Chapter 11: Pandora's Box Opened 1972-1974[1]

FOLLOWING HIS CONFLICT WITH President Nixon, Handler reorganized his agenda. His professional ethos remained the pursuit of scientific truth, especially the biochemical understanding of life, but his days of practicing biochemistry and even associating with biochemists were gone, replaced by concerted efforts at using the Academy's aegis to expand his influence on national science policy. Handler was mostly interested in developing policies that would lead to increased funding for biomedical research, achieving some form of institutional status for science, and promoting greater public interest in and respect for science. But the major political science-related issue at the time was the danger to public health caused by anthropogenic chemicals in the human environment which resulted from technological development. Additionally, the issue was on the cusp of greatly expanding because the danger to public health caused by anthropogenic electromagnetic energy was developing, a problem Handler knew about because he was a consultant to federal agencies that were interested in the issue and had secretly sponsored relevant animal gold-standard studies. Although there was general agreement the chemical exposure issue must be addressed, how best to do it was unresolved. The exigency of the issue forced Handler to concentrate his policy interests on regulation of the health and environmental consequences of chemical technology.

Handler was aggravated by what he considered to be irrationality and outright error in governmental decision-making regarding the health consequences of exposure to man-made chemicals, and believed governmental ineptitude was responsible for the funding and public-relations problems besetting organized science. According to Handler, the Congress decreased research funding when it was in the nation's interest to do the opposite. Further, according to Handler, the Congress seemingly accepted emotional arguments and false assumptions regarding the side effects of chemical technology, resulting in unnecessary laws and regulations and the creation of a frequently hostile press and an aroused public. Handler resented the laymen who complained and scorned the scientists who raise questions about the side effects of exposure to chemicals. He developed a particularly deep personal opprobrium toward the health-risk problem in the area of food additives. On the basis of nothing more than his reductionistic ideology, Handler was certain man-made chemicals added to food were economically and socially desirable, and devoid of any side effects that endangered health, and he seemed almost bewildered others disagreed. In his view, there was no coherent procedural policy for decision-making by the relevant regulatory agency, thereby allowing determinations of safety levels for chemicals to be made on the basis of politics rather than science which, to him, was anathema. Motivated by a belief that the regulatory situation was antagonistic to what he called "the interests of the nation," Handler developed a policy for federal regulatory decision-making regarding the public-health consequences of man-made chemicals.

Handler feared the independence of science was collapsing and the enterprise was becoming subservient to the government, especially regarding science-related policy decisions, an area where there was no serious participation by the leaders of science. Determinations of

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

safe exposure levels, a task Handler considered scientific in nature, were being made by politically appointed officials pursuant to congressional mandates to protect public health which Handler believed didn't need protection in the first place. In his view, the basic problem was that objectively identifying safe exposure levels to chemicals was not possible because the requisite biochemical information was nonexistent due to lack of biochemical research. And even if the information existed, biochemists, the only individuals who understood and could interpret it, were not directly involved in the decisional process used by regulatory agencies. Handler reluctantly recognized that what actually existed were subjective opinions of agency officials and the chemical industry, which invariably disagreed even though both sides relied on subjective opinions of biochemists as authority for their positions. Just as real, and comparably disputatious, were press reports of disputes concerning health risks that were based on interviews with orthodox biochemists and those whom Handler derogated as "mavericks." Handler concluded that the biochemical cacophony could not be resolved, only managed, because the term *safety* had no biochemical meaning, and that there would be perpetual controversy and a resulting black mark against science, until a coherent national policy for determining safe exposure levels was developed. He envisioned the framework of a solution in which technical considerations were managed by a group of experts who were not scientists — a restriction that would shield science from public opprobrium — and decisional authority was formally located in the political sphere. Early in his considerations, Handler settled on the use of risk-benefit analysis — invented by an engineering consultant to the nuclear power industry — which created the appearance the advice was objective but ensured decision-making was the responsibility of the regulator.

The historical root of the policy problem Handler addressed, at least as far as public awareness was concerned, was a scandal in the early 1960s that involved a drug which had not been tested for safety and consequently caused numerous birth defects.
The public reaction led to changes in federal law that required drug manufacturers to obtain premarket government approval of the safety and effectiveness of drugs. The regulatory agency tasked to evaluate the evidence of safety and effectiveness provided by drug companies lacked the requisite scientific expertise to do so and turned to the Academy for advice in carrying out its mission. When the agency's jurisdiction was expanded to include food safety, the Academy created the Food Protection Committee to oversee the Academy's ad hoc committees that provided advice to the agency concerning specific food additives, and to liaise with food companies, some of whose employees served on the Food Protection Committee. The agency relied on the Academy for advice regarding safety in many areas including pesticide contamination of food, drug contamination of food resulting from the addition of drugs to animal feed, and nonprescription food supplements.

Motivated by concerns the Food Protection Committee was biased in favor of food companies and Handler was hostile toward regulatory agencies, the agency slowly acquired inhouse scientific expertise and-worked toward extricating itself from reliance on the Academy for advice. Handler was hostile toward the agency even though it was an important customer; the profits the Academy made by providing advice to the agency provided the funds Handler needed to advocate for policies he favored. He opposed regulation of nonprescription drugs and recommended to the drug industry that it sue the agency to ensure it didn't "go to extremes" regarding drug safety and effectiveness. He warned, "The danger is that the bureaucracy will

lean too far backward in its determination to avoid error," resulting in overregulation. But his hard advocacy in support of industry interests taxed public and congressional confidence in the reliability of Academy reports, and increased the frequency of newspaper articles that decried the untoward influence of the Food Protection Committee and its subcommittees. Handler denied they were controlled by food industry, but there was reason to doubt his veracity because their reports often sympathized with the industry and created doubt about the role of food additives in causing cancer. Nevertheless, he took no more than sham steps to remedy the problem because he did not agree that the obvious potential conflicts-of-interest of the committees' conflicted members had any impact on their objectivity because, he said, they were scientists and therefore instinctively objective.

Handler's efforts to develop policies for standard-setting were circumscribed by law, but not necessarily in practice. The legal standard for adding chemicals to food was defined in the legislative history of the law as meaning a reasonable certainty of harmlessness — a standard that forbade the marketing of additives when there were serious questions of safety. Handler, however, motivated by an ideology that true science was based on conclusive facts, opposed the lawful standard because it was based on the subjective contingencies of safety and seriousness. Instead, he adopted a standard he called "relative safety," which permitted chemicals to be added to food even when serious questions existed concerning their safety if their benefits were judged to exceed their risks which, hypocritically, was a judgement based on subjective contingencies.

The law also placed the burden of proof regarding the safety of a food additive on the company that sought to market it. Handler, however, believed the evidentiary burden should be on the regulatory agency because development and marketing of a chemical shouldn't be impeded unless the agency had strong evidence indicating the chemical would be harmful. Consequently, notwithstanding the legal provision, the advisory language of his ad hoc committees was structured to favor the policy that the agency should prove a food additive was unsafe as part of its justification of a safety standard. The law also required all decisions be based on "substantial evidence," but Handler successfully blunted the impact of the provision by encouraging his appointees to Academy committees to interpret "substantial evidence" to mean whatever its members accepted. He opposed a legal requirement that consumers be alerted about possible health risks of food additives, and he prohibited Academy committees from recommending such labeling requirements. Handler's policy views concerning the legal aspects of regulatory decision-making were incorporated into the advice the Academy provided to regulatory agencies, as were his views regarding matters that were not covered by law.

