# HEALTH HAZARDS ON MEADOW STREETS

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## INTRODUCTION

The July 9, 1990 issue of *The New Yorker* magazine carried an article entitled Calamity on Meadow Street, by Paul Brodeur. The article described clusters of cancer cases at three different locations that involved the presence of electromagnetic fields from powerlines. On Meadow Street, in Guilford, Connecticut two malignant brain tumors, a malignant eye tumor, and a non-malignant brain tumor occurred in people who lived in four adjacent houses on Meadow Street, across from an electrical substation and close to powerlines operated by the Connecticut Light & Power Company. In Dukeville, North Carolina, 7 people who either worked at a power plant or lived near powerlines operated by the Duke Power Company died from brain cancer. In Montecito, California, four cases of blood cancer occurred among children that attended a school located next to a substation and a powerline operated by the Southern California Edison Company.

Brodeur suggested that there was probably a link between the electromagnetic fields produced by the substations and powerlines, and the incidence of cancer, and he described the experiences of people who lived in the cluster areas when they sought help from the power companies and state health officials. The residents were rebuffed by power company spokesmen who, typically, made self-serving statements and denied all responsibility or potential danger. The health officials were condescending and evasive; they measured the electromagnetic fields but conceded that the measurements were meaningless because there is no recognized safe or unsafe level of electromagnetic fields. According to Brodeur, the residents were humored by the state officials, as an adult might humor children.

A century ago, Upton Sinclair wrote about the squalid conditions in the American meat-packing industry and his journalistic activities led to food and drug laws that protect the American consumer. At least in form and tone, Brodeur's article is similar because it exposes today's power industry as one that is willing to tolerate the occurrence of increased cancer levels among the American public. He argues that powerline and substation electromagnetic fields (EMFs) are related to cancer risk, and that the responses of industry and government have been self-serving and impotent, respectively. Let us consider these charges individually.

## HEALTH RISKS DUE TO EMFs

### Electric and Magnetic Fields

Powerlines and substations conduct and operate by means of electricity. The flow of electricity is usually described by stating its voltage (in volts) and current (in amperes). Electric and magnetic fields are real but incorporeal entities that always arise in the space near any wire that carries electricity. These fields are distinct from one another, but are often referred to jointly as the electromagnetic field. The strength of the fields can be measured using suitable instruments. To compare the results of

measurements using different meters, units must be chosen for each field. Here, the volt per meter (V/m) and the milligauss (mG) will be used to describe respectively the electric and magnetic field. Every powerline and substation creates an electric field and a magnetic field in its general vicinity. Consequently, questions arise whether the fields have the capacity and likelihood to adversely influence human health, and whether any such risks would be different from those experienced in homes and offices that are not near powerlines or substations.

Physical Effects of Electric and Magnetic Fields

All objects are composed of atoms, and all atoms contain positive and negative electric charges. When objects are exposed to electric and magnetic fields, the electric charges in the objects respond and begin to rotate, move (translate), and vibrate; the amount of each type of motion is determined by the characteristics of the object and by the strength of the fields. Conductors are·objects in which the electric charges are (relatively) free to respond to the presence of an electric or magnetic field. The human body is a conductor. Consequently, the fields necessarily affect the electric charges in the tissues of exposed human subjects in the sense that the fields will cause the charges in the tissues to translate, rotate, and vibrate.

Health Risks of Electromagnetic Fields

The health implications of exposure to powerline electric and magnetic fields emerged as an important issue during the 1970s (1-4). The amount of pertinent research has continued to grow (5-50).

Animal studies are frequently used to evaluate the side-effects of various substances. Usually, high doses are administered to animals, and from observing the levels at which no important effects are produced, judgments may be made concerning the risks to human subjects by employing suitable safety factors. Despite the expenditure of an estimated $100-200 million on bioeffects research by the power industry since 1975, safe doses of powerline fields have not been established because animal studies have not disclosed field levels at which no important effects occur. On the other hand, many scientific studies have shown that electric and magnetic fields can cause diverse and significant effects in animals including effects on growth, healing, and development (39-45), and can produce potentially dangerous changes in tissues (46,47). The absence of objectively established safe doses together with the many reports of field-induced changes in body and tissue function in animals, have raised serious questions concerning the safety of long-term exposure of human subjects to powerline electric and magnetic fields.

