

# **THE ELECTRIC WILDERNESS**

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**With a Preface by Robert Becker**



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## PREFACE

The development of electromagnetic energy for power and communications is widely regarded as a boon to mankind and even as “the manifestation of civilization at its finest.”\* Although one cannot dispute that mankind’s mastery of this silent force is most responsible for our present global technology, disquieting questions have arisen over its present safety and the wisdom of continued unlimited expansion in its use. The electromagnetic force is, like the nuclear force, one of the four basic physical forces of the universe. While the ego of some men exults in “mastering” giant forces, have we once again acted like children playing with fire? Thus far we have been able to keep the nuclear genie for the most part in the bottle, but the electromagnetic genie is out of the bottle and all around us. There is no place left on earth that is free of manmade, abnormal electromagnetic radiation. Have we already done perhaps irretrievable harm to the biota, or is there time to step back, look at what we have done, and plan for a safe, logical, and environmentally sound use of this silent force?

When I set in motion the affair described in this book with my letter to Joseph Swidler, then head of the New York Public Service Commission, I naïvely believed that the questions I raised over the possible hazards of powerline radiation would be settled by the logical, dispassionate methods of science. As *The Electric Wilderness* shows, that was most certainly not the case. Our arguments, based on what we considered clear scientific data, were met with a ferocious onslaught—not only against our data but our reputations and even our livelihoods. Legal, political, and bureaucratic maneuvering extended from the local level to the highest levels of the Federal government. Why? Was it simply that we were calling into question a favorite technological application and with it the egos of the engineers, or that our actions might diminish the profits of the industries concerned?

In my opinion we faced a concerted and coordinated effort to suppress the truth, which emanated from the military establishment and was simply aided and abetted by the greed of the utilities and the tarnished testimony of scientists for hire. Today the military is planning and constructing the largest expansion of electromagnetic emitting facilities in history, with the aim of fighting and winning the next World War. In the process the very population, culture, and civilization they are sworn to protect may be placed at risk. Although someone has apparently weighed the relative risks and decided that this was the path to follow, the decision has been made not only without input from the citizens, but with every effort to conceal the risk from them. It seems the same mind-set that led to disaster in Vietnam is still operating—that “in order to save the village from Communism, we have to destroy it”—only now the villagers are not our “enemies” but our own citizens.

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\* Review by Samuel C. Florman of *Networks of Power* by Thomas P. Hughes (Johns Hopkins, 1984), in *The Sciences*, New York Academy of Sciences, 1984.

The decisive information that would help citizens contest this expansion will not be available; as this is being written, the decision has been made to terminate all Federal funding for electromagnetic hazards research. Thus those of us still committed to this fight are effectively deprived of the conclusive proof of hazard which has just begun to emerge. If a serious hazard does exist, no one is to know about it, least of all the citizens of the village. If opposition to a facility develops, no matter how small or obscure, the full weight and power of the establishment will be brought to bear to insure that it is constructed, and that all questions of health hazards are submerged in a sea of doubletalk and outright deception.

The citizens of this country are poorly served by the present system. They lack funds, battalions of lawyers, paid scientific experts, and organization. Their one source of power, concerted action at the ballot box, is continuously subverted by misinformation and distortion. Meanwhile the issue is obfuscated, the public is convinced that no hazard exists, and the scientists who insist on open and public debate are unmercifully attacked.

This book is important not only in the issue it raises of the probable hazard of electromagnetic technology, but in the hazards it reveals that are the result of *raising the issue*. It spotlights the present defects in our political system that leave the citizen defenseless against the powerful manipulations of the government. The truly important questions of our time are those relating to technology and its uses and abuses in relation to human beings. The public has a right to the relevant scientific information, and cannot be denied the right to have a voice in decisions that affect their health, safety, and quality of life. However, though scientists can provide the information, any scheme that calls for "experts" to make the decisions of relative risk tends to have little value. The only valid and ethical risk analysis must be made by those who are at risk. That requires that citizens have access to the truth. *The Electric Wilderness* is the truth.

Robert O. Becker, M.D.

Lowville, N.Y., 1985

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# PART I

## CHAPTER 1

### The Meeting

When my boss, Dr. Robert Becker, returned to the lab from the Washington meeting, a new and troubling concern was taking shape in his mind.

