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NCI Dismisses Leukemia Risk for Children Living Near Power Lines

Measured Magnetic Fields Stir Debate

A major study by the National Cancer Institute (NCI) has found “little evidence” that living near high-current power lines is associated with childhood leukemia.

“The results of our study differ from three earlier studies,” said the lead investigator, Dr. Martha Linet of the NCI’s radiation epidemiology branch. Linet explained that her team found no evidence of a significantly increased risk of acute lymphoblastic leukemia (ALL) among children who lived in homes near high-current electrical wiring.

**More Coverage of the NCI Study on pp.10-14
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For measured magnetic fields, the NCI team found “a slightly elevated, but not statistically significant, risk” for ALL among those children exposed to 2 mG or more, as compared to those in homes with magnetic fields below 0.65 mG. Linet also said that there was “no evidence” of a dose-response relationship—that is, an increase in the risk of leukemia with increasing exposures to electromagnetic fields (EMFs).

Newspapers across the country and television networks featured prominent coverage of the NCI study, which appeared in the July 3 *New England Journal of Medicine* (337, pp.1-7). In an accompanying editorial, the *Journal* called for an end to power line health research.

The NCI’s characterization of the results for measured fields has provoked

(continued on p.10)

—Views on the News: The NCI Study—

NCI Comes to a Cautious Conclusion —Or Is It Reckless?

CANCER STUDY FINDS NO LINK TO POWER LINES read the headline in the *Los Angeles Times*. The NCI study has “debunked” the link between EMFs and childhood cancer, according to a news story in the *Montreal Gazette*, while the *Hartford Courant* reported that the study has “discounted” the connection. *Science* magazine suggested, “It could be the obituary” for the EMF issue.

Yet the NCI’s own data show an increased leukemia risk at EMF levels found in about 5% of U.S. homes. On the job, workers are often exposed to levels many times higher. Is the NCI willing to tell these people that they are safe?

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At the World Congress

The Talk of Bologna: Wireless Comes Home

Bologna was the star attraction. A beautiful, cosmopolitan setting where the people take their food seriously and the cafés stay open into the early morning hours. A good time was had by all—except for those fleeced by pickpockets.

When our minds wandered—a not infrequent event in the warm June sun—we were soon reminded of why we were there. Cellular phones were everywhere. From the moment we walked off the plane in Milan, we were surrounded by them. It looked like Motorola heaven. That seemed appropriate when we were reminded that Bologna is the birthplace of Guglielmo Marconi, the father of wireless communications.

Motorola also dominated the science presented at the conference.* And with good reason: The company has the largest cellular phone health research program in the world—a situation that will continue now that the European Commission's \$20 million initiative has been delayed until at least 1999, and as long as the U.S. Cellular Telecommunications Industry Association's (CTIA) \$25 million program remains in its perpetual holding pattern.

Is there anything to worry about? It all depends on whom you ask. In an invited lecture, Dr. Konstantin Hossmann of the Max Planck Institute in Cologne, Germany, a Motorola contractor, expressed skepticism about any health risks. "My guess is that nonbiological health hazards are more important than biological effects," he said, citing the dangers of car accidents and EMI to pacemakers. Hossmann reserved his harshest criticism for those who use "handys" near him: They are, he said, "a pain in the neck."

Others are less dismissive. Poland's Dr. Stanislaw Szmigielski of the Military Institute of Hygiene and Epidemiology in Warsaw presented the latest findings of his long-term study showing that servicemen exposed to RF/MW radiation (mostly pulsed) have higher rates of cancer. Szmigielski said that he is now seeing indications of a dose-response relationship.

Dr. George Carlo of CTIA's Wireless Technology Research in Washington was impressed. "If it were our data, it would clearly tell me that we should look closer," he told us.

Perhaps the most remarkable results were presented by Dr. Sianette Kwee of Denmark's University of Aarhus. She reported seeing changes in cell proliferation following exposures to GSM radiation at SARs of 0.021 mW/Kg. These exposures seemed so startlingly low that we sought her out during one of the coffee breaks and asked whether she had made a typo and had really exposed the cells to 0.021 W/Kg (already a low level). There was no mistake, she answered. We resigned ourselves to waiting for a replication study—if one is ever funded.

Wondering how long the Australian GSM-mouse lymphoma study would stay in replication limbo, we went to see Motorola's Dr. Q. Balzano. "It will be repeated," he declared, "whether by Motorola or by someone else. It cannot be left as an open

question."

Dr. Michael Repacholi was in Bologna, albeit briefly, to give a paper on the Australian study's results, which show a doubling of lymphoma among the GSM radiation-exposed mice. The presentation was almost a nonevent, however, after the international media blitz that followed the publication of his paper in May.

The amount of radiation to which Repacholi's mice were actually exposed, though, was a hot topic. "It's hard to tell if this is a thermal effect. The SARs are very difficult to pin down," Balzano said. Dr. Niels Kuster of the ETH in Zurich, Switzerland, also a Motorola-funded researcher, had less difficulty. "It is very unlikely that the mice had a thermal response," he said.

Nevertheless, Kuster was not impressed with Repacholi's experimental setup, pointing to the "large, uncontrolled standing waves" in the room where the mice were exposed. He said there was a simple solution: Move the cages from the wall to the floor and put absorbent material on the walls.

Also still awaiting replication is the now well-known Lai-Singh experiment. Three years after word first began to spread that Drs. Henry Lai and N.P. Singh of the University of Washington, Seattle, had observed more DNA breaks in the brains of rats exposed to RF/MW radiation, their work remains unsettled. Dr. Joseph Roti Roti of Washington University in St. Louis, hired by Motorola to repeat the study, has been doing the experiment differently and has been getting different results. In Bologna, Motorola's Dr. Mays Swicord announced that Roti Roti would now embark on an *exact* replication.

And then there are the concerns over RF/MW-induced leakage through the blood-brain barrier (BBB). This is possibly the most talked about and most contentious effect in the literature. Dr. Leif Salford of Sweden's Lund University has been saying at scientific meetings for most of the 1990s that he sees such leakage. Anyone who has been tracking the RF/MW debate must have a sense of *déjà, déjà vu*.

Over the last 20 years, Drs. Ernest Albert, Allan Frey, Daryl Hawkins, Henry Kues, David Lange, Kenneth Oscar, Frank Prato and others in North America alone have all documented BBB leakage—and yet the effect is still considered an anomaly.

In Bologna, Salford once again reported that he sees leakage at very low levels (0.4 mW/Kg)—levels similar to those used by Kwee! "It's a dramatic effect. What it means, I can't say," Salford concluded. But, he said, it may be "more significant for Alzheimer's disease than for brain tumors."

Dr. Terry Kenny, a consultant to the cellular phone industry based in Southampton, U.K., balked, asking for electron microscope images of the breaks in the BBB. Salford had no such pictures, but he did not waver: "It's very difficult to believe that we have an artifact after so many years of work," he replied.

We left Bologna wondering when a single biological effect of RF/MW radiation will be replicated and resolved. With the current funding situation, that time seems as elusive as ever. Where, we asked ourselves, are the pickpockets when we really need them.

* 2nd World Congress for Electricity and Magnetism in Biology and Medicine, Bologna, Italy, June 8-13, 1997.

« Wireless Notes »

Opposition to tower siting from wireless industry employees is not common. One reason why may be found in the case of **Ann Shirreffs**: When she tried to keep a **PCS** tower from her children's school, she lost her job as a cellular phone sales rep. On June 1, the Cleveland *Plain Dealer* reported that Shirreffs was asking parents of children at the school in suburban Pepper Pike to petition the school board against an **AT&T Wireless** tower. Early that same Sunday morning, her boss called and they "mutually agreed" that she should look for another job, Shirreffs told *Microwave News*. Two weeks later, Pepper Pike Mayor Bruce Akers announced that the school board had voted down the AT&T tower—in large part due to the petition, which had been signed by 950 parents. "I have truly risked my job and my career," Shirreffs said. "I wouldn't have done it if I didn't have doubts about the safety of this technology." She sees no inconsistency between selling hand-held phones and opposing the tower. "The difference is very clear. The person who buys a phone has choices—when and how to use it," Shirreffs said. "The minute we place a cell tower on school property, we eliminate choices for the students." The lack of long-term RF/MW exposure studies prompted her decision to oppose the tower at the school, which runs from pre-K through high school. Still, the decision has been unpopular in some quarters because AT&T would have paid \$100,000 up-front and \$1,000 per month after five years.

One of those in favor of the tower was school board member David Noble, who was absent for the deciding vote, according to the June 26 *Chagrin Valley Times* (OH). "You cost us money for certain towers that are not a health hazard," the paper quoted him as telling residents. "They've given up thousands of dollars a month," Kathleen Riehle, a spokesperson for AT&T in Cincinnati, said in an interview. "I think that's kind of sad." AT&T is proceeding with a plan to locate the tower at a nearby electrical substation, according to Riehle. Shirreffs, meanwhile, has put her job hunt on hold while she helps nearby communities keep towers away from their schools.

