

# EIR Science & Technology

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## Are high-voltage power lines a threat?

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*Janet G. West reviews the evidence on the latest target of hysteria from environmentalists, and concludes that the problems—if they exist—can easily be solved.*

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Today, we are increasingly besieged by strident warnings of destruction of the Earth and its environment—air pollution, chemical and other hazardous waste, the hoax of the “ozone layer depletion,” and others.

The greenies have insisted there are too many people, and that nuclear energy is dangerous, either because it causes cancer, or attracts terrorists. Now we are hearing similar warnings that high-voltage power transmission lines may pose a mortal threat to humans. These lines have become the subject of numerous studies, some suggesting an association between long-term exposure to the electromagnetic fields (60 Hz) produced by the lines, and the incidence of cancer. But other studies have suggested that no such correlation exists.

At the present time, high voltage alternating current (AC) lines are becoming the backbone of long distance power delivery systems in the United States: They are stable and reliable, they use less space than lower voltage lines, and their loss of power through heat is about 5% per 1,000 km.

One should bear in mind that were it not for the actions of the environmentalists whose persistent threats, legal actions, and outright terrorism have worked to halt construction of nuclear power or hydroelectric plants near population centers, it would not even be necessary to transport energy over great distances, because power plants would be already located near major cities.

### The Florida case

In the past year, Florida became the first state in the nation to adopt emission standards for electromagnetic fields generated by high-voltage electricity lines. This move by the

Florida Environmental Regulatory Commission came after four years of study by various state commissions and followed a public hearing in Tampa on Jan. 18.<sup>1</sup> The regulations became effective Feb. 17, and are applicable only to lines already under construction or in the planning stages.

It is the estimate of the Florida Department of Environmental Regulation that the new rules will “add \$100 million to \$5 billion to the cost of 500 kilovolt (kV) lines over the next 30 years.” In that time period, Florida will have 330 miles of 500 kV lines under construction, and another 4,000 miles of 230 kV lines are being considered for construction. One line alone, a 500 kV line spanning the 146 miles from northern Palm Beach County to North Dade County, is estimated to cost a total of about \$1 million a mile. Construction will not even begin until opposition groups complete all appeals.

Is there a real threat to human or animal life from these lines? The response of a spokeswoman for the state’s largest electric utility, Florida Power and Light, makes clear that the real issue is not potentially adverse biological effects:

The rule is a reasonable compromise. . . . Obviously, it has some costs involved, but in light of all the political pressure for the state to set some kind of standard, [it] attempted to balance—with no scientific evidence of the need of a standard—the economic impact with the emotional concerns.<sup>2</sup>

### Your toaster may be more dangerous

Numerous studies have investigated the biochemical changes that occur in a wide variety of species—both plant

## Lying with statistics

In an article entitled "Lies and Statistics" in the March 1969 issue of *Nuclear News* magazine, author Jon Payne presents the truth about how statistics about clusters of illness around nuclear power plants have been manipulated to fuel fears of radiation.

In the real world, he reports, studies exist that show a "moderate excess above the expected in the number of leukemia cases" near a particular nuclear plant. However, there are other geographical locations in the vicinity of other plants where there exists a "moderate deficiency" of such cases.

"The most reasonable conclusion should be that probably the nuclear facilities were not the cause of either the excess or the deficiency." If you conclude, he explains, that the findings of one are accurate, then you also have to explain the findings of the other case. "Unfortunately, reasonable conclusions are not always drawn in such situations," Payne observes. Most often, the clusters of disease are considered to be relevant, and the lack of clusters,

irrelevant. "Two forces are at work in these matters: emotionalism, and innumeracy," he explains. Clustering itself is not unusual, but should be expected. "Clusters of illness occur because of statistical variation, and in fact they occurred even before there was industrialized society," Payne states.

"Take the situation where two cases of leukemia are expected in a population in 10 years. If just one case occurs, the public yawns and turns its attention elsewhere; if there are three cases, the nearest industrial facility is blamed. In most instances, these are normal variations around the expected, but many people remain unaware of this. Consequently, this is fertile ground for planting claims that a nuclear plant is the source of the illness.

"In fact, you can guarantee variations from the expected by looking at smaller and smaller subsets of data," he points out. "In most of the instances we are talking about, the radiation releases are so small they are lost in the noise of variation in Mother Nature's background radiation."