Handler agreed to a series of contracts for the Academy to advise the regulatory agency regarding the safety of specific food additives, and he appointed ad hoc committees that reflected his developing opinions about what advice should be offered. Under Handler, the Academy's approach to the safety issue was based on the dogma that toxicity mediated by known biochemical pathways was the only pathological process that merited attention. The possibility that food additives might be contributing causes to chronic illnesses was ignored even though they were far more likely than toxicity to be side effects of prolonged consumption of additives.

Consequently, causal acute toxicity was the sole biomedical consequence of food additives the committees were permitted to consider when evaluating their health risks. Handler essentially originated the policy of requiring scientific knowledge of primary causes of disease, as opposed to also contributory causes, as a condition for regulatory action, and he mandated that his committees adhere to the policy. They focused entirely on toxicity — a relatively pedestrian biomedical process — and neglected the possibility that additives had a causal role in chronic adverse side effects of additives such as cancer or any of the other numerous degenerative diseases.

Handler was an ardent opponent of the idea of contributing causes since the early days of career when he opposed reliance on the method of analyzing public-health data to prove that smoking was a contributory cause of cancer, and he manifested this chronic bias in the context of food additives. He believed that considering the possibility of chronic adverse side effects of additives was as an unscientific attempt to undermine the food industry. The biochemist who headed the Food Protection Committee, relying on Handler's assertion that absence of biochemical evidence of risks was proof of their absence, derided contentions that long-term exposure to food additives might contribute to disease. He claimed, "There is not a shred of evidence or even a basis of reasonable suspicion that any such damaging effects have ever been caused by the additives or pesticides in food consumed in North America," a sentiment to which Handler gave full-throated support.

The regulatory agency used animal studies to identify legally permissible levels of food additives. The method was based on controlled experiments which identified the highest level of an additive that had no biological effect on test animals. Then, in recognition of the myriad uncertainties in extrapolating results of animal studies to humans, and in consideration of the ethical principle of erring in favor of protecting public health over economic factors, the no-effects level was divided by 100 to obtain an assumed safety level in humans. Handler, however, opposed both reliance on gold-standard studies and the policy of using a safety factor to favor protecting public health, and he rejected their use as elements in his developing plan. His policies for determining permissible levels of food additives included laboratory studies of mechanisms of toxicity, reliance on anecdotal observations, and subjective judgements of his ad hoc committees. That particular decisional process was uncomfortable for Handler because it contradicted his life-long praise of scientists as objective students of nature. However, considering the complexity of the safety issue and its political ramifications, he decided the process was the lessor evil and he implemented a policy of relying on the ability of the experts he appointed to make sound judgements even in the absence of scientific evidence.

A new law defined the the evidence needed for determining the safety of food additives to be "adequate and well-controlled investigations." The law did not specify exactly what kind of investigations were required, but it rejected Handler's formula of experts making subjective decisions as a valid basis for safety determinations.

However, the requirement of well-controlled investigations did not immediately bring forth a stream of such studies, so Handler's committees continued to make subjective judgments that food additives, when used at industry-recommended concentrations, were completely safe. Routinely, Academy committees decided that the existing animal testing data was inferior and

indecisive. Because of the lack scientific evidence, their judgment was based on their general education, experience, and personal biases — what Handler called their "general experience." The judgements were formed in secret meetings, the record of which Handler refused to disclose publicly. Proceeding in this manner, Handler allowed the Food Protection Committee—most of whose members were economically bonded to the food industry and none of whom were answerable to anyone except Handler — to provide advice to the agency regarding the meaning of federal regulations.

By the time the regulatory agency was first tasked by the Congress to evaluate the safety of food additives, many thousands of chemicals had already been added to the nation's food supply with nil evaluation of safety. The agency, which historically had little experimental and adjudicatory capabilities regarding safety, mostly relied on self-reporting by the food companies and followed the advice of the Academy, the gist of which was that all the additives on the market were generally regarded as safe.
Under Handler, the Academy continued to offer similar advice, notwithstanding the developing literature that indicating legal food additives caused adverse effects in animals. He supported the position of the food industry, which lobbied for continuation of the legal presumption of safety, claiming that animal testing for each food additive would be prohibitively expensive. Handler promoted the idea of subjective guidelines, the application of which would have the effect of retrospectively validating the safety of many thousands of food additives already in use.

Handler frequently proselytized about safety levels in speeches and testimonies, using a variety of oratorical tropes to emphasize his strong pro-industry sympathy.
Sometimes he berated the obvious as when he told an audience, "Complete safety is unattainable." Other times he was paternalistic, "We must accept relatively safe for its proposed use or surrender the benefits of the additive," or irrelevant, "Any chemical can be shown to have some type of adverse effect." Handler commonly displayed a penchant to mislead. He testified, "It is altogether too easy to use adverse effects obtained in animals or in man under unusual or inappropriate conditions to condemn a food additive," and said doing so was "a disservice to consumers because it results in needless restrictions." His testimony misleadingly obfuscated the fact that the studies were performed to prove that the additives were biologically active, not to show that they caused a specific effect as a particular dose level. In reality, using animals was the only experimental method known to science for evaluating the safety of chemicals. The experimental circumstances used were an absolute physiological and pragmatic necessity. They could, however, easily be deprecated by a trickster like Handler as "unusual" or "inappropriate" by tacitly resorting to the false assumption that the circumstances of animal testing should mimic the precise circumstances of human consumption. Only Handler and biochemists employed by the food industry raised such a fatuous objection.

Handler's policy was to protect the continued legality of food additives that had historically been approved under the assumption they were safe, and to encourage the development of new additives. He assumed that for every additive, the number of individuals who benefited from its use was much greater than the number in whom it caused disease, and

that the assumption was sufficient justification for its use. He reacted adversely to safety levels that favored protecting public health over the economic interest of chemical companies. From the pulpit of the Academy, he preached that the rules should place greater emphasis on creativity of the food company and less on safety considerations. Handler said that the risk and benefits of food additives such as colors, flavors, and texturizers cannot be weighed and compared but that, in the end, "consumers should not be denied anything that might be a factor in their food choice."

Handler met regularly with the Food Production Committee to discuss and design a decision-making procedure the Academy could recommend to the agency that would eliminate animal testing, protect the interests of the food industry, and ostensibly ensure food additives were safe. The basis of the policy that evolved was a shift in focus from whether food additives were biologically active chemicals after they entered the human body, to a series of subjective guidelines used to assess whether an additive was "toxicologically insignificant," a term Handler coined and used as an alternative to the term safe. The guidelines first appeared in the report of a Food Protection Committee sub-committee composed mostly of food-industry employees. The guidelines consisted of a collection of criteria for determining whether an additive could validly be assumed to be toxicologically insignificant, formerly safe. Handler characterized them as a common-sense, experienced-based, scientific judgments that were suitable as the basis for regulating food additives. One criterion for regarding an additive as toxicologically insignificant was a history of at least five years of use without obvious evidence of toxicological consequences; another was automatic approval of an additive that was structurally similar to an approved additive. Handler asserted that If a new additive met the listed criteria, "reliable biochemical judgement indicated the additive could safety be added to food at a level of a tenth of a part per million" — a number he pulled out of his imagination.

Handler began supporting a series of policies regarding regulatory decision-making about food additives, and the resulting controversy further weakened his national stature and that of science. He proposed a regulatory policy in which the tasks of risk assessment and risk management would be formally separated. Under the policy, employing his guidelines, biochemists would parse all available information pertinent to possible health risks of a food additive and express the level of risk semi-quantitatively using a fourfold classification scheme — safe, probably safe, probably unsafe, unsafe. Handler maintained that such a risk assessment was possible because, for every chemical, food additive or otherwise, there was a level below which exposed humans would experience no more than "insignificant biological effects." After the risk assessment was completed, the process of setting safe exposure levels would be managed by the regulatory agency. Handler argued that the advantage of formally separating risk assessment from risk management was that scientists could perform the former function in a semi-quantitative manner and laymen could manage the latter politically. The appeal for Handler was that organized science retained a major role in decision-making while remaining untainted by politics.