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Would anyone at the **Harvard School of Public Health** sign a petition on public health without reading it? **Beverly Freeman**, the school's director of public affairs, says that more than 40 of the faculty, staff and students did exactly that. They endorsed an effort to keep Sprint Corp. from activating its **PCS** system in Boston. The petition, which was also signed by some faculty members from the **Boston University School of Public Health** and **MIT**, was circulated by **Susan Clarke**, an environmental health advocate based in Concord, MA. The *Boston Globe* (June 16) ran an article in which Harvard's Dr. Joel Schwartz, one of the signers, said: "There are a lot of studies that suggest there's

Cellular Phones Pronounced Safe in Helsinki —But Some Key Data Not Yet Available

On May 22, Finnish scientists briefed the press in Helsinki on new research that found **NO HEALTH HAZARDS FROM MOBILE PHONES**—as the State Technical Research Center (VTT) declared in its press release. The Reuter news service picked up the story, reporting that a Finnish study had concluded that "mobile phones pose no health threat to phone users."

At that time, the only information available was in Finnish. Specifics emerged two weeks later when an English-language synopsis of the research, dated June 6, was given out at the *World Congress* in Bologna, Italy (see p. 2). Some key data were missing, however: The group studying cancer-promotion effects of cellular phone radiation in mice had no cancer results yet.

Finnish researchers have also been investigating how much radiation cellular phones deposit in the brain, and whether such radiation can affect human electroencephalograms (EEGs). The studies began in 1994 as part of the European Cooperation in the Field of Scientific and Technical Research program on biomedical effects of EMFs (COST 244). A substantial part of the program funding came from Finnish cellular phone manufacturers (Nokia and Benefon) and telecommunications firms (Telecom Finland and HPY).

Dr. Jukka Juutilainen of the University of Kuopio exposed mice to 902 MHz radiation—50 mice each to analog and to

pulsed signals—after the mice were initiated with ionizing radiation. A mortality analysis found no difference between the RF-exposed mice and the controls. In an interview, Juutilainen said that a final report, which will include the results of a histopathological analysis, should be finished early next year.

Dr. Maila Hietanen of the Institute of Occupational Health in Helsinki directed the EEG study. She exposed 19 volunteers to signals lasting 20 minutes each from analog and from digital (GSM) phones. Data analysis showed no effect on "human brain activity." When *Microwave News* asked whether either 20-minute exposure was sufficient to reach this conclusion, Hietanen replied, "If there were some real changes, we would have seen them."

At the Center for Radiation and Nuclear Safety, also in Helsinki, Dr. Kari Jokela and colleagues are developing techniques to estimate specific absorption rates (SARs) in mice and in simulated human heads. Jokela presented some mouse data in his report; however, he does not yet have any "useful data on actual SAR measurements" for human phantoms, he told *Microwave News*.

The Helsinki press conference came only three weeks after results of the Repacholi mouse study were published. The timing, Juutilainen said, was "just a coincidence."

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an increased cancer risk." Schwartz, who in 1991 won a MacArthur "genius" award, declined to talk to *Microwave News*, instead referring us to Freeman. "What they thought they were signing was a petition to encourage research on the subject," Freeman said in an interview. She maintained that Clarke did not disclose to the signers that her intent was to present the petition to the Massachusetts Department of Public Health (DPH) in an effort to stop Sprint's PCS system. Nevertheless, the petition begins:

We the undersigned physicians and scientists call upon public health officials to intervene to halt the initiation of communication transmissions employing ground level, horizontally transmitted, pulsed microwaves in Boston. This form of transmission is scheduled to begin in June 1997 by the Sprint Corporation for PCS.

Freeman said she was disappointed that the *Globe* had covered the story, explaining that it implied that the opinions of the signers represented the official position of the school. "It's really not a story at all," she said. "It was the work of a woman who really sort of used Harvard." Clarke herself said that her motive was to protect people from involuntary exposure. "The industry is in effect precluding any right to know regarding the health effects of digital microwaves," she said. In July, Clarke presented the petition to the DPH as well as to the EPA and the federal Agency for Toxic Substances and Disease Registry.

Cell Phone EMI with Pacemakers Confirmed, Seen as Manageable

With the publication of an industry-sponsored study in the *New England Journal of Medicine*, there appears to be a consensus that cellular phones can interfere with implanted cardiac pacemakers, but that the problem is manageable.

Dr. David Hayes and colleagues report in the *Journal's* May 22 issue (336, pp.1473-1479, 1997) that cellular phones can cause "clinically significant" electromagnetic interference (EMI) with pacemakers. Such interference occurred in only 6.6% of their tests, however, and never when the phone was next to the ear. The study defined clinically significant EMI as that which can cause dizziness, fainting, shortness of breath and irregularities in heart function.

There is "no significant public health issue" concerning wireless phones and pacemakers, Hayes told *Microwave News* from his office at the Mayo Clinic in Rochester, MN. He noted that a pacemaker user can minimize the risk of interference by carrying and using a cellular phone away from his or her chest, and that those "who want to be safest," including people dependent on their pacemakers, can use analog or PCS phones.

Filters are an important part of the solution to the pacemaker EMI problem. Hayes found that interference occurred in only 0.4% of the tests on pacemakers with feed-through filters, but in 28.9% of the tests on pacemakers lacking such filters. Dr. Roger Carrillo of Mt. Sinai Medical Center in Miami Beach, FL, first reported that pacemakers with filters were much less susceptible to EMI (see *MWN*, M/J96).

In Hayes's view, there is no need for further study of pacemaker EMI unless a new phone technology is introduced. But he believes that more research is needed on the possible vulnerabil-

IEEE Reaffirms Its RF/MW Exposure Standard

The Institute of Electrical and Electronics Engineers (IEEE) has reaffirmed its guidelines for human exposure to radiofrequency and microwave (RF/MW) radiation. The standard, officially known as ANSI/IEEE C95.1-1992, is now under review by the American National Standards Institute (ANSI).

The IEEE's Standards Board voted in April to reaffirm C95.1-1992, concluding a yearlong review and comment process, Dr. John Osepchuk told *Microwave News*. Osepchuk is chair of the IEEE's Standards Coordinating Committee (SCC) 28, which developed C95.1-1992 and other standards on non-ionizing radiation. ANSI requires participating organizations to revise or reaffirm standards every five years.

SCC28 has already begun a substantive revision of the standard, however. "Extensive work" is under way, said Osepchuk, a consultant based in Concord, MA, who was formerly with Raytheon Co. "We expect the revision will be finished and on the street well before the end of the [next] five-year cycle" that runs through 2002. Prior to that, Osepchuk added, SCC28 may issue a supplement that will make minor changes in the standard.

The IEEE completed its last major revision of the RF/MW standard, which covers 3 kHz-300 GHz, in 1991; the revision was adopted by ANSI in 1992 (see *MWN*, N/D 91 and N/D92).

ity of implanted defibrillators to cellular phone interference (see *MWN*, M/J97). The Mayo Clinic and the New England Medical Center in Boston are seeking funding to study this question.

The newly published study involved 5,533 tests with 980 subjects at the Mayo Clinic, the New England Medical Center and the University of Oklahoma Health Sciences Center, Oklahoma City. It was funded by Wireless Technology Research (WTR); preliminary results were released in May 1996 (see *MWN*, M/J96). Previous research in the U.S. and Europe had shown that pacemakers can be affected by cellular phone radiation (see *MWN*, J/A94 and M/J95).

Hayes's recommendations were echoed in an accompanying editorial in the *New England Journal* (pp.1518-1519). Drs. Marc Roelke, an electrophysiologist, and Alan Bernstein, an electrical engineer, both of Beth Israel Medical Center in Newark, NJ, advised that, "Patients should be counseled to keep cellular telephones away from the pacemaker pulse generator when carrying, dialing or talking into the telephones." This recommendation is similar to that issued in September 1996 by WTR, and endorsed by the U.S. Food and Drug Administration and the Cellular Telecommunications Industry Association (see *MWN*, N/D96).

Hayes and his team confirmed previous findings that analog phones are less likely to cause interference than digital models. The incidence of EMI was 2.5% with analog phones, as compared to 23.7% with digital units. But the incidence of EMI varied

with different digital signals. The highest incidence of interference, 52.6%, was observed with TDMA-11, which is not in commercial use. PCS-1900 phones had the least—1.2%. The incidence of EMI for NADC units was 21.3%, the highest among the phones tested that are currently on the U.S. market.

Australian Insurance Company Opposes Wireless Antennas

A leading insurance company in Australia, Mercantile Mutual, has sided with residents and local elected officials in their efforts to block mobile phone antennas in Sydney.

Vodafone—one of three cellular service providers in Australia—sought to put antennas on a Mercantile office building located in a residential area near a school.

On June 30, when Vodafone workers arrived at the site to begin installing the antennas, Mercantile officials refused them entrance into the building. Later that day, the officials backed down when police told them that Vodafone had a legal right to install the antennas.

“We objected because of community concerns including the school nearby,” David Sinclair, a spokesperson for Mercantile,

told *Microwave News*. “We’re sympathetic to those concerns and worry that there might be health effects.”