Mr. Payne's article is clear proof that rigorous scientific study has clearly not been one of the methods used by those posing as the protectors of humanity who have a vested interest in stopping nuclear power, transmission line construction, or other industrial projects.

—Marsha Freeman

and animal—when subjected to electromagnetic fields of the sort produced by high-voltage transmission lines. Many experiments, however, have not been successfully repeated; even when effects are demonstrated—such as reduced honey production in apiaries—no one yet knows what health risks, if any, are posed to human beings. A study prepared for the Office of Technology Assessment<sup>3</sup> points out that electromagnetic field effects may exist in common home appliances: High-voltage transmission lines may be the least of your worries, and you may instead eye that toaster or electric blanket with a bit more caution. (See **Figures 1-3.**)

One of the first in-depth studies of the effects of extra-high voltage transmission lines was conducted under the New York State Power Lines Project in 1987. The study was undertaken to answer opposition to a line to facilitate importing cheap hydroelectric power from Canada. The line would have formed a ring tying all of the state's systems together, thereby allowing New York State to eliminate the use of oil for its power generation. (See **Figures 4-7.**) The New York State study was one of the first to specify whether they were measuring effects from electric or magnetic fields, and cautioned that

There are important general differences between the electric and magnetic fields produced by power

transmission lines which should be emphasized. The first of these differences concerns the sensitivity to the current flowing in the lines. Once a power transmission line is raised to its operating voltage, the amplitudes of the electric fields produced by the line are essentially independent of the currents flowing in the conductors comprising the line. On the other hand, the magnetic fields produced by the line depend primarily on the currents flowing in the conductors, and not on the line voltage.

Thus a specification of line voltage alone is inadequate to define the magnetic field levels that a particular line is likely to produce.

Another important difference concerns the directions of the fields. The electric fields on the ground beneath an overhead power transmission line are necessarily very nearly vertical at all times, whereas the magnetic fields on the ground are largely confined to planes perpendicular to the lines (although there can be a small component parallel to the lines), where, due to the phase differences of the currents flowing in the individual line conductors, the horizontal and vertical components combine to give a total magnetic field vector that rotates at the power line frequency. . . . in general the magnetic

FIGURE 1

**Magnetic fields of representative low-power electrical appliances**

Appliance	Distance (cm)	Magnetic field (μTesla)
Welders	50	1,000
Soldering gun	Contact	1,000
Arc furnace	200	300
Wall clock	5	300
Alarm clock #1	Contact	300
Massager	5	200
Fluorescent light	5	200
Teakettle	Contact	30
Heating pad	Contact	17
Razor	Contact	10
Alarm clock #2	2	10
Television	25	1

*Measurements were made with a meter manufactured by the Electric Field Measuring Company, West Stockbridge, Massachusetts. The diameter of the measuring coil was approximately 10 cm. With the exception of the electric razor, all of the measured magnetic fields were nearly pure 60 Hz. The razor had a rich spectrum of higher frequencies. The welder and furnace data are from Lövsund (1984).*

Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen.

flux density vector near the ground rotates in an ellipse with highly variable characteristics. . . .

With respect to biological, genetic, and cancerous changes, the authors concluded:

No effects were found on reproduction, growth or development. Several studies showed no evidence of genetic or chromosomal damage that might lead to inherited effects or cause cancer. While most measurements of behavior and brain function did not demonstrate changes, some did show changes that were small but consistent. . . . Some of these appear to result from changes in body rhythms, and might interfere with normal sleep patterns. . . .

[S]tudies using soft agar cloning assays to assess the proliferative response of normal cells and human colon carcinoma cells to fields, reported that for the cancer cells, but not the normal cells, magnetic or combined magnetic and electric fields caused increased cell proliferation, increased numbers of surface transferrin receptors, increased resistance to natural-killer-cell activities and increased expression of

FIGURE 2

**Power frequency electric fields near electrical appliances**

Appliance	Electric field (V/m)
Electric blanket	250
Broiler	130
Stereo	90
Refrigerator	60
Toaster	40
Color television	30
Incandescent light bulb	2

*All measurements were made at a distance of 30 cm from the device. Data from Miller (1974).*

Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen.

tumor cell surface antigens. The observation that normal cells did not grow in soft agar is consistent with the conclusion that exposure to the fields did not cause cells to become cancerous.