There are few laboratory studies of the effects of intentional exposure of human subjects to EMFs. These reports include findings of alterations in blood-fat levels (1 day exposure) (48), performance on various psychological tests (a few hours' exposure) (49), and body rhythms (6-8 weeks' exposure) (50). Following these studies, and reports on effects on growth rate in animals (45) the use of human subjects has

apparently been avoided. The ability of electric and magnetic fields to affect tissues has been used to treat disease (51). This fact further underscores the potential danger of indiscriminate human exposure.

Some people are exposed to higher levels of electric and magnetic fields because of where they live or work. The occurrence of disease in this group has been studied to determine whether the observed levels were similar to those that would ordinarily be expected irrespective of the fields. Except under specific circumstances (55), intentionally using human beings for the purpose of evaluating risks is ethically abhorrent and impermissible. But in the residential and occupational studies involving EMFs (called epidemiological studies), the investigators did not apply or control the fields experienced by the subjects; rather, those subjects who had been exposed were identified and evaluated. These studies (5-37) permit estimation of the amount of risk associated with a given increase in field exposure. Not all studies report an association, but there have been enough such reports of associations to definitely implicate exposure to fields as a significant factor in human disease (38,52).

Estimating unsafe Levels of Magnetic and Electric Field

Adult subjects whose houses had magnetic fields of about 2 mG had a 28% increased risk for cancer, compared with subjects who lived in a field of 0.5 mG (8). In another study, children who lived in the 2 mG field had 133% increased risk for cancer, compared with children who experienced about 0.5 mG (5). Thus, addition of approximately 1.5 mG to the environment of the subjects produced a demonstrated increase in cancer risk. The magnetic fields measured on Meadow Street were 3-200 mG, depending on whether one accepts the power-company data, or measurements made by the Meadow-Street residents. A level of 12 mG was measured under the powerline near the Montecito school by California officials, and 4-6 mG was measured in the school's kindergarten patio by the power company, which also found 17 mG in one classroom.

Although cancer is the most frequently studied disease in relation to electric and magnetic fields, other diseases have also been implicated (and none have been excluded from potential involvement). For example, in a study investigating the link between depressive mental illness and magnetic fields, subjects who committed suicide were 47% more likely than expected to have lived in a house where the magnetic field was equal or greater than 1.5 mG (6). Subsequent research has strengthened the link between field exposure and mental illness (53).

In ordinary sensory perception of sight, touch, and sound, the particular cells that respond to the stimuli are known, as are the paths of the nerves that convey the information to the brain. In the case of powerline fields, the cells responsible for detecting the fields and the signals they may send to other parts of the body are not yet known. Uncertainties are also associated with the doses that are linked to disease. Some persons, particularly the old or the young, may be particularly susceptible to field

exposure. A complicating factor is that fields do not cause disease in the sense that illness results every time individuals receive a specific dose. In several studies, for example, the incidence of cancer was found to be greater among subjects who lived near powerlines, compared with the incidence among those who did not live near powerlines (34,35). But not all subjects who lived near powerlines developed cancer, and cancer occurred in some subjects who did not live near powerlines. These studies indicate that exposure to powerline fields increases the risk for developing cancer, but they do not prove that fields cause cancer, in the ordinary sense of cause (54).

Exposure from Household Appliances

A dose of a substance is an amount of that substance received by a subject. A dose of medication, for example, might consist of two pills taken every 24 hours. If 20 pills were taken in 24 hours, or two pills were taken every 2.4 hours, the dose would be 10 times greater. Thus, both the amount and time are pertinent aspects of the dose of a substance. In some cases .(particularly involving non-chemical factors), the area over which the substance is given must be specified to provide a reasonable basis for comparison between different situations. For example, if a beam used for chest x-ray is broadened so that the entire body is irradiated with the same strength used previously for the chest, then the dose of x-rays received by the subject would be significantly increased, even though neither the time of exposure nor the strength of the x-rays at a particular point were increased. Similarly, if one square inch of skin of a subject in a room at 75°F is heated to 100°F, the heat dose (and consequently, its physiological effects) would be quite different compared with the case in which the temperature of the entire room was raised to I00°F. From these considerations it is clear that the strength, time, and spatial extent of a field as it impacts on a subject must each be considered in calculating a dose.