A national controversy developed after cyclamate, an artificial sweetener approved for use as a food additive, was shown to cause cancer in animals. Ironically, a company Handler

served as a corporate director was a producer of cyclamate and added it to various products including baby foods. Industry leaders — who viewed the Academy as a sympathetic counterweight to the regulatory agency and supported the Academy's activities in many different ways — successfully lobbied the Congress to direct the agency to seek the Academy's advice regarding the issue of carcinogens in food. An ad hoc Academy committee appointed by Handler asserted in its report that there was always a level of a chemical below which humans could be safely exposed — the level that caused only insignificant biological effects in humans. This so-called threshold theory was completely rejected by the vast majority of the nation's cancer experts, who contended that it was impossible to set any safe threshold for chemicals that caused cancer in animal experiments. A committee of scientists formed by the National Cancer Institute at the request of the agency stunned Handler when it issued a report that contradicted almost every claim, assertion, and subjective judgement in the Academy's ad hoc committee report, and characterized it as "scientifically unacceptable," "of dubious merit," and of "absolutely no validity in the field of carcinogenesis." The cancer committee also criticized the Academy committee's guidelines for determining whether a food additive was toxicologically insignificant, and its opinion that a chemical not toxic immediately after exposure should be considered safe even after long-term exposure. The cancer committee recommended adherence to a principle of a zero tolerance for addition of cancer-causing chemicals to food, meaning that any chemical shown capable of causing cancer in laboratory animals should never be added to food.

The agency offered Handler an opportunity to permit the ad hoc committee to respond to the criticisms made by the cancer committee, but Handler was displeased by his committee's draft rebuttal, and he prevented it from being sent to the agency.

Instead, he sent a letter to the agency in which he adopted the Janus-faced position that was his trademark — he said both committees were correct, and both were incorrect. "Categorical statements of safety regarding toxic effects of chemicals in food were possible," Handler said, but the same was not true regarding cancer because it was a "complex disease" and consequently "no categorical statements are rationally acceptable." He wrote, "We do not as yet have the capacity adequately to assess the hazard to man from potential chemical carcinogens."

Handler's dilemma was that if the policy guidelines based on the threshold theory had no application to cancer-causing chemicals, which clearly was the case, there was no reason to believe the guidelines applied to any "complex disease" — a euphemism which essentially characterized every disease known to mankind with the possible exception of toxicity. Because he had directed his committee to take an extreme position, he was unable to defend the committee when its reasoning was criticized by the cancer committee. The prestige of the Academy was tarnished, and Handler had a difficult time defending the Academy when he was forced to respond to a congressional inquiry.

Handler attempted to rescue his situation by hubristically positioning himself as someone more knowledgeable than both committees; he urged a "concerted effort to steer a course between the two extremes," namely the report of the cancer committee which contradicted his beliefs as one extreme, and the sub-committee report which failed to defend them adequately as the other extreme. Handler asserted that cancer causation was complex and "Sometimes a near-hysteria on the part of the general public, and at least a portion of the

professional and political community, can easily lead us to overreact to situations of possible human hazard, with the result that needed substances may be removed from the market." He ignored the cancer committee's harsh criticism of his guidelines but called its advice that all food additives on the market be tested to identify those that caused cancer "totally impractical," and he rejected the suggestion that all such chemicals be banned. Handler concluded his letter to the agency with the bewildering assertions that "The two groups were not in conflict" and that "the disagreement stemmed largely from semantics." His futile attempt to bridge the gulf between the two committees, underscored the reality that he and his committees had ignored the possibility that food additives could cause cancer and other health problems. It also nakedly exposed his hypocrisy — how was it possible for experts to disagree so strongly on the matter of allowing dangerous chemicals to remain in the food supply if it were true, as he claimed, science was dispassionate, objective, unbiassed, and mankind's greatest invention?

The implications of the cyclamate affair for Handler's overarching agenda to promote the scientific endeavor were exceedingly serious. Cyclamate had been legally added to many foods for several years, based essentially on Academy advice that the absence of evidence of harm which resulted from the absence of relevant experimentation was evidence there was no harm. Handler expanded the advice into a policy he called a "marketability criterion" applicable to all food additives under which "no obvious side-effects among consumers" was evidence of safety. Even after doubts about the safety of cyclamate were raised by the results of gold-standard studies, Handler remained steadfast in his use of the Academy's aegis to protect its marketability. The report of the Academy committee he created to evaluate the dangers to public health from cyclamate concluded there were no side-effects with the possible exception of diarrhea, on the basis of which he recommended that cyclamate be removed from baby foods.

Under a federal law that prohibited use of food additives which caused cancer, the agency banned use of cyclamate as a food additive, and after a non-Academy committee advised the agency that the risks of cyclamate outweighed its benefits, the ban was extended to prescription use of cyclamate for diabetics. Handler's reaction was what could be expected from a corporate director protecting his company's product, which he was. He decried the banning of cyclamate and defended its continued use at unregulated levels in foods despite the evidence of its carcinogenicity. According to him, "The unlikelihood of cancer in individuals who consume cyclamates should be weighed against the number of obese people whose lives were lengthened. Had it been done, cyclamates would not have been banned."

The Congress enacted a law that dealt specifically with the risks of cancer from food additives. The law barred any food additive that had been shown to cause cancer in man or animals, thus denying the regulatory agency the option of weighing any purported benefits of the additive against the risk of cancer. Handler strongly opposes the law on grounds of ideology, values, and science. In his ideology, the only possible adverse effects of chemicals were toxological in nature, a policy he commonly expressed in the jingle, "The dose makes the poison." For carcinogens, however, the law implicitly rejected Handler's policy of safety thresholds in favor of zero tolerance — the equivalent of an assumption that even one molecule

of a carcinogen in foods was unsafe. Handler falsely claimed the law "removes every opportunity for bringing informed scientific judgment to bear," because it forbade setting a safety threshold for carcinogens. The truth, however, was that the law allowed scientists at the regulatory agency the discretion to decide whether an additive had been shown to produce cancer when added to the diet of test animals. What actually angered Handler was that, once this decision was made, the limit of judgment was reached, and no further judgement could legally be made regarding the existence of a safe threshold for a carcinogen.

Handler criticized the Congress for enacting the law because, “The law puts too much of a value on avoiding cancer,” and he made unsubstantiated and misleading arguments in support of his criticism. He said some chemicals that caused cancer in animals might be appropriate for use in foods, and that entire chemical industries might be destroyed by application of the law. He opined that the law was a “great red herring” because it “misleads or distracts from the important question,” which he claimed was not whether an additive causes cancer at high doses in animals but how it causes cancer in humans in low doses. His claim was misleading because experiments to determine how additives in low doses caused cancer in humans were impossible.

The true basis of Handler’s concern was that the government would not fund basic research regarding carcinogens because they were banned for use as food additives and, consequently, putative knowledge of the underlying biochemical reactions would have no practical use. He said, “Such a situation seems, to me, to be repugnant” According to Handler, “Basic research can provide a rational extrapolation from animal experiments to human responses.” “There is a need to expand our knowledge by carrying out basic research about life processes before we can develop policies and procedures that ensure the safety of food additives.” He said, “What is needed is a fundamental understanding of the way in which metabolic reactions can be extrapolated from experimental animals to man. Such a development would provide a more scientific basis for regulation.”

