

## <sup>1</sup>Chapter 10: Consequences 1972-1975

### **PART 1: GRAND ILLUSION REBUFFED BUT NOT ERASED**

DURING HANDLER'S SECOND YEAR in college, only his fifth year of education outside his home, the child prodigy read a book and listened to lectures about the chemical energy necessary for life and became converted to the view that living things were biochemical machines. During his three years in graduate school, Handler was seized by a grand illusion that biochemistry could provide a full and complete explanation of life; he imagined the day would come when a selected mix of chemicals poured into a beaker would produce life. At Duke University, Handler overcame what he later called his "social paralysis" and, by dint of management skills, aggressive fund-raising for biochemical research, and a silver tongue, became the head of his department. He contributed resources to the financially strapped society of biochemists which, in turn, helped Handler secure a coveted position at the National Institutes of Health where he had the authority to choose the investigators who received federal funds for biological research. While working at the Institute, Handler funneled essentially the entire federal largess for biological experimentation to his biochemical constituency — a community that shared his ideology concerning the supremacy of the reductive pointillist approach to biological research. In furtherance of his dogmatic beliefs, Handler blocked funding of integrative system-level research, thereby preventing exploration of the biological role of electromagnetic energy — which logically must exist because it the only force in nature that acts at distance and therefore is essential to an understanding of life, health, and disease

In the years that followed, while functioning as the brain and mouth of the National Science Foundation, Handler proselytized science as mankind's greatest intellectual achievement, the solution to society's problems, and deserving of fifteen percent annual increases in federal funding for research. He argued that he, rather than the Congress or the Administration, was uniquely qualified to apportion the allocated funds among the sciences and to choose the proposals, programs, and policies that best served the nation's interests. Handler was in a formal position to advise the Administration on any policy issue related to science or technology, but his advice was oratorical as opposed to substantive, and rarely was sought by the President's assistants although frequently offered. His recommended solution to the problem of environmental degradation caused by technology was a cliché. He said, "We need more technology," but the policy was a prescription for an infinite regress because new technology would also cause degradation, necessitating still more technology. Handler's approach to the issue of health risks similarly amounted to only a rhetorical device. He believed public concern about health risks was only an emotional reaction to modernity, but he recognized that emotions were real and required political consideration rather than basic research, as he had preached. Handler's putative solution to the problem of assessing the

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impact of technological programs was to balance political and economic factors, with science playing only a secondary role. He proposed treating health risks as a business rather than biological issue and expressed his proposal in the form of a doggerel: "The issue should be resolved by balancing the public good against the risk to the individual."

Handler claimed that the determination of environmental threats to health was the exclusive province of scientists, because they were trained to analyze data produced in biochemical studies and human experimentation, and to evaluate the safety of suspected dangerous agents; he had opposed reliance on animal studies, claiming their biochemistry differed from humans. But Handler's policy of reliance on biochemical studies gained no support outside the biochemical culture, and ethical concerns led to development of federal rules that greatly restricted use on human experimentation. Handler responded by urging a policy that amounted to a form of involuntary human experimentation — the statistical analysis of data in public records to assess whether the death rate of humans who were likely to have been unknowingly exposed to a particular environmental agent was higher than expected. Under his new policy, a committees of scientists would determine the risk to individuals by analyzing results of the human statistical studies, and then balance the risk against what they considered to be the public good. Handler believed that, in almost all instances, human statistical studies would document the absence of meaningful health risks, thereby entailing the experts to conclude that concerns about health risks were outweighed by considerations of the public good. Such outcomes, Handler predicted, would enable the public to see that exposure to the environmental agent was safe.

Handler's ambition was to establish science as a preeminent institution in American society, on par with the three branches of government and, despite chronic bad health, he worked unstintingly to bring about some version of his grand illusion. He provided science policy advice to three Presidents and seven Congresses, before whom he testified several hundred times, and he strongly influenced the policies of the major governmental agencies that supported biological and biomedical research — the National Institutes of Health, one of which he created, the National Science Foundation, and the Veterans Administration. By virtue of his organizational skills, financial acumen, rhetorical capabilities, and a special arrangement with the outgoing president of the National Academy of Sciences, Handler was unanimously elected as his successor, then the most prestigious position in the firmament of American science.

Handler was employed as the chief executive officer and chairman of the board of the Academy, a private business created by the government to provide paid science-related advice, when asked, but whose scope Handler enlarged to include advice he thought the government needed to hear. His authority at the Academy was absolute.

Handler controlled a thousand employees and five thousand volunteer scientists whom he appointed annually to five hundred ad hoc committees, that generated advice for federal agencies pursuant to negotiated contracts. Additionally, he appointed private committees that Handler convened to provide public advice on issues Handler deemed important, an enterprise

Handler funded using the vigorish from the Academy's government contracts. Handler maintained ultimate editorial control over every final report produced under the aegis of the Academy; some of which were published, others remained secret if requested or required by the sponsor.

Handler also held other politically powerful positions. He remained the chairman of the National Science Foundation, which dispensed funds for research grants, but only regarding matters he considered appropriate unless the Congress or the President specifically directed otherwise. In his capacity as the head of the Academy, Handler was a member of the President's Science Advisory Committee, an office inside the White House that offered a direct connection to President Nixon, with whom Handler was constantly in conflict. He was also remained a consultant to the National Institutes of Health and the Veterans Administration. The former funded only biochemistry-based research but the latter also funded biomedical research based on electromagnetic energy, which in Handler's eyes was wholly inappropriate inconsistent with the advancement of scientific knowledge, and opposed whenever he had the opportunity. Handler was also a board member of three drug companies, whose biochemical research was deeply important to him because it symbolized the power of biochemistry in a manner that the public could understand. Despite constant criticism, Handler saw no conflict-in-interest in arranging for Academy drug studies that yielded pro-industry advice because, he argued, the contracts were with federal agencies, not drug companies. The only powerful interest in the government Handler refused to serve as a consultant was the Department of Defense; doing so, he maintained would be a conflict-in-interest because the Department was the Academy's biggest customer.

While heading the Academy, Handler's scientific crusade became so extreme, science as a whole lost credibility within the Administration, and the threat of eviction from its privileged place within the White House became palpable. The shrunken political state of science awakened Handler from his dogmatic slumber at least to the extent that he realized the halcyon post-war period of science's popularity had ended and the status of science in society was decreasing. Handler, however, remained undaunted and reacted by increasing his commitment to scientism and taking even stronger stances despite the risks and criticisms. He manifested his resolve in press interviews and speeches where he reiterated his routine pretentious characterization of science — that it was proof of humanity's greatness and a universal solvent for its problems. But he also began resorting to other rhetorical flourishes that were novel and aimed at fostering a positive public perception of science or at explaining why the progress of science was often judged as insufficient. He acknowledged the public's concerns regarding health risks and environmental degradation and said he felt their pain. He offered advice, both personally and via Academy committees he appointed, that he said would resolve many societal concerns. Handler conceded that some committees appeared to be biased in favor of business interests but claimed he had fixed the problem by implementing new rules. He agreed there had been scant progress in finding the causes and cures for cancer and other diseases, but blamed the Administration and the Congress because they chronically underfunded basic biochemical research.

During the course of his rise in national prominence, Handler unceasingly proselytized about science as mankind's greatest intellectual activity and the solution to society's problems. But his scientific crusade was continually challenged politically and financially, and over the years its level of popularity decreased monotonically, forcing him to moderate his rhetoric and alter his tactics. The exigencies of his time, particularly the side-effects of technology and environmental degradation, forced Handler to show the Congress and the public how financial support of science was a major part of the solution to society's problems. But he failed badly. His earliest attempts were various forms of the argument that science spawns technology which in turn repairs environmental degradation and eliminated health dangers. His advice, however, was generally perceived as meritless, which he recognized and responded by reconceptualizing health risks and environmental degradation as business issues that touched the domain of science only lightly. He explained the new policy using a doggerel; "The issues should be resolved by balancing the public good against the risk to the individual," he said. His approach was similarly ignored and his situation worsened still further. Agencies and the Congress, acting for their own political purposes, commenced addressing questions to the Academy which was required by its charter to address, but frequently, Handler could not appoint a credible Academy committee because there were no volunteers, leaving the Academy with hopelessly impossible tasks.

## **PART 2: NIXON NIXES HANDLER'S SCIENTISM**

### **SECTION 1: PAST AS PROLOGUE**

PRESIDENT NIXON ASSUMED OFFICE during the period Handler was in the process of consolidating his control of the National Academy of Sciences and beginning to use its ostensible authority to proselytize his opinions about science. Shifting cultural and political currents were jeopardizing its status in society, and the sustainability of publicly supported basic scientific research of the kind so dear to Handler was in doubt. He told the new President, in effect, that the head of the Academy was the nation's majordomo regarding scientific matters, and that strengthening the scientific endeavor was critical to the health and welfare of the nation. The President was a pragmatist in contrast to Handler, an ideologue whose ideas about science were pregnant with political implications. In an effort to attract support for his gospel, Handler sought to associate the values of basic research with those of the wider American culture — a task he found progressively more difficult because the public no longer viewed scientists as an admirable priesthood. He had very little to point to as progress in the biochemical approach to clinical medicine, so he surrounded himself at the Academy with physicists and engineers, who carried forward his argument that, in modern times, technological progress depended on basic research, just as it had led to the atomic bomb. Handler equated science with the advance of civilization, claiming it provided "the intellectual structure of our time" and "ranks among the most magnificent accomplishments of our civilization."

In his assertion of the cultural authority of science, Handler portrayed it as a rational activity implemented by an objective methodology that yielded a true understanding of reality

in objective language, and provided a sound basis for decision making. Handler believed the distrust for science he saw among the middle and upper-middle classes could be overcome by educating them about the importance of science.

He said, "it is essential that the humanist, the artist, and all who follow careers outside the world of science have full cognizance and understanding of the nature of the world within which we live, a perspective that has been laboriously achieved over decades and centuries by scientists."

Handler expected that educated, thinking lay persons would accept the evidence and interpretations scientists produced as facts and, consequently, would respect their authority and pronouncements. When he made his annual pleas before the House and Senate budget committees for federal funds to support research and education, he relied principally on anecdotal stories of past achievements and his dictum that technological progress rests upon advances in basic science. He lamented the utilitarian basis of the Administration's funding for science because, he said, it obscured the intellectual importance of science. Handler's rationale for public support went beyond asserting that all true knowledge was scientific in nature and that basic research was the mother's milk of technological progress, he also declared that scientific research was necessary for solving social problems. His claims, however, were counterproductive politically and met with strong criticism from sociologists. They argued that Handler's perception of social reality was grossly simplistic, and that training as a biochemist could not supplant cultivation of habits and values that are important for the well-being of a community as the solution to societal problems in a democracy.

Handler thought the President was overwhelmed by the complexities and challenges he faced when dealing with issues involving science and technology, and Handler considered the President's aides as ignorant about science and incapable of forming effective national science policies. Handler used his position as a presidential science advisor in the White House science office as a vehicle for directly providing advice to presidential aids, but had a negligible impact on Administration science policymaking. The aides viewed Handler as a loose cannon much more likely to hurt than help the Administration he nominally served as a science advisor and as head of the National Science Foundation. They also regarded Handler as an arrogant and ambitious zealot who was trying to usurp the constitutional power of the President to set national policy, and who ran the National Academy of Sciences in a personal fashion.

Handler used the Academy as a platform to volunteer advice about science policymaking — a radical change in practice compared with that of previous Academy heads, who spoke only when asked by the government. And adding to the antagonism he created, Handler's advice often conflicted with the President's plans and policies. In turn, he ignored what Handler had to say, and used him like a tool in instances when it was helpful to the Administration to do so. Handler's appointment to a committee that assessed the impact of technology was an example. The committee recommended increased funding for biochemical research to assess health risks from technology, and that risk-benefit analysis be used to evaluate the social desirability of technology. The President not only declined to fund the biochemical research as Handler urged in the committee report, but also continued the

trend of reducing research's annual budgeted funding level at the National Science Foundation, which Handler headed.

Additionally, President Nixon sanctioned the policy of regarding health risks as a managerial rather than biological problem by adopting the recommendation of the committee's industrialists to support the risk-benefit analysis method for evaluating the risks of technology. The President further aggravated Handler by directing the Foundation to repurpose funds allocated for basic research to support development of an international group of economists that was developing a business-management method for assessing health risks of technology, and he appointed Handler as the U.S. representative to the group. Handler complained strongly about the President's decisions and predicted American scientific advancements would lag that of other nations, a claim presidential aides dismissed as out of touch with reality.

Handler believed the Administration's plan to reduce research funding was a political reaction to the public's misunderstanding of the relationship between science and technology. As Handler saw things, the public conflated science, an erudite intellectual activity, with technology, a collection of products and services, and wrongfully blamed science for environmental degradation and negative health impacts, not the misuse of technology, which he said was the actual cause of any adverse consequences. Handler told presidential aides that the Administration should acknowledge the public's misapprehension and correct it via specifically budgeted educational efforts overseen by the Foundation, and also should refrain from using the public's attitude toward the negative impacts of technology as a reason to decrease federal support for basic research. Handler's perception of science and that of the Administration, however, were incommensurable, and the aides ignored Handler's advice.

In speeches at meetings of biochemical societies, Handler rallied his constituency to oppose the Administration's policies regarding lack of support for scientific research, and to work toward dispelling the confusion in the minds of laymen concerning the distinction between science and technology. Handler modeled the relationship like that between father and son, intimating that technology could not exist in the absence of continuing basic research. The Administration, in contrast, saw technology as means to a larger economy and a stronger nation, and maintained a focus on practical applications. Basic research was regarded as an expensive pastime of a small self-regulating group that consumed the taxpayer's money in pursuit of intellectual satisfaction that had no foreseeable public benefit. The Administration's policymakers favored funding the applied research of engineers — the group of scientists that specialized in producing a foreseeable benefit and that, at the time, Handler was desperately trying to prevent becoming a permanent part of the corporate Academy.

Handler told the Administration that knowledge of how the environment reacted to various forms of large-scale pollution was unknown, and consequently, until appropriate research was done for each pollutant, predicting what regulatory strategy would be successful was impossible. He recommended no regulatory or protective steps be taken until the necessary biochemical understanding had been achieved.

Doing otherwise, Handler said would likely result in more harm than good; he urged producing more biochemists to facilitate the elucidation of the needed information more quickly. Handler also advised the Administration that industry's a responsibility to warn the public about known hazards did not extend to warning about alleged health risks that had no known biochemical basis. He rejected the idea that the burden of responsibility for health risks from untried technologies or industrial practices should be on industry, choosing instead to place it on the public. According to Handler, biochemists should be funded to search for conclusive evidence of the biochemical mechanisms of toxicological hazards; he said biochemists should be relied upon to parse their data and identify the dose level at which a chemical became hazardous. In the meantime, to avoid damaging the economy and limiting the benefits of technology, Handler advised the Administration to adopt a policy of relying on statistical studies of ordinary citizens to identify catastrophes in the human population, as he had recommended earlier in his career regarding the hazards of smoking.

Speaking under the color of the Academy, Handler routinely volunteered policy advice regarding any matter that interested him. When he spoke, the prestige the Academy enjoyed at the time was often imputed to him personally, generating public pressure on the Administration to explain and defend its policy in the area when, often, none had been develop. Handler's strategy thus maneuvered the President into a defensive posture in areas not of its choosing— abortion was an example. Handler maintained that industry was unjustly blamed for the consequences of side-effects and pollution, claiming the real cause was the uncontrolled growth of the population. Handler urged the President to support national policies of destroying prenatal babies based on results of prenatal genetic tests, permitting elective abortion as determined by the physician, and funding biochemical research of reproduction aimed ultimately at eliminating the growth of the population.

Handler claimed that the inherent ability of scientists to provide objective information was the foundation for the policies he offered the Administration which, he believed, had no other reliable source of the knowledge needed to solve the nation's problems. However, his actions and persona undercut his credibility, revealing his limitations as a policy doyen and the impossibility that his goal —a role for scientists in governing society — could be realized. His extreme public-health and environmental policies, public language, and behavior set in motion counter forces that weakened both him personally and scientific itself.

A vivid example of his excesses was his version of risk-benefit analysis for identifying acceptable health risks created by technology. According to Handler, final decisions regarding public safety should be made by science experts who weighed their perception of the meaning of biochemical data against speculative benefits of technology. When Handler used his risk-benefit method and played the role of a science expert, he concluded DDT in the environment was harmless except for a few bird species, and that air pollution from automobiles was acceptable. Because of its elitism and subjectivity, Handler's egregious method of health-risk analysis had negative impact on the Administration

Other actions by Handler also had undesirable consequences for his reputation and that of science. From his Academy bully pulpit, he attacked other scientists — invariably far better scientists than he — in revenge for their nonconformity with his opinions about the side-effects of technology and the health consequences of pollution. Handler believed the consequences were negligible and that the only meaningful problem was the public's emotional overreaction to wayward scientists who spoke out of ignorance. Handler's criticism of scientists who disagreed with him — hallmarks of his speeches and behavior throughout the 1970s — was not his only form of retaliation. He also employed the machinery of the Academy to block nationally prominent scientists from being admitted as members. His behavior toward other scientists belied the rationality of scientists which he maintained was the reason the Administration should rely on the judgement of scientists. Further, Handler's behavior undercut the validity of his proposed method for assessing acceptable health risks, which relied heavily on the judgement of experts ; his retributive actions made clear that he meant only the judgement of scientists who agreed with him, and his actions contributed to the public's adverse perception of science as an institution.

Handler advanced an extreme policy regarding the consequences of chemical technology that was politically untenable and detrimental. He assumed that anthropogenic environmental chemicals posed no meaningful threat to human health and the environment, contending that whatever harm they produced was outweighed by the good they provided. He sought to insulate chemical technology from governmental scrutiny for safety, thereby ensuring technology's true impact would remain unknown. The gist of his advice to the Administration was that concerns regarding health and environmental risks should be ignored unless and until results of biochemical research strongly indicated otherwise. He recommended reliance on pointillist biochemical studies, even though they were generally recognized as having a nil possibility of resolving the ills of society and a high probability of exacerbating them by dissipating time and money. Regardless of whether Handler's preferred policy stemmed from ideology, expediency, or mental instability, it essentially amounted to a concession that science was irrelevant to the class of problems that most troubled people.

Even though no studies indicated scientists were smarter or more ethical than other professionals, Handler theorized that scientists were intellectually and morally superior because only they had the methodology and integrity to discover true knowledge of the world. Handler himself, however, furnished abundant evidence against his theory. The research methodology he used was strictly descriptive, the meanest level of knowledge in science (see Chapter 1), and after leaving the laboratory he manifested dubious ethical behavior. For many years, Handler accepted a salary, through Duke, from the National Institutes of Health for research in North Carolina he did not perform or supervise because he lived in Washington, D.C. He served as a director of a drug company while simultaneously using his influence to help drug companies escape federal regulation. When in authority at the Institutes and the Foundation, he favorably influenced research funding for his friends and blocked funding for scientists who refused to adhere to his ideology of science or who disagreed with his opinions about the health risks of technology.



Academy committees Handler appointed were commonly identified as rigged because their members were economically bonded to the stakeholders or were selected because their opinions were foreseeable based on their prior publications and speeches, or both. The universal syntactical style manifested in Academy reports was for a committee to issue a judgement using one voice, with no disagreements, contrary opinions, or even an indication they existed. The uniformity of style was irrefutable evidence the committees were manipulated, because a truly representative group of experts assembled to opine on an important issue would not credibly be expected to agree unanimously on every salient point. Typically, what the one voice had to say was foreseeable from an analysis of the historical positions of Handler's appointees.

Handler's Testament (see Chapter 8) was a graphic example of a rigged deliberative process, as were his appointments of biased Academy committees to evaluate pesticides, food additives, air pollution from automobiles, and human exposure to electromagnetic energy of the type produced by powerlines and other technologies that inject such energy into human living space.

Handler himself was a near perfect model of the kind of member he sought to appoint to Academy committees: his opinion on almost every subject was already known, his standard practice was to never debate an opinion but only express it, and he was aghast at the suggestion his position as a board member of a drug company might have any influence on his appointees to Academy committees tasked to opine on proposed national drug policies. The issue of committee rigging brought into sharp focus Handler's limitations and those of science, revealing that, ultimately, it was governed not by knowledge but rather by values as reflected in political maneuvering.

The message Handler quite inadvertently delivered to the Nixon Administration was that it didn't need a White House based committee of pro bono science experts to provide advice, he already had political advisors who were far more skilled than Handler.

Handler sharply opposed the Administration's research program to find a cure for cancer. He believed government health officials and the President's aides knew too little about science, and were hopelessly unable to create and manage such a program. He believed the money budgeted for the program would have been far better spent for basic biochemical research at the nation's elite universities. Handler claimed that too much money was being spent on patient treatment and too little on university-based research and education of more biochemists. He said the President's cancer program was failing because of a lack of biochemical knowledge, a fact he claimed was obscured by the Administration in press interviews and public presentations. Handler claimed the program would result in a lowering in excellence of basic research, and advised the Administration to begin basing its biomedical policies on objective analysis rather than ideas that were popular with the public. On numerous occasions, Handler proposed creation of a national department of science that would control the nation's biomedical endeavors, but he never even came close to eliciting a serious response from the Administration or any group of capable scientists and administrators.

## SECTION 2: DEMISE OF THE PRESIDENT'S SCIENCE ADVISORY OFFICE

Handler attempted to influence Administration science policy from the inside in his capacity as a member of the President's science advisory committee and head of the National Science Foundation, and from the outside as the head of the Academy. In the latter capacity, he organized a national revolt of scientists against President Nixon's decision to reject the recommendation Handler made to the President for appointment as chief administrator of the Foundation because that person had publicly opposed a particular Administration technology program. Handler said he was shocked that politics was involved in the President's decision, and the resulting furor forced the President to approve Handler's choice — a rare instance of intentionally humiliating a President of the United States. Unknown to Handler at the moment, he would pay a great price for his hubris — President Nixon resolved that Handler's formal role in his Administration as a science advisor, and that of all other establishment scientists, would be eliminated.