It was December 1973. Three months before, at a conference in New York City, Becker had been approached by U.S. Navy Commander Paul Tyler with a request to serve on a panel of experts to evaluate some experiments the Navy had funded. It all had to do with an antenna system the Navy was planning to build in northern Wisconsin, a bizarre project involving grids of buried wires that would extend over thousands of square miles of land there. The Navy had been studying ways of communicating with submerged submarines for years; the project, called Sanguine, was believed to be the answer. (It was to be later renamed SEAFARER, and still later ELF, an acronym for Extremely Low Frequency.) But because of the large size of the antenna system, and fears that the NIEMR it would emit might have environmental and health impacts, Congress had ordered the Navy to undertake a series of studies to see whether there would be any problems. All the studies involved exposing living systems to Sanguine-type NIEMR. The program, Tyler had told Becker, was now at its midpoint: initial studies had been completed, and what the Navy needed was expert opinion on the meaning of the results.

Tyler must have realized that of all the scientists attending the conference—sponsored by the New York Academy of Sciences—Becker was among the best qualified to answer the Navy's questions. And that was in fact true. For fifteen years Becker had been conducting research into the relation between electrical and magnetic forces and living things, and the three-day Academy conference, entitled *Electrically Mediated Growth Mechanisms in Living Systems*, was in large measure a result of his work. It was the first time that American scientists had been gathered under such prestigious auspices to explore the subject of bioelectricity; the tributes to Becker were frequent. After he had delivered the keynote paper of the second day, one scientist had acknowledged that “we have learned so much from you over the years, in fact, almost everything that we know about this field”; another had called Becker's paper “one of the most significant in the history of human biology.”

Becker's 1973 paper had been the grand summation of his work up to that time. His interest was in growth and regeneration, and in 1958 he had set out to determine how these key biological phenomena occurred. In a way, his interest was an embodiment of the question that had puzzled scientists from the beginning: What is the difference between "living" and "dead"?

It had not taken Becker very long to uncover some important clues. Though he had no lab at the time—he was Chief of Orthopedic Surgery and mainly concerned with clinical matters—U.S. Veterans Administration (VA) hospitals had been gearing up their research programs in response to the Soviet launch of Sputnik in 1957, and he had asked for some funds from the VA Board for a small experiment. He had been reading Luigi Galvani, the 18th century Italian anatomist, and had noted that in an anonymously published experiment Galvani had observed that injury was accompanied by an electrical current. Becker had also read Albert Szent-Gyorgyi's 1941 lecture in which the Nobel prizewinner had hypothesized that the cell might have electrical properties crucial to certain biological functions. Then, after reading a startling Russian paper that reported the regeneration of tomato plants by electricity, Becker requested \$1000 from the VA Board to do an experiment with electricity and animals.

Soon things began to move fast. In the early 1960s Becker obtained the first evidence for his hypothesis that healing and growth were controlled by tiny self-generated electrical signals which mobilized and directed cellular activity. By 1964, around the time I went to work for him, he had postulated the existence of a previously undescribed electrical communications system within living things. These were revolutionary ideas in biology, and they generated a lot of controversy.

Becker's main interest in these ideas was medical. He reasoned that if one could find out how the body heals itself, one should be able to gain control over that process and reproduce it in cases where healing broke down for some reason. But in addition to the medical implications, there were other questions as well, questions that had to do with the origins of life and with the relationship between living things and the natural electromagnetic environment.

If there were these weak neural currents inside living things, did they provide a way for animals and humans to interact with the changing magnetic field of the earth? Becker's research was many-sided. In 1963 he found that the number of admissions to psychiatric hospitals seemed to vary according to changes in the earth's magnetic field. And in 1967 he reported that weak magnetic fields applied to the heads of humans altered their reaction time.

Shortly after that, Becker did a very interesting experiment in which he applied currents to frog blood cells in glass chambers and found that they reverted to a more primitive cell type. Then he was able to regenerate partially the foreleg of a rat with electrical current. Regeneration was a power that amphibians possessed—salamanders could grow back whole limbs—but not mammals. It was one of the most controversial experiments Becker ever did; there are still scientists today who do not believe it.

By 1973 he had begun to use tiny electrical currents applied through implanted electrodes to cure human bones that would not heal normally. Thus it was just at the time of the New York Academy conference that the

therapeutic implications of Becker's work were beginning to take shape. His research at that point was on bone, but perhaps the techniques of electrotherapy might be eventually applied to soft tissue as well, such as heart muscle. The horizon, in 1973, seemed unlimited.