Handler said “extremists,” whom he did not identify, were drowning out the voice of reason regarding the safety of cancer-causing chemicals added to food, and he was especially aggravated by the hormone DES, which was added inadvertently to meat marketed for human consumption. DES caused cancer in humans when used as a drug, and in five animal species in gold-standard studies. When DES was used in the meat industry to stimulate growth in livestock, DES residue was detected in meat used for human consumption. Handler supported the use of DES in feed and baselessly claimed no one would develop cancer from eating meat containing DES. Experts in cancer causation who worked at the at the National Cancer Institute near unanimously opposed Handler’s claim. Handler asserted the DES would not appear in meat brought to market because, he baselessly believed, it was excreted within two days. But government testing detected DES in meat from animals that had been slaughtered weeks after DES-treated fed had been withdrawn.

Handler remained unswayed. He said DES, like all other chemicals that cause cancer at high doses, did not do so at low doses, which he called “toxicologically insignificant.” The nation’s cancer experts again criticized Handler’s speculation that low levels of DES couldn’t cause cancer in humans. They said any chemical shown to cause tumors in animals should be considered a potential hazard to man, and that scientific knowledge was insufficient to assert

that any concentration in foods was safe because, as far as anyone knew, even one molecule of DES could induce cancer. Handler responded with an economic argument. Based on data provided to him by the meat industry, Handler said DES saved meat consumers about four dollars a year which, even if true, was irrelevant because the law set safety and efficacy as the only two criteria for adding chemicals to food.

After Russian reports that red dye 2, a widely used food-color additive, caused cancer in animals, the U.S. regulatory agency conducted similar studies and confirmed the Russian results. The agency announced plans to restrict or ban the additive, and asked for the Academy's opinion of the contemplated rulemaking. Handler, gun-shy about being trapped again in the middle of another dispute between industry and the government that could further injure the Academy's reputation, declined the offer of a contract from the agency, saying that the questions of safety of red dye 2 were of "routine character" and didn't merit Academy consideration. But under pressure from the food industry, Handler changed his mind and said that the questions were "not necessarily routine," and he agreed to accept the contract offer. He appointed an ad hoc committee and directed it to conduct an inquisitorial investigation in which it heard testimony and cross-examined witnesses. Its draft report, which Handler approved, concluded there was convincing evidence of safety and no evidence that red dye 2 was unsafe. However, Handler was confronted with a rare rebellion within the Academy by some who disagreed with both the adjudicatory process and the substance of report, which prompted him to rewrite the report. He restructured its reasoning in a manner he believed would be more convincing but offered the same advice to the agency that had been offered by the committee. On the basis of subjective criteria he concluded, "There is insufficient reason, today, to take measures to reduce the present extent of human exposure to red dye 2." He said it was "a coloring agent that has been in widespread use since the early days of this century without suggestion of harmful effect on human health." Handler arbitrarily discounted to zero the value of scientific observations involving effects of the dye on reproduction, mutagenesis and teratogenesis, calling them "inconclusive." In his covering letter accompanying transmittal of his revision of the committee's report to the regulatory agency, Handler made a pitifully inferior attempt to protect the Academy from criticism; he said his personal opinion was that the committee's conclusion should be understood as only the opinion of one group of scientists exercising their professional judgment, and not a definitive answer on the safety of red dye 2. Ultimately, red dye 2, which Handler said had been "thoroughly tested and found safe," was banned because the agency ruled that the proponents of the additive had not proved it would be safe. Handler objected, and said the decision was a case where pressure from the media and consumer groups took precedence over scientific judgment.

Glutamate, a chemical closely related to a constituent of proteins and to a signaling agent in the brain, was an example of a group of several thousand food additives that were marketed with nil vetting for possible health risk in the period prior to recognition of the problem of chemical side effects. Glutamate had a history of use as a seasoning agent and flavor enhancer in foods, and its natural character led Handler to claim that a natural chemical couldn't be unsafe, notwithstanding that that the claim contradicted his jingle that "dose makes the poison." But when

gold-standard animal studies were done, adverse biological effects were found, suggesting that even natural substances could be harmful if uses at levels that were unnatural. Nevertheless, Handler supported continued legalization of all the food additives that were generally assumed to be safe, including glutamate. He did so on the basis of a legal argument — the companies had acted legally, and in good faith, and therefore had acquired a legal right to use approved additives in foods, and that right could not properly be taken away by subsequent legislation.

In response to public pressure, the major glutamate users, which included the company Handler served as a director, voluntarily paused using it in baby foods. But they asked Handler to accept the request of the regulatory agency that he create an hoc committee to evaluate the safety of glutamate for all other uses, fully expecting it would exonerate the additive. Handler appointed a committee that consisted of employees of chemical companies and academics whose research was supported by the industry, and who had already absolved glutamate of side-effects. The committee's report said, essentially, that the additive must be safe because it was related to a natural chemical, and even in baby foods the risk to babies was "extremely small." The report was exactly what the industry wanted to buttress its continuing argument that glutamate was inherently safe and had come under agency scrutiny only because of ill-informed public pressure. But during a senate hearing, the Academy committee was accused by witnesses of being highly biased in favor of the industry because its judgement was only naked opinion, influenced by the employers of the committee's members. Handler replied that the members of the subcommittee were "eminent," "well informed," "experts in the area of safety evaluation," "eminently qualified by expertise and research experience," and that "it could it be argued their employers had no stake in the outcome of the decision." Handler argued misleadingly from the pulpit of the Academy that since glutamate was a natural component of food, it should not only be "regarded as totally safe" but also as essential for "the normal metabolism of all cells," and therefore was a "positive contribution to the nutritional value of the food to which it was added."

Handler's evaluations of the safety of food additives prioritized adherence to biochemical theory, historical use of food additives, and opinions of biochemists employed by the food industry that the concentrations of chemicals added to foods were completely safe, over animal studies that showed adverse effects. Handler's Academy food committees proffered advice that dutifully reflected his policies and beliefs. Handler and his committees placed the burden of proof regarding safety on the government or the consumer rather than the proponent of the food additive and, based solely on ideology and in contrary to the law, demanded that certainty beyond a reasonable doubt should be the evidentiary standard necessary to meet that burden.

The reports Handler authorized for release by the Academy reflected a hyper-weak approach to safety regulation of food additives, and supported the continued classification of thousands of food additives as presumed safe unless and until incontrovertible evidence emerged to challenge their status. The reports were biased against restrictions on the use of chemical additives, consistently considered only the possibility of short-term toxic side-effects, and failed to consider the likelihood of long-term adverse consequences such as cancer, genetic damage, and birth defects.

Handler believed every chemical had a level below which it could safely be added to food, a theory that was rejected by the preponderate majority of cancer experts and specialists in genetics, who believed it was impossible to set any safe threshold for chemicals that cause cancer or adverse effects on genes.

IN 1971, THE CONGRESS BECAME CONCERNED that Operation Ranch Hand — the military's defoliation program of aerial spraying in Vietnam for war-related purposes using high doses of herbicides — might be a violation of international protocols against chemical warfare. There were persistent reports of widespread environmental destruction and an unusual number of birth defects and stillbirths among the Montagnard tribes people who lived in the highlands of Vietnam, which were repeatedly sprayed. The largest organization of scientists in the United States criticized the environmental destruction caused by the spraying program and began a study of its environmental and health effects. At the time, the Congress frequently insisted that the National Academy of Sciences be consulted by Executive Department agencies and departments concerning broad questions of science and its attendant policies, and Operation Ranch Hand became a prominent example. When senators informally asked Handler if the Academy would undertake a comprehensive study and investigation into the environmental and health effects of the defoliation program carried out by the military in Vietnam, he told them the Academy welcomed requests involving broad issues.