Handler used his White House position as science advisor as well as his position as head of the Academy to volunteer advice to the President in numerous areas of science. He slipped seamlessly between speaking as an official presidential science advisor, the head of the Foundation — and Executive Department agency directly answerable to the President — and the head of the Academy, the principal institution in the American science establishment. But whenever he spoke, his purpose usually was to foster creation of a permanent structural presence for science in the government, obtaining more money for basic research, and the education of more biochemists, all of which rankled the President and his aids. Even though scientists had been relatively well-treated financially and were generally heard by successive administrations, Handler continued to seek his fundamental objectives — a supposed need for increased research funding and the formal establishment of an influential voice for scientists in shaping the government's science policies. He regarded the objectives as necessary remedies for what he saw as the inability of politicians to form effective national science policies because of their ignorance of science. Handler believed that the President was morally obligated to consult the Academy and the Foundation in matters involving science policymaking, which essentially meant deciding how much money would be spent for science, what areas in science would be supported, and who would receive the funds.

Handler never presented a rationale for the objectives he espoused nor offered evidence that their achievement would benefit society. He provided only a series of speeches infected with contradictions. For example, he told an audience, "Our national apparatus for the conduct of research is falling into shambles," and a few months later another audience, "Our scientific capabilities were never greater; our scientific productivity remains the marvel of the world."

President Nixon's view of science differed profoundly from Handler's, and the Administration acted accordingly. The President said science was "self-evidently among the high priorities of the Administration," but he believed science policymaking was political and not in the domain of unelected scientists, and that only research which had a practical purpose

should be supported by the government. He favored the use of science to produce societal benefits and opposed the use of federal funds to solely to elevate the intellectual level of scientists. The White House's budget office — the Executive Department's most powerful planning tool — dismissed Handler's cries for money for such a purpose as baseless and evidence of the financial insatiability of academic science.

President Nixon looked to his principal science advisor, who headed a White House office on science and technology and chaired a committee of experts — which included Handler — that was expected to provide ideas about specific programs which could lead to industrial applications, technological improvements, and cures for disease, but he received none he considered worthwhile. But the ideas that led to projects which appealed to the President — finding a cure for cancer and developing a supersonic airplane, as examples— came from a White House aide. The President replaced his principal science advisor with a non-academic scientist, which aggravated Handler because he viewed the new advisor as a poor conductor of ideas to the President.

The President also appointed an engineer working in the White House to head a White House group charged to find new forms of technology that could promote economic growth. The appointment further upset Handler, who saw it as confirmation of the President's interest in technological innovation and relative disinterest in basic research.

Working in the inner circle of Presidential advisers, the engineer studied hundreds of federal projects whose objectives were to exploit technology for use in resolving major national issues, including healthcare. He assumed control of an ongoing but lethargic study by the science office for developing technology to serve social purposes, and broadened it to include other governmental projects engaged in evaluating the economic, legal, and political aspects of technological development.

One of his recommendations was that the practice of supporting unfocused research in which each researcher decides what research would be done should be ended in favor of government supervision of basic research. The President's favorable response to the recommendation reinforced Handler's fears that the technology initiative would advance the interests of the business community at the expense of academic science.

Handler's conflict with the President spread to his science advisor — the head of the White House office that represented the interests of academic science inside the Administration — after he publicly opined that the National Academy of Sciences was not universally regarded as a source of objective advice in its role of scientific adviser to the federal government. He said the Academy was a quasi-governmental organization that earned almost all the payroll for its large bureaucracy from federal contracts and, consequently, had built-in conflicts-of interest. There was a need, he said, for a means of "generating unbiased, authoritative positions on subjects which involve science and technology," and also said the Academy had "shades of advocacy" and that "the best which could be done was to get a balance of interests rather than have no conflicts of interests in advisory groups." He said, "One thing that is missing is a credible group which can lay out in terms understandable to the public, Congress, and the Executive branch, too, what the scientific and technological facts are

and to do it in an unbiased and credible way.” Handler responded with an intemperate personal letter to the science advisor, attacking him for suggesting that the Academy was biased. When he attempted to placate Handler he was criticized by the President’s closest aides, and he resigned.

His resignation, and the absence of an indication from the Administration that a successor would be appointed, further hardened Handler’s belief that his opinions and the needs of science were being frustrated by what he considered to be an Administration that was hostile to science and basic research, and his pessimism was reinforced by other ominous signs. The President replaced the entire upper levels of management in Department of Health — which controlled biomedical research in the U.S. — with officials who were sympathetic to his policies regarding research, indicating to Handler that money budgeted to the National Institutes of Science for basic biochemical research would be allotted to the President’s War on Cancer, exactly the kind of government-specified research Handler hated. Additionally, the Administration’s proposed budget for the new fiscal year included further reductions in spending for basic research.

Early in 1973, President Nixon, having decided science wasn’t entitled to a special place in the White House, ordered elimination of his White House science office, which consisted of his science advisor and staff, and a committee of presidential science advisors chaired by the science advisor. Nixon assigned the duties of the science office to the National Science Foundation, a small second-rank agency created to finance research and education at universities, and he appointed its director not as presidential science advisor but as a science advisor for all non-defense-related technological research funded by the government, with instructions to report directly to the Secretary of the Treasury. The President’s reorganization was generally accepted as a presidential prerogative; the only strong objection was raised by Handler the amalgamated biochemical societies. He interpreted removal of the science office from the White House as a demeaning of the societal status of science, and he viewed the choice of a replacement plan for the science advisory function as a trivialization of the function because the director of the Academy had no staff capable of providing advice about technological projects to the President’s aides, budget assistants, or to first-rank agencies.

Handler complained into the wind that even if the Foundation director hired a staff with the requisite experience and knowledge, he was certain to be ineffective because he lacked the clout of a White House official who had direct access to the President. Assigning the duties of the science advisor to the director of the Foundation, Handler further said, would result in a conflict-of-interest because he could be asked to advise on the allocation of science funds to agencies that were competitors with his agency for those funds. Handler expressed fear the Foundation was being used as a tool to discredit science, making it appear to the public in what he called “a more political light” because of a perception its funding decisions were influenced by “directives from White House staff rather than being governed entirely by scientific considerations.”.

The President's reorganization of the advisory function in the Executive branch and the conspicuous absence of a role for the Academy in advising the government alienated Handler, and he reacted petulantly, publicly criticizing Nixon for downgrading science at a time when upgrading was vital to the nation. Handler said the reorganization reflected the President's ignorance about the relation between science and government: "I fear there is a lack of understanding of the pervasive role of science and technology in all areas of public policy. What also bothers me is the lack of an objective voice in the executive office viewing agency proposals from a technical point of view." The President's aides, however, did not share Handler's pretentious attitude about science; they maintained that the scientific advice provided by the eliminated office was unnecessary for policy formation by the White House, and that science, although important, was a lower-level activity appropriately performed at the department and agency level. A direct consequence of the reorganization was a heavy budgetary emphasis by the Administration on technological goals whose achievement would have immediate social importance, and a corresponding decrease in funding for Handler's dream — research that sought basic scientific knowledge for knowledge's sake.

Only a decade earlier, President Kennedy, who first brought Handler to Washington, D.C., said science needed "to be coordinated and shaped at the level of the Executive Office of the President" and that "staff efforts at that higher level are required for the evaluation of Government programs in science and technology."

But times and presidents changed, and the culture of science was no longer seen by the public or the government as privileged over other cultures. When Handler was asked whether the shift of the advisory function from a White House office to his agency, the Foundation, represented a downgrading of science, he conceded, "it could be interpreted that way."

Handler crusaded for many years to secure recognition of science as a permanent independent establishment that was immune to the vagaries of the American political system. He advocated centralism and opposed pluralism as the desirable mechanism for developing science; he envisioned a structure consisting of a government-funded agency which awarded research grants, and his Academy which provided guidance and policy advice both on its own volition to the polity and public, and under contract to various clients.—Handler used the Academy advisory process to generate policy reports consistent with his ambitions, and he exploited his presence at monthly meetings of the White House science advisory committee to offer policy advice directly to the President, mainly focused on budgets for basic research and the ever-increasing technology-related problems of side-effects and environmental degradation. President Nixon's termination of the science office evidenced his refusal to recognize an impactful role in policymaking for Handler or other academic scientists. Around the time Handler was ousted from the White House, the Congress also turned away from reliance on his advice. He had testified before the congressional committees numerous times to the effect that providing more money to educate more scientists and support their lifelong university research programs was the best step possible toward solutions to society's problems. His gilded language about the greatness and purity of science resulted in a financial

largesse that raised Handler to exalted heights of popularity within his constituency, the amalgamated biochemical societies of America, whose membership exceeded a half-million scientists. However, the Congress created its own think-tank to provide advice relevant to legislation dealing with science and the environmental consequences of technology, a development that further marginalized Handler.

Nixon perceived no distinction between basic research and technological development — in his view both were science. He decided that the expertise in science needed to generate new ideas, evaluate proposed technological projects, and make funding decisions already existed in the White House and at the agency level, thereby obviating the need for a science office in the White House. Its elimination disposed of the troublesome science advisory committee, which had members like Handler who chronically irritated Nixon by advocating for the interests of university-based scientists and against administration policies.

The Academy produced reports whose advice fit Handler's perception of science perfectly because each had a poison pill — the process of its making. Handler personally appointed each member of every committee, functioning as the ultimate judge of each appointee's expertise and objectivity, and he implemented a rigid star-chamber process in which all details regarding how the members arrived at their conclusion were permanently hidden from the public. Handler' procedure of creating puppet committees to tell the public how important science was, and to obscure the reality that the word *science* had two quite disparate meanings — basic research and technological development — did not have the desired effect on President Nixon, who believed only technological development was relevant to the public. No one except Handler argued that science should be supported by taxpayers because of its inherent beauty, and no one except Handler used the cathedral and Renaissance-art metaphor to justify requests for funding research.

Handler pleaded with audiences of biochemists to join him in insisting that society had an obligation to fund the pursuit of scientific knowledge for its own sake, like an evangelist insisting society had an obligation to pursue religious truth. He said basic research was the parent of technology and claimed, without a scintilla of evidence, that unless the government funded more basic research, the Russians would forge ahead of the U.S. in science, the health of Americans would suffer, and American culture would decline. But no one could predict whether the research Handler wanted would yield a cathedral or a bottomless money pit — Handler was willing for the country to take that chance, but the President was not. Handler was also ideologically committed to providing a free education, but only for science students. The President's aides decried the wisdom of such a policy, considering there was a rising level of unemployment among scientists. They also condemned the unfairness of continuing to provide a free education to aspiring biochemists and physicists but not to aspiring doctors, lawyers, and engineers, who received no direct federal assistance.

The dismantling of the science office was a serious blow to Handler in his attempt to create a permanent independent science establishment. In a single stroke, the reorganization of the science office blunted Handler's influence on the government science policy and largely

vanished the possibility that his illusion of a society based on scientism could be realized. And another sharp blow to Handler's dream was administered by the legislative branch in the form of a decision to create a congressional science office with a staff of experts to advise senators and representatives regarding science issues, thereby obviating dependence on Handler's congressional testimony.

The rebukes Handler suffered at the governmental level only added to his ongoing difficulties regarding his credibility. He lost much of his earlier support in the press for exaggerating the benefits to society of basic research and making false claims of a putative national surfeit of scientists. Handler's ambition to advance science above all other human thought systems, and his incessant complaining about low budgets for basic research became a stereotype in the work of newspaper and science writers for the arrogance of establishment biochemists. He was harassed and satirized by in the press and in books but didn't respond, with one notable exception; when an article in the Washington Post called him the Idi Amin of science, Handler visited the editor and demanded a retraction. His influence drained away among segments of the science culture not represented by biochemical societies. The cumulative developments marked a precipitous decline in the possibility Handler's dream of science as a guiding and legitimizing force in American public policy would ever be realized.

### SECTION 3; AFTERMATH OF THE DEMISE

Handler complained bitterly about President Nixon's dismantling of the the science advisory machinery in the White House. He said the President's aides had badly misguided him, providing advice that was "unsound", "abrupt and harmful," "inept" and "not genuine," and that as a result, competent and knowledgeable scientists were no longer available to advise the President regarding science matters. Handler said that even though some government agencies had staff scientists, the President could not personally evaluate their advice because he did not speak the languages of the various scientific disciplines. Objective scientists who could directly advise the President and serve as checks and balances to agency decisions. were desperately needed, Handler proclaimed. Prominent among his specific grievances concerning biomedical research was what he characterized as the "politization" of cancer research in which biochemists were "mandated" to seek the specific research objective of finding a cure for cancer.

Handler said science advisors in the White House could have helped the Administration avoid that mistake. The absence of a science office, Handler asserted, meant that scientific viewpoints would be crowded out by those of "economists, lawyers, and businessmen," and he offered himself as an example — he said his direct access to the President was terminated when his governmental position as presidential science advisor ended.

The few people who knew Handler well more or less agreed that on the matter of a science office in the White house, he would not go gentle into the good night. Promotion of the elitism of science was Handler's prominent reasons for demanding an official presence of spokesmen for science in the White House. He articulated an ideology that proclaimed the superiority of scientists over laymen in the resolution of societal and political

issues involving science, and he emphasized the primacy of the values of science over those from other sources. Moving the science advisory function out of the White House marginalized the scientific community he complained, and said was diametrically opposite to what was needed to show appropriate governmental regard for science. A mechanism within the White House that could insinuate the advice of scientists into national issues and federal policymaking was an absolute necessity, Handler claimed.

President Nixon, however, decided that despite the obvious importance of science, the direct influence of scientists qua scientists in societal matters was properly reduced in favor of a broader participation by laymen. He dismissed as unfounded the complaints by Handler that the reduction compromised the integrity of presidential decisions, and that science had been downgraded. What had been downgraded, according to the President's aides, was the direct influence of scientists on societal matters, which the President viewed as a positive development.

He regarded competition as vital in the world of science as in the economic realm, and spurned Handler's notion that science policy should be made by an elite fraternity of scientists without the benefit of competition.

Handler believed science would become impure and lose its dedication to a strictly reductive approach to the study of nature if it were used by the various agencies independently of each other in furtherance of their respective missions, but without central synchronization from within the White House. He feared that if the government continued to follow a pluralistic approach to the funding and use of science, the endeavor would become polluted. Handler envisioned two central mechanisms that were potentially available within the American political system for the development of science. One possibility was a law that created an independent federal agency which answered to the President but had statutory authority the President couldn't overrule, and a legislated budget which ensured its continued existence. Another possibility, less desirable to Handler but which he viewed as a useful first step toward creation of an independent scientific establishment, was a law that required the President to centralize science and seek an adequate budget to promote its growth and development.

In a stunning hubristic ploy, Handler mobilized the resources of the Academy to produce a report formally advising the Congress and the President to adopt a law that would create a science advisory office in the White House. He hired the staff of the defunct White House science office and appointed members of its science advisory committee to an Academy committee he created, and he directed it to produce a report that recommended adoption of such a law. After several months of private meetings, and consultations with Handler's senior staff, the Academy committee report dutifully reached the conclusion Handler engineered, and justified it by replicating the same ethereal language Handler commonly employed to praise science and technology.

The committee report said science and technology provided "something more than material goods." Science and technology were "enterprises of the human mind and spirit" that not only "extended the reach of man's mind out to the furthestmost galaxies" but also promised "to provide an intimate comprehension of man himself."



In furtherance of these goals, the committee recommended creation of a science advisory structure within the White House that was protected by law against presidential hegemony and bureaucratic conflicts with other White House offices.

The advisory body for science and technology, called a Council, would provide the President “with balanced judgments deriving from the pooled knowledge and insights of a small group of first-rate scientists and engineers.” The Council would analyze all national science programs and policies, require that they be expressed in language the President could understand, formulate coherent research and development strategies, and set research priorities. Additionally, the Council would assist the President in the use of science to predict the future in areas like energy, environment, transportation, and urban development, and develop policies consonant with the predictions. The law envisioned by the committee would authorize the Council to advise the White House budget office regarding the quality and technical feasibility of proposed programs and prioritize them, and it would require that the Council have a “strong presence” in all White House offices dealing with “domestic and national-security issues” and a role “in those areas of foreign policy strongly affected by scientific and technological considerations.” The functions of the Council assigned by law could be discharged independently of the President's wishes and without accountability to the public or to the federal agencies on whose areas of responsibility the Council would encroach. The committee declared that its advice was based on three pillars: recognition that science and technology as essential drivers of societal and economic advancement; the necessity for science experts to play a central role in presidential decisions; integration of advice from scientists into domestic and international policy arenas.

Like a proud father, Handler praised the report, for asserting the view that science and technology were critical for social and economic progress, and were necessary tools for military, domestic, and foreign policymaking. He emphasized the importance of the panel's requirement that the proposed Council be composed of scientists who had operational responsibilities over federal science policy. Handler also lauded a committee recommendation that the entire Executive Office of the President itself be eliminated and replaced by a new organizational structure based on “modern techniques of policy research and analysis” and on “the method and spirit of the physical, biological, and behavioral sciences.”

Handler's push for implementation of a Council mechanism in the White House was a desperate last effort to create an estate for science in the American political system. He had risen to positions of authority in the culture of academic biochemistry and expanded his influence after he moved to Washington D.C. where honed his ambition to establish recognition and acceptance of eminent university scientists, including himself, as reliable purveyors of objective advice to the government about science. But as Handler's ambition, strategy, and goal became apparent, the likelihood he would achieve his goal became nil. Despite his efforts, scientists were recognized as no more reliable and trustworthy than any other class of professionals, and equally prone to questionable ethical behavior and self-interested decision making. Like virtually every other academic scientist on the defunct science advisory council, Handler had strong financial ties to industry, and his defense of an imagined inherent moral superiority of scientists was no more than ritualized speech divorced from reality. This history

together with the personal acrimony that had developed between Handler and the President accounted for the resounding thud of the committee report when it landed on the Nixon Administration.

After Gerard Ford became President, Handler made a Hail-Mary attempt to resurrect interest in the recommendation of his committee's report. The designation by President Nixon of the head of the National Science Foundation as science adviser lapsed with the change in Administration, and there was a need to reaffirm or modify the existing arrangement, or else replace it. Handler sent the report to President Ford and lobbied in favor of replacing the existing arrangement in accordance with the reports' recommendations. The President's chief advisor advised the President that the present arrangement could provide "you and your senior staff with independent advice on scientific aspects of major policy issues," and that the present science advisor agreed. The advisor told President Ford advisor that Handler's proposal to establish a full-time science adviser and a statutory agency in the White House were not warranted because they: "overly represent in your immediate office the clientele interests of science and scientists; emphasize science and technology as ends in themselves rather than means of achieving national objectives; do not recognize the necessity of integrating science advice with that from other fields." President Ford implemented the advice of his advisor.

In response to President Nixon's decision to eliminate his White House science office Handler developed a political strategy for recapturing his lost political influence over its science policy. He voiced an ideology that was clearly antagonistic to the fundamental assumption in the American tradition that the privileges and responsibilities of political power could be yielded to a single group. The ideas of liberty and self-government rested on an informed citizenry and the moral force of civic virtue, not upon a presumption of the primacy of scientific truth as part of the definition of good government. The public, consequently, was likely to put more trust in the processes of politics than in the opinions of unchallengeable scientists like Handler because the expectation in a democracy is that all important questions be answered by politics. In support of his committee's support of his ideas about the privileged role of science in society, Handler urged creation of machinery located in the Executive Department that was controlled by scientists with legal authority to regulate federal science policy but who were not politically responsible for their decisions. Handler's attempt to have large societal questions answered by science was tantamount to imposing his scientific ideology and values on the political system, and his attempt was roundly rejected by both presidents to whom he pitched them.

### **PART 3: ENVIRONMENTAL ISSUES**

#### **SECTION 1: SAFETY OF FOOD ADDITIVES**

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 led to increased funding for basic research, achieving a heightened 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 that stemmed from technological development.

Although there was general agreement the issue should 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 consequences of technology. He believed governmental ineptitude was responsible for the 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, the Congress seemingly accepted emotional arguments and false assumptions regarding the side effects of technology, resulting in laws and regulations and created a frequently hostile press and an aroused public. Handler resented the laymen and scorned the scientists who raise questions about the side effects of exposure to chemicals, and developed a deeply personal opprobrium over the health-risk problem, especially in the area of food additives. As biochemist who had once specialized in nutrition, he 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 regulatory agencies, thereby allowing determinations of safety levels for chemicals in the environment to be made on the basis of politics rather than science. The situation angered Handler and what he called "in the interests of the nation," he began developing 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 decisions, an area where there was no serious participation by the leaders of science. Determinations of 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 the agencies. Handler reluctantly recognized, however, what actually existed were subjective opinions of agency officials and heads of the chemical industry that 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 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 the method of risk-benefit analysis invented by Chauncey Starr as a useful device to create the appearance that the advice of the experts was objective while ensuring that decisions regarding safety were the responsibility of the regulators.

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 a permanent division called the Food Protection Committee to oversee the Academy’s ad hoc committees that provided advice to the agency concerning food additives, and to liaise with food companies, some of whose employees served on the Committee. The agency soon began relying on the Academy for advice regarding safety in related 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 more or less moved in the opposite direction even though the agency was an important customer and paid for the advice the Academy provided with funds he needed to maintain its path of advocacy he charted. Handler opposed regulation of nonprescription drugs and said the drug industry should sue the agency to ensure it didn’t “go to extremes” regarding drug safety and effectiveness and 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 taxed 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 the food industry controlled them but there was reason to doubt his veracity because their reports were 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 conflicts-of-interest of the committees' conflicted members had any impact on their objectivity because they were scientists, and therefore instinctively objective.

In principle, Handler's efforts to develop policies for standard-setting were circumscribed by the law, but not necessarily in practice. The legal standard for adding chemicals to food was defined in the legislative history of a statute 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 objective facts, opposed that interpretation of the 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, either known or suspected.

The law also required that the burden of proof regarding the safety of food additives was 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 particular safety standard. The law also required all decisions be based on "substantial evidence," but Handler successfully blunted the impact of the provision by interpreting "substantial evidence" to mean be whatever the experts would accept. 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 at least partially because of his efforts. He opposed a legal requirement that consumers be alerted about possible health risks of food additives and prohibited Academy committees from recommending such labeling requirements.