We can estimate the dosage from powerlines near homes produced by a field of 1.5 mG by taking into consideration the length of time a typical subject might be at home. If the subject were present 14 hours/day for 340 days, the magnetic field dose would be about 7000 mG-hrs/year. Since a powerline field of 1.5 mG contacts a subject's body at all points, this value represents the average full-body dose produced by the powerline.

The highest dose from household appliances probably occurs from electric blankets. Assuming that a blanket is used 100 days in a year, 8 hrs/day, and that it has a duty cycle (on time) of 25%, the resulting average full-body exposure is 400 mG-hr/year (56). Magnetic fields measured near other appliances are listed in Table 1 (57). High fields occur near many appliances, but they decrease rapidly with distance; the field is usually less than 0.1 mG at 1-3 feet. By averaging the magnetic fields in Table 1 over the body of the user, and assuming a reasonable time per day of use for each appliance, it becomes clear that none of the appliances results in an average full-body exposure exceeding about 25 mG-hrs/yr. Consequently, although some home appliances produce magnetic fields significantly higher than 1.5 mG in their immediate

vicinity, appliances do not result in a significant dose of magnetic fields because the periods of use are short and the fields are localized.

TABLE 1. Magnetic Fields Near Various Appliances (57)

| | MAGNETIC FIELD (mG) | |
|---|---|---|
| APPLIANCE | 1 Foot | 3 Feet |
| Can opener | 35-300 | .7-10 |
| Hair dryers | <.1-70 | <.1-3 |
| Electric shavers | .8-90 | <.1-3 |
| Sabre & circular saws | 10-250 | .1-10 |
| Drills | 20-35 | .8-2 |
| Vacuum cleaners | 20-200 | 1.3-20 |
| Mixers | 6-100 | .2-2.5 |
| Fluorescent desk lamps | 5-20 | .2-2.5 |
| Garbage disposals | 10-20 | .3-1 |
| Microwave ovens | 40-80 | 2.5-6 |
| Fluorescent fixtures | 2-40 | .1-3 |
| Electric ranges | 3.5-40 | .1-1 |
| Portable heaters | 1.5-50 | .1-2.5 |
| Blenders | 6-20 | .3-1.2 |
| Television | .4-20 | <.1-1.5 |
| Electric ovens | 1.5-5 | .1-.4 |
| Clothes washers | 1.5-30 | .1-1.5 |
| Irons | 1.2-3 | .1-.25 |
| Fans and blowers | .3-40 | .1-3.5 |
| Coffee makers | .8-1.5 | <.1 |
| Dishwashers | 6-30 | .7-3 |
| Toasters | .6-7 | <.1 |
| Crock pots | .8-1.5 | .2-.6 |
| Clothes dryers | .8-3 | <.1 |
| Refrigerators | .1-2.5 | <.1 |

Summary

Despite many studies during the last 15 years, levels of electromagnetic fields that can reasonably be regarded as safe have not been identified. On the other hand, ample research indicates that long-term exposure to electromagnetic fields from powerlines and substations are unsafe because they can significantly increase the likelihood of the occurrence of disease. Exposed subjects are more likely to develop disease—cancer is the disease most frequently studied—than they would have been if they had not been exposed. In two important studies (5,8), an increase in the magnetic field of 1.5 mG increased the risk for cancer by 28-133%.

The dose of magnetic fields provided to the residents of Meadow Street and

Dukeville, and to the students at the Montecito school far exceeds the doses of these fields normally experienced from household appliances. It is clear, therefore, in light of current scientific knowledge, that their dose of electromagnetic fields increased their individual risk of developing cancer, and consequently could have accounted for the observed occurrence of the cancer clusters. This does not mean that the powerline field definitely caused cancer in specific persons—such a statement has no scientific meaning because it is not possible to design an experiment to test it. It does mean, however, that a specific person living on Meadow Street or in Dukeville, or attending school in Montecito was more likely to develop cancer, compared with the likelihood that would exist if such a person did not live or study near a powerline substation. This was what Brodeur said, and consequently, in my view, he got it right.