Handler had ample motives for welcoming congressional interest in securing Academy advice. He believed the Vietnam war had throttled government support of science and that a surge in funding was likely when it ended. In the interim, he worked to elevate the status of scientists in society and to increase the footprint of science in government. One of Handler's principal strategies for accomplishing these objectives was to provide answers to broad questions propounded by Congress and publicize the results of the efforts, and Project Ranch Hand presented such an opportunity. There were also other reasons for Handler to accede to the congressional request.

Doing so conformed to an Academy tradition — for many years it provided advice to the military in matters related to chemical and biological warfare. The military was, by far, the Academy's biggest client and always had been. Additionally, accepting the task provided Handler with an opportunity to revisit the question of safety of pesticides — a toot he had been on throughout his career.

A provision in a military budget act required the military to negotiate an appropriate arrangement with the Academy to carry out the study, and the resulting contract provided that it would be financed by the military and from Academy funds available to Handler at his discretion. From the start of the study, Handler faced problems within the Academy bureaucracy. He appointed a herbicide committee to study the effects of the military's herbicide spraying program without consulting the military. Doing so was unprecedented in the long business relationship between the military and the Academy, and was generally seen as motivated by his desire to control the committee's work product. Whatever the reason, Handler's herbicide committee was overtly friendly toward the military, and was chosen over the stout objection of the Academy Vice-President, who had the authority to appoint the committee that would review and edit drafts of reports composed under the supervision of the herbicide committee. Almost half of Handler's appointees were foreign nationals and,

consequently, malleable within the Academy's secret, authoritarian decision-making system. The other appointees evinced no meaningful relevant experience in the area of the study — evaluating causal associations between herbicide spraying and adverse effects on health and the environment. The lack of qualifications of Handler's appointees in relation to the objectives of the study necessitated his authorizing the committee to hire three times as many consultants as there were committee members.

The best that could be said about Handler's appointment process was that he eliminated candidates who had a direct financial interest in the herbicide industry.

The herbicide committee learned of the consequences of Operation Ranch Hand through the reports provided by consultants hired by the Academy, who actually visited Vietnam. Ongoing military activity prevented their direct investigation of the health consequences, and their inquiry into environmental effects was dependent on analysis of aerial photographs and other data supplied by the military. An even more significant limitation on the reliability of the Academy study arose during the process of generating the final report. Handler and the herbicide committee he appointed fought bitterly with The Academy Vice-president and the report review committee over the content and semantical shadings in the consultants and committee draft reports.

The consultants produced working reports that were melded into draft reports by the herbicide committee and the Academy staff with, from time to time, personal inputs from Handler, who had a keen nearest in the substance and tone on the report that would ultimately emerge. The review committee repeatedly demanded changes in the draft reports on the grounds of imprecise language, inadequate technical analysis, naiveness, and turbid language. The changes angered Handler because they invariably clarified and strengthened the report's discussion and explanation of the devastation caused by the spraying program. The chairman of the herbicides committee repeatedly asked Handler to force several resignations from the review committee, which Handler declined to do only after the Vice-President threatened a public disclosure of the controversy. During the course of the study, the personal relationship between Handler and his Vice-President deteriorated to the point where they no longer spoke to one another. Handler called the imbroglio the "most traumatic incident" he had ever seen.

The in-fighting involved every aspect of the study, especially the composition of the review committee, the effect of the herbicides on the health of the Montagnard tribes who were directly exposed to the aerial spraying, how to count the number of dead trees in aerial photographs, and how to reason to an overall conclusion. One example of the scientific logic in a draft report involved language implying that since the herbicide committee hadn't found definitive human health effects, they didn't exist. The review committee eliminated the implication and materially altering numerous subsequent drafts so that the central message in the final report was that military use of herbicides might have adversely affected the health of Vietnamese noncombatants, and actually did inflict long-term damage on Vietnam's environment.

Although the message was far from a conclusive finding that herbicides caused health effects — a conclusion precluded from the beginning by the design and circumstances of the study — it was a level of indictment of Operation Ranch Hand that Handler and the herbicide committee had sought to prevent.

A primary interest of the military was that the Academy's final report not appear to support the position of some in the Congress who believed Operation Ranch Hand, the first systematic use of herbicides in warfare, could be construed as a violation of international protocols regarding the use of chemicals in warfare. The Academy study was not based on experiments, controlled observations, evidence collected independently of the military, or first-hand research by the authors of the final report.

Consequently, the final report was a soup of sentences of two antagonistic Academy committees, heavily salted by Handler. Both committees recognized that the first party out the door to the press would have a significant advantage in shaping public perception of the health and environmental impact of the aerial spraying of herbicides in Vietnam that was described in the report. Normally, Handler sent Academy reports to the military which released them publicly, thereby insuring the advantage belonged to the military and was exploited by its press office. However, during the period after the military received the Academy's report and was digesting the contents in preparation for a press release to inform the public of the military's interpretation, some members of the Academy — concerned the military would obscure and discredit the study because it described serious health and environmental consequences of Operation Ranch Hand — contacted numerous news sources throughout the country and disclosed their view of the report. They believed the report should have used less opaque and laborious language in describing the human consequences and environmental destruction caused by the herbicides, and that the military's press office would exploit the report's ambiguities and prolixity to reduce its impact on the public.

The academicians acted without Handler's permission — and probably without any sorrow that their actions would embarrass him — to ensure that their characterization of the results and conclusions of the study, not that of the military's public relations office, was what appeared first in the initial news cycle of the study.

The accounts of the report published in the newspapers said the likely medical consequences of the spraying in the highlands were sickness and death in adults and children among the Montagnard tribes, and the environmental damage in coastal forests was extensive and likely to last a century. The news articles said the upshot of the use of herbicides was to turn Vietnamese public opinion against the United States.

Handler responded immediately, lamenting that "selected materials from the report and personal criticism of the methods and findings described in the report were given to the press without authorization." As a result, he claimed, the reporters who wrote articles based on interviews with the leakers were misled because the reporters did not have access to the four-hundred-page final report of the study or the accompanying nineteen consultants' reports. Handler contended that misleading information — which he did not identify — propagated like a wave in a series of newspapers and periodicals, all of which echoed the same misleading perspective regarding the report.

He added, ''Once such articles were published, there was little likelihood that the same periodicals would subsequently publish more objective and complete accounts."

Referring to "highly personal, critical views," generally assumed to have been those of the Vice-President of the Academy, Handler lamented that the news reporters had no opportunity to interview those who disagreed with the Vice-President.

Handler had intended and expected that the military would have the first opportunity to characterize the report in the expectation it would be relied on by journalists. He wept crocodile tears for the members of the herbicide committee, who were listed in the report as if they were its authors, which was not the case. Handler claimed they were disrespected by the disclosures and offered them what he called ‘‘a sincere apology.’’ “It is deeply regretted,” he added, “that their scientific accomplishments have been improperly denigrated and that their contribution to the commonweal has been unfortunately lessened thereby,” which was seen in various segments of science as another example of Handler’s hypocrisy.