Vodafone acted quickly, because under telecom siting rules which took effect on July 1, antenna siting requires approval from local governing bodies.

In an April letter from Mercantile to Vodafone, quoted in *The Australian* (July 4), the company warned about the potential financial backlash it could face. “The risk to health...may expose us as owners of the property to liability for injury to persons who are or who are alleged to have been exposed to emissions from the base station,” the letter stated. “The amount of such claims is impossible to calculate.”

Vodafone—a mostly U.K.-owned telecom company—did not respond to requests for comment.

Potential health effects from wireless technology remain a hot issue in Australia. On July 2, for instance, residents of a town south of Sydney claimed victory in their campaign to keep Vodafone from building a tower near two schools and a children’s center. And the July 21 *Herald Sun* reported that 500 protesters marched through a Sydney suburb calling for the removal of towers. The mob carried a burning effigy of Australian Senator Richard Alston, an outspoken skeptic of health risks from mobile phones and towers (see *MWN*, M/A97).

Australian Mobile Telecom Association on the Repacholi GSM–Mouse Lymphoma Study

The following “talking points” were prepared by the Australian Mobile Telecommunications Association in Canberra to guide responses to questions from the press and the public about the recent Australian mouse study by Dr. Michael Repacholi and colleagues. The study showed that transgenic mice exposed to weak GSM radiation had twice the rate of lymphoma as controls (see MWN, M/J97).

Q1: What does this say about the safety of mobile phones?

A1: In a word, nothing. That’s not our position, but the position of the scientists who did this study. Their clear position is that it can’t be directly related to human health. And that means it definitely can’t be related to the safety of mobile phones.

Q2: But weren’t these animals exposed to mobile phone signals?

A2: The animals were exposed to a type of radio signal common to some digital phone systems. However, the conditions and levels of exposure were quite different from the use of those phones.

Q3: How so?

A3: In short, the animals were in cages at a certain distance from an antenna operating at higher power than mobile phones. They were exposed in a way and at levels unlike those of mobile phones. In fact, in humans, whole-body exposures of this kind would be in excess of recognized safety standards.

Q4: You seem to be dismissing this study as completely irrelevant?

A4: Not at all. As the researchers have said, it raises some interesting questions. Those questions involve the use of a certain genetically engineered mouse in research of this kind. That warrants further independent, focused investigation. But as the researchers say, their findings cannot and should not be interpreted as bearing on human health or the safety of cellular phones.

Q5: You say this raises “interesting questions.” What do you mean?

A5: Well, there seems to be general agreement that issues about the

kind of mouse used, the exposure conditions and other factors need further investigation to more fully assess the significance of this study.

Q6: But in the meantime, that’s not a cause for concern by cellular phone users?

A6: Not at all. The researchers themselves have said their findings cannot be directly related to human health. In fact, they stated that *no* single study can yield qualified judgments about human health risks. The scientific community understands that, government and international health authorities understand that, and the public should understand that.

Q7: What’s going to be done to follow up on this research?

A7: That remains to be seen, but the Australian government is in the process of developing priorities for its own research program in this area and I suspect this latest study may be a subject for consideration in those deliberations.

Q8: What do you say to those who contend there has been far too little research to conclude the safety of cellular phones?

A8: I say they’re wrong. The safety of cellular phones is supported by a broad and expanding body of scientific knowledge. Anyone claiming evidence of risk in this latest study ignores the fact that it was done with a highly experimental model and produced results contrary to other animal studies. Research continues and more will be done. We anticipate it will provide further support for the safety of cellular phones.

« Power Line Talk »

A dispute has arisen over the future of the **California EMF Program**. Dr. **Raymond Neutra**, the program's chief, wants to extend it through December 31, 2000. **San Diego Gas & Electric Co.** (SDG&E), however, disagrees, arguing that the five-year program should end two years earlier. In a June 9 petition, SDG&E attorney **Steven Nelson** stated that the need for an extension results from "unwarranted program delays"—specifically, in the naming of a research director. Nelson also criticized the program's "emphasis upon 'nonscience' and perception issues unrelated to public health," as well as its methodologies, which "could cause the program results to be rejected by mainstream scientific and public health communities." Neutra responded on July 3 that the budget had to be planned before a director could be picked and research could begin. Neutra maintained that the program did not start until February 1995 and therefore was running on time (see *MWN*, N/D93 and N/D94). SDG&E's schedule is "patently unrealistic," Neutra stated, stressing that a number of research projects will not be finished until early 1999. Some members of the Stakeholders Advisory Committee—a group that advises the program—also oppose SDG&E's proposal. **Ellen Stern Harris**, executive director of the **Fund for the Environment** in Beverly Hills, charges that the program's "alleged science has been largely corrupted by conflicts of interest." She said that too many of the researchers work for utilities. "My only hope for this program lies in dealing with public policy issues," she said. Some in the electric utility industry are also siding with Neutra. "I tend to agree more with Raymond," said Dr. **Jack Sahl** of **Southern California Edison** in Rosemead. "There's no reason to short-circuit the process at this time." On July 22, SDG&E amended its petition, citing the recent *New England Journal of Medicine* editorial calling for an end to EMF research (see p.1). The final word will come from the state's Public Utilities Commission.

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On May 8, New York state's highest court refused to hear an appeal of **Howard and Eve Reiss's** lawsuit against Consolidated Edison Co., which was dismissed by a lower court on December 5 of last year (see *MWN*, J/F97). The Reisses charged that a Con Ed power line next to their property caused them to lose money on the sale of their home in Pleasantville, NY. One of their attorneys, **Michael Rikon** of Goldstein, Goldstein & Rikon in New York City, told *Microwave News* that they have asked the high court to reconsider. "It's not a long shot," said Rikon, "but it's not a certain thing at all. They have stated that we don't have the right to an automatic appeal—so we're telling them why we think it's important anyway." Rikon said he did not expect a response until late August.

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The **Southwest Research Institute** (SwRI) in San Antonio has pulled the plug on its biosciences program. "It was strictly an economic decision," Craig Witherow, SwRI's communications director, told *Microwave News*, explaining that the program had "a cost structure that just was not working well." The program had included an EMF research effort best known for studies of the effects of 60 Hz EMFs on melatonin levels and behavior in baboons. The research was conducted for a Japanese client, the utility-funded Central Research Institute of the Electric Power Industry. Dr. **Walter Rogers**, who directed the EMF studies, is leaving SwRI to work in San Antonio as a consultant on neurotoxicology and bioelectromagnetics. An expert on animal behavior who has worked at the institute since 1974, Rogers is also a member of the NAS-NRC panel reviewing the performance of the RAPID program (see *MWN*, N/D95 and M/J97).

NAS-NRC Reviews, Criticizes Navy Studies of Project ELF

A National Academy of Sciences-National Research Council (NAS-NRC) committee has found that there is "no evidence of statistically significant, widespread, adverse effects of EMFs" from a U.S. Navy submarine communications system in northern Wisconsin and Michigan, known as "Project ELF." But the committee's report is sharply critical of the Navy's 14-year ecological monitoring program, urging a reanalysis of the data from many studies and calling other studies "unsalvageable."

Few of the studies could have picked up small effects, according to the report—defining "small effects" as those comparable to natural factors, such as drought. "Calling it a small effect doesn't mean that it's insignificant," committee chair Dr. Duncan Patten, professor emeritus at Arizona State University in Tempe, told *Microwave News*. "An accumulation of small effects can become a big effect."

The report concludes that, "The few small possible effects that were found were often too readily dismissed" by research-

ers. It warns that "concerns arose about the scientific credibility" of such interpretations.

Dr. Asher Sheppard, a consultant who worked on the monitoring program for Research & Development Laboratories in Culver City, CA, told *Microwave News*, "I was surprised at the strength of the critical tone in the NRC report." Sheppard, who is based in Redlands, CA, expressed concern that "some of the program's accomplishments might have gotten lost with ten years of hindsight."

"The NRC's report supports the general findings of the Navy's ecological programs," said Commander John Tull, public affairs officer with the Navy's Space & Naval Warfare Systems Command in San Diego. Tull could not say when the Navy would respond to the report's recommendations. He emphasized that there had been no evidence of harm "to the surrounding ecosystem."

But John LaForge, codirector of the peace group Nukewatch, in Luck, WI, pointed to the possible small effects discussed in the report, such as apparent increases in moss growth and chlorophyll production in river algae. "This increased cell growth is frightening," he said, "considering that other studies have connected cancers, especially childhood leukemia, to exposure to EMFs."

NAS–NRC Report Challenges Project ELF Tree Study: Growth Effect “Disappears”—Or Maybe Not

One Project ELF study linked EMFs to an increase in tree growth. The NAS–NRC report attacks this conclusion—but a key committee member says that the issue is still open.

The tree growth study, by Dr. David Reed and colleagues at the School of Forestry and Wood Products at Michigan Technological University (MTU) in Houghton, sparked news stories in both *Science* and *New Scientist* two years ago. The NAS–NRC report questions its validity with some very blunt language:

The committee’s analysis of the primary data indicates mis-use of the data. When the analysis is corrected, the growth effect disappears.

