Chapter 17: Electromagnetic Risk Denied 1973-1977[1]

Philip Handler was a tireless proponent of biochemical reductionism, convinced that it offered the only legitimate framework for understanding biological processes. His scientific outlook, formed in the 1930s, rested on the premise that chemical energy was both necessary and sufficient to explain all biophenomena. From this premise, Handler did not merely doubt the biological relevance of electromagnetic energy, he rejected it as a deduction, reasoning that a reductionist model defined exclusively in chemical terms could not admit electromagnetic biomechanisms without undermining its own foundations. Handler's exclusion of electromagnetic energy adversely influenced both biomedical science and the professional fortunes of researchers who pursued alternative models in the study of emergent biophenomena. He left no meaningful space for the emergent-level experimentation or explanations, and used institutional force to marginalize these efforts. Handler locked in this way of thinking early in his career and adopted it as the hill he was prepared to die on.

Handler's commitment to reductionism shaped the way he intervened in questions involving health risks from exposure to anthropogenic electromagnetic energy. Whether assessing X-ray risks in the 1950s, the Moscow Embassy microwave emissions in the 1960s, or the low-frequency emissions of Navy's Sanguine–Seafarer antenna in the 1970s, Handler consistently framed the issue in reductionistic terms and discounted system-level approaches. His experience with electromagnetic energy began when he served as a consultant to the government's atomic energy agency, promoting biomedical uses of radioactive chemicals that emitted electromagnetic energy in the form of X-rays. Government animal studies proved X-rays caused cancers and birth defects, but Handler told physicians what he had been told by the agency — the dose of X-rays used for diagnosis was too small to cause harm and any risk was balanced by the benefit. He similarly adopted the agency's theory that X-rays caused cancer because they broke chemical bonds when they hit DNA, resulting in uncontrolled growth. Since the hit theory applied only to electromagnetic energy in the high frequency range of X-rays, Handler concluded cancer causation was simply an exception to the rule that electromagnetic energy was biologically unimportant, as was the obvious exception of electromagnetic energy at the relatively low frequency of light.

A decade later, when the U.S. embassy staff in Moscow were revealed to be undergoing continuous exposed to a Russian-generated beam of microwaves — electromagnetic energy at a frequency lower than light — Handler's reductionist outlook led him to deny the possibility that the microwave exposure was a health risk.

When consulted, he dismissed the possibility of biomedical consequences because the microwave levels were small and, according to his reductive ethos, a small dose of any agent — chemical or energy — had no biomedical relevance. Handler advised government officials that his view was in perfect agreement with Schwan's, who advised that that the microwave was not a health risk because it was too low to cause heating. By framing the issue as he did and incorporating Schwan's legerdemain as support, Handler defined the possibility of energy-induced health effects out of existence by confining biomedical relevance to physiological consequences that matched reductionist expectation. Supported by the Navy for many years,

[1] This is a preprint of a manuscript that will undergo proof-reading and copy-edi ng prior to publica on

Schwan had developed his story by modeling humans as copper spheres, assuming the only possible health risk was a thermal rise, and declaring that his calculations proved that all man-made electromagnetic energy in the environment was completely safe. Schwan's dogmatic exclusion of non-thermal effects was a perfect fit with Handler's ideology.
Their ways of thinking were not just close, they overlapped, as evidenced by Handler adoption of Schwan's rhetorical argument that since humans evolved in a sea of solar electromagnetic energy, they could not be harmed by additional man-made exposures.
Handler had used the same argument to defend the food industry's use of additives.

In 1968, the Navy announced Project Sanguine — a plan to build an immense antenna across Wisconsin to communicate with submerged submarines — and the Project immediately ignited fierce opposition. The Navy held numerous local meetings where its spokesmen contended the antenna, would be safe, just like the powerlines; quoting Schwan, they said there was no mechanism by which the antenna's electromagnetic energy could cause harm. But despite the Navy's efforts to assuage a range of health and environmental concerns, its promises the antenna would be safe, compatible with the environment, an economic boom, and important for national defense, the Sanguine was stoutly resisted by the public and the state's politicians. To calm the state-wide alarm, the Navy, working with Handler, sequenced three layers of expert judgment: an Academy committee he appointed consisting of Navy contractors, and charged to evaluate the feasibility of the antenna they were building; a second Academy committee he appointed, headed by Schwan, to evaluate the antenna's biomedical safety; a committee appointed by the Navy to reconcile the conflict that developed between the Schwan committee's assurances of safety and emerging scientific evidence — uncovered during animal and human studies sponsored by the Navy — that suggested an opposite conclusion. Read together, the three committee reports revealed how the question being asked was progressively narrowed — from "Will it work?" to "Will there clearly be human harm?" to "What interim research results merit further study?"—and how that narrowing shaped the public narrative regarding safety.

When doubts arose regarding whether the antenna would function as claimed, Handler agreed to rapidly provide an Academy feasibility assessment. He appointed a Committee of engineers economically linked to the Navy, including a chairman who designed the antenna, and the Committee's report concluded it would work as anticipated — exactly the endorsement the Navy sought under Academy aegis. The report, together with the Navy's Environmental Impact Statement that soon followed, magnified perceptions that feasibility and risk had been pre-judged from inside a closed expert circle. Wisconsin congressmen criticized the project as a "billion-dollar boondoggle," and critics faulted the impact statement for denying the possibility of health risks and environmental damage even though the Navy's gold-standard human and animal studies and environmental investigations were still in progress.

Political considerations forced the Navy to move the antenna project to Michigan, where its design was reduced ninety-five percent in land area and renamed Seafarer. When the issue of health risks surged to prominence in Michigan, Handler contracted with the Navy to appoint a committee to investigate the scientific basis of the concern. The Navy allowed Handler to determine the specific objective of the contract, and he chose determining whether existing studies provided **"**clear evidence of a harmful human effect," which was a fake version of the concerns expressed by the antenna's opponents because it did not engage the real problem —

health risks. Handler went even further and placed Herman Schwan at the head of a committee and populated it with current and former Navy officers, which further muddied the water, because it erased the boundary between independent scientific judgment and institutional self-protection, leaving the underlying risks more, not less, disputed.
Unsurprisingly, the committee's report aligned with long-standing Navy reliance on Schwan's thermal model, which confined risk to heating or shock and treated non-thermal effects as either nonexistent or biomedically irrelevant. The report went beyond consideration of the Seafarer antenna and also affirmed the propriety of Navy exposure hygiene in the context of any form of anthropogenic electromagnetic energy such as that from radars and antennas associated with communications and weapons control systems. The vast over-reach of Schwan's committee reinforced the sense that it was designed to mirror Handler's bias against any biomedical significance of electromagnetic energy as well as to support the Navy programmatic needs, and only magnified the complaints and concerns in Michigan.

The Navy, facing public distrust regarding the Sanguine-Seafarer antenna, and a wide range of results from relevant human and animal studies it sponsored, appointed a Committee to provide advice — one of whose members was Robert Becker. A two-day conference was convened in Washington, D.C. in December 1973 to provide an opportunity for Navy personal to describe the results of the studies to the Committee members. Information regarding ongoing and completed biomedical and ecological studies of the effects of the antenna's electromagnetic energy was presented by Navy spokesmen to the Committee, which evaluated it and made recommendations for future work. The presentations and evaluations were summarized by the Navy in a digest, the Proceedings, whose distribution was limited to the conferees.

Prior to the conference, in line with advice provided by Schwan and Handler, the Navy had expected that the studies would produce no genuine, scientifically observable effects in humans or animals exposed to the antenna's electromagnetic energy, but the opposite occurred. In a principal line of investigation, a field study of personnel at a Wisconsin antenna test facility found elevated serum triglycerides in seventy-five percent of the workers. The results became quite credible after controlled human studies at the Navy's Pensacola laboratory showed triglyceride levels rose consistently in ninety percent of the subjects after exposure for two days. The Committee stressed that because triglyceride levels were sensitive indicators of stress, follow-up studies should measure other stress markers. It emphasized the need for a suitable animal model before definitive human studies were undertaken. The Committee members agreed that human experimentation was ultimately necessary to verify the safety of the electromagnetic energy expected from the antenna.

In experiments at the University of California, Los Angeles, monkeys exposed to simulated antenna electromagnetic energy showed changes in brain electrical activity.
The Committee recommended further research using the antenna's modulation frequencies, which overlapped natural rhythms in the brain. Fish studies at the University of Maine determined that eels and salmon could detect the antenna's energy. Studies at a Naval laboratory in Warminster, Pennsylvania, showed that rats reared while exposed to vertical antenna energy had decreased weight gains. Altered concentrations of a liver enzyme and a brain enzyme, possibly linked to stress or growth suppression, were also observed in the study. Rats exposed to horizontal antenna energy did not exhibit decreased weight gains, suggesting

the effect depended on the direction of the energy. The Proceedings reported, “Dr. Becker stated that in studies ongoing in his laboratory they were also noting differences in the results that appear to be due to field orientation. It was the Committee's recommendation that careful studies should be undertaken to explore subtle alterations related to field orientation.” Results from a wide of studies in the areas of behavioral studies, physiology, biorhythms, genetics, growth and development, and ecology were presented and discussed.

The Committee’s major recommendations included replication of the reported effects, expanded animal studies on stress markers before undertaking broader human studies, and further exploration of field orientation effects. The Committee noted that concerns about exposure to the electromagnetic energy of the antenna could not be separated from the wider public debate about power lines, which also generated anxiety over electromagnetic energy — a linkage that reinforced the urgency of conducting more studies. According to the Proceedings, “This Committee went on record to recommend that” the Council in the Executive Office of the President that manages issues related to anthropogenic electromagnetic energy “be apprised of the positive findings evaluated by this Committee and their possible significance, should they be validated by future studies, to the large population at risk in the United States who are exposed to 60 Hz fields from power lines and other 60 Hz sources.” The Proceedings concluded the Committee’s judgement was that the Navy studies had produced scattered suggestive results — especially regarding increased levels of triglycerides, changes in brain electrical behavior, and growth. The Committee urged a focused program of rigorous, long-term studies to resolve uncertainties, and acknowledged the growing salience of electromagnetic issues in the broader context of public concern over power lines and environmental health.

