ELF: The Current Controversy

Does extremely low-frequency electromagnetic radiation harm our health, or doesn't it? No one — not even those with the latest incriminating data — knows for sure.

By DIANE D. EDWARDS

In 1979, Nancy Wertheimer of the University of Colorado Medical Center and physicist Ed Leeper suggested a link between living near high-current electric power lines and an increased risk of cancer, particularly childhood leukemia. The key, said the Boulder scientists, might be the extremely low-frequency (ELF) magnetic fields produced as electricity flows through wires.

Since then, the role of ELF fields in cancer has been debated among those studying electromagnetic fields, with the power industry challenging the existence of such a link. A number of studies, including a recent one that has replicated the 1979 findings, are now sparking more controversy. Some of the studies have also linked ELF fields to tumor growth and electrically heated beds to spontaneous abortions.

Unlike some potential environmental hazards, ELF magnetic fields are virtually everywhere, making avoidance difficult. The flow of electric current through power lines creates magnetic fields, which easily penetrate walls of buildings and the body. These low-frequency fields localize near plumbing in houses and under streets, and their strength appears to be related to the types of wiring configurations nearby. They are, for example, found around power stations, welding equipment, subways and movie projectors.

Wertheimer and Leeper found the overall death rate for certain cancers among children living in homes with high-current wiring configurations (with their higher radiation of ELF fields) to be twice that expected for children in general (SN: 4/21/79, p.263), but there was no proof that ELF fields were the cause. Nonetheless, such early studies generated interest among epidemiologists and power utility officials, and illuminated the need for replicate studies.

Last November, epidemiologist David Savitz of the University of North Carolina in Chapel Hill announced research results that support the Wertheimer-Leeper findings. He reported his findings at a Denver meeting on the health effects of power lines, organized by the Electric Power Research Institute (EPRI) of Palo Alto, Calif., and the U.S. Department of Energy.

Savitz, along with Frank Barnes and Howard Wachtel of the University of Colorado, found a fivefold increase in childhood cancer — particularly leukemia — in those homes near the highest level of ELF fields. Homes in this group were located within 15 meters of primary wires designed to carry very high electric currents, or within 7.5 meters of primary wires that carry lower currents. (Primary wires carry electricity from the power substation to the neighborhood transformer.) The data, currently being prepared for publication, were based on current configurations similar to those in the 1979 study, lending credibility, say the researchers, to the ELF-cancer theory.

'There is no solid evidence that you should be worried, even if you live *under* the power line. . . . [But] from a public health perspective, there is a reason for concern.' — D. Savitz

Savitz and his colleagues evaluated approximately 500 homes in Denver in 1984-85; about half of them contained cases of childhood cancer as reported in the state's tumor registry. While some of the researchers classified both cancer and control homes on the basis of their proximity to different types of residential power lines, another group independently interviewed test subjects and controls.

Savitz and Barnes told SCIENCE NEWS that certain aspects of their study addressed some of the criticisms aimed at the earlier work. For instance, the researchers coding the homes' current configurations did not know which households had cancer cases; this removed certain biases that may have affected the first study. Also, Savitz and his co-workers concluded that the Wertheimer-Leeper wire configuration schemes — which rated houses on their proximity to different types of wiring — was a better parameter for evaluating long-term ELF field exposure than on-the-spot measurements inside the home.

There remain, however, problems that have no ready-made solutions. As Savitz points out, the number of households evaluated represents a "limited amount of data": Only about 3 percent of the Denver homes studied were classified at the highest exposure level. He points out that magnetic fields, unlike air and noise pollution, are not noticed by the human senses, making detection more complicated. Perhaps most significant is the problem — often faced in epidemiologic studies — that proving a causal relationship is difficult when researchers must rely on past records and events.

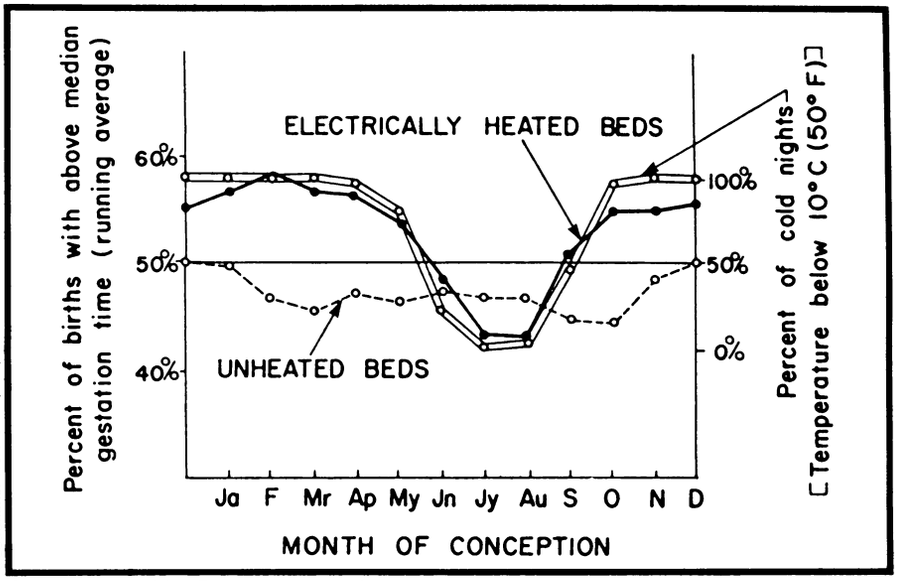
Wertheimer and Leeper's latest work is another example of the suspicious-but-is-it-the-cause