## RESPONSE OFTHE POWER INDUSTRY

### Background

The first publicized suggestions in the U.S. of potential health problems from powerlines occurred in ·the late 1960s, when American power companies acknowledged Soviet reports that exposure to powerline EMFs impaired the health of workers. Studies involving American powerline workers were begun, and were expanded in 1972 after Soviet scientists formally reported their data at an international meeting in Paris. Around 1975, the American power industry formed a consortium, the Electric Power Research Institute (EPRI), and EPRI assumed the lead for the industry regarding the health risk issue.

During 1975–1980, the industry was confronted in various powerline hearings by arguments that the Soviet studies and other published scientific studies showed that animals and people exposed to EMFs exhibited changes in their cardiovascular, endocrinological, immunological, and central nervous systems. Since these changes occurred in animals, it was suggested that similar changes could occur in people exposed to powerline EMFs. In response, the power industry formulated the Rochester Defense (named after the scientists from the University of Rochester who were hired to implement it) which consisted in personal attacks on the scientific competence of investigators whose animal studies indicated that exposure to powerline EMFs might be a health risk. The gist of the Rochester Defense was that it was impossible for powerline EMFs to produce any effects in animals; consequently, they argued, scientists who reported such effects were incompetent. Transcripts of public hearings in Minnesota, California, New York, and West Virginia are replete with these arguments and derogatory comments. During this period, almost all investigators whose published studies supported the inference that there might be health risks lost their research funding. After 1980 virtually all research funding directly intended to study the health issues posed by powerline EMFs came under the control of the power industry.

During 1975–1985, the power industry spent hundreds of millions of dollars on secret research in an effort to provide documentation that affirmatively supported its position that powerlines were safe. Even though it failed, throughout this period the

industry benefitted from legal presumptions in its favor, intimate familiarity with state regulatory agencies, and the absence of organized opposition. Consequently, from a financial viewpoint, the Rochester Defense was successful because the industry was able to build most of the new powerlines that were desired, with no significant design changes incorporated to promote public safety. Nevertheless, the number of published scientific studies whose reasonable inference suggested risk increased each year. Additionally, the American public was becoming increasingly aware of the health-risk controversy because of numerous articles in the lay press.

The Crowell/Moring Defense

The power industry in North America held a meeting in Toronto in late 1986; shortly thereafter the Rochester Defense was officially discontinued, and the Crowell/Moring Defense (named after the Washington, DC law firm that is largely responsible for implementing it) was initiated. Power-industry officials announced that EMFs could affect animals but argued that effects in animals don't necessarily mean risks for human subjects. A cornerstone in the Crowell/Moring defense is that the power company does not have the responsibility to prove that powerline EMFs are safe; rather, the burden rests on those who believe that they are unsafe. The industry seeks to have all doubts resolved in its favor.

Consistency of position is an important element in the Crowell/Moring Defense. The aim is for all power companies to respond in a similar fashion to public inquiries such as those that follow in the wake of a Brodeur-type article. One method for synchronizing the responses involves holding seminars in which the appropriate responses are taught to spokesmen for the individual power companies. Another method involves hiring writers to dispute journalistic endeavors deemed adverse. The industry's response to the Brodeur article is a good example.

The Banks Report

Following the Brodeur article, EPRI hired Robert Banks, a founder of Robert S. Banks Associates, Inc. to write a report that would help individual power companies respond to public inquiries concerning Brodeur's article. Banks' report provided capsule summaries of responses that power-company public-relations employees could use to denigrate Brodeur and mollify individuals who expressed concern about health risks from powerline EMFs (58).

Banks' initial involvement with powerline electromagnetic fields occurred during his relationship with the Minnesota Department of Health in the late 1970s. At that time, the Department was involved in a controversy regarding the construction of a 400,000-volt powerline, and Banks assisted the Department in opposing the farmers' groups that were fighting construction of the powerline because of the possible health risks. Shortly thereafter, Banks formed his corporation, and has assisted EPRI in various public relations, literary, and educational activities.

In his report, Banks suggests the following arguments:

(1) Brodeur has no known training in epidemiology.

(2) Brodeur's article is shoddy because he made no attempt to talk to state officials in any of the three states where the cancer clusters occurred.

(3) In publicizing the three clusters, Brodeur urged the abandonment of public-health science for analyzing disease clusters and suggested that we should substitute intuition and anecdotal data for justification of environmental health control measures.