Becker had commenced a series of rat studies in response to his concern that the commercial use of electromagnetic energy to treat orthopedic problems was premature because animal studies to evaluate undesirable side-effects had not been performed. He speculated that the body had a control and regulatory system mediated by an internally generated flow of electromagnetic energy, and that the system might be susceptible to interference from external man-made energy. Since the body was not evolutionally conditioned to detect and respond to electromagnetic energy of the type used in modern technology, he viewed such energy as a potential health risk that merited laboratory study prior to marketing. He had no immediate interest in experimentally addressing the questions of how the body detected man-made energy or how the energy caused disease — the reductionistic approach factored by Handler — because nonexistent effects have no mechanisms or causes. Becker believed the seminal question was whether an effect existed; his idea was that if and only if that were so, would it be rational and reasonable to investigate the range of the effects and their mechanisms. Thinking in this manner, Becker initiated experiments on rats that I conducted, and the results supported his hypothesis that the body’s regulatory system was susceptible to interference from external man-made energy. He learned at the Washington D.C. Conference that that the Navy had sponsored a similar rat study and observed a similar effect, further supporting his idea that such energy was a potential health risk.

The frequency of the electromagnetic energy used in Becker’s rat studies, 60 Hertz, was chosen because that energy and its’s control equipment were readily available; it was roughly the frequency used to stimulate bone growth, very close to that of the antenna, and exactly the same as that of powerlines. The strength of the electric component of the energy employed in

Becker's studies was more than ten thousand greater than that employed in the antenna study, but was roughly equal to that near the centerline of high-voltage power lines. Having learned that fact at the Washington D.C. Conference, Becker notified New York state agencies and power-companies of possible health risks from two proposed extremely high-voltage powerlines pending construction approval by a state agency He told the agencies to "be assured that responsible laboratory research does indicate that the electromagnetic energy is not a trivial environmental factor for living organisms, and that permission for construction should "be withheld until pending experimentation within the confines of the Sanguine project is completed and a true analysis of the risk obtained. Becker wrote, "The biological experimentation connected with the Sanguine project is not classified" and that he was sure the Navy "would be pleased to furnish you with complete information, particularly that which was discussed at a meeting on December 6 and *7* of this year."

Becker soon learned the Navy had restricted distribution of the conference Proceeding to conferees, and would provide state and company officials only the small subset of its research findings that was published. The state agency that regulated power lines sent a lawyer, Robert Simpson, to visit Becker, hoping he would agree to testify in the hearing about the health risks of the powerlines, based on his personal knowledge and opinions. Becker agreed on two conditions. I had been a part-time law student for four years and only recently graduated, and he wanted me also to testify.

Additionally, he had to secure permission from the Veterans Administration for us to participate in the hearing as a public service. After we received the necessary permission, and Simpson readily agreed to my participation, we both testified.

Working with Simpson, Becker gave his direct testimony in the form of a written statement in which he expressed his opinions about health risks related to man-made electromagnetic energy, and their biomedical basis. He explained why he thought the agency should evaluate the possible health impacts before approving the powerlines. In pertinent part, he testified:

Q. What have you been experimenting on, and for how long?

A. For the past 15 years we have been studying the effects on animals caused by a variety of different kinds of electromagnetic energy.

Q. How do these effects come about?

A. The basic reason is that the body has an electrical system which controls growth and healing, and is probably related to the perception of pain. There is evidence that the system also links biological cycles of behavior exhibited by humans and animals to the cyclic patterns of environmental electromagnetic energy that occur in nature. The physical properties of the cells of this electrical control system are such that it would be influenced by changes in the level of electromagnetic energy in the environment.

Q. Could effects occur in response to the electromagnetic energy from the proposed powerlines?

A. The strength of those energy levels and the duration of exposure to them are both far beyond the levels and durations that result from any other source of electromagnetic

energy man has ever built. Consequently the proposed powerlines pose the highest risk of biological effects.

Q. What is the medical significance of your conclusion?

A. From a medical viewpoint, our work and that of many others described in the literature represents a solid body of data indicating that living organisms are influenced by electromagnetic energy, and that such effects are likely to occur in the areas of growth, both cellular and of the total organism, and in the function of the central nervous system and cardiovascular system. The effects could occur directly, as when the energy interacts with a particular tissue and causes it to change from healthy to diseased tissue, or they could occur indirectly, as for example a stress response. Obviously, to answer particular questions such as the specific effects of different durations of exposure to various strengths of electromagnetic energy upon the health of the variable human population will require specific laboratory experimentation. These answers are not available at this time.

Q. Do you believe that the proposed powerlines would be safe if they were built as presently designed?

A. No, for the reason that its electromagnetic energy level will be in the range possibly productive of biological effects. I believe that chronic exposure of humans to such levels should be viewed as human experimentation, and subjected to those rules. I believe that the most prudent course to follow would be to determine the complete spectrum of biological effects produced by exposure to powerline energy. It should then be possible to establish firm levels of permitted exposure with regard to both the energy levels and the permissible duration of exposure.

My testimony was intended to support Becker by putting into evidence many relevant, published, gold-standard studies that reported biological effects caused by man-made electromagnetic energy. The results of forty experiments, including two from our laboratory, were described, and summarized in a Table listing the living systems studied together with their durations of exposure. In humans, the energy altered reaction time, triglyceride levels, psychological performance, and biorhythms; in rats and mice it affected brain waves, blood cells, growth rate, and enzyme levels.

The energy produced a diverse range of alterations in chickens, brain cells, amoebae, birds, worms, slime mold, bees, dogs, and monkeys. Every study described in the testimony — some of which were produced as part of the Sanguine project — directly contradicted Handler and Schwan because the energy levels used were vastly too low to cause heating or shock, and thus were dogmatically illegal

In each study, the biological measurements were made using standard laboratory methods, and the data obtained was analyzed using standard statistical methods; the possibility that the reported effects were due to chance was shown to be less than five percent, the conventional standard used in science, and the studies were subjected to peer-review prior to publication. In most cases, the distance from the power line where the energy used in the study would occur was beyond the proposed power line right-of-way. Moreover, the exposure times employed in the studies were relatively brief compared with the exposure duration that would

be experienced by those living or working in the vicinity of the proposed powerlines. The logical implication of the energy level and exposure duration, taken together, was that the effective dose of electromagnetic energy received by the public from the proposed power line would be significantly greatly than that received by the living systems described in the testimony. The conclusion was that the power-line's electromagnetic energy would likely cause biomedical effects in exposed people, as it had in animals, but that exactly what effect would occur in any particular person, or what length of exposure would be needed to produce an effect, were unpredictable, and would remain so indefinitely, until science developed new methods of research not presently envisioned.

Gold-standard studies of the biological effects of man-made electromagnetic energy.
Peer-reviewed studies, including two from Becker's laboratory, that were described in testimony during a powerline safety hearing.

Investigator	Institution	Animal	Duration of Exposure
Altman	Univ. of Saarbrucken	Guinea pigs	13 days
Altman	Univ. of Saarbrucken	Mice	3 days
Bassett	Columbia Univ.	Dogs	28 days
Bassett	Columbia Univ.	Humans	3–6 months
Bawin	UCLA	Brain tissue	20 minutes
Becker	VA Hospital Syracuse	Mice	6 months
Becker	VA Hospital Syracuse	Rats	1 month
Beischer	US Navy	Humans	1 day
Blanchi	Turin Univ.	Mice, rats	1000 hours
Durfee	Univ. of Rhode Island	Cells	3 days
Friedman	VA Hospital Syracuse	Humans	Several hours
Friend	US Navy	Amoebas	10 minutes
Gann	Johns Hopkins	Cells	7 days
Gann	Johns Hopkins	Dogs	5 hours
Gavalas-Medici	UCLA	Monkeys	Several minutes
Giarola	Texas A&M Univ.	Chicks	28 days
Gibson	US Navy	Humans	1 day
Goodman	Univ. of Wisconsin	Slime mold	600 days
Graue	Bowling Green Univ.	Birds	Several minutes
Hamer	UCLA	Humans	Several minutes
Hilme	Univ. of Berlin	Rats	10 days
Knickerbocker	Johns Hopkins	Mice	10 months
Konig	Tech. Univ. of Munich	Humans	Several minutes
Kruger	Texas A&M Univ.	Chickens	4 months
Lang	Univ. of Saarbrucken	Mice	56 days
Lott	N. Texas State Univ.	Rats	90 minutes
Mamontov	Moscow Medical Inst.	Mice	4 hours
Marsh	Univ. of Iowa	Flatworms	5 days
McCleave	Univ. of Maine	Fish	Several minutes
McElhaney	West Virginia Univ.	Rats	28 days
Moos	Univ. of Illinois	Mice	10–150 days
Noval	Temple University	Rats	1 month
Riesen	IIT Research Inst.	Cells	40 minutes
Solov'ev	USSR	Mice	Several hours
Southern	Northern Illinois Univ.	Birds	2 minutes
Spittka	University of Berlin	Rats	Several minutes
US Navy	Naval Research Unit 4	Humans	Several months
Warnke	Univ. of Saarbrucken	Bees	Several days
Watson	University of Wales	Chicks	9 days
Wever	Max Planck Institute	Humans	8 weeks

Herman Schwan was the main expert hired by the power companies to represent their interests. He was born and raised in Germany, and studied biophysics in the laboratory of his mentor, a well-known Nazi. In 1940 Schwan completed his doctoral research, which dealt with the physical effects of microwaves, especially heating, on cells and tissues, and continued his work on microwaves during the War, escaping the draft because of the influence of his mentor, eerily paralleling Handler's experience.

After the War, Schwan became a person of interest to U.S. officials because of his experience with the biological effects of microwaves, and was sponsored for U.S. citizenship by the Navy, which hired him as a researcher at the Philadelphia Navy Yard.

He soon joined the faculty of the University of Pennsylvania, where his salary was paid by research contracts between the University and the Navy — essentially, the same process by which Handler had been paid by the National Institutes of Health through Duke.