Handler agreed to a series of contracts for the Academy to advise the 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 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, genetic damage, and birth defects and 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 analyzing public-health data to prove that smoking was a contributory cause of cancer, and he manifested this permanent bias in the context of food additives. He believed that considering the possibility of chronic adverse side effects of additive 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 proof 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 the 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 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, in his eyes the process was the lesser evil, and he implemented the 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 concerning the evidence needed for determining safety required "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 appropriate studies, and Handler's committees continued to make judgments on food additives on such evidence as they could find. Routinely, they decided that what evidence existed was inferior and indecisive. Because of the lack scientific evidence, their judgment was based on their general education, personal experiences practicing science, and personal biases — what Handler called their "general experience."

Precisely how the judgments were formed was regarded by Handler as privileged information; they were formed in secret meeting whose actual proceedings Handler refused to disclose publicly. Proceeding in this manner, Handler's policies allowed a homogeneous group of

experts he chose to codify their experience and beliefs into recommendations for 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 limited 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 proselytized publicly about safety levels in speeches and testimonies, using a variety of oratorical tropes to emphasize his strong feeling. 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." Most commonly, he 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 at a particular dose level. In reality, using animals was the only experimental method known to science for evaluating the safety of chemicals, and "unusual" or "inappropriate" circumstances were an absolute physiological and pragmatic necessity. Only Handler and biochemists employed by 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 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, 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 safely be added to food at a level of a tenth of a part per million” — a number he pulled out of his imagination.

In the early 1970s, 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, scientists 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 ad hoc committee's 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 probably 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 reply in the inquiry with the bewildering assertions that "The two groups were not in conflict" and that "the disagreement stemmed largely from semantics."

Handle made a futile attempt to bridge the gulf between the two committees, underscoring the reality that Handler and his committees had ignored the possibility that food additives could cause cancer and other health problems. The implications of cyclamate affair for Handler's overarching agenda to promote the scientific endeavor were exceedingly serious. 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 Handler claimed, science was dispassionate, objective, unbiassed, and mankind's greatest invention?

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 that of a corporate director protecting his company's products. 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 them from setting a safety threshold for carcinogens. Factually, 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 displeased 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 the carcinogen. Exacerbated by the law, he told the regulatory agency, "Among those I have consulted, there is substantial agreement that strict interpretation of the law removes every opportunity for bringing informed judgment to bear on a given instance of hazard evaluation."

Handler criticized the Congress because, "The law puts too much of a value on avoiding cancer," and made unsubstantiated and misleading arguments in support of his criticisms. 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 his 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 him, "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," generally speaking, 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. 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 at the National Cancer Institute near unanimously opposed Handler's claim. Handler claimed the DES would not appear in meat brought to market because, he believed, it

was excreted within two days. But government testing detected DES in meat from animals that had been slaughtered weeks after DES-treated feed had been withdrawn.

Handler remained unswayed. He said that DES, like all other chemicals that cause cancer at high doses, do not do so at low doses, which he called "toxicologically insignificant." The nation's cancer experts 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 then 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 furnish advice. Handler appointed an ad hoc committee and directed it to conduct an inquisitorial investigation in which it heard testimony and cross-examined witnesses, and its draft report 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 agency, Handler made a piteous 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 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 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 used 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, that the companies had acted legally, and in good faith, and therefore had acquired a legal right to use approved additives in foods that could not properly be taken away by subsequent legislation.

In the case of glutamate, 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 ad 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 subcommittee report was exactly the result 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. The committee was charged by witnesses before a senate committee with a high degree of industry bias because their judgements were only naked opinion influenced by their employers. 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 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 should be regarded as a "positive contribution to the nutritional value of the food to which it was added."

Handler's subjective evaluations prioritized adherence to biochemical theory and historical use of food additives over animal studies and epidemiological studies suggesting adverse effects. Following his lead, the advice offered by Academy committees he appointed emphasized the importance of distinguishing between the results of studies in which animals were fed high levels of food additives and typical consumption levels for the general population. Handler and his committees essentially placed the burden of proof regarding safety on the government or the consumer rather than the proponent of the food additive and

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 hypercautious 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. Handler's food committees reflected of his toxic ideology. They 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, and chronic diseases. He 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.

## SECTION 2: HERBICIDES IN VIETNAM

In 1971, the Congress became concerned that Operation Ranch Hand — the military's decade-long 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 massive use of herbicides was one of the public policy issues involving science and technology that evoked emotion and outrage. 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 was frequently insisting 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 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 in government. One of his 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 also were other reasons for Handler to accede to the congressional request. Doing so had the benefit of conforming to an institutional tradition — for many years the Academy had provided advice to the military in matters related to chemical and biological warfare. The military department of government was, by far, the Academy's biggest client and

always had been. Accepting the task would provide him with an opportunity to revisit the question of safety of pesticides — a toot he had been on throughout his career.

A provision in the 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 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 by 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 gap between the qualifications of Handler's appointees to the herbicide committee and 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 lens through which the herbicide committee saw the consequences of Operation Ranch Hand consisted of reports provided by consultants hired by the Academy who actually visited Vietnam, unlike the members of the herbicide committee. However, ongoing military activity prevented direct investigation of the health consequences, despite its high priority, and the inquiries of the consultants into environmental effects were wholly 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 together with the herbicide committee he appointed fought bitterly with The Academy Vice-president and the report review committee he appointed over semantical shadings in the final report.

The consultants produced working papers 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 interest in the substance and tone on the report that would ultimately emerge. The review committee repeatedly demanded changes in draft versions of working papers and reports on the grounds of imprecise language, inadequate technical analysis, naivness, and turbid language, among others. The changes angered Handler because they invariably 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, which was largely caused by his actions, the “most traumatic incident” he had ever seen.

The in-fighting involved essentially every aspect of the study including 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 an early draft report was language that implied 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 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 final report of the Academy's study 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 that was heavily salted by Handler to achieve the taste he desired. Both committees recognized that the first one 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. Normally, Handler sent the report to the military which released it publicly, thereby insuring that 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 ambiguities and prolixity to reduce the report's 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 immediately responded, 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 Military 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, unsurprisingly, they found none, and 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 to find botanical facts, however unimportant they might be; Handler’s sole requirement was that they be determined scientifically. The committee found that Operation Ranch Hand caused widespread persistent damage to coastal mangrove forests with consequent damage to the eatable fish, and permanent destruction of hardwood trees in upland forests. It determined the number of acres of mangrove forest that were destroyed by means of tedious evaluations of aerial photographs provided by the Military; although the answer was known to a militarily sufficient level of accuracy, the committee increased it. 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. However, 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 does not make the aggregate scientific. 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. Nevertheless, the committee said the results of the interviews were "so striking it is difficult to dismiss them" and recommended further studies. It also said it found hints that military personnel who handled the herbicides might have experienced medical consequences, and suggested the issue also warranted further study.

The committee report said its consultants found evidence that an extraordinarily toxic chemical — known to cause cancer and other genetic effects in laboratory animals — present in the principal herbicide used in Operation Ranch Hand — was detected in the soil, and in fish and shellfish from Vietnamese waters. The committee gratuitously asserted there was no scientific evidence that exposure to herbicides caused birth defects among the Vietnamese — a claim no one actually made and an issue that was not considered in the study. Nevertheless, the assertion was politically useful to the military, and was prominently cited by its press office. The committee's attack on the straw man apparently was a preemptive attempt to undercut potential congressional concern that the herbicide spraying was a form of chemical warfare — a view Handler strongly opposed.

In a personal commentary Handler sent to the Military, he emphasized the importance of Operation Ranch Hand in saving American lives and explained the formation and meaning of the committee 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, which provided a preponderant portion of the Academy's annual budget. Handler was also motivated 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 committee of not even attempting to find conclusive scientific evidence that herbicides caused medical harm, notwithstanding that it was he who signed the contract with the Military and was 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 he hired the anthropologist. 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.

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," which he implied was the case. He labelled "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 asserted that their conclusion and tone were correct, and were consistent with the view that herbicides were not within the range of chemicals banned by international protocols against using chemicals in warfare. Handler praised the committee for correctly assessing the environmental effects of the herbicides. He said it precisely determined the fraction of the coastal mangrove forests destroyed by herbicides and it preserved in developing a novel statistic to precisely describe the effect of herbicides on the inland forests. 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 used his position as head of the Academy to strongly influence the study, which he managed as if it were undertaken in the service of the Military rather than the nation. He believed herbicides were inherently beneficial and, absent irrefutable evidence of harm, were beyond governmental or international regulation.

Handler believed herbicide use in Vietnam did not cause adverse medical conditions, deaths, or birth defects, and did not violate of international protocols prohibiting the use of chemicals in warfare. He chose members of the herbicide committee who were biased in favor of the Military, or were foreigners and thus subject to the hegemony of the other members. Handler heavily influenced the study design, which was limited to anthropological interviews, photographic analysis of sprayed areas using photos provided by the Military, and economic calculations of the value of lumber in dead trees as a metric for the economic effect of the spraying. Handler used discretionary Academy funds to support the anthropological studies because the national anthropology society refused to take part in the study.

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.” His fervid opposition to the ban on DDT was a prominent example of his attitude toward the control of pesticides. Handler said that banning DDT in the absence of conclusive evidence of harm denied the nation “the use of a compound of considerable economic and esthetic value,” and that the decision to do so “was political rather than scientific, a sop to uninformed, emotional citizens who had been swayed by unsubstantiated allegations.” He manifested a similar attitude toward the anthropological evidence of medical harm from spraying herbicides, which he rejected as unscientific and invalid because there was no conclusive evidence that the spraying caused harm. The testimony of primitive tribes people who claimed 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 explanation was that the anthropologist, whom he hired, was deceived by enemy propaganda that affected his analysis of the interviews. Handler cruelly demeaned the anthropologist’s work, knowing that he had no means of defending himself. His rejection of evidence that Operation Ranch Hand adversely affected the health was foreseeable, based on his ideological biases against restricting the use of pesticides and in favor of biochemical studies as the sole source of valid evidence.

Handler colored his commentary on the committee report to promote a pro-Military view of the report’s conclusion. He praised the importance of herbicides in agriculture and suggested the report vindicated the probity of herbicides in warfare, but he criticized what he perceived to be a weak rejection of the possibility herbicides caused health effects in the people who were sprayed or the military personnel who did the spraying. Handler was disappointed with the lack of emphasis in the committee’s report of the value to the Military of the destruction of the Vietnamese forests. Handler mocked his committee for conducting their investigation without ever visiting Vietnam and then offering unduly weak criticism of the evidence regarding health effects, and for defending their conclusion using a faulty argument — that probably no evidence of health effects existed because they found none. Handler asserted that the committee did not carry out an investigation that could reach forceful conclusions and that, consequently, its exoneration of Operation Ranch Hand was too weak.

After undercutting the credibility of the committee for what it didn’t do and for how it described the meaning of what it did do, in conformity with his penchant for Janus-like speech, Handler 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.” Still, amid the soupy praise, Handler expressed displeasure with what he called the committee’s failure to adequately defend the military’s point-of-view regarding mass environmental spraying of herbicides. He saw the final report as providing less support for the Military than he had privately indicated would likely be provided.

Handler's commentary supported the military's position regarding the use of herbicides and thus, effectively, subverted the putative mission of the National Academy of Sciences — to provide objective bias-free advice in the service of the nation — because, to all appearances, it wasn't the nation but rather his client he primarily supported. He 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, in the end, supported Military use of chemical defoliants in warfare. He said the widespread devastation on the forests and wetlands of Vietnam wreaked by herbicide spraying was beneficial because it eliminated vegetation that protected the enemy. Handler maintained that a careful reading of the study would lead to the conclusion that the environmental was intended and that allegations of medical harm were unfounded.

While managing the herbicide investigation, Handler generated an unprecedented level of antagonism within the Academy which led to revelations of sordid details regarding the Academy's secret deliberative procedures. Handler remained in a constant conflict with other Academicians that illuminated both his autocratic authority and unsuitability as head of the Academy. He participated in and was largely responsible for a poorly designed study that had a nil possibility of providing useful information. He appointed a pro-Military herbicide committee that was foreseeably likely to support 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; He precipitated in 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; He demeaned the work of anthropological consultant he hired; He stifled intra-Academy criticism and resorted to authoritarianism to bring about compliance with his opinions; He criticized the Academy Vice-President for opining that he thought the herbicide committee's report "seriously underestimated the damage and is too casual about the possible ill effects on humans;" He attacked Academicians who had the temerity to disclose the contents of the herbicide committee report without his permission.

### SECTION 3: BREEDER REACTORS

Handler's ecclesiastical-like authority over the machinery of the Academy provided him opportunities to influence any area of science or science policy he chose to enter; irrespective of the limits of his expertise, he frequently exercised his prerogative. The luxury of his high office allowed him to couch his opinions in rhetorical language absent analyzed evidence, and to remain indifferent to his critics and dismissive of any responsibility for explaining the basis of 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 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 that reinforced the perception.

For example, when asked about the consequences of a nuclear war 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. 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 lauding the greatness of America and its dependence on science, he warned against the peril of relying on nuclear power plants fueled by plutonium produced in breeder reactors, and said 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 hazards 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, an ardent supporter of big technological projects, 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 in February 1975 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 Handler’s speech in which he 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 the conditions precedent that Handler publicly express pro-nuclear views about breeder reactors and appoint an Academy committee to conduct the study that 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." 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 life styles 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, 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 said nothing about why he changed his. 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.”

#### SECTION 4: RISK-BENEFIT ANALYSIS POLICY ADOPTED BY HANDLER

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 ethos of pursuing scientific truth led him to object to what he saw as the government's failure to adequately support the scientific enterprise. Among the many detrimental consequences he discerned was the 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 disparaged the government's policy of enacting safe exposure levels in response to the exaggerated concern. He said the policy was unscientific and an unnecessary burden on industry and, as an example, offered the government's ongoing retrospective review of the safety of food additives that had not previously been 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 alleged that regulatory agency lacked policies for decision-making and suffered from a dearth of the scientific information needed to understand the biochemical consequences of anthropogenic chemicals. And even if the information existed, he believed that since only scientists could understand and interpret it, the public would not benefit because scientists, under the government's policy, were not directly involved in the decisional process. The lack of needed research and the absence of a valid policy for decision-making, according to Handler, ensured that the decisions made by the agency would be based on inconsistent subjective opinions of lay bureaucrats. Handler mobilized the resources of the Academy to develop a regulatory framework consistent with his ideology that could guide agency decision-making in determining safe exposure levels.

Private organizations and industry strategists who were dealing with the problem of assessing the human and environmental impact of massive technological projects prioritized study of the impact of building and operating nuclear power plants and a nation-wide grid of suspended wires to transport the manufactured electromagnetic energy. A key actor in the effort was Chauncey Starr, a nuclear engineer whom Handler knew from their joint service on various government committees and their work together as members of the Academy. Starr was tasked by his employers to overcome public fear of side-effects from nuclear pollution and meltdown, and to create a welcoming public attitude toward nuclear power. He devised an approach for gaining acceptance which depended on persuading the public that their concerns were unfounded, like childish fears of things that go bump in the night. He regarded the key to developing public willingness to accept nuclear power was somehow to numerically characterize both its risk and benefit and then cultivate belief that comparison of the numbers proved the risk was nil and the benefit was enormous.



There was no scientific law or actuarial principle that facilitated calculation of either number, and no economic or sociological theory that provided a method to do so. However, employing engineering concepts and jimmied analysis of recorded public data, Starr developed mathematical equations that he claimed quantified the health risks and benefits of nuclear plants. His equations yielded a range from zero to one for the probability of the risk of death from a nuclear power plant—zero meaning impossible and one meaning certain. According to his interpretation of his calculations, 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 argued 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 claimed his method of mathematical risk-benefit analysis was equally useful in many other areas of technology assessment including the addition of carcinogens to food, approval of a pesticide, the use of lead in gasoline, and permissible exposure levels to automotive air pollution. Starr's method of risk-benefit analysis, and his further puffery that it would transform decision-making by regulatory agencies into a rote activity manageable by officials with no scientific training, caught Handler's attention. He adopted the use of risk-benefit analysis, at least insofar as he understood it, and incorporated it into his policies. Although risk-benefit analysis was unrelated to what Handler regarded as science, his awareness of the method somewhat opened his mind to the idea that the public-health aspect of technology was fundamentally a political matter rather than a scientific issue, as he had long imagined.

After Starr became a member of the engineering arm of the National Academy of Sciences, he tutored Handler in the use of engineering and mathematical language, and he frequently used the phrase "risk-benefit analysis" in his speeches on regulatory decision-making for its oratorical impact.

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 either verbally or by resort to arbitrary mathematical manipulations. Handler said the risk-benefit model was "objective," and championed 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 believed 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 largely extricate science from the process of decision-making regarding health risks, which he had come to regard as akin to 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 regarding the risks, benefits, and the highest concentration of the chemical balancing the factors suggested, in their collective opinion would be safe for exposure of the public. Based on that evaluation, and after taking into account economic, ethical, and political factors, agency officials would specify a legal level for safe exposure to the chemical.

Handler believed a decision-making policy based on his framework separated scientific facts from political considerations — an important consideration for him because of his ideological belief that science, in contrast to politics, was objective and value-free. Handler 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 benefits are made mathematically rather than 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 anticipated 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 was to be based on identification of a specific disease but, on ideological grounds, he rejected the possibility a chemical could contribute to multifarious diseases depending on differing individual susceptibility, like the effects of stress. Instead, he professed belief that each disease had one cause and each cause produced only one disease, at most, and then explained one of the operational steps. 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, therefore, 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 inartfully mirrored Starr's bombastic claims. Handler said calculated values of health risks due to food additives were invariably nil, and that there was an important difference between risks "that were forced upon us" and those "undertaken voluntarily." Seemingly claiming the risks of food additives were low, Handler added, "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." Handler 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.

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, regulatory agencies, 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 that 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 attempt 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 a bizarre nonbiomedical formulation 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 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 were 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 Handler was hypocritical because determinations of the numbers was a fraudulent activity and the bases he demeaned were exactly what he expected the scientists he appointed to Academy committees to emulate, namely that they would rely on their "perceptions, values, and judgments" and define "risk, hazard, and safety." Handler could expect nothing else. Scientific information needed to establish conclusive safety levels did not exist. The government had rejected the necessity of reliance on such a basis because of its enormous cost, interminable time period it would require, and complete absence of evidence that it could ultimately be successful, despite Handler constant squealing that doing so was a huge mistake. And 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. In the vacuum of knowledge Handler helped create, human nature being what it is, the advice provided by his committee appointees could come only from their personal values as influenced by their personal biases, the desires of their employers or grant funders, and

Handler's pro-industry attitude, which affected every Academy committee to one degree or another.

The effects of Handler's policies and actions were more harmful than his hypocrisy. His constant touting of the importance of science as the parent of technology spurred technological development. Industry — the owner of technology — being what it is, encouraged creation of private companies to perform mathematical calculations, conduct research, and write reports that supported its perceptions, values, and judgments. That development, in turn fostered development of organizations of scientists who worked to protect and advance the interests of industry. Their work products, which sometimes had the formal trappings of valid scientific activity, were used by industry lobbyists in attempts to persuade the Congress to weaken safety regulations, and were relied on by Handler's committee appointees as evidence supporting their advice.

There ensued a foreseeable diminution in the value of and respect for the scientific enterprise

The knowledge vacuum, its immediate consequences, and the misleading material produced for lobbyists were only part of the harm to science attributable to Handler. While attempting to grow perception of the importance of biochemical research and eliminate reliance on animal studies, Handler essentially fathered a pseudo-knowledge branch of science that competed for federal attention and financial support with what he called Cathedral science — the search for truth. Handler had stimulated industry support for research in the expectation the Cathedral science would benefit, but he erred grievously. Instead, industry supported development of a pseudo-scientific knowledge that was professed by scientists in research, testimony, and blue-ribbon committees as advice that served the interests of their clients, thereby ensuring that "the public interest cannot intelligently be served."

Handler further harmed science by advancing in the context of his decision-making policy the unjustifiable notion that scientists should not be held accountable for statements and advice in reports for which they accepted responsibility as authors.

He incorporated the rule that scientists on Academy-approved committees who provide advice regarding safety levels should not be required or expected to answer questions propounded by agency officials regarding judgments or conclusions in reports authored by the scientists. Handler explained that politics was an adversarial process which produced only subjective answers but science was non-adversarial and produced objective answers. This putative ability, he asserted, allow 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 the experts' report, which obviated any need for them to ask the experts any questions concerning their opinions. Handler declared that posing questions was a form of cross-examination was an adversarial process that was not proper in a scientific context because the scientific method was not an adversarial process, and that his policy of prohibiting cross-examination ensured the committees he appointed would "avoid the taint of politics." He 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 scientific 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.

The strategy that industry developed 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 further weakened the scientific endeavor. 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: science was not a methodology for finding truth, at least not to the extent then believed; more than was ever imagined, science was a tool, usable by industry or any other party for its purposes. Handler had struggled for two decades to institutionalize the notion of Cathedral science, but his tragic flaw — extreme scientific ideology —led to industry’s creation of pseudo-science, which was a foreseeable consequence of his Svengali-like machinations while functioning as the head of the Academy.

## SECTION 5: AIR POLLUTION FROM AUTOMOBILES

THE GOVERNMENT’S POLICY REGARDING side-effects of food additives was to protect the public against foreseeable health consequences. The basic assumption of the food regulatory agency created to implement federal policy was that food regulations should be based on a scientific understanding of human health and disease as determined from gold-standard animal research, which differed fundamentally from Handler’s assumption that the policy should be based on basic biochemical research. The agency’s objective for implementing its policy was to ensure safety but not zero exposure — except for cancer-causing chemicals — when individuals voluntarily consumed food containing chemical additives.

The agency had not yet fully developed an in-house capability to analyze research results for purposes of setting safe exposure levels, it often contracted with the Academy to

provide advice. Handler, who regarded himself as both a policy wonk and expert on food biochemistry, influenced agency policy by means of his authority over both the Academy's advice-furnishing committees — the membership of which he controlled— and the procedures by which they produced their reports. In his view, protecting public health was not a goal but rather a factor to be weighed against the economic benefits of new chemicals. He regarded the promotion of an optimal balance of public health and economic benefits as the goal of science policy, and considered the balancing process as scientific and apolitical. Handler believed that all Academy deliberations were best carried out in secret meetings with only the results presented to the agency, devoid of the working papers that revealed how the results was formed.

By means of Academy committees, whose reports almost invariably mirrored his opinions, Handler encouraged the government to implement his policies regarding foreseeable health risks of food additives.

