation to wide variations in exposure to natural radiation.<sup>29</sup>

### 3. No Unique Effects

No one disputes the fact that there is clear scientific evidence to support this statement: "Ionizing radiation, delivered in sufficiently large amounts, can cause determinable effects or injuries to any biological system."<sup>30</sup> Nonetheless, as Lauriston Taylor and others have repeatedly stated, any somatic or genetic effect caused by radiation can also be caused by at least 1500 other agents, with no possibility of positively identifying which one might be the culprit. Besides not being unique in its biological effects, radiation dose effects are not cumulative, since a process of repair or replacement of cells both somatic and genetic in nature has been demonstrated to occur in radiation therapy techniques.<sup>31</sup>

### 4. A Practical Threshold

There is an ethically sufficient basis for recognizing a "practical threshold" for low exposures to radiation, namely, a dose level below which the elapse of time before any likely effect could be expected to appear is in excess of one's remaining life expectancy. Raabe-Book-Parks have shown that, for bone tumors caused by radium, there is clearly a practical threshold: if the dose is lower than 39 millirem per day, the elapse of time before any tumor could be expected to appear exceeds the lifespan.<sup>32</sup>

### 5. Etiology of Cancer

The scientific status of hypotheses about the environmental origin of cancer have proved to be as problematic as the linear, zero-threshold hypothesis.



Thirty years ago John Higginson formulated a complex theory which, through misinterpretations and distortion, has led people to believe that some cancer-causing agent lurks in everything we eat, drink, and breathe. He has attempted to correct distortions of his theory by pointing out that, when he ascribed the incidence of cancer in industrialized societies to "environmental causes," he meant the total environment: cultural components of lifestyles such as diet and behavior, agricultural practices, hygiene, social mores, and not merely or exclusively physical chemicals.<sup>33</sup>

In his major statement on cancer policy, the late Philip Handler, while President of the National Academy of Sciences, stated in a public address:

"... we should lay to rest the idea that it is these man-made compounds, abroad in the land, that are responsible for the fact that 25% of Americans die of cancer. They are not. The possible effects of all known man-made chemicals, when totalled, could contribute only a miniscule fraction of the total of all carcinogens in our population."<sup>34</sup>

John Totter has reflected on the origin of spontaneous cancer. He shows that, when corrected for competing risks, mortality from cancer appears independent of the level of industrialization in a country and, thus, of its man-made pollution. He maintains that it is not among man-made agents that one should look for primary carcinogens, but instead, among all-pervasive "normal" environmental components. Totter suggests that the culprit is oxygen: it is a recognized mutagen; experiments have shown that it causes tumors in fruit flies; in the Ames assay test for screening carcinogens, it shows up positive.<sup>35</sup>

To summarize: Popular beliefs have generated moral claims that risks from technological applications of toxic substances are morally evil and a violation of human rights, unjustified by any foreseen and intended benefits to the many. To the contrary, scientific evidence does not support these claims. First, the assertion that any and every exposure to toxic materials not only can but does cause somatic and genetic harm is based on a profound misinterpretation of the scientific status of the linear hypothesis. Second, no scientific--much less ethical--justification exists for singling out radiation as a unique cause of cancer or genetic mutations when over a thousand other toxic agents are known to produce the same health effects if exposed to them in sufficient quantities. There is both a scientific and ethical basis for recognizing a practical threshold or de minimis dose below which risks of exposure to toxic materials are trivial and can be ignored. Finally, since the etiology of cancer remains highly theoretical, uncertain, and hypothetical, any moral condemnation of "technological hazards" is ethically unjustifiable, since it presumes as a scientific conclusion that any exposure to a suspected carcinogen actually causes harm which can and should be prevented. A hypothetical harm can entail only a hypothetical violation of rights, fairness, and intergenerational equity.