In due course, Schwan published a series of theoretical articles concerning the relationship between the electrical properties of cells and tissues, and the amount of heat deposited when exposed to microwaves, as quantified by the resulting increase in temperature. His ideas were tested by Sol Michaelson, a veterinarian who exposed dogs to microwaves to determine the highest level of exposure they could tolerate before the temperature-regulatory system failed and they died of heat stroke. In the 1960s, during the Moscow Embassy incident — which accelerated the government's interest in the consequences of exposure to microwaves — Schwan announced he had solved the problem of identifying a safe exposure level. He conceptualized a human as a copper sphere that had some electrical properties of muscle tissue, and calculated the temperature increase caused by exposure to a beam of microwaves; since the spherical model had no temperature-regulatory system, Ohm's law required that *any* level of microwaves would increase the temperature, so there was no such thing as a nonthermal level of microwaves. Schwan imagined that if sphere were alive it would be completely safe if the temperature rise caused by a microwave beam were not what he described as "uncomfortable," and he arbitrarily defined that condition as the temperature rise in the sphere when it was exposed to the summer sun. Reasoning in this manner, Schwan determined experimentally that the safe level, as he defined it, was ten milliwatts. In publications and public forums, essentially without opposition, Schwan repeatedly made a military-friendly ideological argument of the type he had learned from Handler — that ten milliwatts should be adopted by the military as the safe exposure level until incontrovertible empirical evidence of health injuries appeared. During an amazingly short time period, in the absence of any gold-standard animal studies to validate Schwan's putative safety level, it was adopted by the military for its personnel. Soon thereafter, it was extended to civilians by federal agencies that regulated microwave ovens, radio and television antennas, walkie-talkies, the forerunner of cellphones, and myriad other sources of man-made electromagnetic energy. In this manner, Schwan set the national standard in the U.S. for exposure to anthropogenic electromagnetic energy for the twentieth century and, at least, for the first half of the twenty-first century.

In 1974, in the context of an Academy committee to which Handler had pointed him, Schwan extended his spherical model to the low-frequency electromagnetic energy produced by the Sanguine antenna and concluded it would be completely safe.

A year later he was hired by the power companies to oppose Becker and me in the powerline hearing regarding the safety of the low-frequency electromagnetic energy produced by powerlines, and he reached the same conclusion in his direct testimony. He said:

Q. Could you outline your major areas of specialty?

A. I am a biophysicist. My major areas of specialty include: mechanisms of electricity conduction in tissues, cells, subcellular organelles, and biological molecules; effects of electromagnetic energy on cells and biological molecules; effects of electromagnetic energy on biological systems in general and man in particular. The electromagnetic energy includes that from powerlines, radio and television antennas, and radar. I am aware of environmental health considerations that are under debate in these areas. I am concerned on the one hand to see man appropriately protected and on the other hand to provide protection at a reasonable and economically justifiable cost to society.

Q. What was the methodology utilized which permitted you to conclude with certainty that the electromagnetic energy from the proposed powerlines will be completely safe?

A. My theoretical analysis showed that the energy levels which will be caused inside exposed persons will be far too low to produce any biological effect whatsoever.

Q. It has been alleged there is potential for deleterious biological effects from powerlines fields. Do you agree with this statement?

A. No, I certainly do not agree. Extensive background and experience exists in the general field. It is reported that the attractive powers of lodestone were observed about 3000 BC. Written records mentioning the electrical properties of amber come from a Greek, Theophrastus, about 300 BC. In 1600, Gilbert, of England, deduced ideas concerning magnetic fields and polarity. Further, discovery and organization of this earlier knowledge into scientific principles took place substantially in the 1700s and 1800s by such scientists as Volta, Faraday, Ampere, Gauss, Galvani, Henry, Kelvin, and Maxwell. Muscle contraction of a frog under influence of electric discharges was demonstrated by Galvani. Maxwell developed his electromagnetic theory about 1870; these principles are universally accepted today. These principles coupled with biological principles form a body of information that has been scientifically tested and proven. Based upon this information we can predict that there will be no biological effects from the electromagnetic energy emitted by the proposed powerlines. Consequently, it is my firm conclusion that exposure to the proposed powerlines' electromagnetic energy will be completely safe.

Q. It has been claimed that effects of electromagnetic energy have been observed to take place at the system or organ level. Have you studied these claims, and if so, would you state your conclusions?

A. The support for the postulation of such effects is derived from studies which are either incomplete and/or of poor scientific quality. The studies claiming to have demonstrated the effects are characterized by a lack of proven cause-effect relationships and inconsistent experimental results. Additionally, there is no basis in the laws of physics to substantiate the conclusion that such effects are harmful.

Sol Michaelson was the second expert witness offered by the power companies. He was a colleague of Handler within the group of investigators assembled in the early 1950s by the atomic energy agency to commercialize the use of radioactive chemicals. Michaelson's research involved exposing dogs to lethal doses of X-rays, but after joining with Schwan in 1957, under contract with the Navy, he began studying the heating effects of microwaves on dogs. He proved they could kill dogs by inducing heat stroke but contended exposure below Schwan's safety level was safe because it was what he called a "nonthermal exposure level." When Michaelson began his microwave studies, evaluation of its health-risk was in the military domain but rapidly becoming a concern of industry, which was on the cusp of a great increase in commercialization of man-made electromagnetic energy. He became deeply involved with industry as an advisor, consultant, contractor, and expert witness, and rocketed to national prominence. In 1975, he extended his opinion about the safety of electromagnetic energy to powerlines. In his direct testimony Michaelson said:

Q. Have you formed a professional opinion as to whether the levels of electromagnetic energy that will be produced at ground level by the proposed powerlines will be a risk to health and safety, and if so, what is that opinion?

A. Yes. It is my opinion that there will be no hazardous biological effects resulting from exposure to those levels.

Q. What is the effect of electromagnetic energy on animal tissues?

A. It produces a tiny amount of heat that is of no physiological consequence because the body can handle it; according to Dr. Schwan, it is impossible for the powerlines to produce enough heat to be hazardous.

Q. Is there a distinction between a biological effect and a hazardous effect?

A. The fact that a living organism responds to many stimuli is a part of the process of living. Such responses are examples of biological effects. Since biological organisms have considerable tolerance to change these effects may be well within the capability of the organism to maintain a normal equilibrium. If, on the other hand, the effect is of such an intense nature that it compromises the individual's ability to function properly or overcome the recovery capability of the individual, then the effect may be considered a hazard. Thus we must first ask if there are effects, and then if there are, we can ask if they are hazardous.

Q. Have there been studies to determine the biological effects of electromagnetic energy like that from the proposed powerlines?

A. Yes. Most of those are associated with Project Sanguine. One of the studies that has received much undeserved attention is the Beischer study. The only observed change in his subjects was an increase in serum triglycerides, and the importance read into this change is unwarranted.

The third power-company expert witness, Morton Miller, was a botanist who studied the roots of bean plants and was one of the few university researchers in the Sanguine Project who found no effects. In his testimony Miller said:

Q. Please describe your role in this case.

A. My role was to advise the power companies as to whether or not I believe there are potentially significant biological effects due to exposure to the electromagnetic energy from the proposed powerlines. Because of my personal involvement in the Project Sanguine program, I have focused my analysis on the biological research conducted in connection with this project.

Q. What methodology did you use in forming your opinion?

A. I examined the biological literature dealing with the effects of electromagnetic energy, and I also drew on my own research. In addition, I visited an operating powerline to assure myself that I had not overlooked any obvious potential effects on plants. As a trained observer, I was in a position to see any adverse effects on plants. I also consulted with Dr. Herman Schwan and Dr. Sol Michaelson.

Q. How would you summarize and interpret the completed Sanguine studies?

A. No consistent effects have been found. Hence the results of the studies indicate that there are no adverse health or safety effects to living organisms as a result of exposure to the electromagnetic energy.

Q. Have you formed a professional opinion regarding the safety of the proposed powerlines, and if so please state that opinion?

A. Yes. It is my opinion that the electromagnetic energy from the proposed powerlines does not pose an unreasonable risk to public health or safety.

In his direct testimony, Schwan said that health risks from anthropogenic electromagnetic energy were impossible according to the laws of physics. He was only the latest of a long line of arrogant physicists who made foolish pronouncements about biological phenomena that included not only bioelectromagnetic interactions but also long-range biological signaling, complexity in self-organization, and nonlinear and emergent behavior. Schwan's statement, like the historical precedents, was made without engaging in any relevant empirical work.

Physicists had long cultivated a reputation for issuing confident — and often dismissive—pronouncements about what biological systems could or could not do, a habit born from the extraordinary success of physical theory and the belief that all living processes would ultimately yield to reductionist laws. Philip Handler's biochemical reductionism flourished within this intellectual climate. Trained in the 1930s, when the mechanistic triumphs of physics and chemistry seemed to promise a unified explanatory framework for life, Handler internalized a worldview that regarded emergent biological phenomena as derivative rather than fundamental. That stance made him particularly receptive to the arguments of Herman Schwan, whose physics-based reasoning aligned with Handler's conviction that only chemical and physical mechanisms deserved scientific legitimacy. Robert Becker's work, by contrast, identified regulatory roles for bioelectromagnetism that could not be reconciled with the prevailing dogma. Yet instead of prompting a re-examination of that dogma, Becker's findings were marginalized in part because Handler's authority amplified the physics-derived skepticism embodied by Schwan, solidifying an institutional posture that denied the legitimacy of emergent-level explanations. Handler's reductionism thus did not merely reflect a philosophical

preference; it became an enforcement mechanism that privileged the certainties of physics over the complexities of living systems. In this dynamic, the authority of physics was not merely a background influence but an active filter that shaped what counted as credible evidence. It culminated in Schwan's unequivocal testimony that any health risks from anthropogenic electromagnetic energy were *impossible* according to the laws of physics.

Neither Michaelson nor Miller were serious witness; they were retained by the power companies to provide what they called "biological support." They both had conducted experiments in which living systems were exposed to electromagnetic energy, but it was an obvious exaggeration for them to claim their work was relevant to safety considerations regarding human exposure. Michaelson contended he had verified Schwan's microwave safe-exposure level, even though the endpoint in his dog studies was death by heat stroke — he literally cooked them alive. The best Michaelson could logically conclude from his studies of different exposure levels was that the dogs did or did not die from too much heat being created in their bodies by the microwaves he beamed at them. Miller was a toady, hired by the power companies only because he had a role in the Sanguine Project and was willing to proudly testify he found nothing, which I told him, at the time, was no achievement because even my ninety-year old grandmother could find nothing. Nevertheless, Miller irrationally contended that the lack of effects in his bean-plant studies provided persuasive evidence powerlines "posed no unreasonable risk." The insistence of Schwan, Michaelson, and Miller that the powerlines would be completely safe in the face of numerous scientific studies showing electromagnetic energy caused biological distress recalled the miner who dismisses the dying canary as irrelevant to human breathing.