The observations with the cancer cells, however, suggested to the investigators the possibility that magnetic fields stimulate the rate of cancer cell growth. Even if this observation were confirmed, however, extrapolation to the behavior of cancer cells in humans is not justified, because behavior of cells in soft agar is not predictive of their behavior in the whole organism. . . . [T]here is no basis to extrapolate between growth of cells which are already malignant and initiation or promotion of cancer in the whole organism.

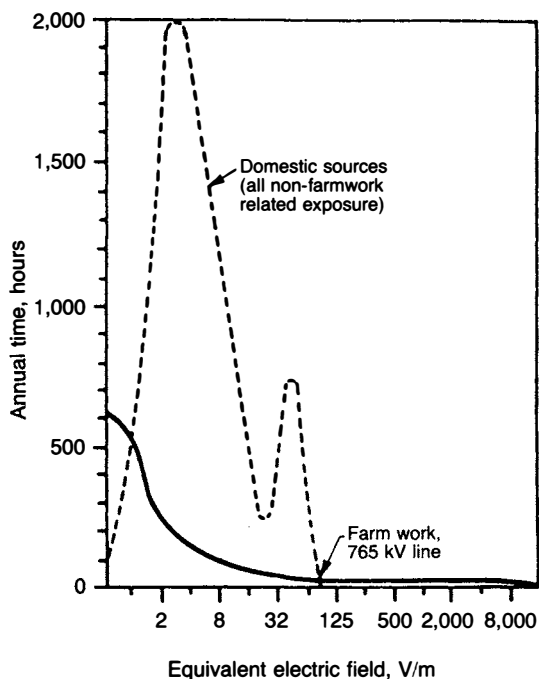
In the end, the New York Public Service Commission was unable to come to a conclusion about whether biological hazards did exist, but *the line was not built*. The cheap electricity that this line would have provided, would have prevented the death from exposure of elderly citizens who lacked adequate heat in winter or air conditioning in summer. The rise of such deaths is especially marked in the larger cities of North America that are already experiencing brownouts and blackouts for lack of adequate reserves of electrical power.

**Green 'science'**

The study that is considered the landmark for the environmentalists was done by Nancy Wertheimer and Ed Leeper in 1979. This was an epidemiological study to determine the effects of long-term exposure to extremely small magnetic fields in the home. They compared childhood mortality records in the greater Denver, Colorado area, and correlated the incidence of cancer with proximity to the network of extra-

FIGURE 3

**Time spent in equivalent electric fields; domestic vs. farms with 765 kV transmission lines**



Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen; Electric Power Research Institute.

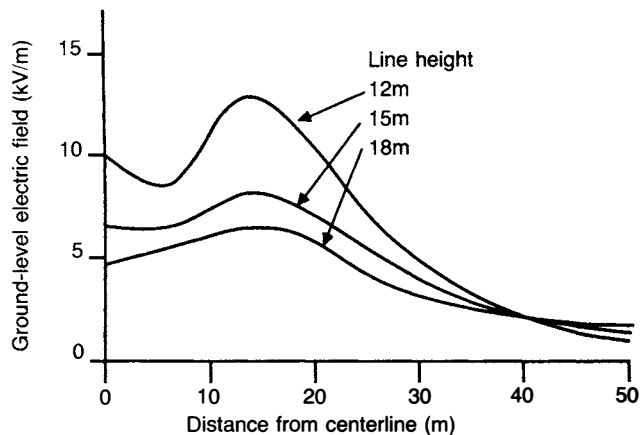
high voltage lines. Their study concluded that there was a statistically significant increase in childhood cancer in the Denver area, compared with a control group. A large fraction (37%) of the homes were near so-called “high-current configuration” power lines, than were found for the controls.

However, the study was not conducted blind—that is, the subjects knew whether they were part of the experimental group or of the control group; it assumed that the magnetic fields in the home were dominated by nearby power lines, as opposed to other sources, such as by domestic consumption of electric power or other invisible sources of fields; it assumed that the magnetic fields could be estimated by visual inspection of neighboring power line wiring configuration.