Committee chair Dr. Duncan Patten referred questions on this point to Dr. Robert Olsen. “Bob Olsen was the one who really looked at that,” said Patten. “He talked to the researchers, and brought it back to the committee.”

But, in an interview, Olsen was more equivocal. “There may or may not be an effect,” said Olsen, of the School of Electrical Engineering and Computer Science at Washington State University in Pullman. “I have no position about whether there is or not.”

“We feel that we pointed out an empirical relationship that, statistically speaking, is pretty strong,” Reed told *Microwave News*. “And we stand by that.”

At issue is the relevant measure of exposure. Reed’s team concluded that EMFs between 1 and 7 mG appeared to increase the growth of aspen, red maple and red pine trees (see *MWN*, J/F95). These figures were based on spot measurements taken by IITRI while the antenna was on.

Olsen insisted that spot measurements are inappropriate, and that a time-weighted average should have been used instead. “In 1988, the spot measurements were between 5 and 2.6 mG—but the antenna was only on for a total of 162 hours,” he said. “To use those values is like taking a spot measurement of the temperature in New York City in July, and saying it represents the whole year.”

Reed responded that his team looked at “many different ways of calculating exposure: for example, hours of operation, time of exposure, number of on/off cycles.” The paper’s analysis, he said, was based on the measure “where we found the strongest relationship. That’s not to say this was the only relationship we found, but it was the strongest.”

Ironically, the NAS–NRC report itself provides an argument in favor of spot measurements. The section discussing the tree growth study in detail notes that:

In fact, the trees almost always were exposed to a magnetic field either higher or lower than the average.... Thus, average strength is not likely to correspond to an actual exposure level.

Olsen said that he did not draft this section of the NAS–NRC report, and that it reflects “the whole debate over how to measure exposure. People have argued for years about what is the right metric. Clearly, it’s an open question.”

“There’s no one right way to measure EMF exposure,” said Reed. “We’re all arguing out of ignorance, because none of us knows what might be the physiology in the plants that would lead to this response.” He added that while the NAS–NRC panel had asked to review his exposure data, “no one ever asked to see the data on tree response.” Olsen acknowledged this, saying, “We didn’t go through the analysis at that level.”

Olsen strongly objected that one passage in Reed’s paper inaccurately defines the exposure metric as “average exposure to magnetic flux density during that particular growing season.” He told *Microwave News*, “If you say you’re using a time-weighted average, you should follow through and do it. But there are no time-weighted averages for any growing season in the range of fields for which the effect was claimed. That’s why we say the effect disappears.”

Reed said the reference to an “average” does not mean an average over time. Instead, he stated, it refers to a calculation over distance, to assess the field strengths in between IITRI’s measurement points.

Olsen asserted that Reed’s growth effect was seen only during one season; Reed said the effect was seen in three seasons, though most strongly in only one. Olsen also argued that the MTU paper is not clear about why certain spot measurements were chosen; Reed responded that they used the prevalent exposure during the growing season.

Olsen praised many features of Reed’s study, noting that it is the only one that tried to use IITRI’s data on measured field levels. And unlike many other teams, Olsen pointed out, the MTU group published its work in the peer-reviewed literature.

For his part, Reed admitted limitations in his group’s exposure assessment, and added that the study “certainly doesn’t prove anything by itself.” But, he insisted, “Our data is consistent with a growth effect.”

In other words, the debate over the Michigan tree growth study is not over yet.

Project ELF uses a total of 84 miles of antennas located in public forests. Transmitting extremely-low-frequency signals between 72 and 80 Hz, the antennas can send instructions to deeply submerged nuclear submarines. Environmentalists and antiwar activists have protested against the project since the 1970s.

The 11 studies in the Navy’s ecological monitoring program

began between 1982 and 1984 and were completed by 1996. In 1994, the Navy asked the NAS–NRC to evaluate the program’s activities and findings, and work began the following year (see *MWN*, J/A95). The NAS–NRC had conducted a review of EMF bioeffects for Project ELF in 1977, when it was known as Project Seafarer. Dr. Woodrow Hastings of Harvard University in Cam-

bridge, MA, who served on both panels, explained that, "The 1977 report said if the Navy built this facility, they should create a monitoring program to see if there were any effects. So that's the origin of the current report."

The NAS-NRC report faults most of the studies for not making use of exposure data provided by the Chicago-based IIT Research Institute (IITRI). For example, studies of short-term phenomena such as local navigation by birds did not examine whether the antenna at the test site was actually turned on at the time of observation. Thus, "the negative results might reflect the lack of exposure rather than the lack of an [EMF] effect." The tree-growth study, which claimed a positive result, did use exposure data—but is strongly criticized for mishandling them (see p.7).

The committee also points to the low statistical power and poor matches of test and control sites in several studies. The frequent use of "only one study site for each level of exposure," it states, could allow other variables to mask any EMF effects.

Despite the number and severity of such problems, the NAS-NRC panel does not call for doing any of the field studies over again. Since there was "no evidence [of]...obvious adverse ecological effects," the committee writes, it is "highly unlikely" that repeating any of the studies would lead to significantly different findings. Where results suggested possible small EMF effects, the committee recommends pursuing these findings with con-

trolled laboratory experiments.

The report does recommend the reanalysis of much of the data, but notes that this will not be easy because the raw data from several studies can be deciphered only by the original investigators. IITRI was responsible for overall management of the monitoring program, and is severely criticized in the report for poor archiving of the data. The NAS-NRC panel recommends that the reanalyses be directed by "an organization that is independent of the Department of Defense and IITRI." IITRI is praised for the quality of its exposure data, but is reproached for not providing more technical assistance to ensure that these data were used.

This year, both of Wisconsin's senators and six of its nine representatives introduced legislation to cut off Project ELF's funding. This proposal passed the Senate in 1995, only to be reversed in a House-Senate conference committee (see *MWN*, M/J95).

Local opponents of Project ELF are planning a 50-mile march from Ashland, WI, to the Wisconsin transmitter. Nukewatch's LaForge said that the protest is timed to coincide with the anniversaries of the bombings of Hiroshima (August 6) and Nagasaki (August 9).

The NAS-NRC report is available for \$39.00 plus \$4.00 shipping from: National Academy Press, 2101 Constitution Ave., NW, Box 285, Washington, DC 20055, (800) 624-6242 or (202) 334-3313, Web site: <www.nap.edu>.

EMF Claims Could Endanger Entire Insurance Industry, Warns Swiss Firm in Report on "Electrosmog"

"The EMF problem is more dangerous and more threatening for the insurance industry than has generally been supposed." So warns a major Swiss insurance firm in a recent report, which argues that EMF cases might "confront...the insurance industry with claims on a scale which could threaten its very existence."

"EMF research has already found out too much to be able to ignore the conceivable health risks, yet has not found out enough to gauge them," notes the Zurich-based Swiss Reinsurance Co. (Swiss Re), which provides coverage to insurance companies to offset their risks. "On the basis of present knowledge alone," the report states, "it must be expected that plaintiffs will win suits dealing with [the EMF] issue." It warns of potential verdicts of tens of billions of dollars—not necessarily because of new research findings, but simply as a result of shifting public attitudes about acceptable risks.

The Swiss Re report does not propose specific responses to either the public health dilemma or the threat to the insurance industry. But it argues that solutions will not be found in the courtroom or the laboratory. Instead, it calls for a focus on "the sociopolitical controversy on how to deal with risks."

"The feedback I've heard from others in the industry is that they think this report is pretty good," Janina Clark, editor of the trade magazine *Reinsurance* in London, told *Microwave News*. *Reinsurance* hosted a roundtable discussion on July 11 with representatives of the different groups in the British EMF debate—activists, trial lawyers, scientists, utility experts and insurance ex-

ecutives. Both British and German insurance companies have recently expressed concern about the EMF issue (see *MWN*, M/J 95 and N/D96).

Swiss Re's EMF report is titled *Electrosmog—A Phantom Risk*, but despite the title it does not take a dismissive view of the EMF issue. Are EMFs harmful to human health? "The only reliable answer," according to Swiss Re, "is 'perhaps.'" While the company seems skeptical that any large-scale danger will be uncovered, it argues that the scientific questions cannot be resolved for years to come: "We are dealing with complex relationships which cannot even be identified, let alone understood, using the research methods presently available."

Some physicists have argued that low-level EMFs simply do not have enough energy to be harmful to human health, but Swiss Re rejects this argument. Life is based on complex systems of signals and responses, the report notes, and "an organism can convert weak signals into powerful biological responses." Swiss Re highlights the distinction between these "signal effects" and simple "energy effects."

As long as the EMF issue "remains a subject of controversy and is not decided, there can be no calculatory basis for providing insurance protection," Swiss Re explains. In fact, it calls the risk "incalculably great." According to the company, the problem is not that EMFs might "gradually [be] proved to be deleterious to health," as happened with asbestos. Instead, it points to "the risk of sociopolitical change," defining this as the risk that

“scientific findings might be assessed differently in a subjective sense due to changing social values.”

