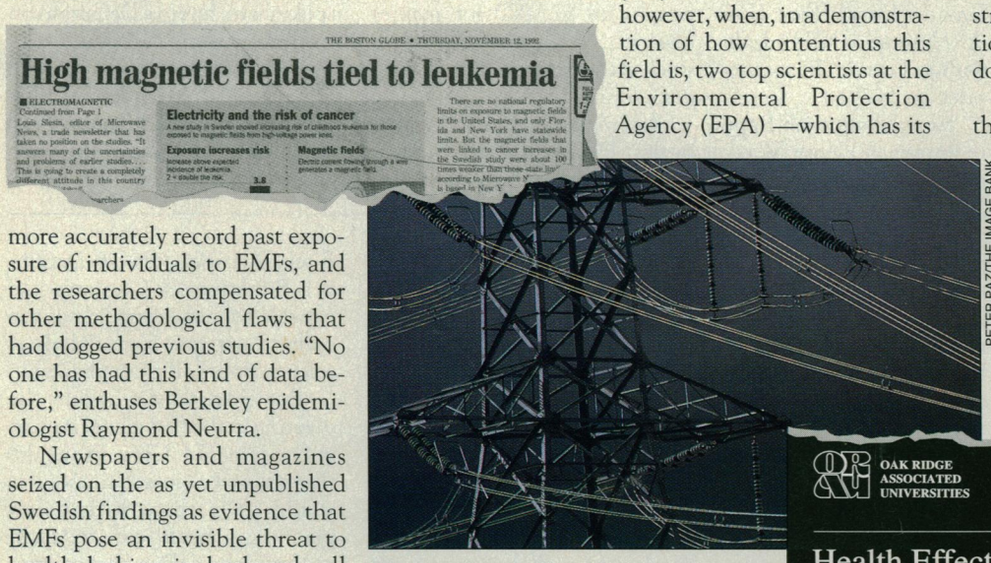
Polarized Debate: EMFs and Cancer

Can the fields associated with power lines cause leukemia? New Swedish studies say yes. But a White House report says probably not and the field continues to be torn by controversy

Last month at a meeting in San Diego, two groups of Swedish researchers made headlines when they presented data that seemed to show that electromagnetic fields (EMFs) of the kind generated by power transmission lines and other electrical equipment can cause cancer. It was hot news, because while several epidemiological studies in the past 13 years have found an association between EMFs and cancer, those studies had been criticized for a lack of precision in measuring exposure to the fields. The Swedish studies, on the other hand, drew from databases that more accurately record past exposure of individuals to EMFs, and the researchers compensated for other methodological flaws that had dogged previous studies. "No one has had this kind of data before," enthuses Berkeley epidemiologist Raymond Neutra.

Newspapers and magazines seized on the as yet unpublished Swedish findings as evidence that EMFs pose an invisible threat to health lurking in backyards all across the world. But do they? Not according to another recent authoritative source: a report from the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), part of the White House Office of Science and Technology Policy (OSTP). Undertaken at the request of the Department of Labor after a series of alarming articles by writer Paul Brodeur in *The New Yorker* in 1989 and 1990, the White House review states that "there is no convincing evidence in the published literature to support the contention that exposures to extremely low frequency electric and magnetic fields (ELF-EMF) generated by sources such as household appliances, video display terminals, and local powerlines are demonstrable health hazards."

Who's right, you ask? Well, there isn't an easy answer. Welcome to the tortured world of EMF research, where deeply held points of view function like opposite poles, and between them stretches a powerful force field that whips the lay media into a frenzy. What keeps the force field strong is a lack of conclusive data to settle the EMF-cancer question. Some scientists think the question ought to be pursued quickly, with more epidemiological studies and research aimed at finding a biological mechanism by which the EMFs could cause cancer. But the authors of the OSTP report say that, compared with AIDS and breast cancer, EMF research just doesn't deserve a high funding priority. The ink was barely dry on that recommendation, however, when, in a demonstration of how contentious this field is, two top scientists at the Environmental Protection Agency (EPA) —which has its own, long-delayed report on EMFs and cancer due out late next year—quickly criticized that conclusion and the general tone of the OSTP report.



Prose and cons. Recent studies that grabbed headlines pointed to a connection between electromagnetic fields and cancer; a White House report disagrees.