However, Becker worried that things might get out of hand. Electrotherapy had been used in the nineteenth century, but because of the fraudulent practices of certain charlatans, among other things, belief in the therapy had been undermined. It would be terrible if history were to repeat itself. Physicians might use electrotherapy irresponsibly, before it was fully understood, and people might get hurt. Becker reasoned that if electricity could cause benign growth, it might also cause malignant growth. Several times at the New York conference, Becker warned the other scientists that caution was the watchword. A few bad mistakes with patients and electrotherapy might once again be discredited. He had not spent fifteen years of difficult and often heavily criticized research to see it all go down the drain because some doctor, overanxious for money or fame, induced cancer in a patient he was trying to heal. (For a full account of Becker's research, see his recent book, co-authored with Gary Selden, *The Body Electric: Electromagnetism and the Foundation of Life*, William Morrow, 1985.)

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Because of the worry about the inadvertent side effects of electrotherapy, and because of some experiments I had just finished that showed adverse effects in mice and rats from exposure to certain kinds of NIEMR, Becker was supersensitive to the potential implications of the Navy antenna. When he returned to the lab that Monday in December he told me what the Navy studies had found.

There had been seven scientists on the panel. After describing the Sanguine antenna, Tyler told them that the Navy needed to know where to go from there with further studies. He spent most of the first morning reading the results of the more than thirty studies; nearly two-thirds of them had found biological effects from exposure to the NIEMR, in a variety of species including slime mold, rats, birds, and human beings. Becker had felt he would probably be in the minority on this panel, because in 1973 very few thought that energy of such low frequency and strength could cause biological effects. But what happened surprised him. Before long it became clear that *all* the panel members were thinking the antenna was a potential hazard to human health.

On the second day, the panel began to draw up a lengthy list of recommendations. It was clear there had to be further study, especially on humans. Becker interpreted some of the results as due to a lowering of the body's normal resistance, a kind of NIEMR-induced stress, similar to what had happened to the mice and rats in our own study.

In the middle of the deliberations someone pointed out that the Sanguine NIEMR was similar in nature to that produced by high-voltage powerlines, and that in the largest lines, those of 765,000 volts, the strength of the NIEMR might be as much as *a million times stronger*. That realization, said Becker, had really thrown the group into a quandary. They had been

asked there to review studies on the antenna. What could they do about powerlines, which might represent an even greater potential hazard, involving many more people? The discussion became heated, but eventually the scientists agreed they had to recommend some action by the government. Their concluding recommendation was that the Navy should inform a special committee advisory to the President that many Americans might be “at risk” from powerline NIEMR.

But Becker’s concern didn’t end there. For when he returned home that weekend he read in the newspaper that the Power Authority of the State of New York (PASNY—a kind of state TVA) planned to build a 765,000-volt line from the Canadian border to Utica, and that the route would take it not far from where some of his friends lived. He had noticed all the powerlines and radio and TV and microwave towers on his way to the airport, he said—all emitting forms of NIEMR—but he remembered telling the panel that there were no really big powerlines in New York. The newspaper notice drove home the point, once and for all, that people *were* “at risk.”

I didn’t pay as much heed to these ramifications as to the fact that the Navy studies seemed to confirm what we were finding; I guess my main reaction at the time was elation. Here we were doing experiments with very little money, and the Navy was coming up with similar results, after the expenditure of millions of dollars. I’m sure that aspect of it pleased Becker too, and he was no doubt thinking that we might get some funding from the Navy. Money was always a problem in the VA lab.

Anyway, I settled down to design another series of experiments, and the NIEMR hazard disappeared from my mind, until six months later.



## CHAPTER 2

### Simpson Arrives

The new experiments we decided to do were in connection not with powerlines but with Becker's bone-healing work. There were a couple of reasons for them. Because the beneficial effects of the electricity on Becker's patients might conceivably be due not to the NIEMR itself but, say, to the metal in the electrodes, we had to test this possibility by using NIEMR without wires in experiments on animals. Instead of implanting electrodes, we would expose animals to NIEMR that involved no contact whatsoever with tissue. The other reason was that it might be possible to develop a therapy that did not use electrodes, a "noninvasive" therapy. Before Becker could try it with humans, we had to check it out on animals.

So I designed an experiment that would expose rats to NIEMR for thirty days. We would compare these animals with control rats that lived in exactly the same circumstances without exposure, and see what the differences were. It was a low-budget experiment, and I built the apparatus in my basement at home, using leftover scrap wood and metal—shelving, paneling, and trim—from when I had remodeled my living room. Esthetically the result wasn't particularly appealing, but functionally it was perfect. It fit smoothly with the regular procedures for animal care at our facility, and I used it in experiments with over 500 animals for more than thirty months and had no significant problems. When the time came to build the power supply to provide the NIEMR, cost was again the overriding consideration, so I used the cheapest source of power available—electricity from the wall outlet, with suitable provisions to protect against the danger of shock.