In the early 1970s, the Congress moved beyond the area of health risks due to food additives and undertook efforts to protect the public against the health risks of chemical pollution in air and water. An environmental regulatory agency was created and authorized authority to assess the long-term side-effects of technology, and to promulgate appropriate regulations to protect the public against any resulting health risks. The difficulties in assessing effects of technology mediated by environmental factors were far more complex than those associated with food additives. Some individuals who experienced risks but not concomitant benefits, and there were no scientific methods to reliably measure individual exposure levels, rates of change with time, or to estimate the consequences of exposure to different combinations of pollutants in different local environments. In further contrast to health risks from food additives, risks from air and water pollution were involuntary.

A new law established permissible levels of exposure to individual chemical pollutants from automobile exhaust gases, and a new federal regulatory agency was directed to enforce the mandated levels with an "ample margin of safety to protect public health." However, the law did not specify mechanism for carrying out the directive, and none existed. Unlike the Administration, which had access to more than a hundred sources of scientific and technological advice in the federal administrative agencies, the Congress had no source of advice on matters of science and technology that was not biased in favor of the Administration's policies. At that time, respect for Handler in the Congress was the inverse of that in the Administration; consequently, the needs and politics of the day forced a shotgun wedding between the Academy and the Congress. Awash in scientific naivete, it assumed that the Academy would be a non-biased source of authoritative advice, and instructed the regulatory agency to seek the Academy's advice regarding how an ample margin of safety could be identified.

In a series of cases involving different pollutants that occurred during a short time span, the Congress' high regard for the Academy's capabilities was reflected not only in laws pertaining to control of air and water pollution, but also in other laws that required executive-branch agencies and departments to similarly contract with the Academy for advice regarding assessment of technology. The agency was directed to determine whether specific standards regarding air pollution from automobile exhausts to be met by the industry were "technologically feasible" and to seek the Academy's advice when doing so. Another law required the agency to examine the scientific evidence regarding the consequences of the use of defoliating herbicides in Vietnam and to contract with the Academy for advice prior to reaching a conclusion.

A law mandating specific water-quality standards required the agency to consult the Academy regarding predictions of the total national economic, social, and ecological consequences of failure or success in meeting the standards within a ten-year period.

The agency was told to examine all the social, ecological, and economic consequences of drilling for offshore oil along the eastern seaboard of the United States and, in the process, to seek the Academy's opinions regarding the consequences. In a proposed law, the Academy was to be asked to maintain continuing surveillance of what may happen to the United States as a result of the continuing introduction of computers into various aspects of national life. Almost overnight, at this unique time in history, for a brief period, the Academy was regarded by the Congress as an unbiased and reliable umpire regarding disputes between the executive and congressional branches of government in matters pertinent to technological assessment — not only those related to public health, but to any matter involving a scientific, economic, or social aspect of science or technology.

In 1971, Handler appointed a seven-man automobile emissions committee and signed his first government contract requiring him and the Academy to provide advice and expert judgement to the regulatory agency that had jurisdiction over automobile emissions. The scope of the task was amazing, especially considering it was given to Handler and a handful of men who had no obvious training or experience in the area.

They were, however, given a multi-million dollar budget which they were expected to use to hire expert consultants. The contract made clear, however, that the responsibility for the final report rested with Handler and the committee. The main question posed was whether it was technologically feasible for the automobile industry to design and produce automobiles, beginning with the 1975 models, that met specific emission standard set in law, and to ascertain the associated costs. Handler was keenly aware that their advice would directly affect every American automobile manufacturer, and every foreign manufacturer that sold automobiles in the American market. He said that meeting the standards "would have a broad impact on the economy of the United States, and our social structure as well, and also the health of the American people."

In mid-1972, the emissions committee advised the regulatory agency to postpone enforcement of the standards for a year because implementation in 1975 was technologically infeasible. The agency implemented the Academy's advice, prompting oversight hearings by

committees of the Senate and House during which Handler and the head of the emissions committee were asked to explain their recommendation. The congressmen, particularly the senators, evinced dissatisfaction with Handler's testimony concerning the testing procedures for exhaust gases, the statistical evaluation of the data performed by the various Academy consultants, and the economic assumptions and analysis made by the Academy committee in support of its judgement of technological infeasibility regarding enforcement of the standards in 1975. Handler, in turn, was irritated by some of the questions posed — a marked departure from the “no sir” and “yes sir” attitude he displayed in hundreds of previous congressional testimonies — which seemingly stemmed from his conviction that the Congress had forced the Academy into a contract wherein the right questions were not asked.

Handler construed “technologically feasible” to mean he need consider only gasoline engines and could exclude diesel engines, which likely would have met the 1975 standards. In response to objections that the law never intended exclusion of diesel engines, Handler responded, “In that case, your legislation may have been unwise,” to which a senator replied, “That is for us to decide. You are to decide whether it is technologically feasible. We did not put you as the Supreme Court on this legislation.” In an attempt to support Handler, the chairman of the emissions committee told the senator that, “Your question leads one to believe it is a good possibility to convert the entire production of American industry to diesel cars.” The senator replied, “I am not the National Academy of Sciences, and I am not the motor car company. All I know is that you do not consider the diesel engine in your report, and you state that you drew your information primarily from the motor car companies, and that relates solely to the engine currently in production, and you anoint it as being the engine, and the only engine to be used henceforth.” In another exchange, Handler was told, “You are not a group of economists, you are not anything other than a group of scientists mandated to find out if something was technically feasible, but you took it on yourselves to get into all sorts of other things, including sticker value, cost, economics, and then you decide to use an averaging test instead of the individual car test”

Handler then went off on a tangent regarding his interpretation of “technological feasibility” and what he regarded as a failure of the Congress to adopt the correct approach to the problem of air pollution. He made what he called a “small comment” about the consequences of the 1975 regulations as compared with unregulated automobiles — that the regulations would increase fuel consumption “something of the order of a third.” He said oil would eventually be in short supply “not for us but for our grandchildren” and “eventually cause them serious problems.” “It is almost a sin to burn petroleum, he added, “It ought to be saved for the petrochemical industry. We ought to find some other way to derive energy.”

Handler told the senators they did not seem to understand the big picture. He said, “The problem which led to the clean air law had to do with the quality of the environment in the United States. It did not have to do with how to regulate automobiles. In time, we will have to grope with fouling the air a wise way.” He speculated that having automobiles inside cities might be impossible. “The notion is not tenable,” he said, “that each of us, in his own right, is entitled to eighteen feet of steel on the streets and the vast amount of fuel we burn when in

cities.” Handler told the senators that while waiting in a city for the next green light, “a driver is getting zero miles per gallon while he is putting out all of that pollutant.” He said, “A new system for transportation in cities is needed if we are serious about avoiding the “consequences to health of automobile pollutants.”

Handler said that the real problem with automobiles was that they killed people in accidents, not the “supposed health impact” of exhaust fumes. He said air pollution might be affecting the health of the American people, but that the quantitative data are not very compelling. On the other hand, he said, “the 56,000 deaths and 200,000 people maimed on the highways annually are, in my view, numbers of greater reliability.” He called that “real damage we can count” and said he suspected it exceeded “damage to health by automobile pollutants as a cause of death,” but he couldn’t be sure because “The statistical evidence linking air pollution to health damage is really rather flimsy.” Even so, Handler said he thought “ridding the nation of the discomfort of air pollution in measured steps was probably a good idea.” He said, “I do not like the tears in my eyes from the muck in the air, so I say let's get rid of it.” Handler then said there was another drawback to the use of automobiles and that it would be worsened as a consequence of the emission standards imposed by the Congress. He said that if the nation continued to rely on the use of the gasoline engine, “before we finally get rid of automobiles,” the decrease in drivability he called “hesitation” that will result from the measures taken to reduce their pollution “is no trivial matter” and must be confronted. He explained, “The fact that a car will not accelerate, when you tramp down on the accelerator suddenly and tends to stall is a very dangerous fact indeed,” and he recounted his personal experiences with the phenomenon of hesitation. “Where my wife and I live in the summer, to get to from the little road on which we live up on to the highway, I have to come up into the highway on an incline, where the highway is making a big U. I have limited visibility in both directions, and in order to do that, I have to wait for that moment when I see nothing and jump. Twice last summer my car got halfway into that highway and stalled, and I just barely escaped being smashed by the cars coming around the bend.” He said hesitation in the cars that meet the 1975 emission standards “will be quite worse. “

Handler told the senators that offering advice about air pollution caused by automobiles would be the first and last contract the Academy would accept where it was not asked to deal with the entire problem. He said that confronting the problem of air quality piecemeal was a mistake. Handler resented that he was not allowed to evaluate the effect on air pollution of mandating smaller engines, which he pointed out would conserve steel, make it easier to find parking spaces, and reduce petroleum consumption, thereby reducing the level of pollution consumption more effectively than using the “primitive approach” of modifying the design of the gasoline engine and attaching catalytic converters to the tailpipe. He said he hadn’t thought about these matters before he signed the contract to provide advice to the agency.

Handler offered an example of the kind of broad charge he wanted. He said he was negotiating the possibility of providing advice regarding a bill to provide for clean water. If he accepted the contract, the Academy would be asked “to address the total economic, social, and ecological consequences of achieving or failing to achieve specific standards.” When asked

by a senator whether that was outside the scope of technical competence, Handler replied that “only Acts of God are outside of our competence.”

Handler had been asked to assess the feasibility of a technology intended to reduce urban air pollution, but he told the senators that in his view technology wasn't the answer to the problem. Instead, he proposed radical solutions— smaller cars, improved engineering to avoid hesitation and new mode of transportation in cities. And he lined up with industry to the extent that he believed clean air was not either technologically feasible or cost effective.

In a speech to an assembly of biochemists, Handler lucidly revealed that his attitude toward the control of air pollution was an example of his ideology concerning regulation of chemical pollution. He said, “The effect of automobile emissions on human health is not understood biochemically, yet, despite the lack of such understanding, the nation has chosen to spend a large sum of money to control the emissions.” “This immediate solution,” he said, “not only will significantly raise the purchase price of automobiles,” it will also be a threat “to accelerate the depletion of petroleum reserves because “engines equipped with catalytic devices to remove pollutants from their exhaust gases will utilize about one-third more gasoline than do unregulated engines, thus engendering a huge addition annual bill.” He similarly lamented spending money to combat water pollution on the basis of the absence of what he regarded as scientific knowledge. He said, “One cannot yet make an adequate mathematical model of pollutants in a river or lake that describes their effect on the ability to sustain life. Nevertheless, the new water pollution legislation will prescribe zero effluents in ten years and the bill will exceed \$20 billion.” He continued, “The situation is the same with food additives, drugs, pesticides, and the like.”

Handler said, “The automobile is now recognized to be a serious environmental malefactor. We are concerned with the widespread biological damage arising from what comes out of the automobile's tailpipe.” But he regretted that “there seem to be no credible quantitative estimates of that damage.” According to Handler, the emissions standards established by the Congress “seem to be entirely arbitrary.”

Handler explained to the audience why they seemed arbitrary. He said science was the only human activity that produced objective knowledge and offered the possibility of providing fact-based answers regarding “the damage caused by chemicals emanating from tailpipes.” However, he asserted, the knowledge needed to answer questions about the health and environmental impact of chemicals doesn't exist because politicians declined to fund the requisite basic research. It was too late to remedy this error, he claimed, because the law required specific automobile emission standards be implemented by industry within a few years. The only possible way that could be done, according to Handler, was for “the scientific community to generate and encourage practical problem-solving organized research.” He deplored the reality that the Administration was irreversibly opposed to funding the requisite basic biochemical research, but praised a new form of research being developed with the support of industry that was based on mathematical manipulation of actuarial data. Handler

said the calculations could be carried out at two levels in parallel — cost and safety. At the cost level, actuarial data should be analyzed for “the purpose of comparing the cost of producing clean air with the economic benefits of doing so.” At the safety level, the data should be parsed by comparing “the health risks of not producing clean air with the resulting economic benefits.” Handler called the actuarial analyses “mathematical research” or “persuasive statistical analysis” and explained that “In this kind of research, usefulness is the chief criterion of excellence” even though it does not produce fundamental understanding and the knowledge it yields is imperfect and incomplete.”

Handler said the new form of research he identified had not resulted in any published “persuasive statistical analysis of costs or risks,” but expressed confidence that it was possible to do so. He added that, presently, “The literature reveals only qualitative statements of the risks and no analysis of the benefits” and, consequently, “regulatory decisions are made on the basis of values, not science.” Handler bewailed what he saw as the fundamental problem, that “The United States has not developed science-based policies for decision-making concerning health risks of environmental chemicals.” Instead, he said, decisions were based on public values as perceived by publicly elected representatives, which he derided as “based on politics in the absence of scientific understanding.” Handler concluded, “thoughtful, enlightened risk-versus-benefit analysis” would “avoid the necessity for political expediency.”

Handler was antagonistic toward the principle of governmental action to protect public health from air or water pollution with an appropriate margin for safety. He said, “one can reasonably speculate” that the absence of environmental controls was responsible for “the growth of industry, the eradication of slavery and indentured servitude, less crowded housing with central heat and plumbing, rapid transportation and communication, increased literacy and universal education, greater social mobility, penicillin, polio vaccine, safe childbirth, longer life, balanced diets, leisure, the forty-hour week, the minimum wage, child labor laws, and the liberation of women.” In his view, regulation of exposure to environmental pollutants could be scientifically justified only by conclusive biochemical evidence showing that humans had died because of exposure to ambient levels which, quixotically, he conceded was impossible. Equally fanciful, he said, “in theory, the only practical alternative was mathematical research which was also impossible because identifying significant numbers of people who are in fact dying from the side-effects of exhaust gases from automobiles is difficult”

Handler expressed a firm belief in the crudely simplistic notion that toxicity was the sole process by which humans died from exposure to chemicals, and he denied the existence of biological process wherein chemicals caused injuries after long-term exposure at relatively low levels — his off-repeated old saw, “dose makes toxicity.” Handler preached intolerance toward recognizing the validity of the idea that adverse health effects could be caused by prolonged exposure to low levels of environmental chemicals even though the effects were not toxicological. He derided public concern about long-term consequences as nothing more than a fleeting contemporary worry. “Today,” Handler said, “there is concern about the lead in paint on ghetto walls or in gasoline, and mutagens,” and

about “the clamor to clean the waters and to free the cities from smog,” but, he said, “tomorrow, attention will shift to something else.”

Early in 1973, Handler approved the work papers of the three dozen experts he appointed to assist the emissions committee that assessed the technological feasibility that the automobile industry could meet national emissions standards, and sent them along with the committee’s report to the contracting agency and the Congress. He also provided them a personal report describing his opinion of the committee’s report — which was almost two years in the making — intermixed with his ideas about policies and issues that were collateral to the contractual task.

Handler said the committee concluded that meeting the 1975 standards might be technologically feasible but meeting the 1976 standards was unlikely because the companies were concentrating on the most expensive and least satisfactory means for doing so. They said four types of engines could meet both standards but that the companies had made exceedingly costly engineering choices for engine design and reduction of pollution. The committee judged the major uncertainty to be the durability of the catalytic converters intended to detoxify automobile exhaust gases.

The committee recommended creation of a network of inspection and maintenance stations to ensure the converters work properly under conditions of consumer use

Handler said the economic experts who advise the emissions committee determined that the annual cost to the customer for adding and maintaining a catalytic converter was several hundred dollars, and that he thought the determination “suggested the need for attention to a series of considerations.”

He expressed his concern for the effect of the cost on the gross national product, and pondered whether the funds used for the converters might come from important areas such as “improvement in the health care delivery system,” which, if so, was probably not “the wisest use of such funds for protection of the public health.” Handler called the Congress’ attention to the emission committee’s judgement that use of the converters would result in increased fuel consumption which, he said, might contribute to “the depletion of the nations’ fuel reserve.” He said he wondered whether the catalysts in the converters should be reserved for other more important uses, because were very rare metals and essential for other technologies. He warned that if catalyst-free emissions control systems from foreign manufacturers were used, the nation’s balance of payments might be adversely affected.

Handler informed the Congress and the agency of what he called a “major quandary” — a foreign-made automobile that met the exhaust standards without the need for catalytic converters. He said the automobile “offers the promise of lower initial purchase costs, greater durability in service and significantly greater fuel economy” as compared with the catalyst-dependent systems now being emphasized by American manufacturers. In addition, he said the mass production of what the committee deemed to be fragile, catalyst-dependent systems of unproved reliability “may engender an episode of considerable national turmoil.” Handler said



he was also concerned that once the “ponderous” American manufacturers committed to use of catalyst-dependent emission control systems, they would continue to do so for years, trying to solve problems that have already been solved. The “dilemma,” Handler said, was how best to meet the emission standards while avoiding dictation by government of the technology to be used or resorting to dependence on foreign manufacturers

Handler raised issues regarding the validity of the government’s emission-control policies, the problem of air pollution, and the need for basic research, even though the issues were far outside the terms in the contract he had signed with the agency to provide advice concerning technological feasibility. He asserted that, despite the undesirability of air pollution, “emission control does not appear to be essential on the basis of either aesthetic or health considerations in large areas of the nation.”

Handler recklessly claimed that air pollution caused by automobiles was negligible, and that production of automobile exhaust gases from natural sources “far exceeds that from man-made sources.” He recommended enforcing the emissions standards only in urban areas and implementing them in rural areas when “inexpensive emissions control systems which exact no fuel penalty are available.”

Handler offered his ideas for new policies to address the problem of air pollution caused by automobile emissions, which he said was only one aspect of “the problem of the automobile in society.” He said the automobile had “enriched the personal experience” and “broadened our horizons” and helped turn “American geography into one nation,” but that it “has begun to be defeated by its very success.”

According to him, the automobile had accelerated depletion of “critical natural resources including petroleum” and “scarred the land and choked the city,” resulting in “deterioration of the quality of urban life.” He opined that the only “truly effective mechanisms for emission control” must include “a significant reduction in the number of cars allowed to operate in cities,” a “public mass-transit systems,” and “a reduction weight, volume, and horsepower of automobiles allowed in cities,” as well as a “redistribution of the pattern of physical relationships among dwelling and working areas.” “Patently, these are relatively long-term goals, achievement of which will require extensive, meticulous study and planning with subsequent large public expenditures and careful public intervention into the behavior of the private sector,” he said. Handler concluded his report by emphasizing that the nature and magnitude of the hazards to health posed by pollutants in automotive emissions was controversial, and the relationship of the level of pollutants to health effects was unknown. Consequently, he said, it was imperative that the Congress initiate a comprehensive study, and that “This Academy would be pleased to be of assistance in such an effort.”

In May 1973, Handler testified before the Senate committee that wrote the Clean Air Act and defended his report and that of the Academy emissions committee. He was greeted with courtesy by Senator Edmond Muskie, the chair of the Senate committee, and thanked for allowing the Academy to take on the public responsibility of providing advice regarding the technological feasibility of the emission standards in the Act. Muskie emphasized

the importance of the independent advice provided by the Academy. He said the subject of hearing involved “highly complicated technical and technological questions” that senators and congressmen were “not equipped personally to evaluate.” “It was our feeling,” he continued, “that we ought to have recourse to independent judgments.” “Independent,” he told Handler, meant “independent of the industry” and “other built-in prejudices that might conceivably influence other sources of scientific opinion.” He said the reason the Congress mandated asking the Academy for advice was that “Independence of view is very Important to us.”

Handler told the committee that the Academy’s almost two-year effort regarding air pollution from automobiles “has been a most useful learning experience to us at the Academy,” and he detailed the steps he took to ensure the committee appreciated the “strength and value” of the Academy’s advice “so that our findings and conclusions may yet more firmly warrant the full confidence of the Congress and the agency.” He said he implemented a “rather searching” and “elaborate procedure” to guarantee that his unpaid emissions-committee appointees and the experts he hired to assist them were “independent and unbiassed” or at least had a “reduced potential conflicts-of-interest.” When there were questions involving conflicts, he said he appointed a committee to resolve them, and if it couldn’t, “I became the final referee.” The appointees and experts, he said, were provided with all needed logistical and administrative services, data gathering, and editing services.

Handler told the senators that the emissions committee was concerned about the durability of catalyst-dependent control systems after they went into actual use by the public. He said the most significant advice in its report was that the nation should not commit to catalytic converters as a pollution control system because alternative technologies appear imminent and are better. Handler opined that the industry’s commitment to the use of converters made it unlikely they would ever pursue a better technology, even though the converters are expensive and will increase gas consumption. He suggested allocating federal funds to universities to support research and development on alternative technologies.

When asked what action the government might take that would have the effect of inducing the industry to pursue alternatives, Handler said he had no answer “that truly satisfies me.” Instead, he offered what he called a long-term answer to the problem of air pollution that would be based on a study that asks the right questions, which not he said the Congress has not be done. Handler said if the Congress and the regulatory agency “wish to initiate appropriate studies of these and related matters, the Academy will help.”

Handler said that when the Congress drafted the Clean Air Act, it did not “ask the right questions” because it failed to consider “emerging problems” that “should be given further consideration.” He told the senators that controversies concerning the nature and magnitude of health risks posed by automotive pollutants were inextricably connected to risks from other sources of air pollution. Further complications resulting from the law requiring public health be protected from air pollution, he said, could arise from the law’s social and economic consequences. Handler predicted new problems would arise as consequences of these

collateral impacts. He said that after he and his staff began “thinking about many social, economic, institutional, and technical issues,” he realized there were many areas related to air pollution that had not been considered and should be explored.

Among the areas Handler intuited were important for consideration was the development accurate methods for measuring presently unconsidered air pollutants including sulphur oxides, carcinogens, trace metals, asbestos, and allergens. He said basic research on air pollution was needed regarding how it was transported in the atmosphere and converted into smog, and applied research was needed on how internal combustion engines could be modified to control nitrous oxides, soot, sulphur oxides, and particulates. Equally critical, Handler asserted, was the need for health-related research into the biochemistry and epidemiology of pollutants and mixtures of pollutants, and their effects on animals, plants, and materials. He said such funding was essentially non-existent and should begin immediately.

Educational programs should be created, Handler said, to train workers in the various categories of research regarding monitoring, regulation, health effects, technological design, and mathematical methods of cost-benefit assessments of the economic, social, and environmental consequences of each air pollutant. He said the government should foster improvement and innovation in automotive technology, and encourage reassessment of present automobile design criteria such as horsepower, acceleration, and size. Additionally, Handler said, the problem of bringing about technology for controlling automobile emissions that was better than catalytic converters should be confronted using various strategies include tax incentives and penalties, car-pooling, staggered work hours, mass transit, gas rationing, and restrictions on advertising.