It was Simpson's responsibility to impeach Schwan, Michaelson, and Miller. He asked for my help, and I agreed to design his cross-examination and sit beside him during its implementation to provide advice when necessary. In Schwan's cross-examination, he was systematically presented with a torrent of published experimental facts, each of which, if valid, contradicted his testimony that biological effects of electromagnetic energy were impossible. Schwan had to criticize and derogate each such fact, which he did at the expense of his credibility, and with progressive anger. By the third day of his cross-examination, Schwan was so frustrated and indignant at the questions he was required to answer, he abruptly stepped down from the witness stand, left the courtroom and never returned, thus removing any impact his testimony might have had in favor of the legal position of his clients. Michaelson self-destructed in other ways during his cross-examination: trying to defend his attacks on Navy scientists who reported human metabolic effects of Sanguine energy; refusing to concede obvious points to Simpson; answering questions in half sentences; acting as an expert in areas unrelated to his expertise. Miller's direct testimony was inherently indefensible, although he tried during cross-examination. His assertion that the powerlines "posed no unreasonable health risk" was based on inspection of existing powerlines and several Sanguine studies that found no effects, including his bean-plant study. It was nonsensical to suggest safety was something a botanist could determine by visual inspection, or to argue that the absence of an effect at a very low exposure level, the Sanguine antenna, implied there would be no effect at a very high level, the powerlines, and those points were established early in the cross-examination.

Miller's tactic of simply ignoring numerous studies, Sanguine and otherwise, that found effects was even less rational — it was as if he though he wouldn't be confronted with them during his

cross-examination. Simpson needed only to invoke the studies, one by one, and ask a preformulated series of question to successfully impeach Miller. Perhaps Miller's most serious limitation was his inability to express himself coherently. During direct testimony he testified the powerlines "posed no unreasonable risk." During cross-examination he denied there were "reasonable risks," but refused to change his testimony to "no risks" because he expressed a belief there might be risks that were neither "reasonable" nor "unreasonable," even though he could not explain what they might be. Simpson's efforts to impeach Schwan, Michaelson, and Miller were successful beyond our fondest expectations [2].

In December 1975, a Wisconsin senator, speaking in the Senate, released the Proceedings of the December 1973 Sanguine conference. A firestorm of public and political opposition to the massive antenna project ensued, and the Navy quickly turned to Handler for help. He appointed an Academy committee he said would provide an objective, expert, opinion regarding the safety of the antenna, but his conduct contradicted and exposed as false the assurances he gave about the committee's neutrality and scientific rigor. Handler chose J. Woodland Hastings as chairman — a biochemist and friend who shared his view that electromagnetic energy was biomedically insignificant — and selected Herman Schwan, Sol Michaelson, and Morton Miller as members. The electromagnetic energy of the Sanguine antenna would be more than a hundred thousand times weaker than that of the powerlines which they testified would be completely safe; even small children could foresee the witnesses would opine that the antenna would similarly be safe.

With one exception, Handler's other appointees, though credentialed in their respective fields, lacked relevant expertise and thus were unlikely to challenge the prevailing view. In effect, the Hastings committee Handler appointed was a version of his 1972 Schwan Academy committee, but strengthened by the addition of more biased members and numerous additional members — it was largest committee Handle ever appointed. The additional members were patently unqualified to opine regarding the safety of the antenna, but their scientific credentials created a look of legitimacy. The guise tended to assuage the concerns that forced the Navy to seek Handler's cooperation, thus helping him to carry out a ceremony of confirmation. As with Handler's first two Sanguine committees, when he appointed the Hasting committee he sought to safeguard the political and military interests in the antenna project. Similar to the first two committees, even before the Hastings committee held its first meeting, the predictability of its conclusions revealed he would achieve his goal.

The process that ensured the Hastings committee would reach the conclusion desired by Handler and the Navy wasn't developed specifically for that purpose. Early in his presidency, as a means of controlling the Academy's bureaucratic machinery, Handler developed a procedural

[2] The power company that hired Schwan, Michaelson, and Miller was denied permission to build a powerline. The second powerline in the hearing was — which was owned by the State of New York — received permission, subject to a set of rules aimed at protecting public health from exposure to electromagnetic energy. See *Electric Wilderness*. Andrew Marino and Joel Ray, Cassandra Publishing, 2011.

method to regulate the boundaries of scientific legitimacy for the purpose of controlling the advice proffered by Academy committees. Now in his sixth year as Academy president, he had refined and repeatedly deployed the procedural machinery, which transformed uncertainty into consensus and consensus into authority. Handler created the machinery as part of his effort to shape the Academy into an administrative instrument for implementing his ideology and exercising authority. He perfected a system in which the composition of committees, the framing of questions, and the language of objectivity itself determined in advance what science would be allowed to conclude. Handler's system for indirectly shaping outcomes was based on manipulating the *process* rather than the *content*. Instead of openly declaring which scientific view was correct and why, he appointed committees, selected members, framed agendas, and worded mandates in such a way that the orthodox or officially acceptable position would inevitably emerge from the process itself. By thus defining orthodoxy by procedure, Handler established what counted as scientific truth or consensus not through open inquiry, but through administrative design — committee composition, report guidelines, and authority. The putative truth produced by Handler's control architecture reliably transformed his beliefs or the desires of his agency patrons into scientific consensus — the Navy's interest in the Sanguine antenna was no exception.

When Handler appointed the Hastings committee in the beginning of 1976, he was no novice at managing scientific controversy, but rather was operating at the height of his procedural mastery. Six years into his presidency of the Academy, he had transformed the use of ad hoc committees into an effective technique for shaping scientific orthodoxy through process rather than argument. Whenever a politically sensitive scientific question threatened to destabilize the reductionist consensus he had created and was intent on defending, Handler ignored the scientific issues and constructed the appearance of balanced deliberation while quietly designing a committee from which only one answer could plausibly emerge. Thus, his decisions about committee membership were not incidental administrative choices — they were the entire strategy. The Sanguine antenna issue, with its nation-wide publicity, potential impact on health or the environment, and its effect on the public's perception of the Academy and science itself, was the latest and perhaps the most consequential application of Handler's procedural methodology. It had become his signature instrument for controlling the work-product of Academy committees, and now faced its strongest test yet. The stakes were far greater than just the impact of an antenna. What hung in the balance was the credibility of the Academy as the nation's brain bank, the public's confidence in science as an impartial enterprise, and continuation of the Navy's lucrative stream of research contracts.

By the time the Hastings committee was announced, Handler's management of the Sanguine affair had assumed the form of a sequence of authoritative pronouncements. The Academy had already issued two determinations that neatly aligned with the objectives of Handler and the Navy: the Booker committee had certified the antenna's technical feasibility and the Schwan committee had assured its biomedical safety. Each committee had been organized to examine only the dimensions of each problem that were compatible with an outcome favorable to the Navy. Yet public anxiety persisted, and with it the risk that the Academy's authority might be drawn into question. To contain the matter without dealing with its substance, Handler created the Hastings committee and couched its mandate in terms of

clarification but whose function was closure. Handler's method at this stage of his Sanguine involvement was not to resolve scientific uncertainty but to neutralize it through process.

Each Sanguine committee Handler appointed and presented as an independent inquiry, served to reinforce the illusion of iterative refinement when in reality the conclusions were embedded in the framing of the questions themselves. The sequence of Academy inquiries transformed an unresolved scientific problem into a narrative of orderly reassurance. Under Handler's orchestration, procedure became a substitute for proof. His committees did not adjudicate evidence — they managed its meaning, converting potentially destabilizing findings into bureaucratically contained affirmations of stability. Through this mechanism, Handler equated the Academy's procedural order with the moral authority of science itself. To question the Academy's findings was, in effect, to question the very legitimacy of scientific reason.

The outputs of the first two committees, each bearing the aegis of the Academy, served not as instruments of discovery but as guarantors of orthodoxy, and the composition of the Hastings committee gave every indication that it was metaphysically certain to follow the pattern. Handler was a wizard at exploiting the public's faith in scientific method to reinforce his ideology of science — one in which reductionism and technocratic optimism were indistinguishable from truth. The creation of the Hastings committee did not signal a reopening of debate but the final act of containment. It was designed to absorb what remained of public concern and transform it into administrative routine. Handler's aim was to preserve the image of a rational, self-correcting scientific establishment at a moment when that image was imperiled. The Sanguine controversy, more than any before it, forced Handler to prove the Academy's mastery over the intersection of science, policy, and public trust. Whether the committee would deliver the expected reassurance or result in a disaster like that created by his Automobile Emissions committee remained to be seen, but the architecture of the creation of the Hastings committee left little doubt about the outcome Handler intended.

Despite Handler's raucous controversies, continuous string of defeats and embarrassments, and worsening personal health problems while president of the Academy, he wanted a second term in office. Since his institutional authority was essentially absolute, it was unsurprising he was reelected unanimously with fewer than ten percent of the Academicians voting. Handler's acceptance speech was pregnant with his discontents regarding science and federal science policy. The speech revealed Handler's frame of mind and the context within which he confronted the antenna issue and managed it, employing the process he designed and used many times previously — defining orthodoxy by procedure.

After humbly thanking the audience for his reelection, Handler described a litany of his discontents. He said he believed American science was not as strong as it should be due to economic, political, and social problems. He contended that extreme environmental policies were leading to marginal costs outweighing benefits, and that advocates for balanced approaches were not heard. He said the public's declining faith in science had not significantly affected the Academy's reputation, but could do so in the near future. Handler criticized a recent book about the Academy in which his management style was described as biased, saying the book emphasized "minor flaws" and ignored the Academy's "positive contributions." He portrayed the Academy's historically responsive stance to agency problems as too passive and outdated, and touted his policy of proactive attempts to exercise leadership in determining

national science policy. Handler expressed frustration with the lack of a dedicated White House office for science and technology, which was continuing despite his recommendations that the office be created, made independent of executive control, and provided a guaranteed budget. He lamented that congressional support for basic research was diminishing in favor of projects with immediate applicability, and protested policies that redirect funds from basic research toward applied research programs. Handler expressed irritation with a proposal that would authorize the Congress to change the objectives of federal research grants, likening it to authoritarianism, and dissatisfaction with the absence of increases in research budgets. He defended the Academy's role in assisting Russian scientists whom he believed were being mistreated by their government, and recommended that the President and the Congress support his position. Handler opposed sending food to starving nations, arguing the money spent on food should be spent on extensive research programs to develop technology that would allow the nations to grow their own food. He blamed the Senate committee that wrote the Clean Air act for the mistakes the Academy made when it evaluated the feasibility of the automobile exhaust regulations stipulated in the Law. Handler expressed grave concern that the Academy's legal battles — which involved demands the Academy's decision-making process be transparent, the biases of committee members be revealed, and that they explain the basis of their decisions — might weaken its unique role as an advisor, and contended the Academy's privacy must be protected to ensure the quality of its advice to the government.