Additionally, the magnetic fields were not measured at the homes of the subjects, but instead were measured directly below several of the lines. The role of the use of everyday household appliances was not accounted for, which could affect or interfere with the fields generated from the extra-high voltage lines. Finally, Wertheimer and Leeper took no account of the fact that there is a higher rate of certain kinds of cancer in the Denver area, because of its extremely high elevation, which other studies have been able to show.

FIGURE 4

**Ground-level electric fields for a 765 kV transmission line**



*Flat configuration with a phase spacing of 14 m (45 ft.)*

Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen.

A new study was conducted by David A. Savitz, correcting for the flaws in the Wertheimer and Leeper study. Savitz, an epidemiologist currently with the University of North Carolina, commented that although he and many other scientists express concern about the possibility of a cancer threat from electromagnetic fields, there exists no persuasive evidence that extremely low-frequency radiation causes cancer.

Several epidemiological studies over the last few years have suggested an association between an increased risk of cancer and industrial and domestic exposure to electromagnetic fields, especially at low frequency. A researcher who has done extensive work in these areas remarked in his study’s findings:

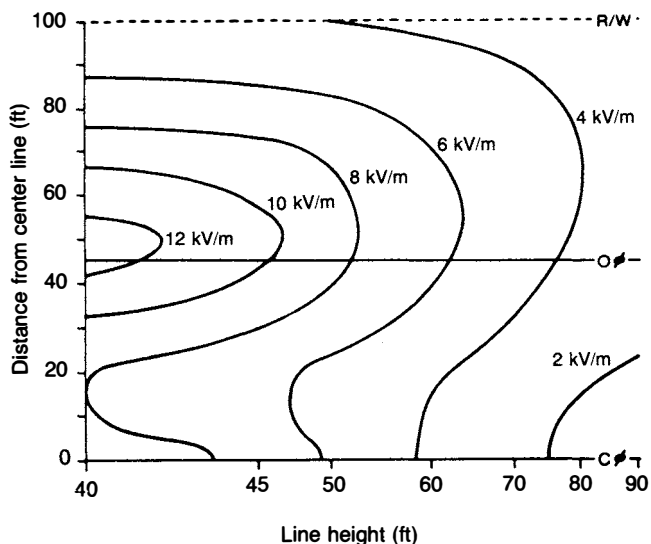
“Controversy still exists as to whether these epidemiological relationships to cancer could be attributed to the weak electromagnetic fields, or exposure to other agents, such as solvents, fluxes . . . [or] synthetic waxes . . . as are known to occur in electrical occupations, or as yet undefined factors.” He continues that the current evidence indicates that “unlike ionizing radiation, low energy electromagnetic fields do not damage DNA and hence do not cause mutations or serve as initiators of the cancer process. . . . [I]ntermittent exposure to electromagnetic fields on a regular basis may serve as a tumor-promoting stimulus. However, this suggestion awaits experimental confirmation in an established animal model.”<sup>4</sup>

In addition to epidemiological studies, laboratory studies have been conducted as well, and the bulk of them show no effect that could be attributed to exposure to fields with the power and frequency of the transmission lines.

These studies apparently do show some biological effects

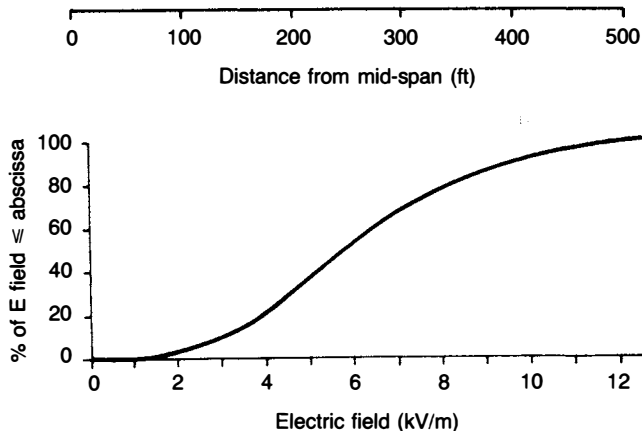
FIGURE 5  
Fields of a typical 765 kV transmission line

(a) 'Contour map' presentation of the distribution of fields within the right of way



$C\phi$  denotes the position of the center conductor and  $O\phi$  the location of the outer conductor.

