Electromagnetic Pollution: Is It Hurting Our Health?

by Joan Arehart-Treichel

One of the most vigorous symptoms of the growth of 20th-century technology is the spreading use of electronic equipment. From transistor radios to military exotica to rural power lines, it seems to be almost everywhere already, yet it relentlessly continues its infiltration. It has gotten to the point, in fact, where a number of researchers are beginning to wonder if there may not be a price to pay: electromagnetic pollution.

Radio and television signals—electromagnetic waves—blanket the country. Power lines, besides carrying electricity, radiate electrical fields that can often make their presence known at great distances. Everything with an electric motor has its own field. Microwave ovens, if improperly sealed, can pour their cooking energy through the cracks in their doors. Then there's all the military equipment, escalated manyfold since World War II—radar, jamming equipment, communications gear and other devices too exotic (and classified) to mention.

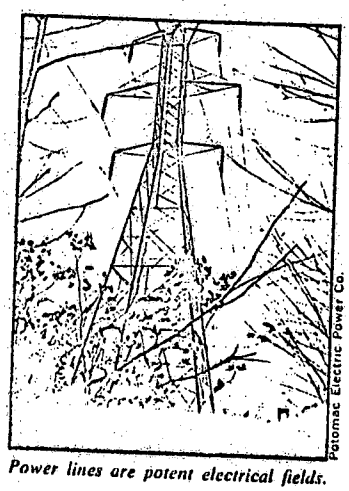
What all these creations have in common is their energy. Some of it is emitted as side effects, such as the fields around power lines. Some is inevitable—you can't have radio without radio waves. Other types are functions of design, such as microwave oven leaks or the off-axis spreading of radar antennas. Lumped together, the waves and fields in question are known as nonionizing radiation, the long-wavelength, low-frequency half of the electromagnetic spectrum (frequencies from zero to 3,000 gigahertz) that is in contrast to the high-frequency ionizing radiation of X-rays and gamma rays. Ionizing radiation has its own closetful of problems—it is the nonionizing side that is beginning to come under new scrutiny.

The double-barreled question is, do nonionizing radiations produce effects of their own, and if so, can they hurt you?

Much of the research into nonionizing radiation is being conducted by the U.S. Government, since Government is the largest single user of such radiation in the United States with an electronics investment of more than $60 billion, but university scientists are beginning to explore the subject as well. Results from both Government and university scientists suggest that nonionizing radiation does indeed affect biological systems, but several key questions need to be answered, such as whether the effects are good, bad or negligible, and whether, in fact, they really occur in people as a result of nonionizing radiation pollution.

The most widespread and in-depth research into the effects of nonionizing radiation is probably that being conducted by the Department of Health, Education and Welfare, the National Science Foundation, the U.S. Information Agency and other Government agencies under the aegis of the White House Office of Telecommunications Policy. OTP's objectives are to determine what effects the radiation has on animals and people at different frequencies, energy levels and exposure durations and to provide a rational scientific basis for establishing safety and remedial measures if necessary.

OTP's results, which it reported to Congress in May, suggest that microwaves, radio waves and electrical fields can effect the nervous system, behavior, growth, development and possibly metabolism and body chemistry at levels lower than estimated in the past. The OTP stresses, however, that "these results are preliminary observations and not scientifically validated results. In many cases they are based on single experiments in a particular laboratory involving small numbers of subjects, and causal relationships between the electromagnetic fields, and the observations are not yet clearly hazards." The OTP also points out that "all the effects are not necessarily hazards. In fact, some effects may have beneficial applications under controlled conditions."



Potomac Electric Power Co.

Power lines are potent electrical fields.

Robert Becker, an orthopedic surgeon at the Veterans Administration Hospital in Syracuse, N.Y., is one non-Government researcher who has observed biological effects with electrical fields. When he exposed rats with tumors to continuous electrical fields of 160 volts per centimeter, the rats experienced five times as many chromosome breaks in their tumor cells as did rats whose tumors were not exposed. He is now examining the effects of such fields on chromosomes in healthy cells.

When Becker exposed rats with iritis, a common eye disease in rats and humans, to vertical electrical fields of 70 volts per centimeter, the iritis got so much worse that the rats developed secondary glaucoma. He also found that rats exposed to such fields experienced both increases and decreases in levels of blood proteins, fats and cholesterol. Furthermore, young rats exposed to comparable fields grew more slowly than did control rats.

On the basis of these experiments and those of others, Becker is concerned about the possible harmful effects of electrical fields on people, although he points out that such effects may turn out to be more helpful than harmful. For instance, since electrical fields can disrupt chromosomes in tumor cells, they may be able to keep tumor cells from reproducing. "So the fields," says Becker, "may turn out to have value for cancer treatment."

Susan Korbel, a psychologist at William Rainey Harper College, exposed rats to low levels of microwaves and found that they became lethargic, more emotional and more prone to seizures. Further tests revealed that rats exposed to the same levels were hampered in learning and displayed increased adrenal gland weight and signs of stress, and that these effects were cumulative.