Handler's acceptance speech exuded a lofty self-importance, portraying the Academy as a singular, almost sacred institution standing above all others. His tone suggested the Academy's uniqueness endowed it with an exclusive right — and even a moral duty — to dispense wisdom to the nation's leaders. Beneath his formal civility there was a sustained implication that the Academy was not merely an adviser to government, but an arbiter of truth — as if it were God's instrument of reason in what Handler said was a "cynical, disbelieving world."

At the beginning of his second term as Academy president, just after experiencing a stunning rebuke from the automobile industry regarding his mis-management of the of the tasks he contracted with a Senate committee to perform,

Handler faced the latest controversy involving the Navy's antenna Project. Ostensibly, his contract with the Navy was to manage an inquiry into the environmental and biomedical effects of the electromagnetic energy emitted by the Sanguine antenna.

In actuality, the inquiry — which was based on his procedural method for defining orthodoxy — was a foregone verdict disguised as investigation. The true function of the inquiry was not to discover truth but to certify safety, thereby insulating the Navy's antenna program from legal and political obstruction. Every structural feature of the Hastings committee — its membership, its timetable, its paucity of pertinent scientific information — served this purpose.

Handler's attempt to administratively construct scientific objectivity was exposed in a March 1976 open letter Becker, with my help, sent to Handler through his assistant. With a courteous tone —"Respectfully submitted" — and a forensic precision that made it impossible to mistake the accusation, the letter began with arithmetic clarity. Of the committee's sixteen members, thirteen possessed no experience whatsoever in the study of biological responses to man-made electromagnetic energy.

The remaining three members — Herman Schwan. a physicist, Sol Michaelson a veterinarian, and Morton Miller, a botanist —were not neutral but paid advocates of the proposition that all

man-made electromagnetic energy was entirely safe. Each had served as a contractor, consultant, and witness for the Navy and for electric-utility companies, and each had repeatedly sworn under oath that exposure to anthropogenic electromagnetic energy posed no risks to health or safety. The letter quoted their own words, allowing them to convict themselves. Schwan had insisted on theoretical grounds that the energy "could not" influence living systems, Michaelson had contended that "no demonstrable biological effect" existed except heat, and Miller had given assurances that existing knowledge was "adequate to insure the public that there will be no unreasonable risks." Their statements — particularly Schwan's, who was the only serious pundit in the group — delineated a reductionist creed that only thermal or chemical mechanisms could be real, and that phenomena unexplainable by those means were, by definition, illusory. From the facts concerning the backgrounds of committee members Handler appointed, the inference drawn in the letter was that the committee would conclude the antenna was completely safe unless independent investigators who had reported biomedical effects of electromagnetic energy were added to balance the committee. The implication in the letter was that the conclusions of the Hastings-Schwan committee were implicit in its membership, and would be in accordance with Handler's desires and value system.

Having established the mechanism of bias, the letter focused on the supporting structure of suppression. Cited in the letter were the Johnsville Project, a semi-secret Navy study from 1970 to 1974 whose data had been withheld, and the Beischer investigations, which had reported elevated triglyceride levels in humans exposed to electromagnetic energy — findings that were neither replicated nor publicly refuted.

The selective disappearance of such research, it was argued, invalidated the Navy's claim that existing evidence demonstrated safety. The pattern identified in the letter was clear: inconvenient data were buried; compliant scientists were elevated; committees were staffed to guarantee continuity between ideology and conclusion.

The letter's three closing paragraphs were restrained but explanatory of the conclusion, "The composition of the committee is inimical to the pursuit of truth." In the first, since the only sources of information of the Hastings-Schwan committee would be documents provided by the Navy and Handler's staff, the committee must be primarily investigative rather than adjudicative, assuming the process is genuine. But there is "an apparent dearth of staff, money, and time necessary to conduct an investigation." The second paragraph insisted that no honest inquiry could yet claim to know the biomedical consequences of the antenna. The letter pointed out that the Navy had not respected the "Priority 1 Urgent and Absolutely Necessary" recommendation for human research made in the Proceedings of the Navy committee, which was empaneled after the Schwan committee appointed by Handler wrote its report alleging on the basis of physics the antenna would be completely safe, but before Handler created the Hastings-Schwan committee. The third paragraph contended, on the basis of the existing literature, "We believe the electromagnetic energy from the Sanguine antenna may cause biological and ecological effects, and that a great deal more research is needed." The Navy's research program proved Sanguine electromagnetic energy could affect the physiology of living systems, which made more credible the possibility the antenna would cause biomedical and ecological effects. "It therefore seems impossible to us to sustain the view that the research done to date is adequate to support a decision in favor of building the Sanguine antenna."

The composition of the Hastings committee revealed, with unusual clarity, the procedural machinery Handler had refined over years of managing scientific controversies. His most telling move was the appointment of Schwan — a physicist whose involvement with the process by which electromagnetic energy heated living and non-living material predated World War II — to a committee ostensibly charged with bringing independent scientific judgment to the Sanguine antenna. Handler launched Schwan as a *Manchurian Candidate* — someone appearing to act independently, but strategically placed to serve Handler's agenda. This decision, and the deliberate failure to appoint anyone capable of opposing Schwan ensured that a single, carefully selected operative, outwardly indistinguishable from a neutral expert, would steer the committee toward a predetermined outcome. Schwan's presence provided the illusion of impartiality while guaranteeing the protection of Handler's reductionist orthodoxy and the Navy's preferred conclusion. In a group deprived of any genuine counterpoint—no advocate for emergent biological phenomena, no investigator familiar with anomalous biological effects, no one prepared to challenge the engineering definition of health risk—Schwan was free to operate as a programmatically reliable instrument. His appointment made clear that the committee's task was never to investigate whether the antenna posed biomedical or environmental risks, but to dress a foregone judgment in the procedural garments of scientific legitimacy. In that sense, Schwan's role exposed the deeper architecture of Handler's method: control the process with sufficient precision, and the outcome becomes inevitable while still bearing the authoritative seal of the Academy.

Three months later, the scientific public encountered the same controversy through a very different lens. Handler's attempted to establish what counted as scientific truth regarding the Sanguine antenna by administratively designing the Hastings-Schwan committee was described in an article in the journal *Science*. The article was based on the letter and claimed, "Critics Attack National Academy's Review Group," and presented the dispute as a symmetrical quarrel between "critics" and "distinguished members of the committee." The headline itself performed the first act of distortion: the objectors were attackers, the committee was the Academy. The article reprised the background of the Navy project and the allegations in the letter — that the committee was loaded with members who had already declared electromagnetic energy harmless — but framed the allegations not as evidence of Handler's intentions but as a clash of opinions. *Science* quoted Hastings calling the charge "ridiculous" and asserted that the sixteen-member group represented "a reasonable balance of viewpoints." The journal did not contact Becker, but interviewed Schwan who said it is "an awful thing" for the Academy to ask what stands he has taken on an issue, "It intimidates my freedom of expression. Where's the borderline between such things and what happens in Russia?" Miller told *Science* be considers the allegations about him to be "slanderous to my integrity, a personal attack which I really resent" because the Seafarer antenna is "entirely different" from power lines.

What had been exposed in the letter as Handler's systemic result-driven committee design was repackaged in the article as no more than a procedural imperfection. The article presented the controversy as a difference of perception rather than of power, implying that the accusation Handler had rigged the committee, if indeed it had done so, was an unintentional administrative error, and nothing deeper.

By presenting the controversy as a difference of perception rather than of power, the journal converted Handler's bias into mere controversy fatigue. Through this article, the public saw

precisely what Handler wished it to see — a functioning mechanism of self-correction within science, not a closed circuit of self-justification. The letter's evidence of corruption was absorbed in the article into the narrative of normal debate, its ethical charge was neutralized by the tone of professional civility, and the Academy's ideological monopoly was disguised as evenhanded reportage.

The letter and the article were complementary halves of a single revelation. The letter unveiled the mechanics of control, and the article was the mask that hid it. Between them lay the essence of Handler's power: the ability to translate ideology into procedure and procedure into fact. Handler's philosophical reductionism — the conviction that all biological phenomena must ultimately be explained in chemical or thermal terms — had, by the 1970s, fused with the culture of technology, which replaced science and was managed by industry and government, not an establishment of scientists , which had been the case. During the alliance between the Academy and government that occurred during Handler's career, reductionism became not just a worldview but a governing technology. It allowed Handler to declare complex environmental and biomedical risks nonexistent until proven otherwise by biochemical mechanisms, and to deny there existed any biophenomena that could not be understood on that basis. Handler's committees functioned as gatekeepers of admissible reality. What could not be reduced could not be funded, published, or believed. The Sanguine case illustrated how this judgmental order perpetuated itself.

Whenever the Navy required scientific reassurance, Handler provided it through an Academy committee structured to deliver the desired conclusion. When the letter exposed Handler's bias, the methodological language of *balance* in the article converted the accusation into evidence of the system's fairness. The article adopted the Academy's vocabulary of neutrality, thereby reinforcing the very authority they presumed to examine. Language intended to protect inquiry from power now protected power from inquiry. The Academy, under Handler's direction, functioned as he intended— that only one side of the story could be told, and that side would always be the side consistent with biochemical reductionism and the interests of his client. The corruption was therefore not personal but structural, embedded in the very syntax of its deliberations.

Handler repeatedly sent Becker invitations to testify before the Hastings-Schwan committee to express his views regarding the safety of the antenna, and offered to pay for Becker's services and expenses. Becker, however, regarded the committee as an illegitimate sham, burdened with bias, ignorance, and divided loyalties, that would mimic the form of scientific truth while subverting its substance

Instead, he had sent the letter in which he sought to establish that there was disagreement on the safety issue, and that the best truth could emerge only through conflict, not consensus among experts personally selected by Handler to serve his agenda.-Becker did not expect the letter to induce Handler or his committee to alter their joint course, but rather to publicly establish there was disagreement on the safety issue. He cared about ordinary people and about the need for a free science.

It disturbed him deeply that the Navy had swept the results of the Navy committee under the rug, and that the decision of both the first and second committees of the National Academy of Sciences had been rigged.