Soon after the study began, I saw changes in the exposed rats that were not occurring in the controls. The exposed animals seemed to gain less weight and drink less water, and they had altered levels of blood proteins and enzymes. Since the results were clearly adverse, they tended to foreclose the use of certain kinds of NIEMR in our clinical work, and that was pretty much what I saw as their value.

But when Becker looked, he saw something more. He saw powerlines. The NIEMR I was using was, after all, from electricity derived from a wall outlet, and that was at a frequency of 60 Hertz (cycles per second)—the frequency of the entire electrical distribution system in North America. Becker asked me what the results meant with regard to 765,000-volt lines. I said I hadn't the foggiest idea. Did I know what the strength was in relation to that of such lines? I did not; I guessed one would have to be very close to the wires—maybe within a foot or two—to experience the same strength I had used in the study, but I really didn't know for sure. "Well," said Becker, "find out." And as he left he said, "Do the experiment again."

I repeated the experiment twice; the results were the same.

Then, in July, Becker told me he had just had a call from a lawyer with the New York Public Service Commission (PSC), who wanted to come and see him about a powerline hearing. That's when I learned that, immediately after he had returned from Washington and the Navy meeting, Becker had written a letter to several state regulatory agencies, to tell them that the powerline planned by PASNY might be a health hazard. He alerted them to the Navy studies and urged them to explore the issue before they allowed the line to be built. I asked whether he'd had any response, and he said an engineer from Niagara-Mohawk (NiMo), the local utility, had called and said rather rudely that he thought Becker was raising a bogus issue. The agencies had not responded until now. It seemed that *another* 765,000-volt line was being planned for the Rochester area, by NiMo and Rochester Gas and Electric (RG&E), and that the NIEMR issue had been raised in that hearing by a citizens' group.

Becker asked me if I would sit in on the meeting with the lawyer, whose name was Bob Simpson.

As I say, powerlines were the furthest thing from my mind. And in a way it's odd that I didn't feel more strongly about the connections Becker was making, because when it came to other forms of pollution I had strong feelings. In fact, three years earlier, partly as a result of a public hearing on a quarry operation that was screwing up my neighborhood, I had decided to go to law school so I could learn how to argue environmental cases. But it was the well-known kinds of pollution I was thinking of then—air and water pollution, food additives, pesticides, and so on. I loved my research work with Becker, but I also had ambitions about going into court some day and arguing the case that would establish the constitutional right to a clean environment. Also, I was married, and beginning a family, and I was concerned about what kind of world my kids were going to have to deal with. When Simpson called to see Becker, I had been out of law school for a month, and I was wondering how I could begin using my legal training—but not in relation to powerlines.

Simpson arrived on 15 July 1974, in the morning. He was younger than I, and had been out of law school only a few years. His only job had been on the PSC staff. He told us a little about the public hearing in Rochester. The experts testifying for the power companies had said there would be no hazard from the NIEMR, but the citizens' group had refused to accept their assurances and had found evidence enough so that the issue ought to be seriously addressed. Simpson showed us the testimony of the main company expert. I thought it was not only inaccurate but downright ignorant. For example, the expert had said that cows under a 765,000-volt line were contented because he had seen their tails wagging.

Simpson asked, was there really a potential health risk? "No question about it," said Becker. He detailed for Simpson the adverse effects that the Sanguine program had turned up, and said that the powerline NIEMR would be far stronger. He also told him about the experiments I was doing on the rats, and that they had been twice repeated with the same results.

Becker is a proud, direct man who likes to be recognized for what he knows and what he can do. As with the request from Paul Tyler to come to Washington, it was flattering to be asked by a government representative to

help him do his job—especially when his job was to help protect the public interest. Sensing this trait, Simpson asked Becker whether he would be willing to testify about the possible health risk in the hearing. Becker was a teacher—the best I had ever encountered—and this was the role in which he felt most comfortable; it was that side of him to which Simpson was appealing.

Becker wanted to know the details. Simpson answered in a way that understated the work that would be involved, and I could see that Becker was rising toward a decision to testify. Though the citizens' group had uncovered some preliminary information, they scarcely had the expertise to testify as Becker could, and I think Becker understood that. Simpson said Becker's testimony would consist of a written report to be transmitted to the power companies, and later perhaps a day of cross-examination in Albany by the power company lawyers. After that, PSC would decide whether the 765,000-volt line could be built, and if so, how it would have to be regulated.