Shortly after sources within the Academy unofficially revealed the findings of its two-year study, the miliary released them to the Congress and the public. The study, as designed by Handler and his staff, made no attempt to find scientific information about health consequence and, unsurprising, they found none; its absence was highlighted by the military’s press office in a tone suggesting that the absence of evidence of harm was evidence that there was none. The actual objective of the study was said to be an attempt to find botanical facts. Handler’s sole requirement was that they be determined scientifically, however unimportant they might be. The herbicide committee found that Operation Ranch Hand caused widespread persistent damage to coastal mangrove forests, with consequent damage to the eatable fish; in the upland forests, the destruction of hardwood trees was permanent. The committee quantified the number of acres of mangrove forest that were destroyed by means of tedious evaluations of aerial photographs; although the number was already known to a militarily sufficient level of accuracy, the herbicide committee took great pains to increase the accuracy. To create a metric of the economic loss caused by the spraying, the committee determined the number of board feet of lumber lost in the upland forests.

The committee’s report discussed the work of an anthropologist hired by the Academy to investigate the effects of the aerial herbicide spraying on Montagnard tribe people indigenous to the Vietnamese highlands. According to the report, during detailed interviews, he was consistently told that children and sometimes adults became ill or died after experiencing direct exposure to the herbicides where they lived or farmed; the descriptions almost always mentioned skin rashes, abdominal pains, and diarrhea. Additional interviews made in Montagnard villages corroborated the initial accounts. The herbicide committee said the information was scientifically unreliable evidence of a link between herbicide exposure and adverse health consequences because the cause-and-effect relationship was not actually observed during spraying.

The committee acknowledged that the reported health consequences were identical to those described in three previous independent studies, but concluded that repetition of unscientific studies did not make the aggregate more reliable; the question of why not was not addressed, which was more than surprising because replication was generally considered to be the hallmark of a scientific finding. The committee’s summary conclusion regarding the interviews was that there was no evidence of any harm to Vietnamese civilians that was “conclusive” in the sense that it could be proved with ninety-five percent certainty to have been caused by herbicides. However, the report was pregnant with the implication the evidence was more probable than not that the civilians were harmed. The committee said the results of the interviews were "so striking it is difficult to dismiss them." It also said it found hints that the

American military personnel who handled the herbicides might have experienced medical consequences.

The committee report said its consultants found evidence that an extraordinarily toxic chemical — known to cause cancer and other genetic effects in laboratory animals —in the principal herbicide used in Operation Ranch Hand was detected in the soil and in fish from Vietnamese waters. The committee gratuitously asserted there was no scientific evidence that exposure to herbicides caused birth defects among the Vietnamese —an issue that was not considered in the study.

Nevertheless, the assertion was included in the report at the direction of Handler, knowing that it would be politically useful to the military. As expected, the military's press office cited the claim prominently and used it to undercut congressional concern that the herbicide spraying was a form of chemical warfare — a view Handler strongly opposed.

Handler sent a personal commentary on the Academy committee's report to the military in which he emphasized the importance of Operation Ranch Hand in saving American lives, and he described his version of the formation and meaning of the report. In accordance with the Academy's long tradition of supporting military development of chemical weapons, Handler was keen to avoid a misinterpretation of the report that jeopardized its relationship with the military — the preponderant source of the Academy's annual budget. He also sought to counter the footprint of the review committee on the herbicide committee's report and the leak of its contents, which weakened the pro-military tone he intended to create and denied the military the initiative regarding creation of public impressions of the report. Handler accused the herbicide committee of not even attempting to find conclusive scientific evidence that herbicides caused medical harm, which was a bizarre criticism considering he signed the contract with the military and was responsible for the study design. He called the anthropological interviews "second-hand tales" even though conducting the interviews was the task for which Handler hired the anthropologist. Handler had no choice. When the American society of anthropologists was apprised of the study design Handler chose, it refused to cooperate with the Academy. Handler added to the hypocrisy by asserting that the tales were not verified by questioning people immediately after they were sprayed, which he surely knew was prohibited by the military because the highlands were an active war zone.

Handler insisted suggestions in the report that innocent civilians might have been harmed as a result of biochemical contact with herbicides were baseless but not necessarily meaningless; cryptically, he said the "secondhand" accounts of death and illness among Montagnard villagers were scientifically worthless although "difficult to ignore." He labelled as "regrettable" the fact that the members of the committee made no effort to travel to Vietnam and conduct their own investigations, and speculated they would not have made the suggestions had they done so. Even though the research on which the committee based its report, was "less than satisfying," Handler said he was gratified the committee uncovered fewer allegations of side effects than he expected. "On balance," he said, "the untoward effects of the herbicide program on the health of the South Vietnamese people appear to have been smaller than one might have feared." Handler praised the committee for concluding they found no reliable evidence that Operation Ranch Hand caused adverse effects on the health of civilians or combatants, and for what he characterized as the dismissive tone of the report regarding

allegations of human harm. He said that its conclusion and tone were correct, and consistent with the view that herbicides were not within the range of chemicals banned by international protocols against using chemicals in warfare.
Handler praised herbicides as inherently beneficial chemicals that are critically important in agriculture, and that helped save the lives of American soldiers in Vietnam.

Handler was ideologically opposed to limitations on the use of pesticides, in agriculture or warfare, unless scientific evidence showed beyond a reasonable doubt they caused harm to health or the environment — what he called “conclusive evidence.”
Until that occurred Handler was content to rely on the opinions of industry experts who maintained that their data showed exposure to pesticides under conditions of normal use was harmless. His ideology, supported by the industry data, led Handler to oppose preemptive regulations — his fervid hostility to the ban on DDT was a prominent example of his attitude. Banning DDT in the absence of conclusive evidence of harm and the presence of evidence supporting its safety, according to Handler, denied the nation “the use of a compound of considerable economic and esthetic value.” The decision to do so, he said, "was political rather than scientific, a sop to uninformed, emotional citizens who had been swayed by unsubstantiated allegations.” Handler manifested a similar attitude toward the anthropological evidence of medical harm from spraying herbicides in Vietnam, which he rejected as unscientific and invalid.
He said the study found no conclusive evidence the herbicides used in Vietnam caused adverse health effects, consistent with the manufacturers’ evidence that they were safe when used as recommended. The testimony of primitive tribes people who said they got sick and their babies died after they saw what they called white smoke coming out of airplanes was no more to Handler than dust before a broom. His limp explanation of their testimony was that the anthropologist, whom Handler hired, was deceived by enemy propaganda that affected his analysis of the interviews.

In his commentary on the committee report, Handler attempted to characterize a classic snafu — a poorly designed, badly executed investigation that took place in the middle of a war where every logistic aspect and data source was controlled by the military — as a bone fide scientific inquiry that showed the military did not violate international protocols prohibiting the use of chemicals in warfare. Handler was clearly angry that the report provided less support for the military than he had privately indicated would likely be provided. He praised the importance of herbicides in agriculture, suggested the report vindicated the probity of herbicides in warfare, but criticized what he perceived to be its weak rejection of the possibility that herbicides adversely affected the health of the people who were sprayed or the military personal who did the spraying. Handler mocked his committee for conducting their investigation without ever visiting Vietnam and then offering unduly weak criticism of the weak evidence they uncovered regarding health effects. Then, speaking out of the other corner of his mouth, he said he was “grateful to the committee, its staff, its consultants, and our reviewers, all of whom gave unstintingly of themselves in the major effort herewith reported.”