In the early 1960s, the research program at the Veterans Administration was divided into orthopedic and biochemical branches. The latter followed the advice of its chief advisor and consultant, Philip Handler, and supported only reductionistic experiments. The orthopedic branch had no such restriction because its questions of interest — the causes, cures, and control mechanisms of orthopedic diseases — necessitated system-level experimental approaches to what were emergent biomedical phenomena. Becker was the most successful investigator in this branch, notwithstanding Handler's volunteered advice against funding his research. In 1964, he won the Veterans Administration highest award for achievement in research and was given the status of Medical Investigator, which allowed him to work full-time in his laboratory and part-time in the clinic. Becker was funded sufficiently to expand his laboratory, adding additional personnel and equipment to carry out experimental studies of the control system for bone growth, clinical problems including fractured bones which failed to heal, chronic bone infection, and animal models of tissue and limb regeneration. Becker's status and funding were reviewed in the late 1960s and, based on his unprecedented prolific production of publications in prominent journals, his status as a Medical Investigator was continued and his grant support was increased.

Handler's complaint, that all appointments as Medical Investigators should be reserved for biochemists, was ignored. Becker was supported almost entirely by Veterans Administration grants tied to his position as a Medical Investigator. With the exception of a grant to train new scientists, Becker applications for research support from the National Institutes of Health were rejected because of Handler, who opposed direct study of emergent biomedical phenomena, and used his influence to prevent it.

In 1975, Becker's status and research support were reviewed again. His renewal application was evaluated by Marguerite Hays, an administrator who, with Handler's support, had recently become the head of the biochemical branch, the administrative home of the Medical Investigator program. Hays sought Handler's advice concerning an appropriate reviewer of Becker's application, and Handler suggested Lionel Jaffe, an ardent reductionist who disapproved of emergentist experimental research in general as much as Handler, and Becker's research in particular. Jaffe was beholden to Handler, who secured approval for several large federal grants to Jaffe for his brainchild, a one-of-a-kind measurement device that was costly, expensive to operate, and ultimately failed to deliver meaningful utility or benefit. The reviews of Becker's application were all favorable and recommended approval, except for the reviews of Jaffe and Handler who both recommended rejection. Becker received copies of all the reviews except Handler's, which Becker learned was oral and unofficial. Relying solely on Jaffe's recommendation, at least formally, Hays rejected Becker's application, and made it clear that she expected his laboratory to close and that he take a completely clinical position. Becker received Hays decision one month after he sent his letter to Handler criticizing his appointment of the Hastings-Schwan committee on the basis of bias and the lack of appropriate research by the Navy regarding the Sanguine antenna. Becker, who believed Hays' decision was a result of Handler's influence, was well connected to Navy officials and had cooperated with them many

times over the years. He told me he had talked with Navy officials and that "The Navy had nothing to do with a campaign against this lab —they protested to the NAS about its actions against me." But even though Becker lost his Medical Investigator status and could no longer work full-time in research, the laboratory survived because he found another source of Veterans Administration funding. The head of the orthopedic branch approved the very same project that Hays had cancelled, thus guaranteeing support for the laboratory for three years.

It appeared Becker's involvement with the Navy's Sanguine antenna project had run its course, but the public-health and environmental-impact issues continued to fester in Michigan, where the Navy had moved the project and renamed it Seafarer after the Secretary of Defense, who was from Wisconsin, banned it there, and the President of the United States, who was from Texas, prohibited the project in that state. Even though the proposed Michigan-based Seafarer antenna was ninety-five percent smaller than the proposed Wisconsin-based Sanguine antenna, stiff public and political opposition in Michigan quickly developed. The controversy caught the attention of a correspondent who contributed investigative and interview segments to a nationally prominent news show, and he went to Becker's laboratory to interview him about the issues.

The correspondent arrived at Becker's laboratory carrying a briefing book and spoke with Becker in my part of the laboratory, where the control equipment for an electron resonance spectrometer was located, because the correspondent decided it was particularly photogenic. Becker's tone and tenor — during both a two-hour question-and-answer session with the correspondent that took place prior to interview, and the recorded fifteen-minute interview — were exactly as they always were when he spoke about scientific matters, precise and direct as he could be while seeking to be responsive and explanatory. During the interview, the correspondent's manner was low-key and disarming, and they both smiled frequently as they spoke. The correspondent commenced, "Dr. Becker, you seem to have the Navy pretty upset. What's going on here?" It was as if the correspondent had just arrived from another planet and knew nothing about the risks from exposure to man-made electromagnetic energy , so Becker began at the beginning. In the televised exchange that followed, Becker did not stride onto the national stage as an accuser or activist. He appeared as a clinician-scientist answering questions put to him, careful with his words, almost painfully reluctant to overstate anything. The correspondent moved the conversation along, but the substantive weight of the program, as it was broadcasted, rested on the alternating replies of two men: Becker, speaking from the vantage point of emergent biomedical phenomena, and the Navy's medical spokesman, a line officer, who supplied Handler's intellectual model.

When asked whether the electromagnetic energy from the Navy's antenna could have any bearing on heart disease or stroke, Becker simply said yes. He did not dramatize the point or offer a homily about modern technology. He acknowledged that the idea would be "mind-blowing" to many viewers — the correspondent's words — and proceeded to explain why he believed it reasonable. For twenty years, he and his staff had been experimenting with electromagnetic energy as tools for understanding and manipulating biomedical control systems. His fracture-healing work — which used exceedingly small currents to trigger bone growth in cases that would not otherwise heal—was described briefly for the audience: if

carefully applied, low levels of electromagnetic energy could initiate healing, then uncontrolled environmental electromagnetic energy could not be dismissed as biomedically irrelevant.

Pressed about animal and human data, Becker did not claim that the antenna would certainly cause a particular disease. Instead, he recalled in plain language what the Navy's own advisory committee had found. He told viewers he sat on a committee appointed by the Navy to evaluate its research and give advice about future research, and he listened to Navy spokesmen who described "several studies that had very definite effects." Animals exposed to simulated antenna electromagnetic energy grew more slowly than controls; that, he said, was shown in "a number of projects." The second category of effects was more profound: exposure to this type of electromagnetic energy "seems to produce stress." By "stress," Becker did not mean a vague feeling of unease but rather referred to the body's neuroendocrine stress axis — the hypothalamic-pituitary-adrenal system elucidated by Hans Selye — which coordinates hormonal responses to sustained challenge and, when chronically activated, adversely affects cardiovascular, metabolic, and immune function. Becker extended the point to human data only when asked. In the Navy's own Pensacola and Clam Lake experiments, volunteers and workers exposed to the simulated electromagnetic energy showed "a very definite indication" of "considerable elevation in their serum triglycerides" after twenty-four hours of exposure. A significant number of employees at the Wisconsin test site, who were exposed to the actual antenna electromagnetic energy had similar elevations. The program's explanatory narration supplied the medical significance: elevated triglycerides are a danger signal, consistent with stress, heart attack, or stroke. Becker did not claim a clear causal chain from the antenna energy to disease; what he insisted on was that the energy was physiologically active and that, according to the experimental evidence, it was capable of activating the kind of systemic stress response known to precede complex disease.

Becker's calm observations were in direct opposition to what Handler's ideology allowed. Handler's reductionism equated reality with mechanisms at the molecular level and insisted that only two categories of electromagnetic effect deserved regulatory attention: acute shocks and thermal injury, or injuries whose biochemical pathway could be spelled out in detail. Anything else was either non-existent or unproven, which for all practical purposes meant safe. Elevation of stress markers arising from effects of the energy on neural or endocrine control systems was a process Handler refused to recognize, even though Selye did, and many experimental observations confirmed the process existed. In Handler's philosophy, a disease process triggered by exposure to electromagnetic energy not related to heat was impossible, as Schwan told him. On camera, Becker never explicitly mentioned the distinction between his observations and Handler's beliefs; he simply described what experiments showed — the implications of the observations were unmistakable. If electromagnetic energy at the intensity of that produced by the Navy's antenna altered growth, stress physiology, and blood chemistry, then the Navy's repeated claim that the energy was harmless because it was "nonthermal" — a term Schwan used to mean harmless — collapsed.

The Navy was deceived by Schwan in two areas. He told the Navy all experiments that reported biomedical effects of electromagnetic energy contained fatal flaws thereby invalidating the claims of the authors the effects were caused by the energy. If the fable were accepted, the logical inference would be that the reports did not contradict his contention such effects were impossible unless the energy level was so high it caused heating that the body could not

"handle." Schwan was brought to the U.S from a Nazi laboratory precisely for the purpose of validating his contention, which he did, using a simplistic calculation and capitalizing on the authoritative support of the military and Handler. Schwan's livelihood depended on continually defending his contention and calculation; consequently, his attacks against each scientist who reported effects were an existential necessity. Becker had great respect for the Navy and understood that if no one in the scientific establishment contradicted Schwan, the Navy was entitled, even required, to accept Schwan's contention as scientific fact. As it happened, not only was Schwan unopposed, Handler, the most prominent science-policy maven in the twentieth century, avidly supported both Schwan's reductionistic biomedical model of electromagnetic energy and his attacks against scientists who reported effects that contradicted his model. In Becker's eyes, the Navy's position regarding Schwan was justified in the light of its awesome responsibilities to protect the nation. He understood why the Navy accepted Schwan's advice over his but believed Handler's behavior was reprehensible. When Handler made his decision to appoint Schwan to the Hastings committee, Schwan's cross-examination disaster had already occurred and was a matter of public record. Nevertheless, it did not matter to Handler that Schwan had been impeached in court — where he was opposed for the first time since he left Germany — and his ideas about the safety of electromagnetic energy were fully discredited. Handler's crusade to protect and elevate the ideology of biochemical reductionism took precedence over all other considerations

The second area where the Navy was deceived by Schwan was his invention of a spurious physical concept — nonthermal electromagnetic energy. Schwan claimed the Sanguine antenna's electromagnetic energy could not produce heat — it was what he called "nonthermal"—and therefore was completely safe. However, the "nonthermal" concept, in association with antenna's electromagnetic energy, was fraudulent because Ohm's law ensured that *any* level of electromagnetic energy, however weak, deposits thermal energy in *any* material it impinged upon, whether living or nonliving, meaning that there was no such thing as a "nonthermal" level of electromagnetic exposure. Becker, who had three scientists with PhD's in physics on his staff, rejected Schwan's conjuration. The Navy, however, had no reason not to accept it or to reject its strong embrace by Handler.