(4) Scientists always assume that something is not true, until someone proves it to be true. Thus, Brodeur is a bad scientist because he is suggesting that something may be true even though he has not proved it.

(5) If Brodeur is correct, and powerline fields are related to cancer, then every study concerning this issue should show that powerlines increase cancer rates. But not every study increases cancer rates, therefore Brodeur is wrong.

(6) No one can define what a cancer cluster actually is because the concept is inherently arbitrary. That is, ten cancers occurring on one street during a five-year period might be a cancer cluster to one person, but not to someone else. Since people don't agree on what the term means, the term is ambiguous and misleading, and one validly can't say that a cancer cluster actually occurred. Therefore, there were no cancer clusters.

(7) Magnetic-field measurements made by the Connecticut light & Power Company on Meadow Street provide no evidence that the Meadow Street residents were exposed to unusually high magnetic field levels.

(8) The Connecticut Health Department concluded that there is no cancer cluster on Meadow Street in Guilford related to the utility substation. The study was conducted by Sandy Geschwind, who is a Ph.D. student in epidemiology at Yale.

(9) John Freeman, Ph.D., an official in North Carolina said that Brodeur doesn't know what the hell he's talking about.

(10) If one looks at the reported cancer clusters and analyzes them properly, it's clear that nothing really happened. For one thing, if there were actual clusters, then everyone would have the same disease. Since there were different kinds of cancer described in Brodeur's article, and even different diseases other than cancer, there is no reason to think that all of the diseases were related. It's simply not biologically plausible to say that magnetic fields from powerlines can cause cancer.

(11) Brodeur is a poor scientist, and in writing the article he simply repeated the mistake of others. In the March/April, 1990 issue of Microwave News, it was

suggested that electromagnetic fields might be related to cancer; Brodeur was simply parroting that report, which appeared several months before his article.

(12) Cancer clusters don't really exist; they're actually a figment of Brodeur's imagination. They can be likened to Texas sharpshooter syndrome. That is, after shooting at a target, a circle is drawn around an arbitrarily chosen cluster of bullet holes, and the circle is called the bulls-eye. This is what Brodeur did. He picked cancers that occurred near powerlines and constructed his story around these facts.

(13) It's probably true that there are many cancer clusters in the United States that occur even when there is no substation or powerline in the vicinity. The fact is, a lot of things are related to cancer, and it's not reasonable to get too concerned about electromagnetic fields.

(14) Brodeur's article contains a number of errors. For example, he said that one of the powerlines on Meadow Street was 22,600 volts, but it actually was 27,600 volts. Also, Brodeur said that the powerlines carried very strong currents, but this is misleading because now, the currents are not very strong.

(15) Brodeur has written many articles and books, and reviewers' comments make it clear that his work is shoddy. W.A. Herman, writing in *Science* said that Brodeur's use of cited materials is sometimes careless. V.E. McElheny, writing in the *New York Times* said that one of the problems with Brodeur's work is that by sheer massive detail, Brodeur's work may be reviewed as thorough and, by implication, balanced. P. Huber, writing in the *New Republic* said Brodeur engages in sloppy, transparently one-sided, and sometimes brazenly dishonest reporting. M. Granger Morgan, writing in the *Scientific American* says that Paul Brodeur has done a disservice to the public interest he presumes to champion. D.A. Savitz, writing in the *Journal of the American Medical Association* says that Brodeur's work is deceptively simple. W.J. Broad, writing in the *New York Times Book Review* says that Brodeur's work turns logic on its head. J. Van, writing in the *Chicago Tribune* says that Brodeur shouldn't have written about the issue until he was more certain that electricity actually posed a danger.

Banks' arguments are irrelevant (#s 1, 2, 4, 14), unfair (#s 3, 8, 9, 11, 15), or specious (#s 6, 7, 10, 12, 13), but the significance of the Banks report lies not in the quality of the argument but in EPRI's motivation in creating and disseminating the report.

Summary

The power industry has a woeful record regarding the issue of health risks from powerline EMFs. Early, the industry took the wrong path and now it is hopelessly lost among sophist arguments and upside-down priorities. In less than two decades, the

leaders of the industry have transformed its public image from Reddy Kilowatt to Darth Vader. Brodeur said that the power industry couldn't be trusted. Consequently, in my view, he got it right.

