Chapter 12: Science Endeavor Diminished 1972-1974[1]

HANDLER'S CONTINUED EFFORTS TO imprint his ideology on national science policy centered on the government's policies regarding funding basic research and regulating the consequences of technology. His biochemical ethos led him to rail against what he saw as the government's failure to appreciate the science enterprise, and to adequately support it. Among the government shortcomings he discerned was its chronic unmerited fear of side effects and health risks from chemical contamination of food, water and air Handler argued that the fear would be dispelled were the government to commission an adequate level of funding for biochemical research, and he disparaged the policy of enacting safe exposure levels in response to its exaggerated concern. He condemned the policy as unscientific and an unnecessary burden on industry and offered, as a prime example, the government's retrospective review of the safety of food additives that were generally regarded as safe but never evaluated for safety. Handler interpreted the absence of public complaints of harm as evidence there was none, and argued there was no need to establish safety levels for any of the thousands of such additives. He claimed the regulatory agency lacked policies for setting safety levels and suffered from a dearth of the scientific information needed to understand their biochemical consequences. And even if the information existed, he said, since only biochemists could understand and interpret it, the public would not benefit because bureaucrats were the regulatory decision-makers. According to Handler, the lack of biochemical research and the absence of a valid policy for determining safe exposure levels, ensured the agency's decisions would be based on the opinions of laymen. Handler mobilized Academy resources and, with the help of Chauncy Starr, a nuclear engineer whom Handler knew from their joint service on various government committees, developed a regulatory framework to guide agency determination of safe exposure levels.

Private organizations and industry strategists who dealt with the problem of overcoming the public's concern of side effects and pollution from large technological projects, prioritized the impact of building and operating nuclear power plants and a nation-wide grid of suspended wires to transport the manufactured electromagnetic energy. Starr was tasked by his employers to create a welcoming public attitude toward nuclear power, and vitiate public fear of health risks from nuclear pollution and meltdown. He devised an approach for gaining acceptance that depended on persuading the public their concerns were unfounded — like childish fears of things that go bump in the night. Starr believed the key to minimizing construction costs and gaining public acceptance of nuclear power was to design a process that guaranteed safety that avoided pre-construction testing, which was expensive, and animal testing, whose results required subjective interpretation and were never conclusive. His solution was the statistical analysis of actuarial data, a scientific method that yielded numbers— the quintessential basis of making objective decisions. Mathematics had never previously been used for such a purpose, but Starr drew his inspiration from Handler, who had already bifurcated biochemistry into university and industry branches — Starr created industry mathematics.

[1] This is a preprint of a manuscript that will undergo proof-reading and copy-editing prior to publication.

Working together, particularly after Handler allowed the National Academy of Engineers — of which Starr was a member — to become a part of the National Academy of Sciences, Starr and Handler developed parallel cognitive systems conducive to achieving their respective goals Starr's method of statistical analysis of actuarial data was based on Handler's idea that safety was not a biomedical concept. Initially, Handler claimed the opposite — that safety was provable by establishing a chain of pointillist biochemical facts. After it became obvious he was wrong, he commenced arguing safety was a value judgement based on the balance between the positive and negative factors pertinent to the situation under consideration, a method he labelled risk-benefit analysis. Handler could not explain what he actually meant by "risk-benefit analysis" because he used the term ambiguously to avoid assigning it a conceptual basis. Instead, the meaning of the term depended on the audience he was addressing: when speaking to biochemists, Handler's rhetorical emphasis was on "risk" so the method was in the biomedical domain; when speaking to the Congress or other lay audience, his emphasis was on "benefit," so the method was in the political domain.

Over time, and depending on the circumstances and his immediate purposes, characteristics of Handler's version of risk-benefit analysis emerged in his speeches.

The incommensurability of *risk* and *benefit*, and the pragmatic necessity of measuring both factors using the same units of measure were the two chief examples. Handler utilized Starr's suggestion that money was the most convenient unit to characterize each factor and incorporated it into his policy for setting safely levels.