(b) Cumulative distribution of the fields

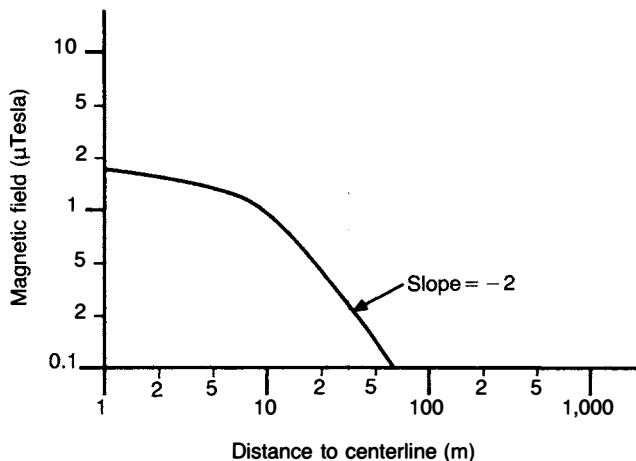


Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen.

of extremely low-frequency and electromagnetic fields. The effects of these fields are used, for instance, in diagnostic medicine and to promote healing in broken bones.

One of the most extensive such studies was conducted by Dr. Richard Phillips, of Battelle Pacific Northwest Laboratory in Richland, Washington, and Professor Rudolf Hauf of the Forschungsstelle für Elektropathologie in Freiburg, West Germany. The experiment involved four generations

FIGURE 6  
The magnetic fields of a 230 kV, double circuit transmission line



Height approximately 12 m, currents 220 and 90 A for the two circuits

Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen.

of mice, which were placed in an unperturbed 60 Hz electric field of 100 kV/m; a variety of tests were then made in behavior, hematology, neurochemistry, reproduction, bone growth, endocrinology, and other areas. The results were overwhelmingly negative.

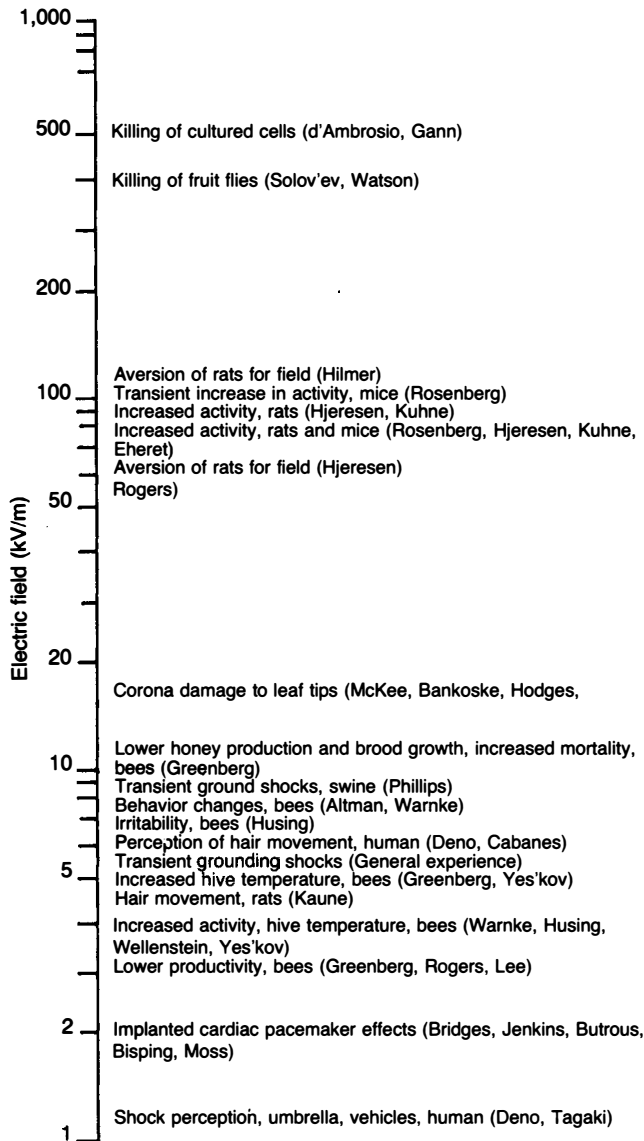
With respect to the effects of magnetic fields, another laboratory study found:

Since there is no magnetic equivalent of free charge and since concentration of magnetic dipoles in living things is extremely small, it is not surprising that there are few examples of clearly established biological effects of magnetic fields . . . the permeability of biological material are very similar to air. Thus, introduction of a biological subject into a magnetic field has a negligible effect on the field. . . . [T]here are no clearly established long-term health effects associated with exposure to electric or magnetic fields comparable in magnitude to those associated with transmission lines. Hence, there are no biologically relevant exposure parameters for extremely low-frequency fields that include the factor of time in the way it is possible for ionizing radiation.<sup>5</sup>

Despite the interest of the scientific community in conducting serious research into the effects of these fields, Congress has approved a measly \$3 million for research for the Department of Energy, for fiscal year 1989. Even most of the Environmental Protection Agency's projects dealing

FIGURE 7

**Confirmed biological effects of power frequency electric fields**



The vertical scale on the chart gives the unperturbed electric field in air before the subject enters the region.

Source: *Biological Effects of Transmission Line Fields*, by Edwin L. Carstensen.

with extremely low-frequency radiation were shut down in 1986, due to budget cuts. Many scientists express the hope of that increased research will give a definite answer, one way or the other, within the next five years. Until that answer is provided, the best approach seems to be to limiting the public's exposure to electromagnetic fields, such as routing new transmission lines to avoid populated areas, and design

new home wiring configurations that minimize the electromagnetic fields.

The real danger continues to lie with environmentalist-generated hysteria that drowns out the voice of scientific findings that certify the safety of high-voltage lines. Witness the destruction of the nuclear industry, against which environmentalists launched their assault, not despite the fact that nuclear is clean and safe, but *because* it is, in order to create a hoax that energy resources are "scarce." The nuclear industry refused to take up this political fight, to mobilize support behind a crash program to develop this cheap source of energy in the way U.S. citizens were moved to support the space program.

As in the case of nuclear energy, the environmentalists' "solution" to any perceived problem—chemical, nuclear, or otherwise—is simple: Shut it down or don't let it be built. It is a simplistic approach that appeals to those who fantasize about a "co-existence" or "guardianship" with nature. The underlying assumption is extremely insidious: Man is not even co-equal with nature, he is her slave. It is an outlook that believes that the order of the universe is such that man must obey what nature demands, regardless of the cost to human life. Such a hateful philosophy is contrary to one of God's first commandments: "Be fruitful, and multiply, and replenish the earth and subdue it: and have dominion over the fish of the sea and over the fowl of the air, and over every living thing that moveth upon the earth."

From the standpoint of reason, we can say that there is currently no proof of actual permanent harm from extra-high voltage or ultra-high-voltage transmission lines. We can, however, demonstrate scientifically that hundreds of millions of people are dying, and will die, especially in the Third World, for a lack of cheap, abundant energy which can be carried through the high-voltage transmission lines the greens would deny us.

**References**

1. Florida Electromagnetic Field Science Advisory Commission, 1984. In the Florida case, the rule for 500 kV lines has three provisions: a limit of 10 kV/m maximum electrical field within the right of way; a limit of 2 kV/m maximum electric field at the edge of the right of way; and no more than 200 milligauss (mG) maximum magnetic field at the edge of the right of way.
- For double-circuit 500 kV lines, the same standards are applied for electric field strengths as for single lines, but the limit on magnetic fields is a maximum 250 mG at the edge of the right of way. For 230 kV and lower voltages, the maximum electric field within the right of way is 8 kV/m, the maximum on the edge of the right of way is 2 kV/m, and the maximum magnetic field limit at the edge of the right of way is 150 mG.
2. *Electric Utility Week*, Jan. 30, 1989.
3. William K. Stevens, "Scientists Debate Health Hazards of Electromagnetic Fields," *New York Times*, July 11, 1989. The report was prepared by Indra Nair and M. Granger Morgan, physicists, Carnegie-Mellon University's Department of Engineering and Public Policy, and H. Keith Florig, a research fellow in the department.
4. C. Byus, K. Kartun, S. Pieper, and W.R. Adey, "Microwaves act at cell membranes alone or in synergy with cancer-promoting phorbol esters to enhance ornithine decarboxylase activity."
5. Edwin L. Carstensen, Ph.D., *Biological Effects of Transmission Line Fields*.