## THE ACTIONS OFSTATE HEALTH AGENCIES

### False Assumption

The positions of the state agencies in Connecticut, North Carolina, and California described by Brodeur are essentially the same as those of the health agencies in the other states: Powerline electromagnetic fields (EMFs) do not *cause* cancer. This conclusion rests on the false assumption that there is such a thing as a cause of cancer. There isn't. A *cause* is commonly perceived as a condition that effectively and inevitably calls forth an issue (54). Moreover, it should be obvious that the condition is the immediate agent in the production of an effect (54). The core meaning of cause is conveyed by the philosophical *efficient cause* or the legal *proximate cause*. Correct usage of cause allows a little weakening in the timing and inevitability of the relationship between the condition and the issue—but not too much. Suppose, for example, that 100 lawyers were dropped off the roof of a 10-story building. We expect a high mortality, and we could conclude that falling from the top of a 10-story building caused lawyers to die; cause would be appropriate even if only 99 of the lawyers died. Suppose 100 other lawyers were dropped off the roof of a 3-story building, and only 50% died immediately. We could conclude that a 3-story fall can cause lawyers to die, and we could even estimate the probability of the event. Clearly, death was caused not only by the fall itself—because not every falling lawyer died—but, additionally, by unascertained conditions in the way the lawyers fell. Perhaps there was a higher mortality among the lawyers that landed on their heads, or among the wealthy lawyers (because wealth was correlated with a death-promoting characteristic such as poor physical health). Replicates of the second experiment aimed at more precisely defining the cause of death would be worthwhile but replicates of the first study would probably be a waste of lawyers. Consider the fate of the lawyers who survived. Many of them spent a long time in surgical intensive care units, where they were maintained supine and fed via a plastic tube; iatrogenic infections and multiple organ failure were common. Twenty years later, it was found that the incidence of cancer among the survivors was twice that of a control group. Can we say that the fall caused cancer? Surely not, if cause has its correct meaning. We can say only that the fall increased the risk for cancer: It made the occurrence of cancer more likely than would have otherwise been the case. Similarly, powerline EMFs do not cause cancer—but they increase the likelihood that it will occur, and this is exactly what upsets and offends the EMF-exposed subjects.

### Partizanist Discrimination

Another false assumption made by the state health agencies is that until someone proves exactly how EMFs are linked to cancer the appropriate regulatory action is to do nothing. But actually, the appropriate action is that which is fair and

nondiscriminatory—molecular mechanisms are irrelevant to the issue. We do not understand the molecular mechanism of memory, digestion, or life, and yet we do not ignore their reality. We do not understand the molecular mechanism of cancer induction by cigarettes, asbestos, or ionizing radiation, and yet we do not fail to regulate them. Courts routinely make decisions on the basis of less-than-perfect information, and there is no legal, logical or scientific principle that compels non-action in the presence of uncertainty. Any decision has its potential down side. If design changes are made and EMF exposure ultimately turns out to be non-hazardous, then money will have been wasted. But failure to act coupled with the reality of EMF health risks means that some luckless subjects would have developed disease that could have been avoided. The right and responsibility to decide rests with the people because, in a democracy, social policy is determined by the people, not by health officials or bureaucrats in the executive branch of government. Nevertheless, the state agencies have arbitrarily chosen to discriminate in favor of a partizan group (power companies) over the interests of all others, including the people who live near substations and powerlines.

Summary

The state agencies that regulate or attempt to regulate power companies lack the talent, resources and express mission necessary to perform the job that the public expects them to perform. Even worse, since a revolving door frequently existed between the state agencies and the power industry, agency staffs show little interest in taking remedial steps. It is not surprising, therefore, that the state agencies are part of the problem, not part of the solution. This is what Brodeur said; consequently, in my view, he got it right.

## POWER-INDUSTRY ABUSES AND THE ROLE OF JOURNALISTS

In 1925, a broker was hired to sell a building in New York. Through a dummy corporation, the broker himself made an offer of $80,000 and the client accepted. When the corporation resold the property a few weeks later for $87,500, the client suspected hanky-panky and sued; ultimately, the case came before Justice Cardozo. First, Cardozo pointed to the obvious conflict-of-interest: A broker's duty is to get the highest price, but a buyer's goal is the opposite. The broker claimed that he revealed enough information when he told his client that the corporation was also a client. Not good enough, said Cardozo, and he laid down the rule regarding disclosure that applies to anyone who owes divided fealty: If dual interests are to be served, the disclosure to be effective must lay bare the truth, without ambiguity or reservation, in all its stark significance.