dilemma. In a 1986 issue of BIOELECTROMAGNETICS (Vol. 7, No. 1), they report that users of electrically heated beds—which can give off ELF fields—are more likely to have miscarriages and longer gestation periods during seasons when heated waterbeds or electric blankets are used. About 1,700 Denver births over the 1976-82 period were studied, along with reported abortions, most of which were spontaneous rather than induced.

Among users, the median gestation period for midwinter conceptions was about one week longer than that for conceptions during July and August. For electric blanket users, 75 percent of the miscarriages occurred in September through January; for waterbed users, 61 percent; and for nonusers, 44 percent. No such seasonal variations were seen among those who did not use heated waterbeds or electric blankets.

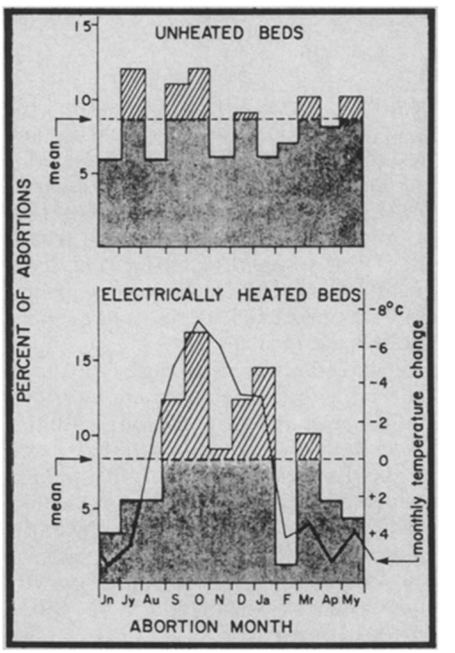
Wertheimer and Leeper currently are evaluating different types of home heating systems, looking for possible heat-related causes of their results. (Other studies have shown heat harms sperm.) Preliminary data indicate heat itself is not the cause, Wertheimer told SCIENCE NEWS.

"It would be very easy to design a waterbed that does not create a field," she says. Wertheimer believes that, for the individual, exposure to ELF fields does not pose a very big risk, but that from a public health viewpoint there may be need to worry. "The early warning is out," she says, "which is what the epidemiologist is supposed to do."



Illustrations: Wertheimer/Leeper

Data gathered by Denver researchers suggest that gestation periods are generally longer for infants of users of electric blankets and electrically heated waterbeds, if conception occurs in seasons with increased use of heated beds (above). For users of electrically heated beds, excess miscarriages apparently occur during relatively colder months (right).



The heated-bed study also provides some evidence that ELF fields may be related to congenital birth defects in humans, says Wertheimer. Laboratory experiments by other researchers indicate that ELF fields can affect fetal development in swine, chickens and rabbits. Whether magnetic fields actually affect cell development is a controversial subject. In order to assess possible effects, research groups are working with ELF fields in such experimental systems as neuronal activity in rat brains and chromosome breakage in human blood cells.

One study attracting attention is that of Jerry Phillips, director of biochemical research at the Cancer Therapy and Research Center in San Antonio, Tex. Phillips told SCIENCE NEWS he has shown in recent experiments that exposure to ELF fields causes an abnormal increase in the growth of cancer cells. Those cells, he says, also show a 60 to 70 percent greater resistance to disruption by the body's naturally occurring killer cells.

The changes appear to be permanent, passed from one generation of cancer cells to the next. They occurred in cells descending from those exposed to ELF fields more than five months prior to experiments, according to Phillips's paper in the November 1986 IMMUNOLOGY LETTERS.

Such results could explain the abnormally high cancer rates reported among those exposed to magnetic fields. But the consensus of researchers, including Phillips, is that the tumor cell experiments need to be repeated by other laboratories to validate the results. To that end, a group at the University of Maryland School of Medicine in Baltimore began similar experiments last year.

The power industry's reaction to the latest results appears to be one of cautious concern. Leonard Sagan, manager of the Radiation Sciences Program at EPRI, calls the work by Wertheimer, Savitz and others "interesting." He told SCIENCE NEWS that the different current configurations "mean something." But, he says, rather than being causative agents, they may instead indicate other potential cancer causes, such as population density, socioeconomic class or local road traffic.

Commenting on Wertheimer and Leeper's bed study, Sagan agrees that "the use of electric blankets deserves some attention, because it is an important source of magnetic radiation to the public."

EPRI, as the power industry's research arm, evidently does not plan to sit idle while others raise suspicions. According to Sagan, EPRI spends $2 million annually to study ELF field effects, and that figure will "significantly increase." One study now being funded is at the School of Public Health at Johns Hopkins University in Baltimore, where researchers are looking at cancer incidence among telephone company employees (phone lines are strung along electrical lines).