Handler told the Senate committee that the influence of the tax structure on air pollution should be examined, because factors such as the depletion allowance, amortization rates, and development of new technology can all affect transportation, which produces air pollution. Future problems should be anticipated, Handler asserted, including those brought about by new engine designs, fuels, gasoline additives, and by emissions from polymer additives in car interiors; procedures to avoid the problems should be developed. He said systematic research should be conducted into all societal activities that can affect air pollution such as transportation, production of materials and food, manufacturing, and construction projects by federal, state, and local government, industry, and private individuals.

In response to other committee questions, Handler expanded his purview of the issue of air pollution and told the senators that coping with the problem of controlling air pollution and achieving the goal of a cleaner atmosphere required trade-offs between economic values and health values rather than reliance on scientific research.

He reconceptualized analysis of health consequences an economic rather than scientific undertaking, and described a general method by which the health-risk problem caused by air pollution should be resolved. He said the best approach was economic, not than scientific — a sea-change in attitude from his earlier opinion that the solution was biochemical research. “It should be clear,” Handler said, that each problem caused by air pollution will result in an

“exercise in cost- and risk-benefit analysis,” and that basing its solution on statistical analysis was a “wise pursuit.” Handler asserted that all factors relevant to decisions regarding air pollution, including risks and benefits, should be quantified in dollars. “Only when the risks are measurable in the same terms as the benefits can risk-benefit analysis be a rational, self-sufficient endeavor,” he said. The limiting factor, Handler testified, was insufficient data to estimate costs and risks in dollars, and effects on the economy or employment of enforcing the present standards of air pollution;” only research could provide reliable answers, he said.

Handler urged adoption of an implementing policy for controlling health effects of air pollutants that is based on dollars, thereby ensuring emission standards are not set too high in relation to the level of health protection they provide. If that policy is not adopted, Handler testified, the regulatory agency “has no choice, because of the law,” but to set strong emission standards to protect public health regardless of cost, which he said was unreasonable because there was no conclusive scientific evidence to warrant strong standards. One of the senators expressed concern that Handler was advocating a policy of mandating weak safety standards when the scientific information was uncertain. Handler replied he thought such a policy was necessary and desirable with regard to all federal programs, “whether it be our tax policy or our attitude toward how clean the air should or shouldn’t be.” He said that regulatory standards should be weak absent conclusive scientific evidence to support adoption of strong standards. The senator said, “If we are going to err, I would rather see us err on the side of the standard that may be a little too stringent.” Replying like Janus, one Handler said, “I thought that is what I said,” but the other Handler said, “When we are uncertain, then we must err on the side of conservatism in the public interest.”

During a hearing before a House committee regarding emission standards for automobiles, doubt was cast on the probity of Handler and Academy in the management of the emissions committee and its subordinate consultant committees. A law professor testifying in favor of the emissions standards expressed concern that the issue was not treated fairly by Handler the Academy’s emission committees. He said he raised the issue because Handler had refused to provide public access to the working papers of the Academy’s committees, and did so without justifying his decision except to say he thought disclosure would be inappropriate. Consequently, the law professor testified, the public could not judge whether the deliberations were unbiased. “Thus arises the possibility that a good portion of the health basis of the Clean Air Act will be worked over in secret under the Academy’s flabby conflict-of-interest rules that have inspired considerable grief in the past,” he said. The law professor urged the House committee to insist that the Academy’s ongoing study of air pollution health standards, like any other worthy scientific enterprise, proceed fully in the public view and without hint of bias.

He asserted that Handler’s rules dealing with bias were weak because the required disclosures of possible conflict-of-interest were made only to committee members, without any public disclosure, a process he said was inconsistent with the totally open scientific inquiry that was expected from the Academy. The difficulty with Handler’s arrangement, the law professor testified, was that scientific judgments were being made on the basis of secret documents and,

consequently, the occurrence of undue bias toward one point of view was obscured. He cited two recent examples of past undue bias by Academy committees; in an Academy study on fluorides, the Academy's committee contained industry employees, and, in a story reported in detail in the science press, an Academy committee on herbicides was alleged to be biased.

The professor listed his reasons for believing the aura of secrecy surrounding Handler's automobile emission committee and sub-committees indicated their advice may have been tainted, resulting in compromised conclusions and diminished confidence in their reliability. He said the Academy did not disclose evidence that all points of view in the scientific community were represented on the committees, and there was a similar lack of evidence that possible conflicts-of-interest did not compromise the reliability of their advice. Thirdly, the information and data upon which decisions were made were undisclosed, thereby preventing independent judgments of their validity. Thus the basic proposition in scientific research — that full disclosures is necessary — was not followed. When asked by a House committee member, "Have we, in this country, reached a point where we can't trust anybody to do research for us," the professor said he doubted the problem was that serious, but he emphasized that the best test of the reliability of scientific advice was public exposure of the bases upon which conclusions were reached. "If the advice doesn't stand the test, it is not good science," he said, and the gist of his testimony was that the Academy was not meeting the test.

In a rebuttal letter to the House committee, Handler accused the law professor of making a "gratuitous slur upon the ability of the Academy to conduct objective, unbiased studies," He said concern for the Academy's willingness to hear both sides of the question was unfounded, and that "when we can, we do avoid inviting individuals already known to us to be in some way conflicted." Handler conceded that the Academy's conflict-of-interest procedures rested heavily on the willingness of his appointees to describe their conflicts with complete candor, but claimed, "I am not aware of a single instance in which a committee's judgment has been shown to have been flawed by virtue of such conflict." He continued, "What I am stating is that I have seen no evidence that those appointments ever influenced unduly the reports which emerged from those committees." Left unconsidered in his oily statement were the questions whether he looked for evidence and what he meant by "unduly."

During his testimony before the Senate committee, Handler lamented the limitation of the Academy's contractual responsibility to evaluation of the technological feasibility of the emission standards. He said all of the consequences and ramifications automobile exhaust gases had on human health should be investigated, and the automobile industry's claim that there was no scientifically established evidence proving the emissions had adverse consequences on human health should be evaluated. He told the Senate committee that the Academy was willing to explore the many scientific and non-scientific factors that play a role in determining the effects air pollution can have on human health. Shortly thereafter, the scientifically naive Senate committee agreed to a large contract with the Academy for Handler to design and manage the type of study he recommended and gave him carte blanche to choose the study objectives. Heady with confidence regarding what he thought he could accomplish, Handler promised the Senate committee that, within a year, the Academy would

provide the answers the committee needed to make the political judgement whether the emission standards struck a reasonable balance between their public health benefits and the costs entailed by their implementation.

Handler sent the Senate committee a list of nine specific study objectives, expressed as questions, that he intended to address in the study: Was there adequate scientific evidence to support the health-related air quality standards in the clean air law?; To what extent do the margins of safety built into the standards represent a reasonable measure of protection against scientific unknowns?; Are the standards based on the health of normal healthy adults or on the health of susceptible groups within the population, and which is a more reasonable basis?; Are the standards based on the assumption that each pollutant has a threshold below which it is harmless and, if so, what is a reasonable margin of safety for determining threshold levels?; What improvement in ambient air quality will result from meeting the present emission standards?; Assuming the standards are met, what groups within the population, as characterized by socioeconomic level, unusual sensitivity to pollutants, age, illness, and geographical location, will still be subjected to health hazards?; What information is available about synergism or antagonism in the automotive-related air pollutants?; What proportion of the total health hazard to the city dweller comes from air pollution, and what fraction thereof is due to automobile emissions?; What are the limitations to predictive judgments on alternative pollution control strategies that are dictated by the probabilistic nature of science, the complexity of environmental health relationships, and the variability among persons?

Handler invited a group of scientists and Edmund Muskie, the senator mostly responsible for the Clean Air Act, to a meeting at the Academy for a discussion the biological effects of automobile emissions. Handler told the audience that the Congress “took it upon itself to specify precisely how much of a given pollutant should come out of a tailpipe,” and that, “At the time I was not at all certain that the Congress was doing the right thing.” But he said, in retrospect, he was wrong because doing so led to progress. He warned that the regulations would not survive politically unless they were based on “firm scientific information” rather than “emotion.”

Handler said he began to “examine what was known about the human health effects of air pollution” and assess whether the standards were appropriate, and told the scientists that the emission limits specified in the law might not be justifiable on the basis of protection of public health. He asked the scientists to determine whether the available data suggests that automobile emissions have health effects while keeping in mind that removal of automobile emissions from the atmosphere is not cheap. He warned the scientists to be precise about their judgements concerning the appropriateness of the mandated standards, and their judgement of the “rational” amount of public health protection should be.

Senator Muskie told the scientists at the meeting, “You are here at the request of the United States Senate Committee on Public Works; the Clean Air Act was a product of that Committee.” He said the committee was concerned that the adequacy of the data upon which

its policy was built had been questioned by the automobile industry and the Academy, and that resolving the issue was crucially important. The emission standards in the law will be enforced, he promised, assuming they are not too high or too low, because the health of people must be protected from the dangers of air pollution. He said scientists had the responsibility to show how conclusions from experiments, as opposed to their value judgements, could be used by the Congress to make public policy decisions. "Public policy makers need this guidance in order to ensure that adequate protection is provided for everyone without creating costs and dislocations that are not justified by the needs of public health," he said. To obtain the needed guidance, the senator added, the Committee asked the Academy to gather the best minds that it could find and challenge them to evaluate the adequacy of the safety margin provided by the standards, to identify which population groups would be protected, to show areas where research was most needed, and to resort its best judgement to the Congress in ten months.

The senator was unaware that a bifurcation of scientists into two types based on employment had occurred, and was oblivious to the implications of who actually paid for the production of the scientific data the Academy was hired to parse. He mistakenly assumed all scientists recognized a responsibility to the public, and that were free to choose their research objectives and interpret data without undue influence or constraint by their employers. But the senator's most serious shortcoming was his naive acceptance of Handler's claim that scientific answers could be found to the questions he posed. In reality, Handler was inherently untrustworthy in the roles of posing questions as study objectives and appointing unbiased scientists to provide answers — Handler may have believed they could be found, but he also believed in the ultimate possibility of creating life by pouring chemicals into a beaker.

Handler published a detailed record of the meeting, but it had no practical or inferential significance because it was written in dense technical language, understandable only by the expert who wrote each section, at most. The record contained no conclusions, but its tone was a harbinger of the path Handler charted for the Academy committees he appointed. He emphasized increased federal spending for biochemical research and maintenance of the status quo regarding emission standards until the results of research are available to guide decision-making. He sought reliance on cost-benefit analysis to resolve questions that must be answered in the absence of what he imagined was forthcoming reliable, dispositive scientific data created by the biochemical research.

Handler created a series of Academy committees ostensibly to achieve the nine specific study objectives he promised the Senate committee. Seemingly, the committees would also provide the guidance Handler promised the Senate committee and which Senator Muskie echoed at the meeting. The contract that Handler signed had two goals: first, to ascertain whether the emission standards were justified on the basis of public health; second, to evaluate industry charges that the standards were too stringent.

In September 1974, Handler released a four-volume report of the Academy committees he appointed. After surveying the literature regarding health effects of air pollution, the committees, speaking unanimously with one voice, concluded that much further research was

needed to provide a firm scientific basis for automobile emission standards. But even though the available scientific evidence was weak, fragmented, and far from conclusive, the Committees said, it was sufficient to support the intuitive view that air pollution adversely affected human health, and thus that there was "no substantial basis" to weaken the emission standards. Notwithstanding what was considered an absence of essential research, the Academy committees said it seemed clear the evidence showing automobile emissions caused human disease was sufficient to justify the present emission standards, and that there was no scientific basis for changing them. The seeming clarity perceived by the committees was derived from subjective economic analysis of the cost-benefit relationship wherein the health benefits of the emission standards, expressed in dollars, were said to be greater than the predicted cost of implementing the standards, indicating they were "cost-effective." The committees guesstimated air pollution would cause 4,000 deaths, even though levels ten times higher or lower were equally likely, based on other, equally valid choices of economic models. The irrelevant fact that automobile accidents annually killed ten times more people than did air pollution was emphasized in the report, as if to derogate the impact of air pollution on health.

The report was larded with wishy-washy statements that frustrated many legislators and sent both positive and negative signals to industry and environmentalists. There was "no substantial basis" to change the standards because they were "cost-effective." The safety factors provided by the standards were "judged to be much smaller" than those typical in regulating other environmental pollutants such as electromagnetic energy from nuclear pollution. The standard for soot were said to possibly be "too lax" and those for nitrogen oxides possibly "too stringent." The committees' report could be, and was, interpreted to support all sides of the issue.

When Handler presented the final report to the Senate committee that had written the Clean Air Act, Edmund Muskie, the committee chairman, thanked him for the effort but expressed consternation with what he perceived as a kind of scientific aporia. Muskie said, "What we want is some one-armed scientists who give definite conclusions; not ones who say, "on the one hand . . . but on the other hand."

At the request of the Senate committee, Handler collated all the recommendations for research in the various volumes of the report and identified five scientific areas — biochemistry, epidemiology, engineering, mathematics, and gold-standard studies. Additionally, he identified the need for research in two areas of economics — techniques for assigning dollar values to identified health benefits attributable to clean air, and methods for identifying costs for achieving cleaner air.

During Senate testimony, Handler said that until the necessary research and analyses were performed, "any discussions or recommendations concerning the adequacy of air quality or emission standards will, of necessity, be couched in language which emphasizes the deficiencies in the available data." Handler said, in the absence of further research, policy-making will continue to be hindered by industry and regulator self-interest, and determinations of the costs and benefits of emission controls will remain educated guesses. He added, "It should be understood that cost-benefit analysis is a young and difficult art, and that quantitative



assignment of benefits in monetary terms will ever be arbitrary for those values that we cherish most: love, truth, beauty, joy, freedom, honor, health and life.”

The ponderous Academy report generated little attention in the lay or science press; when reviewed, the report was mostly interpreted as supporting the regulatory agency in its attempts to establish vehicle emissions standards that reduced key pollutants in vehicle exhaust gases. The motor-vehicle industry offered no official reaction when the report was first released, although unofficially it expressed disappointment because it expected the Academy to recommend relaxation of the emission standards. In June of 1975, however, the Association that represented the manufacturers of motor vehicles filed a detailed censorious analyses of the Academy report with the Senate committee which exercised oversight over implementation of the Clean Air Act. The Association’s analysis —its aggressive tone, adversarial style, and judgement the Academy’s conclusion supporting the existing emission standards was wrong — was unprecedented in the Academy’s history.

Based on its analysis of the Academy report and Handler’s supporting testimony, the Association leveled two serious charges against him and the Academy committees —that they were unscientific and ignorant of economic realities. According to the Association, the questions considered by the Academy committees were inadequate to insure a broad review of the problem of determining emission standards, and further, the questions did not reflect an awareness of contemporary developments such as the energy crisis and the variability in the economy. The Association said there were numerous inconsistencies in the body of the report, its summary statements, and in Handler’s supporting congressional testimony. “Time after time,” the Association asserted, “the report says, in effect, ‘On one hand, there is insufficient data to justify the published standards or relationships or effects, but on the other hand, there is insufficient data to justify the recommendation of different levels for these standards, relationships, or effects.’” The Association accused the Academy of misleading the reader by obscuring the fact there was no scientific evidence to support the emission standards. It said Handler’s testimony showed a lack of understanding of some issues and was misleading regarding other issues, as was the Academy report. As an example, the Association said the Academy’s estimation of the cost-benefit ratio was undoubtedly lower than indicated in the report because the estimates of the monetary value of improved health were far too high and the costs of meeting the emission standards were far too low

The Association agreed with Handler regarding the need for the research outlined in the Academy report, although their reasons for doing so were quite different. The Association argued that research was necessary before sufficient information was available to scientifically establish emission standards — a scenario that would significantly, or even permanently, delay implementation of emission standards, and concomitantly benefit the members of the Association financially.

Handler supported the report’s call for research because the sixty-six research projects it described as essential to the establishment of a scientific emission control program would entail a decade-long need for increased funding of pointillist biochemical research.

The criticism leveled against Handler and the Academy by the Association, however self-serving, surprised and wounded Handler. He had never previously been personally and systematically challenged, even by an individual much less an economically and politically powerful industry. Further, at least during his time, the scope and detailed nature of the Association's criticism of the Academy was unprecedented, and he was entirely responsible because he micromanaged every aspect of the study, from its creation to the publication of its report. Even worse for Handler and the prestige of the Academy, the Association's criticisms were only the beginning of antagonism toward them from American industries. A groundswell of discontent emerged from parties whose interests were impacted by the conclusions in the Academy report, especially companies in the automobile and oil industries. Their scientists, engineers, and economists constructed technical and economic arguments similar to those of their opposite numbers hired or appointed by Handler, but which reached opposite conclusions. In testimony at congressional hearings, industry experts unabashedly criticized the Academy report, mostly on the basis that its conclusions were merely personal opinions that addressed essentially irrelevant questions and ignored economic realities. The general impression created by the industry critiques — which were couched in facile technical language previously the exclusive domain of the Academy — was that its halcyon days of unchallengeable authority were over.

The tide of criticism evinced no hint of the traditional deference toward Academy advice-giving which Handler expected. Nevertheless, he stubbornly believed in the validity of the nine questions he sent to the Academy committee, and in the soundness of the report he had nurtured. Handler was sufficiently concerned, however, about industry's negative reaction to the Academy report and, further prompted by Congressional interest in possible revisions in the emission standards, he developed a strategy he believed would prevail over his adversaries by out-scienceing them.

Handler sponsored and funded a one-day event at the Academy in early May 1975, which he called a "Conference," and invited two dozen of his previous appointees to Academy air-pollution committees and about a dozen members of his staff, and asked them to, "assess the current situation and identify key issues" concerning automobile emission standards. During the Conference, Handler instructed the attendees to create defensible regulatory policies regarding emission standards, and to identify what he called "their technological feasibilities and consequences." He also asked the attendees to pay attention to the balance of costs and benefits to society in achieving the desired air quality. Handler said he wanted the Conference's report to be about twenty pages, not a thousand pages like the previous Academy report, so that the advice it provided could be understood by laymen and would be reported in the press.

The Conference attendees prepared a report of the requested length in about two days; after modifications by Academy functionaries, which took almost a month, Handler released it publicly in early June 1975. The report — a series of annotated conclusions dealing with vehicle emission controls and management of air pollution — implemented Handler's strategy of posturing the issue as an example of the complexity of acquiring and using scientific information in political decision-making.

According to the report, meeting the target emission standards for hydrocarbons and carbon monoxide was “both feasible and worthwhile and should be met,” and that it was “probably feasible,” using catalytic converters, to achieve the emission standard for nitrogen oxides. The report asserted, however, there would have been less uncertainty concerning the nitrogen oxides standard if the automobile industry had not slackened in its development of converter technology.

There was disagreement among the Conference attendees as to whether the marginal benefits of achieving the standards for nitrogen oxides would exceed the marginal costs, and whether the actual costs might be less than what the Academy’s earlier committee predicted because it had assumed a fuel-economy penalty in its calculations that was too high. Achieving the emission standards for hydrocarbons, carbon monoxide, and nitrogen oxides, the report said, could and should be done in a manner that did not significantly increase levels of sulfuric acid. The report further advised that, to ensure the catalytic technology chosen by the industry for meeting the standards was consistent with this goal, a sulfuric acid standard should be established.

In the view of the Conference attendees, there was no evidence to justify relaxing the ambient air-quality standards for the regulated pollutants, and that it was important to examine the health effects of non-regulated pollutants from motor vehicles. The attendees predicted that significant improvement in fuel economy could be achieved by taking certain steps that had nothing to do with emission levels, and they advised that emission standards for heavy-duty vehicles and motorcycles, evaporative emissions from vehicles, and emissions from various stationary sources be developed.

The Conference report was strongly antithetical to the policies of President Gerald Ford, whose main concerns at that time were the energy crises brought on by the country’s heavy dependence on foreign oil, and the economic impact of the emission standards on the nation’s automobile industry, which was heavily concentrated in his home state. President Ford’s proposed solutions for the energy crisis were strongly opposed by the Congress, and his advisors saw Congress’ initiative in establishing emission limits — which would increase energy consumption — as further opposition to the Administration’s energy policies. According to Ford’s aides, the overwhelming weight of the testimony in recent agency and congressional hearings was contrary to the conclusions reached in the Academy Conference report, the gist of which was to regard the emission levels as feasible. The Administration view of the Academy Conference report was that the public welfare, from the standpoint of energy consumption, jobs, the cost of transportation, and other factors affecting personal well-being, were regarded as secondary, if considered at all. According to the Administration, the appropriate basis for deciding emission control standards was the general welfare of the people of the nation, with the role of emission control in protecting their health playing a necessary part, but only a part.

In late June 1975, Texaco, one of America’s large oil companies, publicly disclosed a scathing analysis of the Academy’s Conference report, which contained what President Ford’s aides called “many and often flagrant shortcomings.” The critique, written by experts who

worked for Texaco, described in detail the company's intense disagreement with the reasoning, interpretation, and conclusions in the report.

Handler received the critique in a letter from a company vice-president in which he told Handler that since the Academy was presumed to be the ultimate scientific authority in the United States, the report should have been based on intense study and careful documentation and reflected "cogent, relevant, objective, and scholarly analysis." But to the contrary, the company officer said, "The report resulted from only a few hours of discussion by a committee that included no one involved directly with the manufacture of engines, automobiles, or the products which lubricate and fuel them, which indicated the committee lacked the expertise to validate its conclusions."

He suggested that Handler withdraw the report because the Academy did not remain above reproach, as expected of a putative authority on scientific and technological matters.

The company's critique consisted of three dozen critical comments, each linked to one of the Academy Conference report's eight conclusions. The company's experts said that although attainment of the statutory hydrocarbon and carbon monoxide standards was technically feasible, the report's conclusion that they were "worthwhile" was indefensible, considering the available evidence. They argued that emission control standards must be viewed not as entities in themselves but as they interrelate with air quality, energy requirements, and the national economy. The experts said the report's predictions of the effects of the standards on fuel consumption conflicted with the predictions of all American automobile manufacturers, and that Academy calculations of the costs entailed by the standards were invalid because they were based on faulty data and false assumptions. In view of the limitations and shortcomings in the analysis provided by the Conference report, the company experts said, there can be no rational basis for arbitrarily concluding that the imposition of emission standards for hydrocarbons and carbon monoxide is "worthwhile." The also accused the Academy of evading the basic question of "what nitrogen oxides standards are necessary and justified," and argued that the present standard was indefensible regardless of whether or not its attainment was feasible.