Power companies have a fiduciary responsibility, just as did the New York broker. On the one hand they must supply electrical power and earn a profit, but they must also safeguard those exposed to the electromagnetic fields from their powerlines. In serving these dual interests, the power companies must lay bare the truth, without ambiguity or reservation, in all its stark significance. But the industry has not met this

test; instead, it actively disseminates misinformation, the ordinary consequences of which are to hide the truth, create ambiguity, and minimize significance. One series of efforts in this regard involves the industry's approach toward research. In essentially none of their studies is all of the pertinent research data released to the general scientific community. Sometimes no information is released, such as was the case for studies at Johns Hopkins, Equitable Environmental Health Inc., and Tabershaw Occupational Medicine Associates. In other cases, studies at the Southwest Research Institute and Battelle, for example, selected data is released, but only after it has been treated by industry spin doctors.

Another industry strategy involves the formation of independent companies that are held out to the public as being independent and disinterested when that is not actually the case. ERI Inc., for example, a privately held New York-based consulting company was founded by Robert Kavet, who for many years was an important executive at EPRI. One of ERI's business activities involves furnishing expert witnesses in legal proceedings involving health hazards of powerlines. The ERI witnesses are no more aggressive in exposing their link to the power industry than was the New York broker in disclosing his ownership of the dummy corporation. Perhaps worse, ERI and other similar companies are often hired by state agencies that are supposed to be engaging in independent analysis of EMF issues.

A third strategy involved the creation of a large stable of witnesses who defend the power-industry position, essentially anywhere in the world. The identification and organization of this group of scientists is unprecedented in American jurisprudence. Industry representatives contacted several thousand American scientists, and made a preliminary determination of their opinions concerning health risks from powerlines. Ultimately, about ten scientists were identified, and they now appear in court as a group in EMF cases. The cost of assembling and deploying the group, and the scientific pedigree of several of the scientists are impressive. Stuart Aaronson, for example, who is a prominent molecular virologist employed by the National Cancer Institute, received more than $70,000 for providing a brief report and testifying for 90 minutes in one case in New York. The sheer number of industry witnesses overburdens the resources of the litigants opposed to the power industry.

Another power-industry activity that is antagonistic to the full-disclosure rule articulated by Cardozo is the creation of pamphlets, publications, and reports that shield the American public from the view that exposure to powerline EMFs is a risk to health. Probably, there does not exist an industry pamphlet intended for the public that even remotely conveys the present state of scientific knowledge or opinion. The situation is far worse in industry reports that are intended principally to be read by power-industry employees, such as that by Banks (58). These reports are naked arguments to be memorized and repeated by local power-company public relations employees when they are confronted with local inquiries by concerned individuals. Thus, the concerned citizen in Paducah, Peoria, Fargo, or Anchorage will each receive a canned answer,

designed principally to protect the power company.

The goal of all these strategies directly conflicts with the goal behind the full-disclosure rule articulated by Cardozo. Full disclosure is required when one side has more knowledge than the other party, and where the business activities of the superior party may adversely affect the naive inferior party. The present industry strategy turns the fiduciary responsibility upside-down because it attempts to hide facts that the naive innocent party—the resident near powerlines—might view as unacceptable.

Ultimately, the American public might decide that the risks of cancer from powerline electromagnetic fields are not so great that they justify the added costs in utility bills that would be necessary to eliminate the risks. But the public can't reach any decision if it is kept ignorant of the existence of the issue which, I think, has been the aim of the power industry since the 1960s. Brodeur's efforts undercut the industry strategy and, consequently, serve the public interest. They have the potential to fuel public concern which could then lead to governmental activity—litigation brought by the state or federal government against the power industry to enforce the industry's fiduciary responsibility, or new laws that shift the burden of showing safety to the power companies. The only potential plaintiff big enough to take on the industry is the government itself. Unfortunately, now, the government is part of the problem, not the solution. This could change if the public became more enlightened and this, I think, is the salutary role of journalists, especially Brodeur in view of his wide audience.

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