“The sociopolitical risk...must be classified as extraordinarily high,” argues Swiss Re, “because the legal instrument of liability is increasingly being used or even misused as a means of coping with the problems of life.”

The report points to growing public suspicion of science, technology and industry, and notes that, “A cause, in the sense of legal liability, is whatever society defines it to be.” Thus, “if society wishes to consider weak EMFs a cause of illness,” it will do so, and liability will follow.

Swiss Re stresses that EMFs are just one of many agents in modern life that may be, but have not been proven to be, harmful to our health. Technology changes fast, but science is slow to provide clear answers about safety. “This lack of clarity prompts people to resort to the courts,” Swiss Re notes. But it insists that the concept of legal liability is ill suited for considering technologies that *might* give someone a disease.

What is at stake, according to the report, is broader than the EMF issue: “There is a socio-legal problem: How should society deal with technologies which cannot be used with absolute safety and which therefore may represent a hazard?” New tech-

nologies often bring with them potential risks that cannot be clearly assessed or measured. So, Swiss Re contends, if society wants to employ these technologies, “we must...focus on how much *uncertainty* we are prepared to accept.”

Swiss Re suggests that, “The solution to the EMF problem could thus consist in a binding agreement on who is to be responsible for damages when the cause is not clearly known or can only be conjectured.”

Defining how this might be done is not easy. At the London *Reinsurance* forum, according to Clark, “The discussion didn’t produce any answers. We had a wide-ranging discussion about what the problems were—the scientific and sociopolitical issues, and the underlying questions for reinsurers.” It is that kind of discussion, Swiss Re hopes, that will eventually generate some solutions. “We are ready and willing to enter into this dialogue,” states executive board member Dr. Bruno Porro in his foreword.

Electrosmog—A Phantom Risk can be read on Swiss Re’s Web site: <www.swissre.com/com/reinsurance/earlierpublic.html>. Requests for copies can be made to: Swiss Re, Public Relations, Postfach, CH-8022 Zurich, Switzerland, Fax: (41+1) 285-2023. The report is available in English, French, Spanish and the original German.

Glazer, Jordan Lawsuits Both Withdrawn Voluntarily

Two major EMF personal injury lawsuits have been withdrawn by the plaintiffs. On May 20, Nancy Jordan withdrew her suit against two Georgia utilities, and ten days later Leonard Glazer’s case against Florida Power and Light (FPL) was dismissed at his request.

“Leonard’s leukemia had moved into an accelerated state,” explained Glazer’s attorney, Howard Talenfeld of Colodny, Fass & Talenfeld in Ft. Lauderdale. “And FPL was threatening him and his family with a cost judgment decision for \$280,000. He did not want to take the risk that he’d be leaving his family with that problem—despite the fact that we felt we’d prevail in the state Supreme Court.”

Last year Glazer’s suit was dismissed by a lower court, a ruling that was appealed. But in the meantime, FPL took advantage of Florida’s “loser pays” rules for civil suits and secured an order requiring Glazer to pay for some of its expert witness fees and other expenses (see *MWN*, S/O96).

“They withdrew their appeal to the Florida Supreme Court, and we withdrew our motion for costs,” FPL’s attorney, Alvin Davis of Steel, Hector & Davis in Miami, said in an interview. “We’re very pleased that it’s finally resolved.”

“It was a very difficult decision,” Talenfeld told *Microwave News*, “because we believe that this case would’ve made a difference.” But Talenfeld does not expect the EMF controversy to fade from the courtroom: “This is a battle that’ll be going on for many years to come. Look at the tobacco companies—they’ve denied for 30 years that their product causes cancer.”

Glazer’s wife, Elsa, died of chronic myelogenous leukemia (CML) in 1988. In 1992, Leonard Glazer was also diagnosed with CML; he filed the lawsuit in January 1994. Several power

lines ran across the Glazers’ property, where they had lived since 1969 (see *MWN*, J/F94, M/J94 and S/O95). But most of the EMFs in their home were due to ground currents flowing through the household plumbing system. In May 1996, FPL convinced a circuit court judge that ground currents were not their responsibility, and he dismissed the case (see *MWN*, M/J96; also J/F97). Glazer then appealed to the state Supreme Court. At the time he decided to end his suit, the Supreme Court had not yet indicated whether it would hear the case.

Deteriorating health was also cited in Nancy Jordan’s decision to withdraw her suit against Georgia Power Co. and Oglethorpe Power Co. “Mrs. Jordan has developed much more serious cancer,” attorney Bruce DeBoskey of Silver & DeBoskey in Denver told *Microwave News*. “Sadly, we felt she didn’t have the emotional or physical strength to go through another trial.”

DeBoskey noted that the cancer now threatening Jordan’s life was not at issue in the lawsuit. “It’s breast cancer, and it preceded her EMF exposure,” he said. “It was in remission but unfortunately it came back. Only her subsequent development of non-Hodgkin’s lymphoma was related to the EMFs.”

“The suit was withdrawn at Jordan’s request, and there was no settlement,” said David Mould, spokesperson for Georgia Power in Atlanta. “I don’t think we will have any comment beyond that.”

Jordan developed lymphoma in 1989 and filed suit in 1991. In 1994, a jury returned a verdict in favor of the utilities—although jurors’ comments indicated they would have gone the other way had the case involved childhood, rather than adult, leukemia (see *MWN*, S/O91, S/O93 and M/J94). A Georgia appeals court threw out the jury’s decision and ordered a new trial, on the grounds that the lower court judge had allowed improper testimony (see *MWN*, J/F96 and N/D96). But Jordan withdrew her lawsuit on May 20 before the new trial had begun.

some strong opposing views. “It’s baffling how any epidemiologist could look at the data in the NCI paper and say it is dead negative,” argued Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA.

The principal investigators on the three previous childhood EMF–cancer studies in the U.S. also disagree, to various degrees, with the NCI’s interpretation of the measured field findings. “The NCI study should not be viewed as a negative study,” said Dr. Nancy Wertheimer, “since it reports a significant positive result exactly where one might expect to see such a positive finding—at the high end of the measurement data they collected with such care.” In 1979, Wertheimer and Ed Leeper first reported that children living near high-current electrical wiring (classified by a system of wire codes) had higher cancer rates.

Linnet and coworkers report a nonsignificant 24%-53% increase in leukemia among those children exposed to 2 mG or higher. For exposures of 3 mG or above, the risk rises to 72% and is statistically significant.

“The NCI study is suggestively positive for measured fields,” said Dr. David Savitz of the University of North Carolina, Chapel Hill, who replicated the Wertheimer–Leeper study in 1986 (see *MWN*, N/D86). He added that, “If 3 mG were the cutoff point, this study could be seen as a positive study.”

On the other hand, Dr. Dimitrios Trichopoulos of the Harvard School of Public Health in Boston told *Microwave News* that, “The [3 mG] result in itself would have been significant, but it is an isolated finding because all previous studies have been dead negative with respect to measured magnetic fields.” Trichopoulos added that, “This very important study goes as far as possible in epidemiology to indicate that there is no link between childhood leukemia and magnetic fields.”

In a 1993 reanalysis of the 1986 Savitz data, Savitz and Dr.

Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, found that by shifting the cutoff point from 2 mG to 3 mG, the relative risk of ALL jumped from 1.6 to 5.3 and achieved statistical significance, albeit with only a very small number of cases. They concluded that, “Future studies should seek subject populations with a greater proportion of subjects” with exposures above 3 mG.

Indeed, the NCI had 45 cases and 28 controls with exposures of 3 mG or higher. Savitz had only 3 cases above 3 mG. In a letter to the *New England Journal*, Wartenberg notes that the NCI’s numbers over 3 mG “are statistically robust and rarely considered small in epidemiology.”

“There was not a lot of power to look over 3 mG,” commented Dr. Robert Hoover, the director of the NCI’s epidemiology and biostatistics program, “If the *a priori* hypothesis had been over 3 mG, you would have done a different study.”

The NCI’s view that there is no dose-response data for measured fields has also been challenged (see p.11). “The data are indicative of a trend,” Dr. Anders Ahlbom of the Karolinska Institute in Stockholm, Sweden, told *Microwave News*. In 1992, Ahlbom and Dr. Maria Feychting, also of the Karolinska Institute, reported an association between calculated historical magnetic fields and childhood leukemia; they also found a dose-response relationship (see p.12 and *MWN*, S/O92).

“This study conclusively shows no wire code risk,” said Linnet, referring to the system first devised by Wertheimer and Leeper to categorize homes according to their proximity to different types of power lines.

“I see this as a negative study for wire codes and as an ambiguous study for measurements,” said Dr. Stephanie London of the National Institute of Environmental Health Sciences (NIEHS) in Research Triangle Park, NC. In 1991, London and Dr. John

A Different Story in Germany: Measured EMFs Linked to Leukemia in Kids

Just prior to the release of the NCI study, German researchers announced new evidence linking EMFs and childhood leukemia.