According to the company experts, the claim in the Conference report that "It is probably feasible with catalyst technology to achieve the statutory emission standard for nitrogen oxides" was speculative and misleading because it implied that the catalyst technology needed to achieve this goal on a mass production basis was imminent, which was untrue. Further, the experts said, the report assumed that the industry had a practical method of testing each car as it comes off the assembly line to ensure that manufacturing variability didn't result in cars that failed to meet the standard, which was also untrue because no such method existed. Considering these and other factors, the experts asserted, the credibility of the statement on feasibility can be seen as speculative, not factual. They also claimed that, although the report concluded implementation of the standard for nitrogen oxides would discourage development of alternative technologies that offered the benefit of fuel economy, "it does not offer this fact as a strong argument that the emission standards should be relaxed." Their position, the experts said, would be understandable if the evidence showed the nitrogen oxides standard was required for the protection of health but, "This is not the case. "

The experts interpreted the report as evidence the Conference attendees placed themselves “in a position of favoring overly restrictive emission controls at the expense of energy-saving developments,” a choice that was “not in the best interests of the people of the nation.” Moreover, according to the Company experts, the failure of the attendees to even question the use of catalyst technology similarly could harm public health and the economy. Since neither these or other issues surrounding use of catalytic converters were addressed in the report, the experts contended, advocating in favor of the emission standards was irresponsible because reliance on converters could force the use of a problematical technology, mandate huge capital expenditures unnecessarily, increase costs to consumers, and waste the country's resources. The experts viewed the Academy report's estimation of the cost of removing sulfur from fuel as seriously wrong because it ignored the costs and consequences of major aspects of the process. They said improved technology or less severe emission standards might obviate the need for low-sulfur fuels in the future. In either case, a tremendous waste of capital, manpower, and construction would have needlessly occurred. Further, the experts pointed out, both American associations of petroleum producers and refiners projected that the desulfurization costs for small refineries would be about twice that for large refineries, which could force many small refiners out of business, thereby impeding achievement of the national goal of energy self-sufficiency. The experts said the Academy report seriously erred when it supported the establishment of emission standards based solely on consideration of health effects.

They maintained it was imperative that equal attention be given to many other factors including the time it takes to develop the remedial technology and the effects of the standards on the overall economy. The experts concluded there was a need to control harmful emissions within tolerable levels, but insisted that the Academy should have recognized that emission controls should be cost-effective and only imposed upon society where there is a commensurate and needed benefit.

National and international automobile manufacturing companies, and companies in related industries opposed the conclusions reached in the Conference report, and their scientific and economic experts also attack Handler and the Academy on the basis that their policies and advice regarding emission control were unscientific and economically devastating. A vice-president of Ford Motor Company notified Handler and the Senate committee that was managing the legal aspects of the emissions-control issue about its concerns regarding the procedures and conclusions in the Academy Conference's report. He told them that, in his company's view, “The conclusions and recommendations of the Academy report were “completely contrary to the engineering and scientific data put into the public record in sworn testimony,” and that, “These conclusions also contradict many of the earlier findings of the Academy as reported in late 1974.” He continued, “Unless the new evidence, which must exist to support these contradictory conclusions, is made available, this report must be regarded as nothing more than the personal opinion of a portion of the small group which you assembled.” He told Handler and the Senate committee that, “Any attempt to use the conclusions of a one-day study, unsupported by evidence, to influence national policy is unworthy of an institution with the prestige of the Academy.”

The motor vehicle Association also objected to the 1975 Academy Conference report. The Association told Handler and the Senate committee that although the stated purpose of the Conference was to consider "new and additional information," there was no new information in the report, and that although "the facts are not new" the "conclusions in the Conference report are." Further, it said, the report was heavily laced with value judgments using subjective words such as "should," "ought to," and "can be met," all without proof. According to the Association's experts, conclusions in the Academy Conference report directly contradicted the findings of the 1974 Academy report on air pollution. The Association's experts also rebuked the Conference report writers for repeatedly characterizing the results of their marginal-costs and marginal-benefits analyses as "worthwhile" when in fact the writers included no such determinations in their report.

The Association alleged the cost-benefits relation for the nitrogen oxides standards described in the report— that costs might be reduced and more benefits might be discovered — was only speculative, and the claim that the emission standards could be achieved while improving fuel economy was also speculative because it was unsupported by evidence. The Association called the report's accusation of industry slackening its efforts to develop catalytic converters as "puzzling," and said not only was the claim made without a factual basis, the facts were actually contrary to the opinion. Additionally, the Association's experts suggested the Academy was hypocritical because, on one hand, its report said the industry had not produced a system for controlling nitrogen oxides that "has been proven feasible" but, on the other hand, it characterized the system as "probably feasible." Overall, the critique writers asserted, the Academy Conference report, "ignored the interaction of the major pollutants with one another and offers no new insights into the questions of cost benefits and pollutant effects on human health." "Most disheartening," they said, "the report carries the tone of an opinion paper rather than the well-documented evaluation expected of so prestigious an institution as the National Academy of Sciences."

#### **PART 4: CONSEQUENCES**

HANDLER WAS DEEPLY INFLUENCED by his belief in biochemistry as a fundamental explanation of life and aimed to solidify science, especially biochemistry, as a societal cornerstone. During the early 1970s, he was the chairman of the board of directors of the nation's only agency specifically tasked to fund basic scientific research, head of nation's most prestigious scientific organization, a scientific advisor to the President, and a frequent witness before congressional committees. Except when incapacitated by a flair-up of one of his medical problems, Handler exploited his influence in pursuit of his goal — establishing science as an independent institution within government that functioned like the National Academy of Sciences but with an annual budget required by law. He significantly strengthened the Academy's business arm and use the profits to create the bureaucratic machinery needed to produce advisory reports — some pursuant to government contracts and others Handler decided to issue *sua sponte*, which was novel behavior for a head of the Academy. His resources and authority facilitated his appointment of an average of ten volunteer experts to

each of about five hundred advice-providing Academy committees which existed at any given time. Handler claimed that the Academy was a private institution whose “advice is rendered by the institution rather than by a committee.” As what he asserted was proof of his claim, Handler said he had the right to require strict secrecy for committee deliberations, edit all committee reports, and “comment upon a report while transmitting it.” The device of institutional authorship, called aegis, allowed Handler to create a novel tripartite form of scientific writing consisting of the institution, which was legally responsible for the advice provided, the Academy staff, which did the actual wordsmithing, and the committee members, whom he said were “responsible” for the scientific reliability of the report. It was constantly a struggle for the critics of the institutional reports to decide exactly who should be held to account for perceived errors of commission or omission, absence of expertise or relevant experience, or for bias, which was a frequently leveled charge.

Handler’s credo, early success in establishing federal funding policy for basic research, and control of the Academy platform, together, set the stage for achieving his goal. Highly motivated by his scientific ideology, Handler aimed to solidify science, especially biochemistry, as a societal cornerstone. Earlier in his career, through key positions he held at the National Institutes of Health and the National Science Foundation, Handler propounded and implemented funding policies that systematically favored biochemical approaches to biomedical research, thereby sidelining other perspectives, especially integrative and system-level research. Having done to biomedical research in the United States what Lysenko did to agriculture research in the Soviet Union, Handler’s main hurdle became securing a sufficient level of reliable annual federal appropriations for basic research. But the money never appeared in quantities that satisfied Handler. Instead, his desire to shape national science policy tightly around his beliefs was confronted by increasingly negative public attitudes about science that jeopardized fulfillment of his ambition. Fundamental changes occurring in American society, particularly regarding health and environmental risks linked to technology, increasingly, interfered with Handler’s plans and ideas. Despite his unwavering beliefs and efforts, Handler’s rigid, pro-science rhetoric met substantial backlash, and the role of science in society was increasingly undermined as technology’s unintended consequences sparked public and political disillusionment.

Handler’s initial reaction to the sustained national attention gained by the problems of health risks and environmental degradation caused by technological development was to castigate scientists who pointed to the problems, calling them “mavericks,” and to dismiss the concerns as nothing more than emotional reactions of laymen. Handler zealously preached that basic research and more technology were the solutions, and that biochemical research would yield knowledge that would solve the biomedical problems. He never offered evidence that what he said was true and, for a brief period, remained content in the belief his oratorical skill was quieting what he believed were emotional reactions rather than actual problems. Although unappreciated by Handler, the relative calm he exhibited was misleading, like the period between the time a ship hits an iceberg and the bulkheads flood. Handler’s actions —defensive speeches, adjustments in Academy policies, pragmatic treatment of health and environmental issues as business problems rather than scientific ones — not only failed to

restore public trust, it resulted in growth of public skepticism and diminished of his credibility. His misleading assertion that basic research would solve the nation's problems created confusion and delayed rational discourse regarding experimental approaches that had a realistic chance of doing so. As specific problems arose, the prestige of science, scientists, and the Academy monotonically declined in the eyes of the public and the Congress. Handler was like Hans Christian Andersen's *Emperor*, who believed he was wearing magnificent clothes when he was actually parading around naked.

Handler believed science was based on objective reasoning and proven methodology, and should have a primary role in governance because of its intrinsic value as the engine for the intellectual, economic, and cultural progress of society. He called science the "intellectual structure of our time" and said the government had a moral responsibility to fund the efforts of scientists at an appropriately high level, and claimed it was undeserving of skepticism or blame for the adverse consequences of technological applications. Handler sought to educate the public and policymakers about the necessity of supporting basic research so that it could continue to serve as the parent of technological and societal development. His commitment to that idea clashed with President Nixon's pragmatic approach, which regarded science as a tool that should serve practical, immediate needs; he supported work that sought technological benefits, as distinguished from knowledge for its own sake.

In his role as a member of the President's science advisory committee, Handler advanced his policies, which often opposed those of the Administration and lead to confrontation with the President. Handler used the Academy as a platform to encourage perception of the majesty of science and to undercut many Presidential decisions and programs, which further alienating Handler from the Administration. The President, who was seeking to streamline science policy and direct its focus to practical technological applications, saw Handler's influence and that of his supporters on the advisory committee, as a political problem. Handler's persistent and increasingly contentious relationship with President Nixon culminating in his dissolution of his White House science advisory office, which consisted of his science advisor and an advisory committee that included Handler. The decision to eliminate the science office underscored the Administration's rejection of Handler's vision of the role of scientists as scientists in government

In an unseemly attempt to reverse his banishment from the White House, and reestablish science as a formal element in the Administration, Handler appointed an Academy committee and orchestrated its report, which recommended a law that would create a permanent White House science office to advise the President, with authority in some areas to act independently, without the knowledge and approval of the President.

Handler's vision as mirrored in the report — a government guided by scientific principles— was universally perceived as elitist and disconnected from democratic processes, and received nil support outside the biochemical culture. Handler's desperate attempt to enshrine science as a superior guiding force in policy was seen as undermining the principles of democratic governance, which prioritize political decision-making over the expert advice of unelected



scientists, and the President ignored the Academy report. After Gerald Ford became President, Handler made a second desperate attempt to establish either a full-time science adviser to the President or to establish a statutory agency in the White House. However, President Ford followed the recommendation of aides who advised him that Handler's efforts "are not warranted in our view because they: overly represent in your immediate office the clientele interests of science and scientists; emphasize science and technology as ends in themselves rather than means of achieving national objectives; do not recognize the necessity of integrating science advice with that from other fields."

Handler's overreach in trying to influence science policy and increase funding for basic research led to his marginalization. The reorganization of the science advisory functions in the Executive Department, signified the repudiation of his vision of a privileged leadership role for scientists in government. The rejection of the recommendation in the Academy report affirmed the principle that in a democracy, political decision-making must take precedence over the opinions of scientific elites. Handler's dream of institutionalizing science as a permanent, independent establishment in American governance was thwarted, marking a clear boundary between the roles of science and politics in the United States.

Handler deeply resented what he saw as unwarranted concern about a supposed impact on health from exposure to environmental-level anthropogenic chemicals. He regarded the concern as an emotional reaction to inflammatory media stories stoked by maverick scientists who aroused unfounded fears about safety. Handler relentlessly argued that biochemical research was essential for providing conclusive evidence environmental chemicals had biological effects — other than acute toxic effects resulting from mishandling the chemicals — if they occurred, which he doubted with every fiber of his being. It was as if he had a walnut-sized brain that could not grasp the possibility that something not proven conclusively to cause harm could reasonably be suspected of doing so on the basis of non-pointillist research. The idea that scientific knowledge less than certain could be sufficient to warrant government efforts to protect the public, or at least warn of the possibility of danger, was an alien concept to Handler. Handler's ideology predisposed him toward a laissez faire attitude regarding premarket determinations of the safety of industrially-produced chemicals in the environment, and food additives were no exception. The operational significance of Handler's beliefs was triggered by a new law — with which Handler stoutly disagreed that — required a federal regulatory agency to make retrospective determinations of the safety of numerous chemicals that had historically been added to processed food without prior testing for possible health risks.

Handler's policy on food-additive regulation championed a "relative safety" standard for determining safety levels even though the law required a "reasonable certainty of harmlessness" standard. His policy also challenged the congressional requirement that the agency represent the public, meaning all of the people all of the time regardless of the political activity of stakeholders regarding a particular issue.

Handler, in contrast, contended that the agency had duty was to balance the public's concern about health with the economic interests of the chemical industry. He argued that agency should bear the burden of proving additives unsafe, thereby facilitating industry's ability to introduce new chemicals without the need to provide evidence of safety. Handler, and several Academy committees he appointed to advise the regulatory agency, recommended policies that would shift the burden of proof to the agency, thereby permitting the use of additives unless proven harmful.

Handler's prioritization of economic gains over public health raised serious ethical issues. Despite the mounting experimental evidence from animal studies of health risks, Handler advocated for industry interests, showing that he valued the benefits of additives over their potential dangers, a position that compromised the Academy's responsibility to protect public welfare. And his arbitrary dismissal of the implications of scientific evidence from animal studies — which suggested food additives potentially had adverse effects on public health — demonstrated a disregard of pertinent ethical issues and considerations of social justice. His emphasized corporate benefits over safety concerns, prioritized economic interests at the expense of protecting public health, and ignored the consequences of his policies on vulnerable populations who might be disproportionately affected by food additives.

Handler reasoned that since the government would not fund biochemical research on the biological effects of environmental-level man-made chemicals, the next best policy was to determine safe exposure levels to food additives based on a distinction between *authority*, which would be provided by biochemists he recommended, and *responsibility*, which would be the domain of political appointees at the agency. Under his proposed two-step method for agency decision-making, biochemists would have authority to determine safety levels based somewhat on whatever scant evidence could be found, but mostly on their professional judgement.

Reliance on the subjective judgement of biochemists was a Hobson's choice for Handler, but because of his failure to persuade the government that a huge biochemical research program was the proper scientific course of action, the two-step method was the best alternative pro-industry decision-making process he could conjure up. Consequently, his committees suggested the method to the agency.

The method called for a sequestered committee of biochemists, which did not interact with agency officials, to base their decision regarding what level of chemical exposure was safe on professional judgement; regulatory officials would then rely on the report, and any other information they considered useful, and choose a safety level.

Handler offered to create and manage such committees for each of the many food additives then undergoing agency scrutiny. Anticipating the agency would seek the help he offered, Handler made organizational changes in the Academy that enabled him to continue protecting the food industry's interests and promoting food additives as safe, despite growing evidence and public concern to the contrary.

Handler's committees minimized the health risks associated with food additives by emphasizing the benefits they provided over emerging health concerns. He championed relaxed regulations and criticized scientific findings that questioned the safety of additives, and he ensured that the Academy committees he appointed were sympathetic to his perspective. They dutifully dismissed, as irrelevant, animal studies that linked additives to adverse health effects, and promoted reliance on subjective safety guidelines based on economic considerations and historical experience with the use of additives. By favoring the economic interests of food manufacturers over concerns about potential health impacts, Handler compromised the public's right to safety and skewed the regulatory advice provided by Academy committees in favor of corporate interests.

Handler believed the absence of obvious health problems after food additives were approved for us without premarket testing proved they were safe, and that any problems they might have caused were outweighed by their benefits. He framed the notion of safety as a subjective concept and steered the Academy committees he appointed toward industry-friendly conclusions by rigging their composition, as could readily be determined from the appointees' public statements and publications. The lack of meaningful conflict-of-interest regulations and the imposition of Handler's ideology on the advice provided by Academy committees fueled skepticism about the objectivity of the Academy and its ability to impartially assess the safety of food additives. The problems he created became obvious in the cases of individual food additives .

Handler's standing assertion, that food additives were fundamentally safe unless conclusively proven otherwise was directly contradicted by animal studies showing cyclamates — a sweetener manufactured by a company he served as a board member — caused cancer. Despite that evidence, Handler dogmatically asserted that there existed a level of exposure to every chemical below which no harm would occur, including cancer. The Academy committee he appointed to evaluate the safety of cyclamates presented Handler's dogma to the government's regulatory agency as if it were learned advice, and supported Handler's opinion that the law prohibiting cancer-causing additives was unscientific. National cancer experts vehemently opposed Handler's dogma and the committee's derivative opinion on the grounds that it was impossible to setting a safe threshold for chemicals which caused cancer. Nevertheless, he continued to urge a policy of reliance on biochemical research rather than animal studies for determining safe exposure levels, even though not a scintilla of experimental evidence supported his dogmatic belief. And even worse, were his policy adopted, the setting of safety levels would be impossible because even biochemists could understand that human values, not biochemical data itself, must always be the basis of decision-making regarding safe exposure levels.

Handler created a series of committees to advise application of his dogma to the synthetic hormone DES used in livestock feed, red dye2, and the flavor enhancer glutamate. Despite overwhelming evidence that DES caused cancer in both humans and animals, Handler and his committees supported its use and dismissed concerns raised by cancer experts. He unabashedly demonstrated his preference for protecting the interests of the meat and

agricultural industries over safeguarding public health, and said he would continue to do so until biochemical evidence to the contrary was produced. Red dye 2 was another additive that Handler defended, despite evidence of harm from animal studies and objections from some Academy members, who objected to his revision of an Academy report on the dye to reinforce his opinion that the dye must be safe because it never caused any immediately apparent harm. In defending glutamate, Handler and his committee continued his pattern of relying on economic and legal arguments, claiming that companies had a right to use additives that had previously been approved, and that any opposition to them was driven by ill-informed public fear rather than legitimate scientific concerns.

A draconian outgrowth of Handler's ideology was his belief the safety of anthropogenic chemicals was an objective scientific issue, and food additives were no exception. He acted as if he were filled with resentment because non-scientists were in charge of the process of determining safe exposure levels and treated science as mere tool rather than as the highest expression of mankind's intellect, which it was in his eyes. Handler extended his perceived objective ideal of science to scientists as a group, elevating them to the status of a uniquely superior class of human beings. His distorted imagination blinded him to the reality that scientific advice could be bought, like any other commodity, or influenced by prejudice and self-interest. No biochemist employed by a chemical company expressed opinions counter to those of company management and remained so employed. And conversely, as Handler himself evidenced — he consistently advocated in favor of the safety of cyclamates and he remained a director of a cyclamate manufacturer for many years.

Handler believed in the existence of objective knowledge, and that it was discoverable only by science. Knowledge of how to solve societal problems was an example, but complaints of health risks caused by exposure to man-made contaminants in the environment continued to vex him. Handler's ideology told him there was no such thing as a health risk, so asking scientists for a solution to the problem was futile, like the plea in the Scottish poem for God's protection from the mysterious and frightening noises caused by things that go bump in the night.

Handler considered the problem to be a manifestation of irrational fear and a threat to the authority of science because it seemed to the public that science had no answer. He worried that public respect for scientists — crucial for sustained federal funding of basic research — would be diminished if the complaints were not placated. The issue he chose for his fight to overcome them was the safety of the thousands of chemicals added to foods for non-nutritive purposes, whose health consequences were unknown and unstudied.

Handler formulated a policy to vitiate the problem that he believed had no scientific solution. The foundation of his policy was risk-benefit analysis based on statistical evaluation of actuarial data, the method the nuclear industry originated for determining safe levels of exposure to radioactive chemicals. The method appealed to Handler because of the absence of an explicit role for science and the mathematical certainty of the results it provided. He was particularly enthusiastic after learning from Chauncy Starr that the method proved with

numerical certainty that the health risk from nuclear power was less than the risk of being hit by a meteor.

The objective of risk-benefit analysis was to manipulate data for the purpose of justifying the dollar value of the highest possible safety level and the highest possible dollar value of the benefit factor that didn't evoke laughter. Handler's policy sought to capitalize on the simplistic logic of risk-benefit analysis — that an excess of the dollar value of benefit over the dollar value of risk indicated the chemical would be safe, and the greater the excess the more certain was the interpretation. He believed quantitative determination of risk and benefit could shift public attention from the illusion of health risks to the mathematical certainty of safety. "A decision about safe exposure levels," he said, "would be illogical unless one knew the costs in dollars and the marginal return in decrements of health risks."

When Handler adopted risk-benefit analysis for determining safe exposure levels he assumed that safety could be equated to statistically determined risks and the putative health risks could be objectively characterized purely in monetary terms. He also supposed that risk-benefit analysis was an objective alternative to shortcomings he perceived in the government's regulatory framework regarding exposure to chemicals, which he denigrated as based on "undefined words like risk and safety." In effect, Handler transmuted the multifaceted biological concept of health risk into a capriciously-determined mathematical probability that was summarily quantified in dollars. His strategy obscured but did not erase the subjectivity inherent in judgments formed using risk-benefit analysis. But when Handler added "professional judgement" as another way of determining the numerical values of risk and benefit, the subjectivity of his policy for decision-making became starkly obvious.