Questions about the health effects of EMFs erupted in 1979, when epidemiologists Nancy Wertheimer and Ed Leeper of the University of Colorado Health Center in Denver published a study of 344 children who had died of cancer. They found that children in homes exposed to relatively high levels of EMF were two to three times as likely to develop cancers such as leukemia and lymphoma as children in homes exposed to lower EMF levels. Since then, some epidemiological studies have tended to bear out that conclusion, and others have turned up a correlation between brain tumors and exposure to EMFs in the workplace—while still others have actually registered fewer cancers in people exposed to high levels of EMF (*Science*, 7 September 1990, p. 1096).

Epidemiologists are not alone in being plagued by a morass of contradictory data. Those who doubt the EMF-cancer connection note that most biophysicists believe high-tension powerlines induce EMFs no stronger than the fields that exist naturally in the body. Yet proponents of such a connection shoot back that EMFs do have demonstrable biological effects: They alter secretion of the hormone melatonin and at high doses can help mend broken bones.

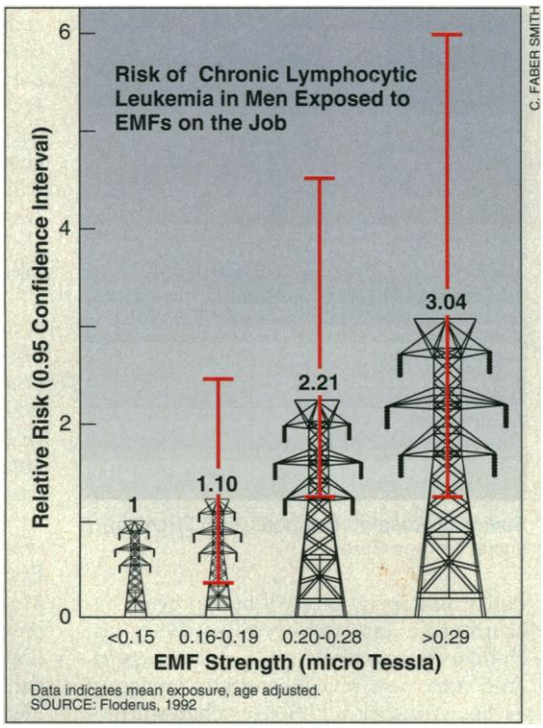
In the welter of contradictory studies, one thing that has been lacking is a consistent dose-response relationship between EMFs and cancer—the kind of relationship that would be expected of most carcinogens. Both Swedish studies came up with evidence of just such an association, however. In one study, epidemiologist Anders Ahlbom and graduate student Maria Feychting of the Karolinska Institute in Stockholm linked 39 cases of childhood leukemia, culled from more than 400,000 people, to EMF exposure related to power transmission lines. The closer the children lived to the power lines (and therefore the higher their exposure to EMFs, which the researchers calculated from detailed historical data, compiled by the Swedish government, on patterns of electricity use over each power line), the more likely they were to have leukemia. The children with the greatest exposures were more than two and a half times as likely to develop leukemia as children exposed to lower fields.

In the other study, a group headed by Birgitta Floderus, an epidemiologist at the National Institute of Occupational Health in Solna, Sweden, analyzed 104 cases of chronic lymphocytic leukemia in men according to their estimated EMF exposure in the workplace. Floderus found that the risk of this form of leukemia increased with the magnitude of the EMFs.

The finding of a dose-response curve isn't

the only intriguing feature of the Swedish studies. In the view of some researchers, they have gained considerable credibility because of the precision of the Swedish databases, which allowed Ahlbom to estimate the strength of the EMFs to which the leukemia victims were exposed. In previous studies researchers have had to rely on such things as wiring schemes of individual houses to estimate EMF exposures, but Ahlbom had access to statistics that told him exactly how much electricity flowed to each home over the course of a year. The findings "certainly add to the weight of evidence that this should be looked at more closely," says M. Granger Morgan, a science policy expert at Carnegie-Mellon.

Some scientists remain unimpressed, however. Yale biophysicist Robert Adair, a skeptic of EMF-induced health effects, takes exception to Ahlbom's statement that "the study provides more support for an association between EMF and childhood leukemia than against." "You have to really suspend scientific logic to come to that conclusion," Adair says. He points out that while Ahlbom shows a "weak" correlation between leukemia and the strength of EMFs as calculated from historical data, he fails to link leukemia to present-day measurements of EMF in homes of children with leukemia. The present-day measurements were similar to EMF levels that Ahlbom had calculated from historical data—so, Adair asks, shouldn't they also correlate with increasing leukemia risk? In fact they don't: Ahlbom's actual EMF measurements, as opposed to his calculated EMFs over time, correlate to a reduction in leukemia risk. Ahlbom says that this sort of peculiar finding has plagued previous studies. David Savitz, an epidemiologist at the University of North Carolina who authored an earlier epidemiological study, suggests that present-day spot measurements of EMFs can't reflect fluctuations in fields that might have occurred over time.