Handler’s management of the study generated an unprecedented level of antagonism within the Academy, leading to revelations of chronic conflict and sordid behavior that subverted the Academy’s reputation. Handler appointed a pro-military herbicide committee

that was foreseeably likely to favor the military position regarding the use of herbicides in warfare. He spent Academy funds to support some committee activities that he desired but could not legally support using funds from the Academy's contract with the military. Handler precipitated a festering dispute between the herbicide committee and the committee that reviewed its work. He undermined the credibility of the herbicide committee by publicly attacking its report, and he demeaned the work of his anthropological consultant. Handler criticized the Academy Vice-President for expressing the view that a herbicide committee's report "seriously underestimated the damage and is too casual about the possible ill effects on humans." The absence of integrity and the presence of bias within the National Academy of Sciences were revealed in ways never previously revealed with such clarity.

HANDLER'S ECCLESIASTICAL-LIKE AUTHORITY over the machinery of the Academy provided opportunities for him to influence any area of science or science policy he chose to enter. He frequently exercised his prerogative, irrespective of the limits of his expertise. The trappings of his high office allowed him to couch his opinions in rhetorical language absent analyzed evidence or rational basis other than his ideology, while remaining indifferent to his critics and dismissive of any responsibility for defending his opinions. Although disparaging of the opinions of laymen because they were unschooled in science and unwilling to correct their ignorance, Handler was the most familiar public scientist in the nation, as judged by the number of times he testified before the Congress and the frequency with which his name was mentioned in the public and science press. His omnipresence in matters involving science and science policy led to the perception by some in the public and the Congress that he was a universal expert, and he routinely reinforced the perception. When asked about the consequences of a nuclear war, for example, he said, "The biosphere and the species Homo sapiens would both likely survive."

Handler's advice concerning the desirability of building hundreds of plutonium breeder reactors to generate nuclear power was another example of his penchant to opine on topics beyond his ken. During a speech in early 1972, he proposed relying on breeder reactors as the basis for a national energy policy, thereby avoiding reliance on foreign oil or burning coal. Handler said the reactors — which changed non-fissile uranium into fissile plutonium that could be used to generate electricity— would be safe, as determined by the engineers who designed them. He asserted, "The increase in local background radiation which such plants might occasion" did not warrant the "considerable alarm and debate breeder reactors had engendered," and added, "This small increase in radiation background is an acceptable risk, in view of the great benefits that would accrue." Handler said he saw "no acceptable alternative to breeder reactors for meeting the nations need for electricity," and that it was "knowingly hypocritical" of people to "demand environmental cleanup yet also fight to prevent construction of nuclear power plants." "If by their efforts we fail, our civilization will go down not in flame, but for lack of flame," he said.

But in September 1974, Handler changed his mind about the desirability and necessity of relying on breeder reactors for producing nuclear power. In a speech about the America's dependence on science, he warned against the peril of relying on nuclear power plants fueled by plutonium produced in breeder reactors, saying it should not be a part of the nation's energy future. Among the nightmarish dangers he listed were: possible catastrophic accidents due to failure of reactor cooling systems; health risks arising from the need to perpetually transport

plutonium — the most carcinogenic substance known to mankind — between breeders and nuclear power plants and spent-fuel processing plants where plutonium is extracted to create new fuel; the necessity to permanently sequester plutonium waste, which remains radioactive for more than fifty thousand years. He told his audience that "the world must forget the breeder reactor," otherwise, "It is inconceivable that the human race will avoid a worldwide calamity on so large a scale as to jeopardize the continuing future of our species." Early in 1975, however, Handler furtively engaged in what probably was his most shameful behavior up until that time. The stage was set when investment bankers declined to invest in the development of breeder technology because of doubts it would be economically competitive. President Nixon perceived political advantage in supporting development of breeder technology, and secured congressional support for funding the project and creating an agency to manage it.

In a senate budget hearing concerning the Ford Administration's request for continued funding of the agency's breeder project, during questioning of the head of the agency, a senator expressed deep concern regarding Handler's strident negative opinion of breeder reactors. The senator quoted the speech in which Handler warned against the peril of relying on nuclear power plants fueled by plutonium produced in breeder reactors. The senator emphasized he had not quoted a "radical" or "lightweight" but the "President of the Academy," and he asked the agency head for his reaction. "I have not heard that quotation before," he responded.

A week after the agency head professed ignorance of Handler's views, he met secretly with Handler and offered him a multi-million dollar contract for an Academy study of the technical feasibility, safety, and economic implications of utilizing breeders as a major source of electricity. The offer was subject to two conditions precedent, that Handler publicly express pro-nuclear views about breeder reactors, and that he appoint an Academy committee to conduct the study that would reach conclusions was favorable to the agency's interests. Handler agreed. The following week, in a letter to the senator, Handler formally announced his flip-flop from anti- to pro-breeder reactor and, without mentioning the planned contract between the agency and the Academy, attempted to explain why his views changed so drastically. Handler told the senator the quote was accurate, but that since then, "I have been impressed by facts which I had not fully considered," and "my approach to the breeder problem has been altered." the Consequently, he said, his speech "no longer adequately represents my views." Handler asserted there was no other realistic alternative to the use of coal or oil for generating electricity, and that he had come to believe rational planning for the future demanded "that we look to nuclear energy fueled by plutonium breeder reactors to become a major source of electrical power." He speculated, "A future without the breeder reactor as a source of electrical power must be viewed as a future in which the lifestyles of Americans will be drastically altered — and not for the better."

He predicted that, in the absence of breeder reactors, food, manufactured products, transportation, and housing would be more expensive, and that "there would be great danger of loss of those social gains which have been so hard won within our own lifetimes." Handler said the breeder program was an "absolute necessity "and had to be pursued with "great vigor."

Handler's support for breeder reactors initially aligned with Administration and industrial interests, and overlooked the health risks associated with radiation exposure and long-term waste management. Subsequently, he acknowledged both risks and on that basis

vehemently opposed reliance on breeder reactors. Soon thereafter, however, enticed by economic benefits for the Academy and the offer of a central policy role for the Academy, Handler reverted to his initial position and aligned his views with the goals of the energy agency and industry. His erratic policy shifts surprised and troubled some in the Academy and the Congress, and questions circulated regarding his mental health. The concern was heightened by Handler's practice of not providing explanations for his periods of sudden unavailability or absence from work, which his staff assumed were related to his chronic bad health, and his practice of self-medication rather than seeking medical help.

The public announcement of the agency's contract with the Academy produced strong press interest in Handler's dramatic change in opinion and the seemingly biased committee he appointed to implement the contract with the agency. In an interview, he said he "did not enjoy eating his words" and added, "All of us find it hard to change our minds," but he offered no further explanation for his bizarre behavior. In response to accusations that he appointed a rigged committee, as evidenced by the fact that many of the appointees publicly expressed a strong pro-nuclear view but no appointees had a strong anti-nuclear view, Handler said only that a balanced committee would not be "productive."