Starr focused extensively on developing the mathematical machinery needed to perform the statistical analysis of actuarial data that would allow numerical comparison of the factors. There were no scientific law, actuarial principle, or economic or sociological theory that determined which equations were correct or even what data should be considered, so Starr counterfeited the equations and chose the data that yielded the results he desired. In this manner, he proved nuclear power plants would be completely safe. In his published articles, Starr employed his chosen equations and jimmied analyses of actuarial data to produce number that range from zero to one for the probability of death from a nuclear power plant — zero meaning impossible and one meaning certain. According to the results of his calculations, he said, the risk of death was less than the risk of being hit by a meteor, which he argued was a risk everyone accepted. And on the basis of the meteor analogy, he claimed the acceptance of risk should be considered voluntary rather than a form of involuntary human experimentation by the nuclear industry. He similarly used mathematics profligately to quantify the benefits of nuclear power in dollars, and claimed his results proved they would be enormous. Starr's main result, as expressed in his technical mumbo-jumbo, was that "the acceptability of the nuclear-based risk of death was proportional to the cube of the dollar-value of the sum of the benefits," his language for declaring that nuclear power was safe.

Starr suggested to Handler that a statistical methodology of risk-benefit analysis would be equally useful in the areas of technology assessment that interested him — addition of carcinogens to food, approval of a pesticide, use of lead in gasoline, permissible exposure levels to automotive air pollution. In response to Handler's expression of interest, Starr provide examples that illustrated the merits of calculating the safe level of exposure to a given chemical. He collected statistical information about the risk side — how many people might get sick or

die, at what probability, and at what cost, and used it to estimate the economic impact of risk. Employing what he called “real-world” data such as exposure levels, disease incidence, mortality rates, and healthcare costs, he estimated the cost of the diseases he considered relevant to the chemical under consideration. The benefit Starr calculated was even more arbitrary.
It included the economic benefits of using the chemical such as agricultural yield, cost savings, product effectiveness, how many lives might be improved, and what alternative harms might be avoided. The policy judgment of safety was determined by whether the expected risk was acceptable in relation to the expected benefit. If the analysis showed the risk was greater than the benefit, the regulatory decision would be that human exposure at the considered exposure level was not safe. If the actuarially calculated benefit exceeded the risk, then the decision would be that
the chemical was safe at the considered exposure level.

Although Handler was mystified by the statistical calculations, he decided Starr’s method of risk-benefit analysis could be used to transform government decisions about safe levels into a rote activity manageable by officials with no scientific training. Handler, who had more or less conceded that biochemistry could offer no pragmatic solution to the problem of determining safety levels, included Starr’s version of risk-benefit analysis in his developing policy for regulatory decision-making, at least rhetorically. Even though Starr’s version was unrelated to what Handler regarded as science, it drew a black line between biochemistry and the issue of health risks, the intrusion of the latter into the former had bedeviled him throughout his career. Although the problem instantaneously evaporated, the price was great — Handler had to eat his earlier words to the effect that biochemistry was the universal panacea for all biomedical problems. The story he began preaching was that the public-health aspect of technology was fundamentally a political rather than scientific issue.

Under Handler’s rule, the Academy extended use of the risk-benefit model of decision-making from technological assessment of construction projects to determination of safety levels for exposure to anthropogenic environmental chemicals.
A succession of Academy reports used the soubriquet *risk-benefit analysis* to convey the misleading notion that two incommensurable factors could be directly compared,
but in almost every instance, Academy reports studiously avoided explicit support for the calculational cesspool Starr summoned into existence. Handler and the Academy committees he appointed referred to the risk-benefit model only in general terms, calling it “objective” and championing its use for determining safe exposure levels. The chemical industry warmly supported Handler’s initiative and lobbied the Congress to support The Academy’s efforts to develop risk-benefit analysis for use in regulatory decision-making. The Congress responded by budgeting millions of dollars for contracts with the Academy to design a science-based process for agency decision-making, and to offer opinions on how the risk of diseases such as cancer could be determined scientifically. At first, Handler denied congressional requests that the Academy provide such services because he had come to believe that decisions regarding health risks were political rather than scientific, and that politics would taint the purity of science and reinforce the downward momentum in the public’s esteem for science. Ultimately, however, he decided the Academy would provide the services. One reason was that the Academy needed

the income, and another was his fear the Congress might revoke its charter, which obligated the Academy to provide advice to the government when asked. But perhaps the most important reason was that he believed he could use the opportunity to formally extricate biochemistry from the process of decision-making regarding health risks, which he had come to regard as an albatross around his neck.