Industry concern over whether a link between ELF and health problems actually exists also can be seen in reports from the November/December 1986 MICROWAVE NEWS:

- EPRI has funded a two-year, $350,000 epidemiologic study at the University of Southern California in Los Angeles to test the Wertheimer-Leeper and Savitz findings. It will include additional information on parent occupation and chemical exposure.
- The Texas Supreme Court has refused to allow the Houston Lighting & Power Co. to activate a power line built across school property. A 1985 lower court ruling awarding the school district $25 million

in punitive damages is still under appeal.

• Last month, representatives of the 20 utilities that form the Western Energy Supply and Transmission Associates were meeting to discuss priorities for future bioeffects research and its funding.

• In Canada, representatives from unions, utilities, academia and government are forming a group to address priorities in ELF exposure research.

Much of the research is directed toward those who work in magnetic fields. More studies are suggesting that such occupations carry the increased risk of developing cancers (SN: 11/10/84, p.292). Response to the studies is flowing from several sectors, including Massachusetts Institute of Technology, which will offer a practical course on the hazards and measurement of nonionizing radiation in August.

All the data, statistical analyses and confounding factors are adding their weight to the hefty problem of deciding which ELF effects should concern the public. Clay Easterly of Oak Ridge (Tenn.) National Laboratory organized a workshop immediately following the Denver power line meeting to review the latest ELF results, but he refuses to talk publicly about a consensus statement being prepared using participants' comments.

"A lot of people had been skeptical for a long, long time [about the ELF-cancer link]," he told SCIENCE NEWS. "But now scientists are recognizing the significance of this research." He says the Oak Ridge lab will recommend a "multicentered approach" to ELF field research.

"Many things need to be sorted out," says Sagan, adding that the public so far has "no reason for taking any protective action. We wouldn't know how to do that, even if there were a need."

Other researchers contacted by SCIENCE NEWS, even those with attention-getting data, agree. "There is no solid evidence that you should be worried, even if you live *under* the power line," says Savitz. "The bottom line . . . is that the evidence does fall short of implicating these fields as a health hazard." But he adds, "The other side is that there are these suspicions raised that haven't been resolved. So from a public health perspective, there is a reason for concern."

The debate on ELF fields and their biological effects is increasingly sensitive as a political issue, according to Wertheimer and others. As Savitz says, "There is certainly a spectrum of views on this – to put it mildly."

While recognizing the potential for scare tactics and public panic, researchers in the field widely believe that, although there is no absolute proof that ELF fields cause conditions like spontaneous abortion and childhood cancer, there is sufficient reason to take a closer look. □

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statement implying we select the data we present to delude the scientific community and the Congress goes unchallenged by the press. We highlight what we perceive as important changes from year to year, but make no attempt to cover all the data in the book and no data are excluded.

Since the Institute has set goals for itself for reducing cancer mortality, we also need to identify trouble spots, and this is also done with the help of the annual review. Trouble spots are not generally viewed as good news. One piece of information we identified as a trouble spot is the increase in mortality in people over 65. Several explanations for this warrant study. Cancer could be diagnosed at a more advanced state or be more virulent in the older population; cancer treatment might also be less well tolerated or not given at all because of the patient's age. There are data in the book to support some of these hypotheses. The Institute has, in addition, begun to initiate studies in population groups in which the statistics show problems to better understand the reasons for these problems.

It should also be noted that we take pains to point out that the decline in mortality we observe is not always due to advances in treatment. Decline in mortality in men under 45, for example, is due in part to the decline in lung cancer incidence and mortality because more young men have quit smoking. This shows that prevention can work. However, with treatment advances, the impact is often first noted in the younger population because new treatments are often more strenuous in the beginning. They are applied more broadly only when they have been modified and made suitable for general use. Therefore, the upward creep of the decline in mortality statistics from the pediatric age group to young adults to those under the age of 55 for the entire population and through 65 in whites indicates that new advances are getting out there in the way we would have predicted.

The fact that the decline in mortality in the minority population is not as impressive gives us another indication of a problem in achieving our goals for the year 2000 – that of assuring equal access to advances in cancer diagnosis, prevention and treatment for minorities. The unchallenged statement by Dr. Bailar implies a coverup of sorts. We would do a much better job covering up by not presenting the data at all.

Finally, it seems to me that SCIENCE NEWS should appreciate the fact that the success or failure of the Cancer Program is not measured by mortality statistics alone, but rather by the enormous contribution its resources have made to the biologic revolution, which almost everyone agrees will provide the ultimate answer to prevention and treatment of cancer. Advances in molecular biology have been applied in the prevention, diagnosis and treatment of cancer too recently to observe their effects in the national statistics. It is ironic that because the fruits of the biologic revolution present both the Cancer Program and organized medicine with problems in the translation of new advances from the laboratory to the bedside, the enormous value of this aspect of the Cancer Program and the value of the annual statistical review are ignored by Dr. Bailar.

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