At the June *World Congress* (see p.2), Dr. Joachim Schüz presented an analysis of 176 cases and 414 controls in Berlin and Lower Saxony, conducted along with Dr. Jörg Michaelis and other colleagues at the Institute of Medical Statistics and Documentation at the University of Mainz.

Schüz reported that children with a median 24-hour exposure above 2 mG were more than twice as likely to develop leukemia as children with lower exposures. Children under four years old with such exposures had a sevenfold increased risk. Children with high nighttime exposures were almost four times more likely than others to get the disease.

In June 1996, Michaelis presented results from Lower Saxony at the Bioelectromagnetics Society conference in Victoria, Canada. At the time, he emphasized the data’s limitations and the lack of statistical significance of the initial findings. Asked about the different tone of this year’s presentation, Schüz told *Microwave News*, “We changed our minds.” He explained that with the addition of data from Berlin, the picture became clearer.

Increased risks for younger children and for those with high nighttime exposures showed up in both the Berlin and Lower

Saxony data. In the combined analysis, these odds ratios become more significant. The researchers suggest that these measurements “may reflect the actual exposure best.” They note that “very young children are more likely to be at home full-time,” and that overnight bedroom measurements would closely track the exposure of a sleeping child.

The Lower Saxony data were recently published in *Cancer Causes and Control* (8, pp.167-174, 1997), while the combined analysis will appear in *Epidemiology* in November.

“Spot measurements were *not* related to childhood cancer,” Schüz said in an interview, contrasting them with the 24-hour and overnight averages. Wire codes were not used, he explained, since they do not apply to the German power system. Almost all measurements were taken within five years of diagnosis.

Schüz cautioned that the reported associations were based on small numbers and often emerged from *post hoc* analyses. Very few subjects had high-EMF exposures, and a nationwide study with greater statistical power is under way.

The combined data “lend some support” to the link between EMFs and childhood leukemia, Schüz and his colleagues conclude. But they estimate that only 2%-4% of German childhood leukemia cases might be attributable to EMFs.

One Tail or Two? A Tale of Statistical Significance and Dose-Response

The NCI team says that it found “no evidence” of a dose-response relationship between magnetic field exposures and childhood leukemia. Others are not so sure.

Dr. Richard Stevens, an epidemiologist at Battelle in Richland, WA, contends that if the NCI had applied a more appropriate statistical test, a significant dose-response relationship would have become apparent. In a letter submitted to the *New England Journal of Medicine* in early July, he concludes that the use of a single-tail, instead of a two-tail, trend test would “substantively change” the message of the NCI paper.

Stevens is not alone. “A one-tail test would be appropriate,” Dr. Raymond Neutra of the California EMF Program said in an interview. Dr. Robert Tarone, who led the statistical analysis of the NCI data, is holding his ground. “It is absolutely conventional to do a two-tail test,” he told *Microwave News*.

All this may appear to be esoteric, but the interpretation of the NCI study hangs in the balance. Dose-response is widely seen as a necessary condition for an association to be judged as reliable. For example, Dr. Charles Stevens of the Salk Institute in La Jolla, CA, told the *New York Times* (July 3), “If you can’t find a dose-response, you can’t believe it.”

At issue are the assumptions that go into the selection of the statistical tests that show whether an association or, in this case, a trend is deemed to be reliable or due to chance. Many outcomes of a study are possible, with some more probable than others. By convention, if a result is estimated to occur less than 5% of the time by chance alone, it is called statistically significant.

The tails refer to the two ends of a standard bell curve—the least likely of all the various possible outcomes of a given study. If it is assumed that magnetic fields are not related to leukemia, then one tail is consistent with promotion of cancer, and the other tail with protection against cancer.

Using a two-tail test, the NCI found that the observed dose-response relationship between measured magnetic fields and

childhood leukemia would occur only 9% of the time by chance—a little short of the standard 5% criterion.

Richard Stevens argues that the NCI study was designed to test only the hypothesis that magnetic fields increase the risk of childhood leukemia. It did not ask whether magnetic fields can increase *or* decrease childhood leukemia. If only a deleterious effect is to be considered, then a one-tail, rather than a two-tail, test is appropriate.

“The authors’ *a priori* hypothesis was that risk would increase with increasing exposure,” wrote Richard Stevens. And when he applied a one-tail test, he found that the dose-response relationship reached statistical significance, occurring only 4.5% of the time by chance.

Tarone countered that if he were looking into the effects of tobacco smoke, then he might favor a one-tail test because there is no doubt about the negative effects of smoking. But for EMFs, he added, “there is no controversy”: A two-tail test is the only way to go.

“I would have probably used a two-tail test,” said Dr. Eugene Sobel, a biostatistician at the University of Southern California in Los Angeles, who worked on the London-Peters EMF-childhood leukemia study. But, he allowed, “You can make an argument that EMFs from power lines can’t possibly be beneficial and therefore favor a one-tail test.”

Dr. Stephanie London, now at the NIEHS, commented that, “It is a very strong convention to use a two-tail test, but there is some justification for the use of a one-tail test.”

Dr. Christopher Portier, the chief of the NIEHS’ Laboratory of Computational Biology and Risk Analysis, acknowledged that a one-tail test “would likely” increase the chance that the observed dose-response relationship would occur less than 5% of the time. But Portier declined to take sides, saying that, “This is a judgment call left to the original authors, whose names must appear on their work.”

Peters of the University of Southern California in Los Angeles also found an association between wire codes and childhood leukemia—the third study in the U.S. to produce such a finding (see *MWN*, M/A91 and S/O91).

The wire code result surprised many observers, especially because a report by a National Academy of Sciences-National Research Council (NAS-NRC) committee concluded last year that, “The link between wire code rating and childhood leukemia is statistically significant (unlikely to have arisen from chance) and is robust” (see *MWN*, N/D96).

“I was amazed when I first saw there was no association with wire codes,” said Dr. William Kaune, a consultant based in Richland, WA, who led the NCI’s exposure assessment effort.

But Wertheimer and Leeper suggest that the NCI team failed to verify the applicability of their wire code before using it for homes in nine different states. “Inadequate tailoring of the W/L code to the various NCI locales is a likely explanation of the discordant results for wire codes and measurements,” they state (see p.12; also p.14 for Kaune’s response).

In addition, Dr. Raymond Neutra, the head of the California EMF Program, argued that, “The power of the NCI study is insufficient to settle the wire code issue because it cannot rule out a 50% increase in cancer risk, the value estimated by the NAS-NRC report.”

Nevertheless, Dr. Robert Tarone, the chief of the NCI’s statistical research and applications section and one of Linet’s co-authors, said that, “The main result [of our study] is that of the wire code because the wire codes have been driving this controversy for a long time.” Tarone added that, “We cannot say that there is nothing going on at higher exposure levels. I don’t know if that will ever be resolved.”

The strengths of the NCI study include the large number of cases and controls (629 and 619, respectively) and the relatively short time between a child’s leukemia diagnosis and the measurement of residential magnetic fields. In most cases, the fields were measured within 24 months of diagnosis.

Dr. Clark Heath of the American Cancer Society in Atlanta called the study “extraordinarily well done.” He told the *Los*

Angeles Times (July 3) that it makes “a strong statement about the lack of association” between power lines and leukemia in children.

For his part, Neutra draws a parallel between the short interval from diagnosis to measurement and the use of calculated historical fields by Ahlbom and Feychting. In a letter submitted to the *New England Journal of Medicine*, Neutra notes that, “Linnet’s real qualitative advance was to measure within two years of diagnosis. Perhaps this is why she came almost as close as the Swedes at showing a direct EMF measurement effect.”

At least two meta-analyses of EMF–childhood cancer studies are planned. On July 14, the NIEHS sought proposals for a meta-analysis that includes the NCI data. “The idea is to have the most up-to-date analysis possible” for the epidemiological review planned for the final report on the EMF research program known as RAPID, said the NIEHS’ Dr. Christopher Portier.

Neutra has also asked Wartenberg, who did the meta-analysis for the NAS–NRC study, to repeat it for the California EMF Program with the NCI results included. “My preliminary analysis shows that the odds ratio for an association between wire codes and leukemia goes down but is still statistically significant, while the odds ratio for measured fields increases but is still not statistically significant. In short, including the data from this additional study does not change the qualitative conclusions from the meta-analysis done for the NAS–NRC report,” Wartenberg told *Microwave News*.

A committee on epidemiology of the International Commission on Non-Ionizing Radiation Protection, chaired by Ahlbom, is preparing an evaluation of the NCI paper.

The *New England Journal* editorial, by Deputy Editor Dr. Edward Campion, called for an end to EMF studies. “It is time to stop wasting our research resources. We should redirect them to research that will be able to discover the true biologic causes of [childhood leukemia].”

Linnet would not endorse this view. She and the NCI’s Hoover are waiting for the two other major EMF–childhood leukemia studies, under way in the U.K. and Canada, before reaching a final verdict. If these were negative, said Hoover, “it would personally convince me it was time to stop.”