During the interview, Becker said living systems, whose functioning relies on minute variations of the physiological environment, cannot be assumed to ignore the the presence of the antenna's energy. The Navy spokesman, however, following the lead of Schwan and Handler, made this assumption, supplying the counterpoint to Becker. Each time Becker described a biomedical effect, the Navy spokesman replied not with new data but with the stock phrases by which Handler's orthodoxy had defended itself for years. When confronted with evidence that animal studies had shown altered growth and stress, the spokesman acknowledged that "there were effects noted," then immediately relativized them. Scientists differed, he said, on whether the effects were significant and whether they were deleterious, and the Navy's position was that no "significant deleterious effects" had been demonstrated. When asked about the human triglyceride findings, he catalogued other possible causes — diet, alcohol, diabetes — and left viewers with the impression that, because multiple factors can influence a marker, none of the observed elevations could be sensibly attributed to exposure to the electromagnetic energy.

The pattern was repeated during the interview. The spokesman conceded that phenomena had been observed but declared them scientifically weightless because no one had yet proven, to the Navy's satisfaction, that the energy caused a specific disease by a mechanism already recognized in reductionist physiology. This was not independent judgment but the rote application of a rule he did not invent — that absent a reductionistic explanation of a biochemical mechanism, the proper public-health response was to assume safety. The spokesman was not a scientist confronting new evidence but rather the Navy's mouthpiece for Schwan's doctrine which Handler adopted as his own. He could safely do so because he answered to no one, so no process existed that could expose his complete ignorance of the laws governing electromagnetic energy — he was never subjected to cross-examination regarding anything he said. When the Navy spokesman assured the listener that he would be "perfectly content" to raise his family directly over the antenna, the claim was not a personal wager but a ritual repetition of Handler's metaphysical certainty that what cannot be reduced cannot be real.

The interview's most direct reference to Handler's doctrines came when Becker was asked about the Hastings-Schwan committee Handler appointed to evaluate the antenna. The program's narration mentioned a one-sentence interim report by the committee which announced it saw no evidence of harm, thus far. Becker, when invited to comment, did not accuse anyone of corruption. He confined himself to the simplest pertinent fact: some of the committee members had already "publicly gone on record" in other forums stating that the energy levels from transmission lines that were "a million times stronger than that from the Navy's antenna were harmless. " "Obviously," he explained, such a person "cannot do an about-face and say the Sanguine antenna may be harmful." From that premise Becker drew his modest conclusion: "a number of people on this committee, I would feel, have a pre-bias." The phrase was so gentle that Handler later clung to it as proof of his own fairness; in his letter to president of the television network, Handler described Becker's remark as "carefully worded" and insisted it made "no accusation whatever." Yet what Becker said, if taken seriously, destroyed any pretense that the committee was an impartial tribunal.

The three men in question—Schwan, Michaelson, and Miller—had told courts and regulatory bodies that even intense anthropogenic fields posed no risk. They had done so as consultants, contractors, and witnesses for the Navy and electric utilities, and their testimony had been contradicted by experimental evidence and shaken under cross-examination. Asking them now to decide whether a much weaker field was a health risk was not a gesture toward balance. It was a guarantee that the Academy's conclusions would remain in harmony with Handler's and the Navy's prior assurances.

Becker did not say any of this on television. He simply gave viewers one concrete example—the million-fold contrast—and allowed them to infer the rest. Only when the interviewer translated Becker's remark into the idiom of everyday unfairness, asking whether the public was "playing with a stacked deck," did Becker say, "I think so, yes."

Even then he spoke quietly, more like a physician forced into reluctant testimony than a man enjoying the spectacle of accusing a great institution. The anger in the story belonged elsewhere.

Another sequence in the interview illuminated the Navy's conduct in its own research program. Asked whether the Navy had repressed the findings of its earlier biological-effects review, Becker did not answer with the language of cover-up. He said, "The Navy did not disseminate the report widely." That was all. The surrounding narrative filled in the context: the report had been completed in 1973, had reviewed experiments on animals and humans, and had concluded, under the heading "Urgent and Absolutely Necessary," that further animal and human studies were needed before exposing populations to the antenna's electromagnetic energy. Yet the report surfaced publicly only two years later, when a senator placed it into the Congressional Record, and in the meantime, Navy-funded projects that reported any effect — Becker emphasized "not even adverse effects, any effect"— had their funding cut and their work halted. Here again the asymmetry between Becker and the spokesman was plain. Becker stated, almost clinically, that in at least five projects in which positive results were obtained, funding was withdrawn. The spokesman replied with a bureaucratic formula, describing an internal process of prioritizing research so that money would go where it produced "the best overall understanding." The explanation sounded neutral, but in practice it meant studies finding nothing could continue indefinitely, while those showing biological effects that called the Navy's safety assurances into question were terminated. Becker did not dramatize this as a conspiracy. He described a pattern.
The viewer who grasped his earlier points about stress, growth, and triglycerides could see what sort of "understanding" the Navy was willing to fund.

Nothing in Becker's demeanor suggested that he adopted a gentler tone out of fear for his job. By 1977, he had already suffered the consequences of disagreeing with Handler's system. Becker's status as a Medical Investigator at the Veterans Administration — the top rung of its research hierarchy — had been withdrawn on the basis of a hostile review, and his laboratory put into a glide path toward extinction timed to coincide with the end of Handler's second term as Academy president. Becker knew his research and public disclosure of its public-health significance despite the views of the Navy and Handler would invite further retaliation. But Becker's speech in the interview matched the way he had always spoken in less charged settings: measured, literal, interested above all in whether a statement was warranted by the facts. He did not dramatize his own plight or treat himself as a martyr. He comported himself as a physician who believed the public was entitled to know what the data actually showed, and he was willing to accept whatever consequences followed from saying so.

The contrast with Handler could not have been sharper. Becker stood on camera as a man whose work had been cut and whose lab was being suffocated because his findings threatened a collaborative arrangement between the Academy, the Navy, and the economic concerns of the electric-utility industry. Handler stayed off camera, as he always did when the interviewer was an investigative reporter. His practice was to remain insulated in Washington, orchestrating committees and writing threating letters in the Academy's name to any individual or institution that criticized him or the Academy. One man internalized the pressure and continued to speak as if the truth mattered; the other converted his ideological commitments into institutional machinery capable of punishing dissent without ever acknowledging that dissent existed.

A few days after the interview, Handler sent a letter to the president of the television company that produced and provided the interview, and copied the letter to many newspapers; it removed any uncertainty concerning his opinion of the interview [3].

He wrote not as an incidental figure who felt belatedly maligned by a stray phrase, but as the man who had designed the Hastings–Schwan committee, whose legitimacy Becker had quietly undermined before a national audience. In the letter, published in a Michigan newspaper under the heading "Not a 'stacked deck'—Academy rebuts Rather," Handler professed himself "shocked" that an Academy committee had been described as "a stacked deck." He proceeded to rehearse the Academy's official mythology: 114 years of disinterested advice, 7,500 uncompensated scientists, procedures "carefully designed" to eliminate bias and to ensure that reports logically derived from objectively evaluated evidence. The tone was as revealing as the content.

Handler described the allegation of bias as "quite intolerable," complained bitterly that the Academy had been given no chance to respond on air, and asked rhetorically whether it did not matter that "at most, only three of the 17-member committee" could be "embraced" by Becker's remark about pre-bias. Those three, he insisted, could "gain nothing" by defending their prior views, and the other fourteen were "far from easily guided sheep."

Handler then turned to Becker personally. When the correspondent asked Becker whether the committee was "a stacked deck," Becker said, "I think so, yes." Handler conceded that Becker's statement was "carefully worded" and made "no accusation whatever," but immediately reinterpreted it as self-discrediting. Becker had said, correctly, that some committee members denied any ills from energy levels one million times stronger than those from the Navy antenna, but there were no members who held opposing views. Additionally, Becker had suggested exposure to the antenna's electromagnetic energy might be a health risk. Two facts: but Handler twisted and corrupted them to obfuscate the truth, a form of oratory he used routinely. Handler, styling himself "a professional biochemist," asserted that he could "think of no noxious influence" for which exposure to one-millionth of a harmful dose would be dangerous.

The truth, however, was that Schwan, Michaelson, and Miller had sworn that the powerline electromagnetic energy would be "completely safe," not that it would be "a harmful dose." Becker's straightforward point was that such witnesses could never opine that one-millionth of a completely safe dose was a health risk, regardless of how much experimental evidence supported that conclusion. Consequently, the Hastings-Schwan committee was a sham: it was composed of Hastings, who had already served Handler by destroying the career of Frank Brown — the scientist who discovered that animals could detect natural electromagnetic energy — the three committed witness, and thirteen other members who were either politically or intellectually unable to disagree with the obvious conclusions the other four members would inevitably reach.

Nevertheless, Handler complained in his letter that Becker's answer, "I think so, yes," should have led viewers to question Becker's judgment, but instead was used by the correspondent to attack the committee by referring to it as "stacked deck."

[3] Available at https://robertobecker.net/later-life/60-minutes/

Handler's anger barely fit inside his decorous language. He called the interview "reckless and ill-advised," charged that it had "failed" in any objective examination of national-defense versus environmental concerns, and claimed that by "casually discrediting" his committee, the television network had "raised the public's level of anxiety far beyond the magnitude of any foreseeable hazard offered by the antenna."

He ended with an assertion that inadvertently revealed more about his thinking than any critic could have conceived. He said, "The deck was stacked, Mr. Backe, but not by the Academy." Handler's letter thus completed the point Becker made in the interview.

Under questioning in the interview, Becker had described a committee whose conclusions were implicit in its composition; Handler replied by insisting that his procedures guaranteed objectivity and that the real offense lay in stating otherwise.

Becker had suggested that the Navy had not disseminated its own cautionary report; Handler boasted of his committees' "carefully designed" filters for relevance and reliability. Becker's few sentences exposed the architecture of Handler's control; Handler's letter of injured prose illustrated how thoroughly that architecture had fused his personal ideology with the Academy's institutional identity. To question the committee's neutrality was, in Handler's mind, to attack science itself.