A tragic irony stalks public preoccupation with the risks we run from technological hazards and a willingness to believe that nature is benevolent and benign. We have grown accustomed to a ritual incantation of symbols of "hazard spectacles" as White calls them: Love Canal, Three Mile Island, Bhopal, Chernobyl. Each is allegedly a catastrophic reminder that human life is beset by ominous unknowns, encroaching on our otherwise safe natural world. The public is rarely confronted with these rude reminders:

In 1978, Love Canal was the subject of a frightening media expose. Hooker Chemical was summarily tried and convicted of harming the public because of sloppy management of chemical wastes. However no immediate deaths resulted from exposure to these wastes. Biostatisticians and epidemiologists have made frightening predictions about cancers and genetic defects, but they remain only statistical and hypothetical.

In 1979, Three Mile Island traumatized the public. Threats to public safety led to mass evacuations. No immediate deaths resulted from radiation exposures. Once again, biostatisticians and epidemiologists are quoted making terrifying predications about hypothetical cancers and genetic defects.

In 1984, Bhopal was the object of global concern and the mecca for trial lawyers. Some 1200 immediate deaths were caused by chemical toxins afflicting people who (we should recall) had moved into close proximity to the plant after its construction in a sparsely populated area.

In 1986, the reactor at Chernobyl caused 32 immediate deaths of workers who fought the fire, receiving large doses of radiation. We now hear mind-boggling statistical predictions of cancer deaths over the next 70 years--based entirely on the linear, zero-threshold hypothesis, with little recognition of its hypothetical status.

The tragic irony surfaces when we recall that, within the same time frame as these so-called Technological Catastrophes, Nature conspired to cause the following natural events:

Item: May 1985, 10,000 immediate deaths in Bangladesh caused by a cyclone.

Item: September 1985, 10,000 immediate deaths in Mexico City caused by an earthquake.

Item: November 1985, 20,000 immediate deaths in Armero, Columbia caused by a volcanic eruption triggering an avalanche of mud.

Item: August 1986, three days after Soviet scientists convened an international body of experts to discuss the causes of the Chernobyl accident, 2,000 immediate deaths at Lake Nios, Camaroon were caused by a release of toxic gases of undetermined origin.

History is replete with stark lessons about the natural environment and its heedless malevolence. The Johnstown flood in 1889 caused 2209 deaths. Winds from a great hurricane caused a storm surge in Galveston, Texas in 1900 taking 6000 lives. A volcanic eruption at Mont Pelee, Martinique in 1902 caused 30,000 immediate deaths. An ethic derived from Nature and a presumed "environmental balance" teach us more lessons that we perhaps care to learn.

### III. TOWARD A CONCEPTUAL FRAMEWORK FOR RISK SELECTION

"Lessons learned" seems to be an increasingly popular caption at a time when, paradoxically, we seem to have a new imperative: "No trials without prior guarantees against error."<sup>36</sup> The foregoing reflections suggest that, among major lessons to be learned, the presumed dangers from "technological hazards" are more shadow than substance. A more serious threat may prove to be the ethically incomplete and myopic framework in which mere hypotheses, and ad hoc and piecemeal risk selections, have been used to legitimate needlessly stringent health protection standards which Nature violates with impunity. Where is the ethical justification for excessively costly expenditures of public money spent to reduce trivial risks? A social policy which denies benefits to the many, based on the mere assumption that some hypothetical and statistical individual might be endangered, violates fairness and equity. The deficiencies in conceptual tools for assessing risks to health and safety

must become part of the "lessons learned" over the past 25 years of regulatory legislation. Let us examine some possible deficiencies in a conceptual framework.

### 1. "Hazards"

Contrary to a common misconception, "hazards" are not baldly "there" in a physical state-of-nature nor in human transactions with it. What people regard as hazardous in any given era reflects what they have come to know about their environment and what they value as essential, desirable, or preferable on a scale of real possibility. In short, human beings structure hazards. We do not accurately define a hazard as "toxicity of substance" or "violence of event" or "magnitude of consequences" that can be classified and predicted. A hazard exists only when and to the degree that harmful exposure of and assimilation by the human body or other valued living systems becomes a genuine and not merely an imaginable possibility. A possibility exists when there is an inability or failure to devise and maintain controlling actions or safeguards over environmental pathways of exposure.