Dr. Lawrence Fischer of Michigan State University in East Lansing, chair of the NCI’s advisory committee, agrees with

EMF Exposure at Both Home and Work Raises Leukemia Risk

Epidemiological studies of adult EMF exposure and cancer face a serious problem: Adults divide their time between home and work, and may have high exposures in the place not under study. This can lead to classifying people as “unexposed” who may, in fact, be exposed—thus diluting the apparent risk.

A new Swedish study examines this problem and finds that adults with high EMF exposures in both home and workplace had the greatest risk of leukemia—a risk between three and four times as high as those with low exposures in both locations.

In the July issue of *Epidemiology* (8, pp.384-389, 1997), Dr. Maria Feychting, Dr. Birgitta Floderus and Ulla Forssén, all of the Karolinska Institute in Stockholm, Sweden, report that adults with residential exposures over 2 mG faced a leukemia risk 30% higher than those with low residential exposures. The one-quarter of adults with the highest workplace exposures faced a risk 70% higher than the one-quarter with the lowest exposures on the job. People with high exposures both at home *and* at work faced the highest risk of all: They were 3.7 times more likely to develop leukemia than people who were unexposed in both places, a statistically significant finding.

The researchers did not find an excess risk of brain tumors, which several other occupational studies have linked to EMFs. Their study combined data from Feychting’s large-scale residential study (see *MWN*, S/O92) and exposure assessment from Floderus’s major workplace study (see p.16).

Campion. “This study tips the scale,” he said, “Exposure to magnetic fields is not a major, and probably not even a minor, cause of cancer.” He added that it would be “more productive” to pursue other avenues of research.

Some are worried that the NCI paper and the editorial might make it difficult to finish ongoing studies. “There is no question that the coverage of this study will have a chilling effect on further research,” said the NIEHS’ London, who is currently at work on an epidemiological study of EMFs and breast cancer.

An Exchange on the Use of Wire Codes in the NCI Study

Microwave News asked Dr. Nancy Wertheimer and Ed Leeper to comment on the wire code results in the NCI study and then offered Dr. William Kaune, a coauthor of the NCI study who led the team’s exposure assessment effort, an opportunity to respond. Here are their comments.

Wertheimer and Leeper

The Wertheimer-Leeper (W/L) wire code was designed to estimate magnetic field exposures in Denver during the 1950s and 1960s, and one should not expect it to work well for other locales and times—as we pointed out in a memo¹ circulated in 1986, as well as in a 1991 article² and in numerous verbal communications before and since then. This caveat certainly applies to the National Cancer Institute’s (NCI) goal of discerning any modest but real risk that may have existed for the 816 children whose 1980s-1990s homes were wire-coded in dozens of different areas in nine states.

In devising the W/L code, we made hundreds of measurements at or near homes and power lines that were representative of our study locale—thus designing our code to discern homes with unusually high fields *in old Denver*. (In our published measurement tables, we always used the percent over 0.3 μ T [3 mG] to illustrate the degree to which a wire code or power line indicated “high” fields.)

The W/L code does have features that will result in a *rough* association with measured fields anywhere in the U.S. We cannot say how “rough” that association is in the NCI study (since data on that subject are not being released at this critical time). However, the NCI’s own pilot work, used to determine their exposure assessment protocol,³ re-

ports that measurement variability within wire code categories was “sufficiently large that the code could not be considered to be an effective predictor of children’s contemporaneous...exposures.” (Furthermore, even if wire codes and measurements *are*, broadly speaking, “well correlated,” they can yield entirely different estimates of cancer risk when the risk level occurs in the high tail of the distribution.⁴)

In old Denver, most homes had good conductive current-return paths in the plumbing, open rather than spun secondaries, wires running in the backyard and wye-connected primaries that had three phases where, and only where, large current loads would be expected. Each of these details carries implications about the type, intensity and variability of magnetic field exposures in nearby homes. In other regions and times with different wiring and plumbing practices, constructing new coding systems taking account of some of these factors has generally produced both a stronger association with measured fields and clearer evidence of a cancer risk.^{2,5,6,7}

To produce valid coding for all the NCI locales, site-specific variations like these would have to be taken into account. This problem was discussed at a 1989 meeting convened by the Electric Power Research Institute (EPRI) to help NCI researchers and others determine how best to assess exposures for their studies. At that time, the general consensus was that constructing “tailored” wire codes for all areas would be prohibitively time-consuming.

Instead, the “gold standard” favored for assessing exposures was the time-weighted average field measured by a dosimeter worn by the child being assessed. That standard was used in the pilot study that guided how the NCI *measurement* data were to be gathered and used.³ Thus, the measurement data—which gave positive results in the NCI report—were the data presumed *a priori* to be most trustworthy; and the W/L wire code—which gave negative results—was recognized *a priori* to be flawed for use in this geographically wide-ranging study.

But if we understand that one may expect the W/L code to perform

poorly in a mixed bag of other locales, we must ask why the W/L code *did* seem to be a fair indicator of magnetic field levels—and leukemia risk—in the Los Angeles leukemia study.⁸ The answer probably lies mainly in the fact that the *wye vs. delta* variable, a major factor that should have been included in any wire code properly tailored to the Los Angeles area (where both types of primary are used), just happened to be associated with our W/L code in Los Angeles. (The relatively high-field wye-connected primaries were seen about twice as often at homes with high W/L codes as at homes with low codes.⁹) To a considerable degree, the significant overall trend associating increased cancer risk with W/L wire codes appears to be due to this fortuitous association.¹⁰

Fortunately, the Los Angeles researchers constructed their own area-specific field predictor, results of which have been published thus far only in their 1991 and 1995 EPRI reports.^{6,7} That improved field predictor did not produce a stronger risk trend over the *entire range* of predicted fields, but it did yield a significant (twofold) risk estimate for the *highest* field estimates analyzed, while the W/L code did not. This finding provides more reliable evidence of a leukemia risk associated with high magnetic fields in Los Angeles than can the somewhat confusing association with the Denver-based W/L codes.

Interestingly, the Feychting-Ahlbom study¹¹ also provides good evidence that the better a surrogate predicts high magnetic fields, the better it predicts cancer risk. Their surrogate, which calculated historical magnetic field levels, did an excellent job of predicting high fields at single-family houses, but a mediocre job of predicting them at apartment houses. Using that surrogate, they found clear evidence of cancer risk at the former, but none at the latter.

Thus, inadequate tailoring of the W/L code to the various NCI locales is a likely explanation of the discordant results for wire codes and measurements in that study, though it is not the only one: Other possible explanations may become evident when data are provided on how the modest number of high-field ($\geq 0.3 \mu\text{T}$) homes retained in the wire-

What They Are Saying

“Overall, I believe this study demonstrates that exposure to electromagnetic fields does not increase a child’s risk of leukemia.”

—Dr. Leslie Robison, University of Minnesota and a coauthor of the NCI study, quoted by Steve Sternberg in “Power Lines Not a Cancer Risk for Kids,” *USA Today*, July 3-6, 1997

“Parents would be well advised to take the National Cancer Institute’s evaluations with a grain of salt and take steps to insure that their children are not exposed to high levels of EMF[s]. This latest study clearly shows that it is hazardous for children to live in homes near power lines giving off strong electromagnetic fields. Don’t allow government officials, or anyone else, to make test animals of your children.”

—Paul Brodeur, quoted in a press statement issued by the EMR Alliance in New York City, July 2, 1997

This study adds important information but does not resolve the issue of whether residential magnetic field exposures or wire codes are associated with childhood ALL.

—Electric Power Research Institute, Palo Alto, CA, comments on the NCI study, July 1997

“As we approach the new millennium, pieces of the puzzle are being put together so that people alarmed by EMF scares are getting the sound science they need to assuage their concerns.”

—David Swanson, senior vice president of energy and environmental activities, Edison Electric Institute (EEI) in Washington, DC, quoted in an EEI press release, July 2, 1997

Any statement claiming the demise of the EMF and cancer issue should be based on an analysis of all the available data and not one study, particularly one in which the reported data are apparently not reflected in the conclusions.

—Dr. Kjell Hansson Mild, National Institute for Working Life, Umeå, Sweden; Cindy Sage, Sage Associates, Santa Barbara, CA; and Dr. Bary Wilson, Battelle Pacific Northwest Labs, Richland, WA, in a press release from the 1st World Conference on Breast Cancer (Canada), July 15, 1997

This study will be announced as “negative” and calling for [an] end to funded EMF research. This is NOT correct!!! It actually acknowledges, in no less than four places, a statistically significant increase in acute lymphoblastic leukemia (ALL) in children exposed to power line magnetic fields in excess of 3 mG, finding almost twice (1.72 times) the number of expected cases.

—Powerwatch Network, Sutton, U.K., press release, July 2, 1997

“The best, strongest study so far,” and one that may hasten the day when an incontestable accumulation of negative results means that “at some point, we’re going to have to say there’s no risk.”