The levels that Korbel used were .15 milliwatts per square centimeter. According to R. H. Weaver of the American Medical Association's Department of Environment, Public and Occupational Health, Federal standards limit allowable radiation leaks from microwave ovens to one milliwatt per square centimeter—almost seven times Korbel's test level—measured at five centimeters from the oven door. This

limit may be allowed to rise to as much as five milliwatts per square centimeter over the life of the appliance. Consequently Korbel is concerned that existing safety standards for microwave ovens may be inadequate, but she believes that more research has to be conducted to be sure.

On May 15, Kathleen A. Culkin and Daniel Y. C. Fung of Pennsylvania State University reported that microwave ovens do not kill bacteria solely by heat, as previously believed. The researchers heated soups contaminated with bacteria in a commercial microwave oven and found that more bacteria were killed in the coolest part of the soup, which was closest to the source of microwaves, than in the warmest part, which was farthest away. Since in a microwave oven the surface of food is always cooler than the interior, the biologists reasoned that if heat alone were responsible for killing the bacteria, as suggested by earlier studies, more of them ought to survive in the coolest region, the top. Yet no matter what the cooking time, bacteria sampled from the top showed the lowest survival rate.

What killed the bacteria? Was there a separate, lethal microwave effect besides heat? Culkin and Fung aren't sure. But they note that "current U.S. microwave safety standards for humans are based solely on heat effects. Should further study indicate that there are damaging effects of microwaves for man as well as bacteria which are not due solely to heat, then it is conceivable that these safety standards should be changed."

U.S. Navy researchers have found that an electrical field of 60 hertz, the frequency common in home and office, altered the levels of fats in the blood of human volunteers. Whether these changes were good or bad, Navy researchers aren't sure. They are now conducting similar studies on animals using rigid controls.

There's more. James Frazier of the School of Aerospace Medicine in San Antonio has found that high-frequency radio waves—30 megahertz, between the AM and FM bands—can change magnesium and zinc levels in liver cells. Magnesium and zinc are two of the trace elements necessary to the health of cells. But here again, whether the effects are good, bad or indifferent is not known.

David Straub of the Veterans Administration Hospital in Little Rock has found that electrical fields with frequencies from 45 to 75 hertz—U.S. house current is 60 hertz—upset active transport of ions through frog skin. And this upset, he says, was generally irreversible. Straub feels that the effect is not on the enzymes that are responsible for active transport. "Something about the structure of the membrane is being affected, we think," he says. But here again, as with other nonionizing radiation effects, Straub doesn't know whether the effect is harmful or helpful.

Present research into nonionizing radiation, then, leaves one with little more than the certainty that nonionizing radiation produces biological effects. The significance of the effects is uncertain. And the questions far outnumber the answers.

Can effects seen in the lab be applied to people in the everyday environment? Are modulated waves more hazardous than continuous ones? (Some research, such as that by Ross Adey and his co-workers at the University of California at Los Angeles, suggests that they are.) What happens when waves interact or reinforce each other in the environment? Are their health hazards greater? What are the long-range effects of the nonionizing radiation at low levels? The OTP is looking into this question with animal studies.

What are the effects of the waves at the cellular and molecular level? No one is sure. "This is in contrast to ionizing radiation," says the OTP, "where the basic mechanisms of energy transfer to atoms and molecules are reasonably well understood." It is also vital to determine whether observed effects are transient or reversible; and even if they are transient, are they acceptable? Effects on the reactions of individuals performing critical tasks, such as airplane pilots, automobile drivers and factory workers, could pose life and safety hazards if not permanent biological damage. And how about the effects on different age groups, say on infants? Might electromagnetic assaults play some role in crib deaths?

So is there a reason to be concerned? "I think the likelihood that nonionizing radiation is posing hazards to human health is low," asserts Paul Tyler, head of the Electromagnetic Radiation Project, Office of the Bureau of Medicine and Surgery, U.S. Navy. "But I think we should investigate and find out for sure."

Says Straub, "If I thought present electricity levels were hazardous, I'd shut off the electricity to my house and scream to the hills about it. Still, I'd like to know what the biological effects are so that I'd feel that we understand what's going on."

Whether or not there is reason to be concerned now, there may well be reason to be concerned as more and more electronics equipment bombards our environment. Power companies are building or contemplating building transmission lines of markedly increased voltage. Television and radio stations are interested in using higher power. The annual sales of microwave ovens in American homes are predicted to reach 200,000 in 1975. Microwaves are being considered for dishwashers, burglar alarm systems and other appliances. Floating personal vehicles, suspended above roads or tracks by electromagnetic fields, are getting under way (SN: 2/23/74, p. 118).

Nor has the Navy given up on its project Sanguine, although Sanguine was postponed again by Congress in April. Sanguine, a system that would use buried cable antennas to communicate with nuclear submarines anywhere in the world, has been contemplated by the Navy for years, but it has been held up in Congress partly in response to environmental concerns. (Straub's research on low-frequency effects has been funded largely on behalf of Sanguine, whose carrier frequency is now planned to be 75 hertz, though Straub feels that commercial 60-hertz power lines pose a much more significant problem.) A Sanguine test antenna was emplaced in Wisconsin in the late 1960's, but the legs of its X-shape are less than 10 miles long, while the operational version might well span hundreds or even thousands of miles. □