With the help of advisors in the Academy and industry, Handler developed a regulatory framework for resolving the issues of health risks and safe exposure levels that was intended to form the backbone of the advice tendered by Academy committees. The first operational step consisted of analytical deliberations of experts and was designed to mirror Handler's ideological commitment to reductive analysis.

He divided the analysis of health risks from exposure to anthropogenetic chemicals into four constituent elements: identification of each risk associated with exposure to the chemical under consideration and a determination of the benefits that stemmed from its use; qualitative or quantitative assessment of the relation between the factors; evaluation of the geographical and demographic distributions of the amount of the chemical in the environment; determination of how often each risk associated with exposure to the chemical will occur in the general and workplace population.

The analyses of the elements were to be combined and shaped into a narrative with recommendations and conclusions, in the traditional manner of an Academy committee report. In the second operational step, the report of the experts would be tendered to the regulatory agency for its evaluation of the experts' judgement. The judgement itself was the collective opinion of the experts of the safe level, which was defined as the highest concentration of the chemical for which the risk was balanced by the benefit. Based on that evaluation, and after considering economic, ethical, and political factors, agency officials would specify a legal level for safe exposure to the chemical.

Handler believed a policy based on his framework separated scientific facts from political considerations, and also achieved another of his objectives — formally relocating the issue of health risks and safety levels from the realm of biological science, where it began following publication of *Silent Spring*, to that of economics and business. Since the report of the experts, like any Academy committee report, would be written in one voice using general language, there would be no disclosure of specific scientific reasoning or disagreements, and no interaction between the committee experts and the agency officials. Further, at least in cases where the assessments of risk and benefit were made mathematically rather than on the basis of what Handler called "professional judgement," he expected the complexity of the operational steps would likely deflect regulatory focus from the health risks to the operational steps used to characterize them, thereby emphasizing the importance of science in the form of mathematics. Handler knew his policy would be endorsed by industry because it had developed the operational elements, and his adaption of them to health-risk issues favored the interests of industry.

After versions of Handler's decision-making policy were used as the basis of several Academy reports, he formally introduced it to the public. Handler created a ten-man advisory committee and a fourteen-man program committee to act on his behalf, and they orchestrated

a meeting at the Academy to explain the purpose, functional steps, and social value of Handler policy. Handler's invitees — many representatives of chemical companies, a few academic biochemists, a regulatory official, and a spokesman for the public, listened to two speeches he gave in which he presented his policy for the determination of safe levels of chemical exposure, with particular application to the case of food additives. In his first speech, Handler said risk-benefit analysis was "really a facile phrase rather than a reference to a developed science or art," but nevertheless served well as the cornerstone of an optimal decision-making policy for establishing safe exposure levels to man-made chemicals in food additives or the environment. Handler said the word *safe* was understood by laymen to mean a general state of protection from harm, but that it was regarded as meaningless by scientists because it could not be proved using the scientific method. This contrast in understanding between the groups, he said, was at the heart of the difficulty in designing a decision-making policy. In the policy he proposed, Handler explained, the term safety denoted a relative concept that was defined in connection with a specific "untoward incident" such as a specific disease, as opposed to the lay understanding of safety as protection against any disease. The advantage of his conceptualization of the term for purposes of decision-making, he said, was that it facilitated moving beyond the traditional biomedically-based policy for regulating exposure to chemicals and toward a management-based policy. He said each application of the policy to a specific chemical would be based on identification of a specific disease; on ideological grounds, he rejected the possibility a chemical could contribute to multifarious diseases depending on differing individual susceptibility, like the ability to resist the biomedical effects of stress. Instead, he professed his belief that each disease had one cause and each cause produced only one disease, at most. He said his policy incorporated calculated probabilities of the risk of a specific untoward incident using actuarial data, and emphasized the policy's cost-effectiveness — its elimination of the need for animal studies.