Simpson seemed wary of me. He hadn't known that I would be sitting in on the meeting, and when he found out that I had just finished law school, he seemed surprised; he was probably juxtaposing "biophysicist" and "lawyer" and wondering exactly what I was and where I fit in here. His invitation to testify was extended only to Becker.

But Becker suggested that both of us should testify. After all, I had actually done the rat studies, and I had in-depth training in the mathematics and physics of electricity (which is why he had hired me in the first place). Also he may have been thinking that my legal knowledge would be helpful, though I doubt that was foremost in his mind. (He had arranged things so that I could go to law school, but he really had little use for lawyers.)

The legal aspect of the hearing certainly interested me. In fact as I listened to Simpson and considered the power company testimony that had already been given in the case, I had an insight into the way the legal system worked that shook me a bit because it seemed so obvious and yet I hadn't really considered it. It had to do with evidence. The point was that judges made their decisions on the basis of evidence presented to them. If some piece of information was "in evidence" it could be used in deciding, but if it wasn't "in evidence" it couldn't. Now the scientific merit of the companies' testimony was abysmal. But the judge didn't know that, and the citizens' group had no real scientific expertise and neither did Simpson. The net result would be the elevation of ignorance and grossly self-serving statements to the level of fact, so as to support an inevitable decision that the line would be safe. What I realized that day as I listened to Simpson was, simply, that if you control the evidence, you control the outcome.

I wondered what it would be like working with Simpson. He troubled me a little. First, he as much as admitted that he'd been assigned to the case because he was the low man on the PSC totem pole. His real interest was utility rate regulation. I couldn't imagine *anything* more dull or boring than that, and it didn't make me especially confident in him. How could he be expected to handle a case involving arcane scientific concepts?

The other question was why he was asking Becker to testify. The Sanguine committee report had been classified For Official Use Only, so Becker didn't feel he could properly use it in a hearing. Why not ask Tyler to testify, or at least the investigators who had done the actual experiments? As I saw it, all *we*

could present were articles in the scientific literature—if there were any—and our own experiments, which were preliminary. That didn't stack up well against all the expensive Navy work. I asked Simpson about it. He said bluntly that he had asked as many people as he could identify, and they had all refused; he didn't really know why.

In the end, Becker established that we would both testify. Simpson said we would be paid for our time, but Becker instinctively realized that would be a bad idea, because it would restrict our independence. He told Simpson no, we would do it for free. That turned out to be a very wise decision.

The only perk Becker requested was that on the day we were to be cross-examined the hearing should be held in Syracuse. He had patients to consider. Simpson said he saw no difficulty in arranging it. And that was that.

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During the next few months Becker and I worked on our reports for Simpson to send the power companies. I found eight studies published in the open scientific literature that described biological effects in animals or humans from exposure to NIEMR similar to that of a powerline. I described these studies, and also my own rat experiments, and with the help of a former classmate who had become a physics professor, I calculated the strength of the NIEMR from the proposed line at various measured distances from the wires. As I had expected, it became progressively weaker with increasing distance from the line. What I didn't expect was the great distance to which perceptible radiation would extend—several thousand feet. This calculation also allowed me to relate my rat study to the powerline. I found that the strength I had used there was comparable to the strength at chest height directly underneath the wires.

Becker's testimony began with a brief recounting of his research over the past fifteen years, to show the firm scientific foundation on which his opinions rested. His medical conclusions were that the existing data showed NIEMR to be a biological stressor, and that as a physician he would have to assume the effects would be harmful.

It would be unethical, Becker wrote, to expose people to levels of NIEMR greater than ambient levels without their permission. Such exposure would be tantamount to human experimentation without informed consent. Before he, as a doctor, could expose human beings to such fields, he had to comply with every provision of the Human Experimentation Regulations, which included obtaining their informed consent and telling them that they could terminate their participation at any time. It seemed to Becker absurd that power companies could expose people without their consent, in the pursuit of profit.

We finished the reports in October and Simpson mailed them to the power companies. It was the first time ever in the U.S. that scientists—moreover, scientists with all the right degrees, experience, and requisite professional affiliations—had presented hard evidence in an official forum that a health risk could result from exposure to powerlines.

The reaction of the power companies to our testimony was immediate and telling. They requested that the Rochester hearing be suspended so they could produce new witnesses. And soon after, things began to develop in such a way that we knew we had opened a real can of worms.