The interview was the first time Handler's system for defining orthodoxy by procedure was forced, however briefly, to confront an uncooperative reality in front of a mass audience. Becker, in his quiet way, exhibited the essential facts: that low-level electromagnetic energy is physiologically active; that the Navy's own research had shown as much; that projects demonstrating such activity were terminated; and that the Academy committee Handler had constructed to sanctify the antenna's safety was chaired by a man with a history of sharing and serving Handler's malcontent with the notion that electromagnetic energy had had a significant biological role, and was populated by three men who had already bet their reputations on the denial of such activity, and thirteen other men who well well-credentialled in their specialties, but which had nothing to do with the antenna's electromagnetic energy. The Navy spokesman, speaking with naval confidence, recited the Handler creed: that without a known mechanism and a named disease, no amount of physiological disturbance could justify concern, and no committee he created could be credibly accused of bias. Stripped of television's dressing — graphics, off-screen narration, staged shots of forests and cables — what remained was a debate between two incompatible visions of science and public health. Becker's vision treated the organism as a hierarchy of control systems, sensitive to chronic perturbation, and insisted that when experiments show such systems being modulated by environmental energy, prudence requires protection of the public while inquiry continues. Handler's vision, as delivered by the Navy spokesman, treated the organism as a bag of molecules, insisted that nothing mattered that could not be reduced to heating or to a specific biochemical chain, and declared that until such a chain was produced exposure must proceed unchecked.

Becker's vision placed the burden of proof on the introducers of the health risk; Handler's placed it on the exposed population, which had neither the resources nor the institutional pathways to discharge it.

The broadcast did not resolve this conflict, but it did lay out the structure of the conflict with clarity. Becker answered questions with the same unadorned honesty he had taken into

courtrooms and committee meetings. The Navy spokesman answered with phrases that bore all the marks of having been written elsewhere, in a register designed to sound like science while serving the Navy's and Handler's interests. The Academy, through Handler's letter, responded by declaring that its procedures were beyond criticism. The president of the television company never responded to Handler's letter, leaving it up to the public to decide whether his letter or Dr. Becker's interview was closer to the truth.

After the broadcast, Handler held back the Hastings-Schwan committee's report for six months, long enough to avoid having it examined under oath in the high-profile New York powerline hearings. During that period, the only official public statement by the Academy was the anodyne interim pronouncement that, so far, no hazard had been demonstrated. When the danger of confrontation in New York had passed, Handler released the report without an explanation for the long delay beyond the promised release date. The report bore every hallmark of Handler's procedural ideology — his machinery did not merely answer the public controversy, it attempted to dissolve it. The report opened with a ritual invocation of balance and expertise, declaring that the committee had been constituted with scrupulous attention to competence and objectivity, which it announced with the confidence of a magician who knows the audience will not examine the apparatus after the performance. Inside the report was an edifice of reassurance, constructed with the calm inevitability of an opinion written before the trial. Its method was a literature review of such breadth and superficiality that no disruptive conclusion could possibly emerge from it. Every study reporting biological anomalies—altered sex ratios in insects, chromosomal abnormalities in plants, developmental irregularities in vertebrates—was acknowledged only to be dismissed. Methodological imperfections, interpretive ambiguities, or failures of replication were invoked with liturgical regularity, as if the committee were performing a sacrament of purification on the scientific record. Positive findings became statistical accidents; anomalies became artifacts; and empirical observations became impurities to be smelted away by the heat of theoretical orthodoxy. This stance was not merely conservative — it was Schwan's worldview, implanted at the heart of the committee. The reductionist creed Handler had spent decades cultivating appeared everywhere: the insistence that no biological effect exists without heating, that any reported physiological change at so-called nonthermal levels must be illusory, that physics , as Schwan understood it, overrides experimental evidence.

Beneath the report's bureaucratic prose lay the unmistakable imprint of Schwan and Handler on the conclusions of the committee, which were metaphysically certain the day he created the committee. Handler had ensured that no countervailing voice — no investigator of anomalous effects, no student of emergent biological systems — sat at the table. In such a chamber, orthodoxy was inevitable, not because it was true but because it was unopposed. The committee's conclusions followed from its architecture.

With solemn assurance, the report declared that the antenna's electromagnetic energy was "not likely to constitute a genetic hazard," and that the limited studies suggesting otherwise were "poorly designed" or "not consistent." The report went further, proclaiming that it was "most improbable" that any additional research would alter its conclusions. In that single phrase the committee revealed its purpose: not to guide future inquiry but to foreclose it. The judgment was final; the science was settled; the matter was closed.

When Hastings stepped before the press to announce the results, his manner was steadied by the knowledge that Handler's machinery had worked. Hastings spoke of the committee's care, its caution, its thoroughness. He acknowledged that some organisms — birds, fish, insects — possess exquisite sensitivities to weak electromagnetic cues. He recognized that biological systems are subtle, complex, and responsive. And yet, with a rhetorical pivot perfected over years of Academy practice, he proclaimed that the Navy's antenna nonetheless received what he called a "qualified clean bill of health." The recognition of complexity was essential for maintaining intellectual credibility; the "clean bill of health" was indispensable for serving the Navy; together they performed the dual function Handler required — the Academy appeared responsible, thoughtful, scientific, and the Navy received its absolution.

The report and the press conference were also Handler's personal rebuttal to the heresy broadcast six months earlier. Becker's calm measured warnings — grounded in the biological evidence the Navy had worked to bury — had threatened to puncture the illusion of objectivity Handler had spent his career manufacturing.

Becker's refusal to subordinate biological fact to theoretical dogma exposed the fragility of Handler's position. Becker saw the pattern: the disappearance of inconvenient research, the premature termination of lines of inquiry that hinted at biological effects, the appointment of committees whose neutrality was no more than a figment of Handler's imagination. Becker's comments had made visible what Handler had worked so hard to conceal — that the Academy was not investigating the safety of the antenna it was certifying it.

Handler's rage, expressed in his letter to the broadcasting company, was that of a man whose private decision-making machinery had been momentarily glimpsed. He accused the correspondent of recklessness, Becker of self-discrediting, and the broadcasting company of irresponsibility. But the fury betrayed the truth. Handler had not been portrayed unfairly. He had been seen. Thus the final report served a double purpose for Handler: it reassured the public and reasserted his control. And yet even in triumph, the fragility of the enterprise was evident. The report's logic — its dismissal of biological anomalies, its confident reliance on theory, its foreclosing of further research — was so tightly bound to the committee's composition that the conclusion read less like a scientific judgment and more like a bureaucratic necessity. By delaying the release of the report for six months, Handler ensured that it would not be scrutinized during the high-profile hearings on the safety of high-voltage power lines. Delay was his final act of management: the suppression not of data but of timing.

When the report finally appeared, the result was unsurprising. The antenna was safe. The case was closed. And the Academy —so it claimed— had once again performed its service to the nation. But the deeper truth remained. Becker had spoken not only about the antenna but about the structure of scientific authority itself that was in Handler's hands. The report was not the product of scientific discovery but of Handler's procedural orthodoxy. It was the latest chapter in a struggle between two visions of science: one reductionist, administrative, and controlled; the other biological, empirical, and open to the possibility that life is more complex than Handler allows.

In the end, the story of the Navy's antennas revealed far more than a dispute about electromagnetic energy. It exposed the deeper machinery by which scientific orthodoxy, once

institutionalized, could be made to regulate not only what counted as truth but what could even be perceived as a question. Handler's mastery in resolving the dispute lay not in disproving the biological effects that Becker and others had laboriously uncovered, but in constructing a bureaucratic architecture so perfectly aligned with his biochemical reductionism that contrary evidence had no place to land.

The great achievement of his presidency was the creation of a procedural world in which the possibility of electromagnetic risk was defined out of existence long before any committee convened or any report was drafted. The committees he assembled — the Booker feasibility panel, the Schwan safety group, and the sprawling Hastings-Schwan committee — did not adjudicate uncertainty; they converted it into the appearance of consensus. Each reflected the same quiet formula by which Handler governed the boundaries of legitimate science: select the right people, frame the right questions, control the documents and the deadlines, and the desired outcome will follow as naturally. What emerged from this machinery carried the imprimatur of the Academy, and with it a cultural authority that no other institution possessed. The Navy understood this. Handler understood it better.

Meanwhile, Becker's warnings — modest, precise, and empirically grounded — were left to drift without institutional mooring. He was never allowed to meet Handler on equal terms. His testimony, whether before a camera, a regulatory panel, or in a letter that enumerated the biases of the Hastings committee, rested on the fragile ground of empirical observation and lacked the support of institutional power. The Navy spokesman could dismiss his concerns with a few stock phrases; *Science* magazine could flatten the controversy into a polite difference of opinion; the Academy could proceed as though its committees were arbiters of objectivity rather than instruments of design. And the public, seeing only the authoritative end-products and not the process that shaped them, was invited to accept the verdict that electromagnetic energy was harmless because no acceptable mechanism could be named that could mediate harm and no reliable evidence indicated that harm occurred. Thus the contest over the biomedical effects of electromagnetic energy ended not with the triumph of one scientific model over another, but with the triumph of an administrative method.

Handler's procedural orthodoxy prevailed because it was embodied in the very structures that determined what counted as credible knowledge. The Academy, under his command, became a device for transforming his ideology into consensus and consensus into federal policy. Through this system, the biological effects reported in dozens of laboratories dissolved beneath the weight of institutional authority.

Here, in this outcome, the true meaning of the electromagnetic-energy controversy becomes clear. Becker had hoped that evidence, openly examined and expanded, would lead to a more expansive understanding of biological regulation.

But Handler ensured that the evidence would never accumulate in a form capable of threatening the reductionist citadel he had spent his career defending. By the Hastings-Schwan report, the Navy had its assurances, the Academy had preserved its prestige, and the public was left with a narrative of safety backed by a prestigious scientific institution. Handler did not win because he was right; he won because he controlled the machinery that defined what rightness meant. And in that victory — procedural, ideological, and nearly invisible—the possibility of electromagnetic risk was not refuted but administratively denied. This denial was not an act but a process, not a conclusion but an architecture. Through Handler's committees, mandates, and

manufactured consensus, the very category of *risk* was rendered illegitimate. What remained was a landscape in which electromagnetic effects could occur, be measured, replicated, and explained at the system level, but still be deemed impossible.

The ultimate achievement of Handler's system was the authoritative proclamation that there was nothing to fear, which he could proclaim only because the structures he built ensured that nothing could be acknowledged. Handler had and used the power to declare, through the machinery of the Academy, that a danger did not exist. In doing so, he did not resolve the scientific question, he foreclosed it. And through that foreclosure, the nation entered an era in which the risks Becker sought to illuminate were denied not by evidence, but by decree.