### 2. At Risk: Benefit and Harm

Another popular misconception is that risk is a normative concept for certifying consequences to human beings which are harmful, dangerous or "bad." These contrast with consequences which are beneficial, pleasurable or "good." By implication, benefits are antithetical to risks or "risk-free." This false antithesis between risks and benefits conveys the mistaken notion that there is a way to have one without the other. We do not intend harm to ourselves. What we intend, what is "at risk," is the possibility that an intended benefit from risk-taking may not materialize and some harm may occur. Any such harm is clearly an unwanted and unintended side effect. The proper symmetry is between harms and benefits; risks are conceptually and morally neutral.

### 3. Degrees of Benefit and Harm

To develop appropriate bioethical principles, we must distinguish among degrees of benefit and corresponding harm. Fairness and rights pertain differently to (1) goods essential to members of society, e.g. food, clothing, shelter, water, energy or basic goods; (2) good advantageous to people, e.g. most manufacturing; (3) goods which are of peripheral value to people, e.g. aerosol deodorants for which there are substitutes at lower cost and potential for harm.

Basic harms may result if people are deprived of goods essential to subsistence and material well-being. In contrast to these goods, there are harms so trivial or negligible as to be undetectable, or perhaps unavoidable, if another greater harm of injury or deprivation is to be prevented. This distinction provides an ethical basis for a category of trivial "justifiable harm" which contrasts with a deprivation of basic goods which, if avoidable, is an "unjustifiable harm."

To illustrate. If one accepts biostatistical estimates based on a linear hypothesis, it is possible that diagnostic X-rays may cause some potentially detectable harm by "killing" or disrupting reparable cells. But preventing the greater harm of serious health impairment to a patient renders a comparatively negligible cellular harm ethically justifiable.

The most pernicious result of using undifferentiated "harm" language--especially when making statistical estimates to describe biological effects--is that an unsuspecting citizen is led to believe that actual body-counts of certified injury and death to human beings are the scientific basis for stating that exposure to low doses of a toxic substance not only can but does and will cause unjustifiable harm. The basis is speculative and hypothetical only.

#### 4. Incremental vs. Systemic Risk Accounting

It has become commonplace to consider a toxic substance or a single "hazardous technology" as if it represents only an incremental risk, or in other words, a simple addition to a current risk background. To the contrary, any "new" risk reorders an entire system by displacing, offsetting or otherwise restructuring a prior pattern of benefits and harms. Only systemic risk-accounting enables us to recognize this modification in a meaningful context.

To illustrate. Several recent studies demonstrate that a positive correlation exists between income, improved health and life expectancy.<sup>37</sup> Steady economic growth in industrialized, developed societies has resulted in improved housing, better nutrition, environmental sanitation, more plentiful food from mechanized agriculture; machines have reduced accidents in the workplace. Unless we make comparisons with pre-existing conditions, or with naturally-occurring risks which would exist in the absence of actions taken by man, we would totally falsify the fact that "new" risks cause displacements of "old" risks. What risks did people live with before freons made possible refrigeration? The incidence of ptomaine poisoning and stomach cancer have dropped dramatically. What risks would we experience if drinking water were not chlorinated? --if DDT were not used against malarial mosquitoes? --if pesticides and preservatives did not protect a food supply from mold and botulism?

In a bioethical framework, systemic risk-accounting is a necessary precondition for formulating social policy. A preoccupation with biological health effects biostatistically predicted, without meaningful comparisons, cannot do justice to the full spectrum of potential benefits and harms. In a bioethical perspective, we do ourselves and our posterity a grave

injustice by allowing our moral concern for basic rights to health protection, and our concern for protecting the life-sustaining qualities of the biosphere, to be narrowed down to, and in too many cases trivialized by, an obsession with hypothetical health effects from a few toxic substances. This myopic preoccupation siphons public attention away from preventable causes of malnutrition, disease, and deaths from natural catastrophes which claim thousands of lives daily in our world.