Towers of power. Swedish epidemiologist Birgitta Floderus found risk of a certain type of leukemia tied to EMF exposure at work.

Despite the fact that the Swedish work has been causing a crackle of electricity in the epidemiological community, it wouldn't have altered the bottom line of the OSTP review, even if it had been available early enough for inclusion, says Dimitrios Trichopoulos, chair of the epidemiology department at the Harvard School of Public Health and author of one of the report's epidemiology chapters. Like Adair, Trichopoulos points out that Ahlbom failed to come up with a correlation between present-day EMFs and cancer risk. He also claims that Ahlbom's findings diverge from previous Swedish studies and notes that some of Ahlbom's calculated cancer risks aren't statistically significant, because of the small number of cases of childhood leukemia. Trichopoulos concludes that the scientific community needs better designed epidemiological studies. "I would take a group of investigators both skeptical and open and I would try to get them to do a study that would address some of the weaknesses in all studies," Trichopoulos told *Science*. "My bet is that it would be a negative study," he says—finding no correlation between EMFs and cancer risk.

That attitude doesn't please the critics of the OSTP report, who think that the document—and in particular its executive summary—slight the possible risk. "There's a tone of dismissiveness," says Savitz. "They say that if the entire picture isn't coherent and clear, then the entire picture should be dismissed."

Savitz isn't alone. In a commentary prepared for the January issue of *Environmental Science and Technology*, Battelle EMF researcher Tom Tenforde concludes the executive summary is "seriously deficient in both content and logic." For example, although the summary notes in general that "changes in pineal melatonin production as a result of either electric or magnetic field exposure may be substantial," Tenforde criticizes it for failing to refer to studies that have shown that female rats with EMF-suppressed levels of melatonin are more susceptible to chemically induced breast tumors.

Scientists at several federal agencies also have criticized the scientific dissonance between the body of the OSTP report (which was published by Oak Ridge Associated Universities) and its executive summary. After a quick review of the report, two EPA scientists—William H. Farland, director of Health and Environmental Assessment, and Margo T. Oge, director of the Office of Radiation and Indoor Air—in a recent letter to Alvin Young, chairman of CIRRPC, wrote that "that there is a lack of support for some of the conclusions reached in the executive summary." They also demanded that it be made clear that the report reflects the views of the CIRRPC panel and not the federal agencies. Researchers at the Public Health Service and the National Science Foundation have also criticized the review in letters to CIRRPC, according to the November/December issue of the newsletter *Microwave News*.

Members of the panel that drew up the report have answers to these criticisms. Russel J. Reiter, a cell biologist at the University of Texas in San Antonio and one of the report's co-authors, who has done research on how EMFs alter melatonin levels, takes issue with Tenforde over how far the executive summary should have gone on the role melatonin might play in breast cancer. "The studies were just not sufficiently consistent" to tie EMFs to breast cancer, Reiter says. "To say it without absolutely being convinced would cause havoc among the public," he says.

Other panel members contend that the report's critics are overlooking data that minimize the possibility that EMFs cause cancer. "I think the power consumption point is very key," says J. Glenn Davis, a medical researcher at Oak Ridge Associated Universities who chaired the panel, referring to the fact that increases in power consumption over time haven't triggered a cancer epidemic. What's more, says Davis, even though the executive summary states that EMF funding should not be a "high priority," that doesn't mean the panel opposes additional funding for EMF research. Indeed, he contends that the report itself could be used as a basis for planning future research. But "in light of things like AIDS and breast cancer, EMF should not be listed ahead of that," Davis says.

Given these polarities, how is the EMF-cancer controversy ever going to be resolved? What EMF researchers need to do is characterize how EMFs affect tissue, says Carnegie-Mellon's Morgan. "A few more epidemiological studies are far less important than understanding this at the cellular level." That's one goal of the National Institute of Environmental Health Sciences, which is about to embark on a $65 million, 5-year research program with the Department of Energy. The bottom line, says Leonard Sagan, an EMF researcher at the Electric Power Research Institute, is "to find a cellular system that reproducibly produces a response." Perhaps then scientists will be able to harness energy from the force field that divides them.

–Richard Stone