Handler emphasized that the general form of risk-benefit analysis for decision-making was based on economics and had no direct relationship with science. He said the method was universally applicable to any decision-making process, by which he meant questions such as how to manage the war in Vietnam, where to locate an airport, and whether two companies should merge; in such cases, however, the method was called cost-benefit analysis. In mathematically based risk-benefit analysis to determine safety levels, Handler said, "Risk and benefits are incommensurate factors because benefits are expressed in dollars whereas risk is expressed in the dimensionless concept of probability." Obviously, he said, both factors must be expressed in the same units to permit a comparison. And since benefits can't be expressed in probabilities, the only alternative was to express risks in dollars. "There is no escape from the need, somehow, to equate dollars and lives, to agree to the dollar value of an average human life in the population at risk," he said. He continued, "Until that is done, we will be unable to engage in logical decision-making regarding safety levels." Handler provided for a role of agency officials in the financial aspects by allowing that "non-dollar value judgments by the officials might take over," which he explained meant value judgements by regulatory officials could override rational "dollar considerations" calculated by experts. Later, however, Handler changed his mind and said it was "nonsense" to claim that value judgements can override "dollar considerations" because "value judgments are dollar considerations" — as if there were two Handlers who disagreed with each other.

Handler discussed other aspects of his version of risk-benefit analysis, which he called the engine of his policy. In principle, he said, the process of identifying a safety level should begin with relevant scientific research. But he acknowledged the nil government interest in systematically funding laboratory research regarding the safety of myriad man-made chemicals in the environment, and the resolute opposition of industry to accepting the burden of showing that its product was safe prior to marketing it. Consequently Handler said, the only remaining options were reliance on professional judgement or mathematical calculations. While attempting to explain the latter to the attendees at the Academy meeting, Handler unartfully mirrored Starr's bombastic claims. Handler said calculated values of health risks due to food additives were invariably nil, indicating that, by definition, they were completely safe. Handler claimed there was an important difference between risks "that were forced upon us" and those "undertaken voluntarily." Handler explained what he meant, using language that suggested his claim was arrived at objectively using a valid scientific method: "Most of us will voluntarily accept risks about two orders of magnitude greater than we will accept when the rest of the society imposes them." In reality, however, Handler sucked the explanation out of his thumb. He further said that for purposes of expediency, his policy called for the calculations of probabilities of health risks to be mathematically transformed into units of dollars so that the units of risks and benefits were identical. He conceded the process was arbitrary but maintained it was objective and thus fulfilled an important requirement for reliable decision-making, as if the impropriety of supporting a phony method could compensate for the impropriety of advocating a phony decisional process.

The next step in risk-benefit analysis, Handler explained, was evaluation of the calculations by regulatory agency officials, and their exercise of judgement regarding the specific permissible level of exposure to a chemical. Handler recommended that, during the period the officials were choosing a safety level, they consult with scientists recommended by the Academy. His idea was that the scientists should be asked to provide a report describing their judgments and conclusions, and he indicated his willingness to make its staff available for that purpose. Handler steadfastly opposed face-to-face meetings between the consultants and agency officials because, he said, science was not an adversarial process and therefore scientist should not be subjected to cross-examination. He asserted that the consultants should not be regarded as involved in the decisional process because decisional responsibility rested solely with the politically appointed non-scientific agency officials, who were expected to perform a "risk-benefit analyses that entailed a greater or lesser degree of social, political, or ethical judgment." "To the extent that they do," he added, they are "at least as well qualified as a scientist to participate in the decision-making process."

Handler offered advice to agency officials concerning their responsibilities when implementing his policy. "In regard to food additives," he said, "There are a few simple ground rules." One rule was that "large benefits certainly justify larger risks than small benefits." Another was that "where there is no benefit, no risk is acceptable;" but he added, "In some instances, value judgments take over so that this rule could be violated in appropriate situations." Handler provided the example of a regulatory agency's ban of cyclamates as an instance where a bad agency decision would not have occurred if his recommended policy were followed. He said, "The benefit side of the risk-benefit equation was never estimated or considered, and hence, a relatively uninformed value judgment took over." .