## 6. Bioethical Principles and Priorities

Correcting deficiencies in conceptual tools could help mitigate public misconceptions. But a more fundamental need remains: a more comprehensive bioethical framework through which to filter scientific evidence and specious moral claims. Whether putative risks or certifiable hazards, chronic or acute, synthetic or natural, created by Nature or God or Man, the operative skill is always proper management, by understanding physical laws as well as cultural biases.

Medical professionals have long had guidance in their conduct toward individual patients from the classic admonition, "Do no harm." It is an inescapable social reality that a public policy cannot possibly "do no harm." Even the wisest of policies will entail risks of some harm to some hypothetical individual at some future circumstance. As a moving target, public policy should reflect this bioethical principle:

Fairness and distributive equity requires a policy for health and environmental protection to be based on a method of assessing risks considered in a total system, so as to prevent members of society from experiencing basic harm deemed to be unjustifiable.

With the premise that an entire spectrum of potential biohazards is taken into



account, a second bioethical principle may be formulated:

Fairness and equal protection requires a policy which has as its goal an equitable management of potential sources of basic harm, that is, management which is proportioned to actual, identifiable basic harms which human effort, time, and money can reduce in the most cost-effective manner available.

This principle requires policy-making to evaluate comparisons among naturally occurring and technology-induced biohazards; it requires cost-comparisons of available methods for per capita reduction of each potential biohazard.

This principle seeks to derive the most public health protection for the most people from a finite amount of money. Comparing more or less cost-effective methods of reducing risks to people and the biosphere, and comparing net benefits (however abstract and arbitrary), are not utilitarian tools for placing a callous dollar-value on human life or impairment as a moral judgment of individual worth, much less of estimating economic losses to society as a measure of personal expendability sacrificed to achieve technological advancement. In the real world of practical decisionmaking and allocating money, we are maximizing the value we place on human life when we endeavor to allocate limited amounts of money in such a way that we reduce widespread basic harm, thereby preventing premature loss of life expectancy and diminished quality of life as covenantal expressions of our common humanity.

#### IV. CONCLUSION

The past quarter-century has presented us with a puzzling anomaly as well as an abiding lesson in the power of paradigmatic ideas. Some thinkers would have us interpret our human predicament as one of suspended animation

between the figures of Faust and Frankenstein. Other thinkers interpret the human predicament as an inheritance of a timeless tension between conflicting images of evil, one symbolized by Promethean suffering and the other symbolized by Christian suffering. George Pickering describes this tension in terms of our shared covenant with fellow humans:

"On the one side are those who fear that human action has grown too large, that too much power must inevitably violate the covenant and invade the province of the divine. On the other side are those who fear that we will shrink from our responsibilities, intimidated by their scale, and thus fail to extend the covenant to its widest possible reach. Each side, it seems, locates responsibility where the other perceives idolatry. . . . Each side recoils from the prospect of being responsible for avoidable suffering."

As we grow in knowledge and awareness of a vast array of potential threats to our personal well-being, as well as to the life-sustaining biosphere, Aaron Wildavsky reminds us that our quest for safety and security is really not a new phenomenon. What is new, he observes, is that "the collective urge to risk reduction is so much greater than the sum of the individual urges it claims to represent. Each of us would do less for ourselves than we would insist that the government do for us." <sup>38</sup> Rather than some laissez-faire abandonment of regulations, he recommends a more demanding set of criteria for resorting to them:

"The dice should be loaded against any 'right' to protection against risk. Only if risks are palpable and remedies ascertainable

and populations limitable and dangers unavoidable, should government regulate risk.

'Killing people with kindness' is only a slightly subtle form of verbal aggression. Killing people with safety would be one of the supreme ironies of our time."<sup>39</sup>

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