Handler misleadingly claimed professional judgement was objective when exercised by the Academy committees he appointed. because their members were elite scientists. The advice of a committee that relied on professional judgement to estimate numerical values for risk and benefit was always provided a committee report that spoke in one voice and provided advice to the contracting agency in a single unconflicted package — a homogenization of the opinions, biases, and conflicts-of-interests of its members. Handler's theory was that the subjective opinion of each of the say ten members of an Academy committee, when converted to one voice, became transformed into value-free objective advice, thereby averaging away the individual biases, conflict-of-interest and professional shortcomings. The objectivity of science, he asserted, allowed a committee scientists, acting in unison, 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 dollars. Pursuant to his policy plan, agency officials would then directly make deductive decisions regarding safety regulations based on the Academy report, confident that their decisions were correct because they were coherent with scientific reasoning and judgement. As if in a scientific trance, Handler said a committee's professional judgement was "sufficiently compelling as to logically determine the agency's decision" — like Santa Claus leaving gifts for children

Handler rendered inconspicuous the subjective nature of “professional judgement” by adopting a rule for Academy committees that prevented holding committee members individually accountable for their advice. He believed science was non-adversarial and produced objective answers, in contrast to politics which he said was adversarial and produced only subjective answers. Because cross-examination was an adversarial process, Handler said, to “avoid the taint of politics,” a policy rule was needed to protect scientists on Academy committees from answering any questions about their opinions, even those posed by the client regulatory officials. His rule prohibited all members of committees whose report contained advice about political matters, such as safety levels, health risks, or economic impacts, from explaining or defending the basis of their individual judgements or contributions to the report. Handler successfully enforced the rule, even though it facilitated the resolution of public issues by unelected individuals who answered to no one except him.

Handler undertook a multifaceted approach to persuade the government and the public of the merits of risk-benefit analysis for determining safety levels. His arguments blended appeals to authority, emotional manipulation, and the portrayal of risk-benefit analysis as a scientifically validated method endorsed by unbiased experts. It was, he said, “the cornerstone of an optimal decision-making policy for establishing safe exposure levels to man-made chemicals.” His arguments centered on the supposed efficiency of the policy, which he framed as a cost-effective strategy that would “eliminate the need for animal studies” and streamline decision-making processes.” Handler’s focus on efficiency and his praise for the results of industry’s method of contrived calculations — such as his claim that “calculated values of health risks due to food additives were invariably nil” — were warmly welcomed by industry.

His exaggerated praise and misleading characterization of the decision-making underpinnings of risk-benefit analysis ignored its quintessential subjectivity and neglected the reality of the scientific uncertainty surrounding the health consequences of chemical exposures. Similarly ignored was the arbitrariness of the metrics employed such as assigning dollar values to human lives and mathematical probabilities to health risks.

Emotional appeals also played a significant role in Handler’s strategy to promote support for reliance on risk-benefit analysis for determining safety levels. He warned that, without risk-benefit analysis, regulatory agencies would continue to make decisions based on “perceptions, values, and judgments” rather than objective science, a scenario he characterized as detrimental to public welfare. This framing of alternatives created a false dichotomy between risk-benefit analysis and reliance on animal studies, and portrayed the former as the only rational method for decision-making regarding safety levels. His misleading rhetoric veered into hyperbole, such as his assertion that “professional judgments” were inherently equivalent to “dollar considerations.”

Unsurprisingly, industry was pleased with Handler’s dismissal of decision-making based on animal studies and his prioritizing of industry interests over considerations of public health. The response to Handler’s policy was quite different among stakeholders who valued reliance

on precautionary principles; Handler alienated them and increased their negative perceptions of science. Although his efforts to popularize decision-making based on risk-benefit analysis pleased industry, it displeased the public and was received coldly by federal regulatory agencies.

They were required by the Congress to continue contracting with the Academy regarding a spectrum of health and environmental issues, at least up to the Nixon era and the emergence of the issue of air pollution. Consequently, the agencies remained forced clients of the Academy, affording Handler multiple opportunities to advance his policies.

Under Handler's rule, the Academy advised extension of risk-benefit analysis beyond assessing safety of new technologies such as nuclear power to determination of safety levels for exposure to anthropogenic environmental chemicals. He promised that the method, using either statistical formulas or professional judgement, would quantitate the risks and facilitate regulatory decisions. Handler demonstrated his duplicitous opposition to recognizing the ontological existence of health risks in the context of the issue of the safety of thousands of food additives that entered the market in the absence of premarket evaluation of safety. At his direction, the Academy entered into a series of contracts concerning food additives in which risk-benefit analysis was the basis of the advice provided. Handler appointed each member of every food-additive committee and inculcated in them a responsibility to adhere to the Academy's policy for providing advice regarding safety issues. During pre-deliberation briefing sessions conducted by Handler's staff, the members learned that Academy policy regarding determination of safety levels was based on economic considerations, actuarial data, and professional judgement, and that the conclusional advice was shaped by balancing risk against benefits. The members were told that the efficiency, clarity, and precision of risk-benefit analysis was unmatched in alternative approaches such as animal studies, and that the method separated scientific facts from political considerations, thereby showing science could operate independently of societal values.

The version of risk-benefit analysis Handler touted was fraudulent because it relied on arbitrary calculations and subjective judgements for determination of the degree of risk and the amount of benefits. In the decision-making process, it derogated science by reducing health risks to an economic factor, and it ignored non-monetary values such as ethical and social concerns. The ethical implications — disregard of precautionary principles and prioritization of economic considerations over human well-being in regulatory decisions — were ideologically invisible to Handler.

He was also blind to the contradiction he preached; on one hand, Academy reports were objective, on the other hand, risk-benefit analysis, the foundational reasoning in the reports, was quintessentially-subjective.

The Academy committees Handler appointed, chronically, were biased; the historical records of the committee members almost invariably indicated how the committees would decide the issues and what advice they would provide. Even when an Academy committee criticized the report of another Academy committee for lack of objectivity, Handler attempted to rebut the latter committee's criticism in a report he wrote and sent to the client agency. The

Academy reports issued during Handler's presidency showed the Academy's role as a nonpartisan provider of advice to the government was intellectually and ethically diminished, measured against the expected performance of a putative prestigious institution. More serious still, together, the reports issued by the Academy showed that such a thing as nonpartisan advice from a self-propagating institution of private advisors who are answerable only to their autocratic leader was probably impossible.

Handler embraced a congressional request to evaluate the medical side effects and environmental impact of the Military's herbicide spraying program. The task aligned with his strategic goal of maintaining the Academy's relevance to government and profitable connection to the Military, particularly the Academy's history of providing advice regarding chemical and biological warfare. Handler also regarded the task as an opportunity to influence public policy as to the safety of pesticides — a cause he championed throughout his career. He chose his appointees to the herbicide committee — who had pro-military biases or no relevant expertise in herbicide-related health or environmental studies, or both limitations, and included compliant foreign nationals — with the aim of vindicating the Operation Ranch Hand, at least to the extent of blunting congressional pressure to classify airborne spraying of herbicides as a violation of international protocols forbidding chemical warfare.

The absence of relevant unbiased knowledge and experience among the members of the committee forced it to hire numerous consultants, whose efforts were shaped by limited access to Vietnam, ongoing military conflicts, and reliance on military-provided data. The working reports of the consultants and the resulting draft reports of the herbicide committee were subjected to continual review by a high-level Academy committee chaired by the Academy Vice-President— the only committee in the Academy that Handler did not control. Fierce unprecedented internal strife ensued between Handler and the review committee concerning the working reports and their integration into draft reports of the herbicide committee. After almost a year of in-fighting, spurred by the review committee's rejection of Handler's demand that members of the review committee be replaced, a truce was declared that satisfied neither side but allowed preparation of a timely final report, as required by its contract.

The final version of the herbicide committee's report aggravated Handler because it reflected the perspective of the review committee. Historically, Handler exercised a *droit du seigneur* over Academy reports, wielding editorial power like a feudal lord. He expected servility from his committee appointees in return for the prestige of serving on an Academy committee, and invariably received it. However, the ad hoc herbicide committee was a precedential exception, mostly because of the determined influence of the institutional review committee. The rebellion of the review committee denied Handler the right to exercise his final word over the report of the herbicide committee.



Handler's distress increased after Academy insiders leaked the report to the press, bypassing the Military's privilege to release Academy studies it funded and shade their characterization in press releases. The internal strife and the leak, together, exacerbated the symptoms of Handler's chronic medical conditions and, to the surprise of some, he considered not running for re-election as the head of the Academy. His staff, however, persuaded him to soldier on.

The leak resulted in news articles that highlighted significant environmental damage and probable medical side-effects of the herbicides among the Montagnard tribes, which included sickness and death. The tone of the stories was directly counter to what Handler had led the Military to expect. He condemned the press coverage of the leaked report as misleading, claiming it excluded key details such as the absence of conclusive evidence that adverse health effects were found. Handler criticized the leakers for undermining the integrity of the Academy and accused them of propagating a false narrative, which took chutzpah considering he had attempted to do exactly that — portray the report as a neutral objective scientific inquiry.

The herbicide committee's report criticized the anthropological evidence as anecdotal and likely influenced by enemy propaganda, but the report avoided definitive conclusions about health impacts. Instead, it supported the Military's position by subtly emphasizing uncertainties and lack of conclusive evidence linking herbicide exposure to adverse health effects. The report also downplayed the possibility of adverse effects over the long term from a toxic herbicide contaminant detected in soil, crops, and animals.

In a personal analysis of the committee report, essentially a rebuttal, that Handler sent to the Military, he took umbrage at the herbicide committee's attitude and some of its findings, as if the committee had not adequately followed the script. He emphasized the strategic benefits of Operation Ranch Hand and dismissed as unjustified the committee's seeming implication that the herbicides might have had health impacts. Handler rationalized the environmental destruction as a military necessity and framed the lack of conclusive health evidence as validation of herbicide safety. Handler's analysis reflected his ideological bias toward the safety of pesticides and his intent to safeguard the Academy's financial ties with the military. He sought to blunt potential congressional characterization of the herbicide program as a form of chemical warfare.

Handler's autocratic management of the herbicide study alienated Academicians, undermined the credibility of the herbicide committee, and triggered serious conflict within the Academy. He prioritized political expediency over scientific integrity in an attempt to control the study and the tone of the committee report. Handler's intention to bolster the Military's narrative subverted the Academy's ostensible mission of providing unbiased advice, exposing fundamental internal dysfunction in the Academy. The herbicide study revealed ideological and structural flaws in the Academy's decision-making structure, leaving a legacy of controversy over whether a nineteenth charter creating a scientific advisory body was obsolete in the twentieth century.

Handler evinced a vacillating view of breeder reactors in which the only common factor was the absence of supporting evidence or rational analysis. At first, for ideological reasons, Handler urged national reliance on breeder reactors for production of electrical energy, believing they would produce cheap energy without causing any health risks. Several years later, out of the blue, Handler reversed himself and warned that breeders were serious public health that jeopardized the future of humanity. Soon thereafter, the head of the government agency that was developing breeder technology made Handler an offer he couldn't refuse. Seeking political help, not wisdom, the agency head secretly offered Handler a multimillion dollar contract to provide the Academy's opinion of breeders in return for Handler's promises to personally endorse their use and to appoint a committee whose report would support the agency's view. Motivated by the desire to raising money for the Academy and showcase its importance, Handler agreed. He publicly proclaimed that resort to the use of breeders to produce electricity was the only possible choice if Americans wanted to avoid facing higher costs for food, housing, and transportation. Handler showed his intention to honor his promise to appoint a rigged committee by choosing only pro-breeder members, thus ensuring that the opposing view was unrepresented and guaranteeing that the committee's report would support the interests of the energy agency.

Handler's deal with the agency head was fraudulent because he sought not wisdom but political cover, and Handler sought money and a prominent role in national policy. At the time, he was overseeing the activity of about five hundred committees, of which he appointed roughly ninety percent pursuant to contracts with government agencies or departments; they produced the profits that allowed him to fund committees to investigate issues he chose.

Handler's flip-flops regarding breeder reactors contributed to a developing back-bench resistance to his authority within the corporate Academy, in contrast to the sentiment within the honorary Academy, which didn't much care what Handler did as long as he didn't interfere with their right to elect new members. Questions also arose within the Academy machinery concerning what policy instructions should be given to the Academy's ad hoc committees in its Business Arm, which were always schooled in Handler's policies. Although he said he did not enjoy eating his words, the fact remained that he did so, thereby creating doubts and uncertainties regarding exactly what ideology the committees he appointed should be tasked to follow.

Handler's influence over national policy matters involving nuclear energy waned after he and the Academy were shown to be susceptible to corruption by the energy agency and industry interests. That perception contributed to shifting governmental priorities which ultimately resulted in abolition of the energy agency and termination of its breeder reactor project. The decrease in value of the stock in Handler and the Academy, considered as a

consulting company, was enhanced by his continuing, doggedly persistent defense of industry's interests.<sup>2</sup>

Handler's erratic behavior regarding breeder-reactor policy stemmed from a toxic admix of his ideology, desire for money to support his discretionary Academy committees, and political pressure exerted by the Academy's contractual clients. That behavior was only the latest example in a series of quizzical actions and decisions he undertook, and it added to intra-Academy speculation about his physical and mental health; he had a history of unexplained absences and secretive behavior regarding his chronic medical problems. His changing opinion about breeders also diminished the Congress' propensity to seek Academy advice, particularly as regards energy policy; seemingly, the legislators realized they were receiving political not scientific advice. Handler's practice of urging policies that favored political expedience and the economic interests of the Academy over health-related issues evidenced corrupt leadership of the Academy and its unreliability as an unbiased advisor, at least in the eyes of key congressional leaders. For the first time, they seriously questioned whether there was such a thing as objective advice from an honorary society that ran a consulting business. The immediate consequence of Handler's behavior was the cessation of congressional demands that regulatory agencies seek Academy advice on energy policy. It more or less became apparent that it was rather foolish to seek rational advice from a self-perpetuating institution of scientists and engineers in the areas of the safety and economics of nuclear power, which were political questions answerable only on the basis of values, rather than scientific questions answerable on the basis of the laws of physics. Even so, some agencies and the military continued to regard Handler and the Academy as politically useful for implementing what was called their "consulting the gods" strategy.

Handler exercised ecclesiastical-like authority over all committees and employees of the National Academy of Sciences. Whenever he spoke or acted, he did so as the Academy incarnate, exercising its aegis, offering advice, and striving to advance the interests of science. *Arrowsmith* was his bible, the source of his inspiration and the foundation of the authoritarian ideology of science he sought to instantiate in society. He raised the funds needed to pursue his objective from contracts for the Academy to advise regulatory agencies and congressional committees. The biggest and most controversial contracts Handler negotiated involved regulation of air pollution caused by automobile emissions — the major environmental issue of the 1970s. The Academy's servant-master relationship with government was strong and mutually beneficial during the early post-War

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<sup>2</sup> By 1976 it became clear that that even if breeder technology were successfully developed, nuclear power would not be economically competitive with other sources of energy, and the Carter Administration terminated the breeder program and its sponsoring agency. Nevertheless, Handler used discretionary Academy funds to perpetuate the Academy committee, which already was two years passed its deadline. In 1979, the committee issued its report, concluding that breeders reactors were safe, economical, and essential for America's survival.

period, but progressively became tendentious during Handler's reign as head of the Academy, and reached its denouement in the context of his management of the emissions problem.

In areas where technical complexities and public interests intersected, the Congress, under the assumption Academy reports were balanced and unbiased, routinely required regulatory agencies to contract with the Academy for policy advice and factual determinations. Handler accepted many such contracts not only because he needed the profits to advance his agenda, but also because the contracts leveraged perception of the Academy as a judicial institution. He attempted to use the contracts to advance a scientific outlook in the sense that science could provide solutions to major societal problems, thus emphasizing the value of science itself as contrasted with the results it produced. Handler's ideology, however, was internally inconsistent and self-defeating, at least to the extent it led him to foster a culture within the Academy that on one hand emphasized the importance of scientific rigor in environmental policymaking, but on the other hand promoted basing policymaking regarding safety of pollutants on economic factors. The two-arm approach was a common thread in his opinions in diverse areas including food additives, pesticides, breeder reactors, offshore drilling, radioactive waste disposal, and pollution of water and air, and reached its zenith in the issue of automobile emissions. Despite criticism from many directions, operational challenges in managing the Academy bureaucracy, and near total dependency on governmental funding, Handler continued his forlorn efforts to advance an ethos of scientism.

Handler used the institutional authority of the Academy to advance his policies regarding environmental health risks. He had a dim view of automobile emission regulations because they were not based on conclusive biochemical studies, and inculcated his view in the Academy emissions committee he appointed to carry out contracts to provide advice. Handler sought to strengthen public and congressional perception of the Academy's prestige and expertise, and their acceptance of the Academy as the appropriate spokesman for issues related to public health and pollution. He believed technology had become a source of concern and anxiety because

the public didn't understand the realities of technology and its proper role in society. Using the language of doubt concerning health risks to mask his ideological agenda, Handler advocated restraint in regulating automobile emissions, and increased research to provide a robust foundation of biochemical knowledge upon which regulatory decisions could be based. He boasted that such knowledge could be discovered before the end of the century if adequate financial support were provided.

In the meantime, while protective regulations were held in abeyance in the vainglorious hope biochemists would be successful, Handler preached tolerance of whatever public harm might result from suspending enforcement of emissions standards as the lesser evil compared with limiting the industry and raising its costs.

Handler was ideologically predisposed in favor of the automobile industry's view that emission standards should not be enforced because of the absence of conclusive evidence that emissions were harmful. He believed toxicity was the sole biological mechanism of harm caused by exposure to environmental anthropogenic chemicals, and automobile emissions

were no exception. Handler used the Academy's bureaucracy as a vehicle to downplay the biomedical significance of chronic exposure to air pollutants and obfuscate development of meaningful remedial policies. He approached the question of safety from the point of view that an air pollutant was either hazardous or not hazardous as determined by whether it produced acute adverse reactions mediated by established biochemical pathways; and if not hazardous, the pollutant was completely safe and unable to constitute a health risk irrespective of the circumstances. Handler refused to recognize the possibility that chronic exposure to pollutants could cause disease via pathways unknown to biochemists; he argued sophistically that the absence of a known mechanism of a harm was evidence that it was not caused by exposure to pollutants. Handler's reductive views of harm and denial of health risks mothered a bias in favor of protecting industry from what he saw as overzealous and premature regulation of air pollution, and a misplacing of the burden of proof. He supported the automobile industry's view that it had no responsibility to prove exposure of the public to exhaust gases was safe but rather that it was the government's responsibility to show exposure was unsafe.

Handler believed that since conclusive evidence of harm from exposure to exhaust gases was nonexistent, decision-making regarding safety could not be based on scientific grounds. He rejected any version of a precautionary principle based on gold-standard animal studies, which would place the burden of proof of safety on the automobile industry, and advocated resolving the issue on economic grounds. His public policy position, however, was a gemisch of heterogeneous, or unrefined concepts. Handler argued that health conditions associated with exposure to exhaust gases should be measured in dollars and ignored if the dollar level were lower than that of the economic benefits, but then contradicted himself when he conceded that the two factors were incommensurable. He believed the only health risks of automobiles were not caused by the automobile industry but rather by drivers who were responsible for deaths and injuries that resulted from traffic accidents.

Handler was a dissembler in the sense that he routinely functioned as a two-armed scientist, giving policy advice in every politically significant area of science or technology, irrespective of his knowledge in the area, and then offering the contrary advice. On one hand, he emphasized the importance of science for developing new technologies to address the problems facing modern society, especially side-effects and environmental degradation, which he blamed on an insufficiently regulated technology. He said society had two choices; either seriously reduce the American standard of living or develop new technology. On the other hand, he objected to regulating new technology because of the economic burdens it places on industry, and did so with the same intensity that characterized his opposition to regulating the existing technology. On one hand, Handler argued that the automobile industry was not responsible for the problems of air pollution because the industry was simply trying to elevate the economy using existing technology. He blamed the pollution on the government because it refused to adequately support the basic research that would lead to technology that eliminated pollution, which he baselessly assumed was possible. On the other hand, Handler opposed government development of automotive technology because building automobiles was in industry's domain, and governmental involvement would violate the principles of capitalism.

On one hand, citing drugs, food additives, and automobiles as examples, Handler said basic knowledge is needed to scientifically evaluate the safety levels of such things so that intelligent decisions can be made regarding their use. On the other hand, he said safety was a political decision based on balancing of values — by which he meant money — not a scientific question based on facts. Handler testified that cost-benefit analysis, an actuarial economic-based methodology, was the skill most in need of cultivation to control the balancing process. He said the analysis consisted of actuarially determining the dollar values of the potential risk of a technology and of its potential benefits; then, if and only if the dollar level of benefits exceeded that of health risks, by definition, the technology was safe.

Handler routinely used words as tropes to misleadingly advance his policies and beliefs regarding the public health and economic consequences of air pollution, “conclusive” and “we” for examples. He said automotive emissions sometimes were annoying but essentially harmless because there was no conclusive proof they were harmful, which was grossly misleading in several ways. Almost nothing in biology or medicine is conclusive, which trivial exceptions of acute phenomena like the consequences of jumping off a tall building or swallowing a poison, indicating his assertion was vacuous. Second, the absence of proof of a biological effect is never evidence of the absence of the effect, even when experiments are negative, because a negative result proves nothing except that the investigators looked in the wrong place.

Privately, Handler complained that the language in the Clean Air Act requiring protection of the public health with an ample margin for safety made the hair he had remaining stand on end. Publicly, he attacked the law as financially wasteful by fabricating assertions that an unidentified “we” would have to pay X dollars, where X was a number he sucked from his thumb and changed depending on the audience.

The trope was particularly misleading when applied to individuals chronically exposed to automobile emissions who developed lung disease, but Handler repeated it often, like a politician delivering a stump speech.

Handler’s air-pollution committees worked for two years to provide an analysis of the technological feasibility and challenges associated with meeting automotive emissions control standards set by the law. It was by far the most complex advisory task ever undertaken by the Academy and its actions were heavily scrutinized. Because of the nature of the contractual task, Handler had less control than normal over the advice the Academy could provide. In previous instances, the committees he appointed provided relatively narrow advice on specific scientific issues, regarding which he usually had personal opinions. Now he found himself dealing with an inter-related complex of engineering, political, and economic problems, all of which were far from his area of interest: the durability of catalyst-dependent control systems; the need for a network of inspection and maintenance stations; the development of dual-catalyst systems; the ability to manufacture sufficient vehicles meeting specific standards by a time certain; the long-term reliability of emissions control systems; the durability of catalyst-dependent control systems; the need for a network of inspection and maintenance stations; the development of new engine designs by foreign manufacturers; the economic implications of emissions control, including costs associated with purchase, maintenance, and operation; the effectiveness of

emissions control standards in improving air quality. Handler neither knew or cared about such issues, but was forced by the circumstances to act as if he did.