Speeches and comments from representatives of the chemical companies, biochemical establishment, a regulatory agency, and the public representative revealed numerous disagreements among the meeting attendees regarding Handler's decision-making policy. The cacophony prompted Handler to decline extemporaneously summarizing the speeches, as planned by the meeting organizers. Instead he offered a proposal aimed at resolving the legal conflicts that usually followed a regulatory decision concerning safe exposure levels. "We have been concerned here with the process of regulating the introduction and use of chemical entities in our society," he said. The "inevitable denouement" he remarked, was that the matter would wind up in the courts, a consequence he said he regarded as "very troublesome" but also understandable because "chemical companies were motivated by profit" which was "the way that most of this society gets on with its business." He added, "If they fail in this effort, it is the stockholders who have to pay the bill," whereas if they succeed, both the stockholders and the public benefit." Consequently, Handler observed, it was understandable that companies would attempt to advance their causes in court and regulatory agencies would defend their positions.

Handler pointed out that judges were uneducated in science and intimated they were biased in favor of the regulatory agencies which, in turn, were biased in favor of the public because the law required the agencies to protect the public health, not the industry purse. Handler offered the services of Academy committees as a counterbalance to bias against industry and an authoritative source of expert advice for judges. He suggested that the Academy "might be a "great utility" by serving as a "special referee" in legal proceedings.

Handler's speeches at the meeting were dissected and criticized in an unprecedented manner and degree by an author with a legal perspective who argued that Handler lacked the training and temperament required to formulate public policy or make safety determinations. The criticism triggered a reply by Handler in which he defended and further described his decision-making policy and its reliance on risk-benefit analysis. Handler said his basic approach to the risk, benefits, and safety aspects of decision-making was "that I insist on quantification" and that their numerical values be "determined by a dose-response curve" calculated by mathematical scientists." Handler explained that "risk represented the statistical likelihood of an undesirable outcome," by which he said he meant "the likelihood of an exposed individual being adversely affected" by an "untoward incident;" he said the term safety meant "the level of risk which is deemed acceptable." In rebuttal, his antagonist asserted that the seeming precision of calculated probabilities of risk on which Handler relied was misleading because there was no such thing as an objectively correct risk probability, a fact the allowed different mathematicians to produce different but equally valid probabilities, as judged by other mathematicians. In surrebuttal, Handler's repeated that the terms *safety* and risk "can only be described meaningfully and usefully by using numbers" but struggled while attempting to defend his policy of risk-benefit analysis. He misleadingly mingled the mathematical and professional-judgement versions of risk-benefit analysis; "The term risk-benefit analysis implies an intellectually rigorous attempts to construct a balance sheet of risks, stated in appropriate units, and benefits, which can be directly stated in dollars."
He falsely implied the mathematical version was especially useful for protecting health and the environment: "In some fields of decision-making such as public health and environmental

protection, risk is precisely stated as a mathematical probability of damage on a scale of zero to one." In several instances, he arbitrarily formulated decisional principles that were devoid of supporting evidence or even rational explanation. In one case, he said when there was no data to calculate risks, "the acceptable safe level can be estimated by agency officials," except that if the case involved "the expenditure of large sums," estimating the safety level was not permissible. In another instance, for "large cases," Handler said, "I argue that when government contemplates regulatory activity to diminish the risk associated with some technology, whether that risk be to the public health, food supply, or environment, an attempt is required to state both the risk and the benefits in quantitative form."

Handler's attempts to defend his opinions and rebut criticism illuminated his hypocrisy. He said, "In every situation which faces regulatory agencies, scientific knowledge of risks is exceedingly poor." Ironically, however, the situation was largely of his making because of the historical success of his policies opposing gold-standard animal studies and supporting industry's practice of bring chemicals to market without vetting for the public-health consequences. In another instance, Handler said scientific knowledge was relatively unimportant in regulatory decisions as to safety because it was in the political domain and, after safety levels were determined, in the judicial domain. This assertion contradicted his long-standing claim that increased funding for basic research would provide answers for all questions regarding health risks and safety levels. In still another case of deceit while trying to defend his views, Handler made the untruthful assertion that the sole objective of science was to determine the mechanisms by which chemicals interacted with tissue, not to discover the causes of disease or death — it was his sole objective, but certainly not the sole objective of the scientific endeavor.