HANDLER MADE THE IDEOLOGICALLY-BASED assumptions there was such a thing as objective knowledge, and that science was mankind's only means for discovering it. On many occasions he told the Congress that biomedical science, spear-headed by basic biochemical research, could provide solutions to public health problems such as health risks, safe exposure levels, and the causes and cures of diseases, if the requisite research were adequately funded. No other prominent contemporaneous scientist openly supported Handler's fatuous assertion of the power of biochemical research, even after he repeated it from the bully pulpit of the Academy. Handler failed to gain support for his views, which was understandable because biochemical research of the kind he deemed necessary had produced no useful information relevant to any public health problem. Gold-standard animal studies were far more practical and productive for the scientific study of public health problems than Handler's proposed reductionistic molecular approach. But he used his authority to oppose reliance on animal studies — which were routinely used by regulatory agencies to rationalize protection of public health on the basis of the precautionary principle — believing that only objective, explanatory biochemical knowledge should be sought. Under Handler's leadership, however, biomedical science appeared useless in matters involving protection of public health, and the Academy's process of empaneling and managing advisory committees, became delegitimated. Handler appointed each member of every committee, but only after obtaining staff estimates of the general opinion of prospective appointees regarding the pertinent issue.
Gaining confidence they would likely conform to Academy policies was a particularly important consideration for Handler when the issue was a matter of personal interest to him, such as the determination of safety levels. The contamination of bias became endemic in Academy committees

Having decided that risk-benefit analysis —based on statistics or judgement but not science— was the appropriate method for decision-making regarding safety levels, Handler turned his attention to the government's reliance of gold-standard animal studies, then the

standard method for setting safety levels, and hence the principal alternative to his risk-benefit method. Handler believed the use of animal studies was the driving force behind the public's interest and concern about health risks of anthropogenetic chemicals — the results of such studies often appeared in the press, showcasing the novelty of the chemical and its potential to cause harm. The use of animals to evaluate health risks prior to exposing humans seemed irrational to Handler but was intuitively understood and widely accepted by laymen, a response Handler had little hope risk-benefit analysis would receive. Adding to Handler's angst was an increasing public apprehension about the consequences of exposure to man-made electromagnetic energy from radio and television towers, microwave ovens, radars, high-voltage powerlines, and a huge planned military communication system that would cover about half of Wisconsin. Relevant animal studies were already underway regarding the health risks of anthropogenic electromagnetic energy, and publicity concerning the issue was increasing.

Handler recognized that the use animal studies to evaluate health risks conflicted with his goal of translocating the issue of safe exposure levels from the biomedical domain to that of actuarial analyses. In his communications with industry — mostly though its representatives and employees on Academy committees — Handler recommended that industry conduct animal studies to oppose and rebut the results of those sponsored by the government, and carry out actuarial studies to support the view that anthropogenic factors in the environment were not health risks. Handler's recommendation increased the pro-industry bias in the advice Academy committees furnished the government, but the major impact of his recommendation was on industry's attitude toward biomedical research. Handler's recommendation that government research should not go unchallenged when it leads to unjustifiable and expensive safety regulations was warmly received by industry. His recommendation green-lighted what industry had already begun by providing what amounted to explicit approval from the highest level of American science for what amounted to adversarial science — biomedical research programs designed to demonstrate, by whatever scientific information was necessary, the safety of products that released anthropogenic factors into the environment. Industry and private organizations composed of various combinations of experts were formed to carry out tactical actions to implement the strategy; the actions included designing and carrying out animal studies and actuarial analyses, and making favorable results widely available. The resulpublications of industry scientists differed greatly from those of university scientists with regard to purpose, objective, and implications for human safety.

The historical purpose of biomedical research — to find the best version of the truth about nature — became supplemented by research primarily intended to serve the interests of whoever paid for the services. Industry-sponsored science was undertaken to oppose or cast doubt on whatever information was perceived by the client as antagonistic to its interests. The result was creation of pseudo-scientific evidence in the form of arguments, analyses, rhetoric, data, or faux doubt regarding the validity of the published results of gold-standard animal studies that supported safe exposure levels. Handler's Machiavellian maneuvering opened a Pandora's box of toxic consequences for the endeavor of science and the public's conception of what science was and whether it was something good or bad.

Handler viewed industry science as a kind of engineering — optimal accomplishment of a specific task within a given time frame and a specific budget — that was entirely unrelated to

cathedral science, his ideological conception of science as mankind's greatest achievement. He viewed cathedral science as under threat from chronic complaints of health risks caused by exposure to man-made contaminants, and responded by weaponizing the Academy to oppose the perceived threat to the use of food additives. When the government raised the question of the safety of the thousands of non-nutrient food additives that were on the market but whose health consequences where unknown and unstudied, Handler's initial policy response called for the determination of safety levels using risk-benefit analysis based on statistical manipulation of actuarial data. According to his policy, regulatory decision-making would be based on manipulating the data to justify the highest possible exposure level — the least expensive option for industry— that had the lowest and highest dollar values for the risk and benefit factors, respectively. Handler's goal was to maximize profits and minimize regulatory interference with product designs and manufacturing practices. However, Handler's enthusiasm for the policy of quantitative determinations of risk and benefit soon waned, partly because he was uneducated in mathematical and statistical methodology, which resulted in awkward rhetoric when he tried to describe it. Another reason was his doubt the government would regard the methodology as credible, because it was malleable and susceptible to arbitrary technical modifications. Handler remained committed to the use of risk-benefit analysis but added "professional judgement" — by which he meant academic training, general experience, and data deemed relevant — as an additional basis for determining safety levels. He colored the subjective decision-making standard as objective when it was used by the Academy committees he appointed. The professional-judgement standard avoided sole Starr's mathematical legerdemain standard while furthering Handler's goal of maintaining a foothold for science in the decision-making process .

The advice offered by a typical Academy committee that relied on Handler's version of risk-benefit analysis was a homogenization of the biases and conflicts-of-interests of the committee's members. Speaking in one voice, the Academy committees offered the government advice that was predictable from an examination of the histories of the members' opinions, employment, and research funding s. Handler obscured the lack of integrity of the committee judgement process by adopting a rule that prevented holding committee members accountable for their advice. He argued that science was non-adversarial and produced objective answers, in contrast to politics which was adversarial and produced only subjective answers. The objectivity of science, he asserted, allows scientists to make valid determinations of what benefits people wanted, what risks they were willing to accept to gain them, and how to quantify both factors in dollar, based on their judgement. Handler said agency officials could then readily make deductive decisions regarding safety regulations.

Handler said the rule was needed to avoid the taint of politics, which would occur if the scientists on Academy committees were required to answer questions about their opinions. He regarded questions posed by regulatory officials as cross-examination that was inappropriate in what he called the non-adversarial process of offering advice. Handler's rule effectively prohibited committee members who opined about political matters such as safety levels, health risks, economic impacts from being asked by federal regulatory officials to explain the basis of their testimony and defend their conclusions. He believed the reports of Academy committees were clear on their face and would ensure regulatory decisions were coherent with scientific reasoning and judgement, and that his rule ensured the scientists would not be involved in

politics. Handler ignored the reality that his rule violated democratic principles because it made unelected experts who were deciding political issues unanswerable to anyone except him. Handler imagined that an Academy report to agency officials contained a committee's opinions and judgements that were. he said, "sufficiently compelling as to logically determine the agency's decision" — like Santa Clause leaving gifts for children.

Handler's policies for determining safety levels, and the toxic ideology from which they sprang, fostered creation of pseudo-knowledge science intended to compete with the historical scientific endeavor that built the cathedral of science. His encouragement of industry to become actively involved in biomedical research and to rely on Starr's actuarial decision-making method to determine safety levels helped promote development and growth of industry science — a tool intended to serve the interests of stockholders. Handler didn't recognize he had gone too far in his efforts to support industry at the expense of public health, seriously injuring public perception of the scientific endeavor. He took no remedial steps to restore the integrity of the cathedral. Industry science found a permanent location to do business in the vestibule, but Handler saw no serious corruption or commercialization of a sacred place, but rather legitimate economic activity on the fringe of true science. Unfortunately, the industry scientist and the cathedral scientist were superficially indistinguishable to the layman— both had a PhD and spoke in a complex lingo — making it difficult for a nonscientist to distinguish between them when they told their stories, which were always conflicted. Handler's strategy for preserving a role for cathedral science in the determination of safety levels and protecting it from the taint of politics, had the net effect of diminishing the status of science, scientists, and the Academy.