There were no scientific measurements or experiments capable of conclusively determining the public health consequences of automobile emissions. Regulatory decisions of the type the Congress envisioned as necessary to protect the public against the health risks of air pollution could be based only on values, not science as envisioned by Handler. But the Congress, in its naivety about science in the early 1970s, did not appreciate the reality that decision-making about safety levels is intrinsically subjective. This reality, however came into sharp focus during the protracted controversy concerning emissions that involved the automobile and petroleum industries, the government, and the Academy.

When Handler testified before the Senate committee that sought the Academy's guidance regarding the technological feasibility of the emission standards, he voiced frustration with the limited scope of the Clean Air Act, which the committee wrote, and the consequent narrowness of the Academy's contractual task. He said the critical issue was not technological feasibility but whether the standards chosen were scientifically justified — Handler's not-to-subtle way of chiding the committee and the Congress for failing to base the standards on solid biochemical evidence. He said the Senate's limited purview led to industry reliance on the catalytic converter, which was faulty technology, and predicted the converters would lead to unscientific decisions by the regulatory agency. Handler told the committee that preventing the Academy from considering the engineering and biochemical justification of the standards was a serious error, and suggested that the Academy be asked to design a long-term strategy to address the problem of air pollution that took into consideration the plethora of unconsidered problematical factors. Among the unconsidered factors, Handler listed sulfur oxides, carcinogens, and allergens, which he said weren't even measured in the environment much less studied to determine their health, and he proceeded to list numerous other factors the committee had failed to consider.

Handler criticized the automobile industry's choice of catalytic converters as the technology for meeting the legal standards because there likely were superior pollution-control technologies that would cost less and not increase fuel consumption, and he predicted the converters would breakdown in public use. As an alternative to depending on the industry to develop cost-effective technology, which he said they clearly had not done, Handler suggested a federal program of research grants to elite universities to foster development of alternative technologies. He said federal funding should also support studies in areas like health-related effects and how pollutants move in the atmosphere. Handler spoke in favor of weak emissions standards, if any, unless and until research yielded scientific evidence indicating otherwise, reasoning that overregulation imposed unreasonable economic burdens on the industry. Presently, he said, excluding the minor inconvenience of smog, the only known health impact of automobiles were automobile accidents, and that the requirement in the Clean Air Act requiring emission standards to include ample margins of safety was based on politics rather than science.

In a striking shift of personal policy, Handler recommended regulating air pollution within an economic rather than scientific framework, pending the future development of conclusive scientific evidence. Under questioning, he conceded that the absence of conclusive scientific knowledge required policymakers to rely on a pragmatic approach, and as a means of doing so, he proposed that the government no longer seek to minimize health risks but rather to minimize costs. He said that quantifying health risks and overall benefits in dollars would lead to rational decision-making regarding safe emission levels, at least over the short run. Handler told the committee that such an approach could be implemented using cost-benefit analysis — a method of manipulating actuarial data, originally developed by the nuclear industry to rationalize industry-friendly safety levels without the need to do any biological research — could be relied upon because, he falsely said, it was scientific and objective. He said cost-benefit analysis would provide short-term answers to the then pressing problems while also allowing sufficient time for biochemical research, which would yield all necessary data needed to provide a true scientific basis for emission standards. Actuarial manipulation was arbitrary and subjective but it putatively provided the tool Handler needed to quantify health effects in terms of dollars — which he had come to regard as a condition precedent to rational decision-making for safe emission levels.

During his testimony before the Senate committee, Handler complained the Academy was not authorized to investigate the totality of the consequences and ramifications automobile exhaust gases had on human health, nor to evaluate the automobile industry's claim there was no valid evidence proving emissions had adverse consequences on human health. The committee accepted his offer to explore numerous scientific and non-scientific factors he said played a role in determining the effects air pollution can have on human health and authorized the study. Handler was given complete authority to plan it, provided that he answer the question whether the emission standards in the Clean Air Act were justified.— a term Handler was allowed to define. Handler, who was punching far above his weight—as he had done when he joined his college boxing team at the age of fifteen, resulting in permanent neurological problems — because he knew nothing about how to design the elaborate study he envisioned. His ineptitude became apparent when he listed nine objectives that, on their face, were unattainable, but which he said would be achieved with a year. Handler promised the Senate committee The Academy would provide all the scientific information the committee needed to make the political judgement whether the emission standards struck a reasonable balance between their public health benefits and the costs entailed by their implementation.

Handler deceived the Senate committee by concealing the sea-change that occurred regarding the objectivity and loyalty of contemporary scientists. Historically, university scientists were the traditional type of scientist. They were paid by the government through research grants, whose budgets reimbursed the university for the percent of the scientist's time spent on research. They did whatever kind of research they chose, subject to the limitation that funding in their area was approved by congressional budget committees and the



Office of the Budget in the White House. Ordinarily, the university remitted the salary portion of the grant's budget to the scientist, who used it to augment the salary paid by the university or to cover the expenses of the research.

In that financial environment for scientists, Handler went on a national campaign about the honesty, objectivity, and distinctive knowledge-generating capabilities of scientists, and annually requested more grant money be provided so that more knowledge could be created. During his toot, *Silent Spring* and epidemiological evidence of a link between smoking and cancer appeared, and irreversibly changed American science. Employment-based bifurcation of scientists began when tobacco companies commenced spending prodigiously to produce sciency evidence that arguably supported the safety of smoking, which is as easy to do as lying. The nations' business and industry leaders, who traditionally hired lawyers to protect and advance their interests, began hiring scientists — either as employees or via contracts with for-profit research companies — to provide help for the same purposes. Thus emerged the industry scientist, a type who did research as directed by their employers, and served them as sciency lawyers by exploiting the limitations, inherent uncertainties, and flexibility of the scientific method.

The moral and legal duty of employees to serve and protect the interests of the employer distinguished the industry scientist from the university scientist. The work of industry scientists opposed that of the subset of university scientists who specialized in the areas of health effects and environmental degradation, and confrontations routinely occurred between the two groups in the press, administrative hearings, and court cases. Industry scientists quickly became dominant because industry spent whatever was necessary to support their interests whereas the government —principally the National Institutes of Science, the National Science Foundation, and the Department of Defense — strictly curtailed their funding for projects that touched or concerned the areas of health effects and environmental degradation, because it contributed to political controversies. Prior to becoming the head of the Academy, Handler was intimately involved, as a proponent, in blocking such funding by the non-military sources. When Handler contracted to provide the Senate committee with honest and objective information, he cultivated the misperception that all scientists were honest and objective, and obfuscated the distinction between the two types of scientists, and its implications.

In the fall of 1974, Handler released a multi-volume report of the Academy committees he appointed whose conclusion simply berated the obvious— there was no conclusive evidence that supported the automobile emission standards nor the industry's view that they were too strict. Why Handler imagined a year earlier that such evidence might be found was inexplicable, considering that neither university nor industry scientist had done any relevant research. The committees said that even though the available evidence was about as unless as one could imagine, it was sufficient to support the intuitive view that air pollution adversely affected human health, and thus that there was "no substantial basis" to weaken the emission standards. Notwithstanding what was considered an absence of essential research, the Academy committees said it seemed clear the evidence showing automobile emissions caused human disease was sufficient to justify the present emission standards, and that there was no

scientific basis for changing them. The seeming clarity perceived by the committees was derived from subjective economic analysis of the cost-benefit relationship wherein the health benefits of the emission standards, expressed in dollars, were said to be greater than the predicted cost of implementing the standards, indicating they were “cost-effective.” The committees said air pollution could have caused somewhere between four-hundred and four-hundred-thousand deaths, as well as a completely unknown amount of non-fatal disease — they just didn’t know.

During Handler’s testimony in defense of the report, the arrogant demeanor he displayed a year earlier was gone, and he appeared cowed or dispirited. The report he produced was a ponderous tome of technical mumbo jumbo fit for no use except kindling — the government’s two million dollars bought nothing more worthwhile. It’s gist was that the automobile industry and the government were responsible for the null result — the industry had consistently acted in bad faith and the government had failed to support the requisite research. Handler promised the Senate committee The Academy would provide all the scientific information the committee needed to make the political judgement whether the emission standards struck a reasonable balance between their public health benefits and the costs entailed by their implementation. Ironically, Handler’s promise that the Academy would provide all needed scientific information to support a political judgement whether the emission standards were appropriate was fulfilled. However, the state of things was exactly as they were before Handler undertook the mammoth study, namely that the existing scientific information supported the Senate committee’s judgement concerning the appropriateness of the emission standards; all that Handler had added to the record was criticism of the industry and the government. The vaunted nine objectives Handler said would be archived by the Academy could now be recognized as fantasy, like someone might experience under the influence of opium.

The Academy report generated little attention in the lay or science press; when reviewed, the report was mostly interpreted as supporting the regulatory agency in its attempts to establish vehicle emissions standards that reduced key pollutants in automobile exhaust gases. Industry offered no official reaction initially, although it was displeased the Academy didn’t recommend relaxation of the emission standards. In mid 1975, however, the Association that represented the automobile industry sent a highly critical examination of the report to the Senate committee which exercised oversight over implementation of the Clean Air Act. The tone and tenor of the Association’s report was unprecedented in the Academy’s history, and it grievously injured Handler, who had personally managed and orchestrated the entire project since he conceived of it.

The Association leveled two serious charges against the Academy report and Handler’s supporting testimony,—that they were unscientific and reflected ignorance of economic realities. The Association claimed the Academy committees were unqualified to opine on the problem of determining emission standards, and that they were ignorant of national developments such as the energy crisis. The Association’s critique listed numerous

inconsistencies in the body of the report, its summary statements, and in Handler's supporting congressional testimony; it accused the report of misleading the reader by obscuring the reality there was no scientific evidence to support the emission standards. Handler and the Academy committees were accused of showing a lack of understanding of important issues and an intention to mislead the reader by fabrication unjustified estimates of monetary value of disease and the costs of meeting the emission standards.

The Association agreed with Handler and the committees regarding the need for the research, but their reasons for doing so were quite different. The Association argued that research was necessary before sufficient information was available to scientifically establish emission standards — a scenario that would significantly, or even permanently, delay implementation of emission standards, and concomitantly benefit the members of the Association financially. Handler supported the report's call for research because it would entail a more or less permanent program of funding biochemical research.

The unprecedented criticism leveled against Handler and the Academy committees by the politically powerful automobile industry stunned Handler, who had to personally shoulder the opprobrium because he controlled every element of the Academy effort — its rationale, solicitation, design, appointment of committee members, and the tone and tenor of the final report. Handler's situation worsened when other stakeholder industries unleashed their scientists — the kind, ironically, Handler had helped create — to deliver sciency arguments like those made by Academy committees he appointed, but that reached opposite conclusions. In testimony at congressional hearings, industry scientists claimed the Academy Conference report was nothing more than a collection of personal opinions regarding irrelevant questions, and that it ignored economic realities. The industry critiques were couched in assertive quasi-pompous technical language, previously the exclusive domain of the Academy, indicating that its halcyon days of unchallenged authority were over, and that it faced strong comments and criticisms which required a response.

Handler's bizarre response was to hold a one-day conference in which his staff and several dozen of his Academy-committee appointees were asked assess the torrent of situation, identify key issues concerning automobile emission standards, and summarize them in a report. Handler asked the group to create defensible regulatory policies regarding emission standards, and to identify their technological feasibilities and consequences, all while paying attention to the balance of costs and benefits to society in achieving the desired air quality. He told the hapless group of employees and volunteers he wanted the Conference's report to be about twenty pages rather than a thousand pages like the Academy report, so that the advice it provided could be understood by laymen and would be reported in the press.

The Conference report, written in less than a month and immediately released by Handler, consisted of several dozen brief conclusory notes dealing with automobile emission controls and management of air pollution, written in Handler's style of posturing a health-risk issue as an example of the complexity of acquiring and using scientific information in political

decision-making. The report said using catalytic converters to meet the emission standards was feasible for hydrocarbons and carbon monoxide and probably feasible for nitrogen oxides, but problematic for nitrogen oxides because the industry had slowed down its development of converters. The Conference attendees concluded there was no evidence to justify relaxing the emission standards, and that it was important to examine the health effects of non-regulated pollutants. They also concluded fuel economy could be improved by modifying the converters, and recommended that emission standards be developed for trucks, motorcycles, evaporation of gasoline, and for stationary sources of air pollution such as electric power-generating plants.

The Texaco oil company sent Handler and the Senate committee a scathing analysis of the Academy's Conference report, specifically delineating many putative flagrant shortcomings, as determined by oil-industry scientists. In a covering letter, a Texaco official told Handler that since the Academy was presumed to be the ultimate scientific authority in the United States, the report should have been based on intense study and careful documentation, and reflective of cogent, relevant, objective, and scholarly analysis. But to the contrary, the official said, the report resulted from only a few hours of discussion by a committee that included no one involved directly with the manufacture of engines, automobiles, or the products which lubricate and fuel them.

The hasty production of a report by unqualified authors, according to the official, indicated the committee was not capable of carrying out its task and incompetent to opine on the matters it discussed, which was reproachable behavior by a supposed authority on scientific and technological matters.

The critique, written by the company's scientists, consisted of three dozen critical comments, each linked to one of eight conclusions in the Academy Conference report. Texaco's intense disagreement with the reasoning, interpretation, and conclusions in the Conference report was described and highly detailed in the critique.

The company's scientists said that although attainment of the statutory hydrocarbon and carbon monoxide standards was technically feasible, the report's conclusion that they were worthwhile was indefensible, considering the available evidence. The scientists argued that emission control standards should be viewed not as entities in themselves, but as they interrelate with air quality, energy requirements, and the national economy. According to the scientists, the report's predictions of the effects of the standards on fuel consumption conflicted with the predictions of all American automobile manufacturers. Furthermore, the Academy calculations of the costs entailed by the standards were invalid because they were based on faulty data and false assumptions. In view of the limitations and shortcomings in the Conference report, the company scientists said there was no rational basis for arbitrarily concluding emission standards for hydrocarbons and carbon monoxide are worthwhile.

They also accused the Academy of evading the basic questions of what nitrogen oxides standards are necessary and how they are justified, and argued that the present standard was indefensible regardless of whether or not its attainment was feasible.

The company scientists said the Conference report's claim that achieving the statutory emission standard for nitrogen oxides is probably feasible with catalyst technology was speculative and misleading because it implied the catalyst technology needed to achieve this goal on a mass production basis was imminent, which was untrue. Also untrue, according to the company scientists, was the Academy's assumption that the automobile industry had a practical method of testing each car as it comes off the assembly line to ensure that manufacturing variability didn't result in cars that failed to meet the standard; no such method existed. Considering these and other factors, the company scientists asserted that the credibility of the Academy's statement on feasibility could be seen as speculative, not factual.

The company scientists interpreted the report as evidence the Academy favored overly restrictive emission controls at the expense of energy-saving developments — a choice they believed was antagonistic to the country's best interests. Additionally, according to the company scientists, the failure of the Academy report to even question the use of catalyst technology similarly could harm public health and the economy. Since none of issues surrounding use of catalytic converters were addressed in the report, the company scientists contended it was irresponsible to support the emission standards, because converters were unproven, expensive, and wasteful.

The company scientists viewed the Academy report's estimation of the cost of removing sulfur from fuel as seriously wrong because it ignored the costs and consequences of the process, and the possibility that improved technology or less severe emission standards might obviate the need for low-sulfur fuels. In either case, a tremendous waste of capital, manpower, and construction would have needlessly occurred. Further, the company scientists pointed out, essentially all American petroleum producers and refiners predicted many small refiners would be forced out of business, which would be antagonistic to achieving the national goal of energy independence. The company critique concluded the Academy report erred by considering only health effects when it supported the establishment of emission standards while ignoring other important factors such as the time it takes to develop the remedial technology and the effects of the standards on the nation's economy. The Academy report also erred when it assumed that controlling harmful emissions within tolerable levels was more important than ensuring that such control should be cost-effective and only imposed upon society when there was a commensurate and needed benefit.

The Senate committee was notified by many national and international automobile manufacturing companies and associations, as well as companies in related industries, that opposed the conclusions reached in the Conference report. Scientists and economists representing these companies also attack Handler and the Academy on the basis that their policies and advice regarding emission control were unscientific and economically devastating. An official at Ford Motor Company told Handler and the Senate that, in his company's view, the conclusions and recommendations of the Academy report were completely contrary to the engineering and scientific data provided in in sworn testimony, and that Academy's conclusions contradicted many of the earlier findings of the Academy as reported in its earlier report. The official concluded that the Conference report was nothing

more than the personal opinion of the small group Handler assembled. He told Handler the attempt to use the conclusions of a one-day study, unsupported by evidence, to influence national policy was unworthy of the Academy.

The automobile industry Association expressed similar thoughts. The Association told Handler and the Senate committee that although the stated purpose of the Conference was to consider new and additional information, there was none in the report, and that although the facts were not new the conclusions in the Conference report were. The Association was particularly critical of Handler's career-long penchant to lace putative objective conclusions with subjective words such as should, ought to, and can be met. The industry scientists relied upon by the Association claimed the Conference report directly contradicted the findings of the previous Academy report on air pollution, made false claims regarding the results of their marginal-costs and marginal-benefits analyses, and made unsupported speculative assertions that the emission standards could be achieved while improving fuel economy. The Association rejected accusations that the automobile industry slackened its efforts to develop catalytic converters as baseless and contrary to reality. In turn, it accused the Academy of hypocrisy regarding its description of the industry's technology for controlling nitrogen oxides, its failure to consider questions regarding the relationship of pollutant effects on human health and cost benefits, and for basing the Conference report on mere unsupported opinion.

In polls of prestige, the Academy and the scientists it relied upon historically were highly ranked by the public. But in the period between when Handler entered public life and completed his first term as the head of the Academy, disenchantment with science and the Academy on the part of the public and the government set in and continually worsened. Handler, who was the most prominent and influential American scientist during the period, contributed significantly to the disenchantment, probably more than any other individual or the Academy itself. Successive Administrations and Congresses progressively saw Handler and the Academy as self-serving and unreliable, and both Departments of government developed their own in-house source of science advice. If Handler ever was a hero in the public eye, his popularity waned because he became more an autocrat and enemy of both nature and humanity, at least with respect to human health. The transition was emphasized and plainly displayed during Handler's mismanagement of the implementation of the Clean Air Act, which sent the last six years of his career and life into an irreversible decline.

During Handler's ascendancy to the leadership of the Academy, many people began to feel that science and technology had done as much harm as good, that in meeting one problem, too often it created more problems — DDT, cancer from food additives, nuclear reactors, side-effects and pollution caused by technology, were examples. The cornucopia Handler promised science would provide never developed. Oppositely, disappointments like the so-called war on cancer occurred. Years of work years and billions of dollars in research funds spent to study cancer produced only obtuse statistics and false claims of gains by Handler and others who stood to gain if research funds continued to flow. He never relaxed his intense efforts to raise money for his biochemical constituency, even

after it began to seem likely that what Handler called gains were actually a harbinger of permanent disillusionment.

Handler's plan was to make science an independent institution controlled by a self-perpetuating authoritarian leader and a committee of like-minded scientists, like the Academy, but with an independent annual budget guaranteed by law and complete freedom to decide what research would be done and who would do it, all with no explicit government oversight, like the Academy. But many developments combined to frustrate implementation of Handler's vision. *Silent Spring* appeared and its consequences permanently hovered over the landscape. Internecine warfare developed among scientists regarding the health and environmental consequences of technology and the side-effects of anthropogenic chemicals and electromagnetic energy in the environment. Controversy raged but Handler uniformly disfavored the interests of public health and favored those of institutional science, which happened to be identical to that of industry. Handler backed the wrong side in every dispute — whether smoking cause cancer, and the safety DDT, cyclamates, radioactive waste, food additives, air pollution, and virtually every other instance where a choice had to be made whether the health of the public or the profits of industry were to be favored when the choice was not obvious. Disputes developed between industry scientists and university scientists, adding to the public's distrust of science and scientists. Handler's most vivid illusion was that scientists had the necessary ability to resolve the disputes, but they continued unresolved only because the government refused to fund basic research. Science became less a scholarly activity by individuals and more a bureaucratic activity of teams serving industry and the military, and the short step from disillusionment to outright hostility was taken by many people. Handler's goal of advancing his ideological Cathedral of Knowledge was permanently thwarted by the reactions of a disillusioned public and a distrustful government that saw Handler was more or less a self-serving fraudster.

For several reasons, Handler's ambitions and personality made him the opposite of the ideal leader to arrest the change in the cultural climate of distrust of science then overtaking American society. He was significantly responsible for the cultural problem, and his characteristically arrogant behavior had worsened following a series embarrassing failures and defeats during the nineteen-seventies, capstoned by his bungling of the automobile emissions issue. Notwithstanding the cacophony he caused, Handler continued to believe he had the requisite knowledge to resolve the central problems of society

Handler's flaws and the shortcomings of the Academy as an advisor to the government were both plainly displayed when they attempted to perform contractual tasks regarding the technological feasibility and safe emission standards of air pollution from automobiles and the policies that governed them — tasks Handler avidly sought. He saw no reason to restrain himself from making outlandish promises and setting unattainable objectives regarding what the Academy committees he appointed and guided could accomplish. He was confident he could steer them through the maze of complex and controversial issues related to accomplishing the objectives he set, notwithstanding the issues were immensely complex matters that had so many dimensions even their number was unknown. The committees

sought what Handler promised — the requisite knowledge government needed to carry out rational decision-making — but found none. Undaunted, Handler fabricated knowledge that appeared to the ignorant to be what he promised. He smoothly reversed his strategy and adopted a pragmatic policy in which he defined safety as the concentration level of a pollutant that caused disease which cost less than the benefits of the technology that produced the pollutant. Thus, as happened in earlier cases involving public health that Handler managed, his ideology spawned error and corruption at the Academy, and he delivered only controversy and irresolution.

Handler's failure was only destiny — no other result was possible. He was motivated by a poisonous ideology and functioned in an intensely political and commercial environment. He indulged his fascination with the power of science and his office. But was blind to their limitations.