Using the language of business management and economics, Handler propounded his ideological characterizations of *health risk* and *safety level*. "Risk is invariably stated with respect to personal injury," he said, and consequently, "a decision regarding safe exposure levels should be made by comparing marginal costs and marginal decrements in the health risks." He explained, "A decision about safe exposure levels would be illogical unless one knew the costs in dollars and the marginal return in decrements of the health risks stated in terms of decreased morbidity or mortality converted to dollars." Handler offered a formulaic balance-sheet metaphor to provide insight into what he called the logical necessity of expressing health risks in terms of dollars: "Implementation of exposure regulations results in the expenditure of N dollars by industry to spare M lives or prevent X cases of tumors or Y cases of diarrhea or Z cases of chemically induced nephritis. Such decision-making requires putting a price on saving a life and preventing a tumor and avoiding diarrhea and causing kidney disease."

Handler characterized the regulatory agencies the Congress had created to protect public health as business entities selling health that should operate at a profit.
He said regulatory agencies, in the process of establishing a safe exposure level had a responsibility to seek what he called a "bargain," by which he meant ensuring that that the risk dollars were much less than the benefit dollars. In other words, according to Handler, even very serious risks, such as cancer, could be justified if the benefits were great — it didn't matter to him that the people who developed cancer where not the same people who reaped any benefits. Handler added that if regulators "do not understand that making such bargains is what they are doing, they are inadequately equipped for the task." He illustrated the

operational significance of using dollars as the unit of measure of risk by crafting a hypothetical situation: “A safety level which would add a penny to the cost of a bottle of baby food and which would ensure that the risk of diarrhea from its ingestion would be reduced from one in a million to one in ten million would be acceptable. But if the price of the product were doubled, the safety level would not be acceptable.”

Handler believed that determining risks and benefits “is a function of the appropriate segment of the scientific community,” by which he meant biochemists who expressed professional judgements, and mathematicians who created and manipulated equations that assigned dollar values to both factors. His decision-making policy prescribed that safety levels promulgated by the regulatory agency “must be made on the basis of numbers provided by the experts.” “If the numbers are not determined,” Handler asserted, “then the regulators are evaluating only perceptions, values, and judgments, and doing so in the context of the use of undefined words like risk, hazard, and safety.” “When this happens,” Handler said, “then I submit that the public interest cannot intelligently be served.” But determinations of the numbers was a fraudulent activity because the data considered and the conversion of the units in which it was expressed to dollars were both arbitrary, so any desired results could be produced — facts that Handler should have known. Additionally, the decisional basis Handler demeaned was exactly what he expected the scientists he appointed to Academy committees to rely upon, namely their “perceptions, values, and judgments” when identifying “risk, hazard, and safety.” The implication of Handler’s decision policy was that science was unable to objectively establish safety levels, and the best it could offer was statical mumbo-jumbo and the subjective opinion of individual scientists — a picture of science far removed from that of a vaunted cathedral of knowledge.

Scientific information of the type Handler had long claimed would permit the establishment of conclusive safety levels – pointillist biochemical studies — did not exist and, even more, could be seen never would exist because it was a figment of his toxic ideology. Handler conveniently ignored his past policies of advocating reliance on objective knowledge produced by reductive biochemical research to solve all biomedical problems. But many others did not overlook his contradictory behavior, which seemed entirely improper for the head of the National Academy of Sciences., and harmed the Academy and Handler. The possibility that he might swing back and again advocate pointillist biochemical studies to identify safety levels was entirely foreclosed by the government because of its enormous cost, the interminable time period it would require, and complete absence of evidence that it could ultimately be successful. Nevertheless, Handler continued squealing that the government made a huge mistake, and the government refused to reconsider its decision. Handler’s perpetuation of the issue only highlighted his folly. and further harmed science

It was as if harming science was Handler’s objective. Handler himself was largely responsible for the paucity of knowledge that would permit establishment of safety levels on the basis of a precautionary principle — protection of public health even in the absence of conclusive scientific information — because of his strident opposition to reliance on animal studies. Handler’s opposition to reliance on gold-standard animal studies — an experimental approach to the question of safety that is intuitively understandable by laymen — harmed the

scientific endeavor because it suggested while physics could create technology that caused the problems of side-effects and environmental destruction, biomedical science could play no role in their solution.

In the vacuum of knowledge Handler helped create, the advice provided by his Academy committees came only from their personal values as influenced by their personal biases, the desires of their employers, and Handler's pro-industry attitude, which affected every Academy committee to one degree or another.

Science suffered yet another wound from Handler's hand, perhaps the most serious one he inflicted while pursuing his ideological vision. Before he appeared on the scene, there was only one science endeavor, mostly located in the universities. After Handler, and in material part because of him, a second class of scientists evolved —those who twist science to favor the interests of their employers. Handler avidly encouraged industry to develop its research capabilities and produce evidence that he knew by some preternatural process were objective facts— the safety of DDT and cyclamate, as examples. However inadvertently, Handler's initiative led to the creation of a class of science experts willing, for a price, to use the flexibility of science to support or expose any given proposition. Insidiously, the layman often cannot distinguish the best truth from the intentional untruth of a scientist who owes a higher loyalty to an employer than to Handler's cathedral.

Handler further harmed science by advancing the unjustifiable rule that scientists should not be held accountable for statements and advice in reports for which they accepted responsibility as authors. He enforced a rule that scientists on Academy committees who provide putative science-related advice to the government may not be required, expected, or permitted to answer questions propounded by agency officials regarding judgments or conclusions in reports they authored. Handler asserted that politics was an adversarial process which produced only subjective answers but science was non-adversarial and produced objective answers. The ability to do so, he asserted, allows scientists to make valid determinations such as what benefits people wanted, what risks they were willing to accept to gain them, and how to quantify both factors in dollars. He said agency officials could then readily make deductive decisions regarding safety regulations based on an experts' report, which obviated any need for them to ask the experts any questions concerning their opinions. Handler declared that posing such questions was a form of cross-examination — an adversarial process that was not proper in a scientific context because the scientific method was not adversarial. He said his policy of prohibiting cross-examination ensured the committees he appointed would "avoid the taint of politics." Handler characterized committee reports presented to agency officials as statements of opinions and judgements that were complete in themselves and "sufficiently compelling as to logically determine the agency's decision" — like Santa Clause leaving gifts for children. In his scientistic trance, Handler perceived his policy as necessary and sufficient for ensuring that regulatory decisions were "coherent with the reasoning and judgement of scientists" while simultaneously guaranteeing that the science was uncontaminated by politics. Handler's gross distortion of the nature of the science enterprise was unprecedented, unsupported by any other nationally known scientist, and probably one he worst thing he could have done to harm public perception of the enterprise.

The strategy developed by industry to cope with the problem of health

risks — its reconceptualization as a business problem resolvable using risk-benefit analysis — was stoutly supported by Handler and thus the Academy, a development that significantly weakened the public perception of science. Handler quickly fell in line with the strategy because it allowed him to avoid dealing with the problem on a scientific basis, which he had long tried to do but failed badly. Health risks had become his personal aporia wherein he proclaimed science could solve all problems except for the problems it couldn't solve such as health risks. Under Handler's leadership, the Academy commenced advising implementation of his version of risk-benefit analysis; decision-making for safety levels was the initial application.

The qualitative decisional bases of Handler's version of risk-benefits analysis was dishonest because the experts he chose were biased and rendered subjective decisions which Handler mischaracterized as objective. The quantitative decisional bases of his version was dishonest for a different reason. The experts on his committees fraudulently dressed the technical aspects of their mathematical manipulations to yield a foreordained outcome that Handler publicized as scientific.

Thus, Handler, who was prominently responsible for the evolution of both faulty decisional bases in his decisional policy, exposed a previously unappreciated face of science as it then existed — that science was not a methodology for finding truth, at least not to the extent then believed. More than ever imagined or appreciated, science was a tool, usable by industry and government for their purposes. .