—Dr. Jerry Williams, Johns Hopkins Oncology Center in Baltimore, quoted by Curt Suplee in “No Greater Cancer Risk Is Found in Children Living Near Power Lines,” *Washington Post*, July 3, 1997

EMF: THEY SAY IT’S NOT OVER TILL IT’S OVER—WELL, IT’S OVER

—Headline from *What’s New* by Dr. Robert Park, Internet newsletter, American Physical Society, July 3, 1997

coded sample were distributed over the wire code categories; and how both measurements and wire codes were distributed over different locales and demographic groups.

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Kaune Replies

The exposure assessment protocol for the NCI's study of childhood leukemia and exposure to residential magnetic fields was developed in 1989 and 1990. At that time, the main guides for this development were the 1979 W/L¹ and the 1988 Savitz² studies. One question that came up early in the design process was whether to include wire coding using the W/L system.^{1,3} At that time, it seemed to us almost unthinkable to undertake a new study of childhood leukemia and magnetic-field exposure in the U.S. without including wire coding, because the strongest findings of previous studies^{1,2} were associations between childhood leukemia and this very measure of exposure.

By 1989, Wertheimer and Leeper had already argued in several venues that it was inappropriate simply to apply their wire coding system to other areas of the U.S. without "tuning" it for local wiring and plumbing practices. Since the geographical area covered by the NCI study was served by more than 200 electric utility companies, we concluded that it was not feasible to carry out this prescription. However, by 1989, we knew that the W/L wire coding system was being used in Los Angeles without modification.⁴ (This study subsequently reported a significant association between childhood leukemia and wire codes, in an area with wiring practices substantially *different* from those used in Denver.) We thus decided to include unmodified W/L coding in a pilot study that we performed in 1990 to provide data to guide the design of the final exposure assessment protocol for the NCI study. This study, conducted in the greater metropolitan Washington, DC, area, provided evidence of an association between contemporaneously measured magnetic fields and wire codes.⁵ When this result was combined with other observations of associations between wire codes and measured magnetic fields in Denver⁶ and Seattle,⁷ it appeared to us that the unmodified W/L wire coding system might be a rather geographically robust surrogate for residential magnetic fields. Based on these results, we decided to include wire codes in the exposure assessment protocol used in the full NCI study.

Data published after 1990 provided additional evidence for our hypothesis that W/L wire codes were associated with contemporaneously measured magnetic fields over a broad geographical area. In the Los Angeles study mentioned earlier, an association was found between wire codes and measured fields.⁴ Zaffanella⁸ examined a sample of 991 homes that spanned the entire U.S. and observed a clear relation between measured residential magnetic fields and wire codes. And, Bracken⁹ studied 396 residences occupied by employees of 39 U.S. electric utility companies and also observed an association between

wire codes and measured magnetic fields. Indeed, I can think of no study in the U.S. that has examined wire codes and magnetic fields and has *failed* to find an association between them.

My colleagues and I have also examined the NCI data to ascertain the relation between magnetic fields and wire codes. A paper reporting these results is currently undergoing journal review. All I can say at this time is that we observe a relation between wire codes and contemporaneously measured magnetic fields similar to those observed in other studies. Even so, it is possible that wire codes were a less effective surrogate for contemporaneously measured (and historical) magnetic fields in the area covered by the NCI study than in Denver, so perhaps we should have observed an association between childhood ALL and residential wire codes somewhat reduced in strength compared to that observed in Denver. However, in actual fact, the NCI study¹⁰ found *no relation whatsoever* between childhood ALL and residential wire codes.

These observations lead me to seriously doubt that the wholly negative wire code results of the NCI study can be explained by the failure of wire codes to be a surrogate for residential magnetic field exposure in the geographical area of the study.

William Kaune, PhD
EM Factors
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FROM THE FIELD

Letter to the Editor

July 16, 1997

To the Editor:

Despite the suggestion in *Microwave News* (M/J97), there has been no industry cover-up in the publication of the results of the study by Repacholi et al., "Lymphomas in Eμ-Pim1 Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields," first published in *Radiation Research* (147, pp.631-640, May 1997).

Indeed at the time of publication, the researchers ensured that they were available to comment on the results of the research, and to put it into its proper context. It is regrettable that a few observers have questioned the integrity of some of Australia's leading researchers and cancer specialists by alleging that they would engage in a cover-up on behalf of industry.

Telstra was not given access to the results until the paper had been peer-reviewed and accepted for publication. And in keeping with the wishes of the researchers, Telstra kept the results confidential until the journal was published.

The Royal Adelaide Hospital chose to publicize the research findings with a video conference held in Adelaide, not Sydney. The hospital arranged the video conference, including the invitation list. Telstra did not fund or stage the video conference and it did not have transcripts. A simple phone call to Telstra or the Royal Adelaide Hospital would have made these facts clear to *Microwave News*. Telstra issued only a media release and provided a copy to *Microwave News*.

To ensure the independence of the research findings, Telstra referred all inquiries from members of the public and media to the Oversight Committee, which carried out the research.

Hugh Bradlow, D. Phil.
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On hearing of the video press conference in Adelaide, we faxed Kerina Lawrence in Telstra's communications office, asking if a transcript was available, and if so, how we could obtain a copy. Lawrence had responded to our earlier request for a copy of the Telstra press release on the Repacholi mouse study. But, this time, we never heard back from her.

Clippings from All Over

[A] disquieting trend. Call it the "whoops factor," a phenomenon that starts with shoddy research or the misinterpretation of solid research, moves on quickly to public outcry, segues swiftly into the enactment of new laws or regulations and often ends with news organizations and some public policy mavens sounding like the late Gilda Radner's character Emily Litella as they sheepishly chirp, "Never mind!" The public has been buffeted by reports suggesting a campaign to torch black churches, a surge in juvenile crime, rampant child abuse in day-care centers, a rape crisis on college campuses and the continued poisoning of the country by cancer-causing chemicals like alar, saccharin or cyclamates or by electromagnetic forces emanating from high-voltage power lines.

—Steven Holmes, "It's Awful! It's Terrible! It's...Never Mind,"
New York Times, Week in Review, p.3, July 6, 1997 (see p.1)

"When in doubt, obfuscate."

—Ron Nessen, former press secretary for President Gerald Ford and, more recently, vice president for communications and public affairs at the CTIA, quoted by Al Kamen in "Some Submit to Washington—And Win," *Washington Post*, p.A17, June 30, 1997

[T]he Air Force's Armstrong Laboratory at Brooks Air Force Base in Texas is heavily engaged in [RF antipersonnel weapons] research. According to budget documents, the lab intends to spend more than \$110 million over the next six years "to exploit less-than-lethal biological effects of electromagnetic radiation for Air Force security, peacekeeping, and war-fighting operations."

—Douglas Pasternak, "Wonder Weapons: The Pentagon's Quest for Nonlethal Arms Is Amazing. But Is It Smart?"
U.S. News & World Report, p.45, July 7, 1997

In my view it is totally irresponsible to position a cellular antenna near a site where young children spend significant periods of time. While I am not saying that the association between these exposures and childhood cancer is proven beyond any shadow of doubt, I do see the evidence to be suggestive. When children's health is concerned, I strongly feel that our society must be cautious...

—Dr. David Carpenter, dean of the School of Public Health at the State University of New York, Albany, in a letter to the Planning Commission and City Council of San Rafael, CA, June 13, 1997

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

- Dr. Samuel Milham Jr. finds a link between occupational exposure to EMFs and elevated leukemia rates among workers in Washington state—the first time such an association is reported.
- A plan to extend a highway under the Omega radio navigational antenna on Oahu, HI, leads to public concerns over shock hazard and interference with pacemakers.
- Attendees of the BEMS conference express concern that severe cuts in spending on EMF research could imperil their research and lead to the dissolution of the society.

Years 10 Ago

- The New York State Power Lines Project issues its final report, estimating that 10%-15% of childhood cancers could be linked to EMFs.

- Researchers at the Swedish University of Agricultural Sciences in Uppsala find that exposure to VDT-type radiation increases the incidence of miscarriages and resorptions in pregnant mice.
- Scientists in Sweden and the U.K. challenge the finding that aqueous solutions of DNA can absorb 1-10 GHz microwaves.

Years 5 Ago

- Dr. Keith Florig of Resources for the Future in Washington estimates that concerns over EMFs are costing over \$1 billion per year.
- Dr. Dana Loomis of the University of North Carolina, Chapel Hill, notes a doubling of male breast cancer rates among electrical workers under 65, but he also sees a decrease in the rates among older workers.
- At the 1st World Congress for EMFs in Biology and Medicine, the Army and the Air Force spar over the adequacy of the ANSI/IEEE RF/MW exposure standard.

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DIGITAL TELEVISION

Sutro Tower EIR...Digital television (DTV) broadcasting is just a year away, and Sutro Tower will be the site of the new antennas in San Francisco. The effect on the area around the 977-foot tower, which now has transmitters for ten TV stations and four FM radio stations, is the subject of a draft environmental impact report (EIR) prepared by Sutro Tower Inc. and the city's public health and planning departments. According to an appendix on bioeffects, the DTV signal will operate at frequencies of 494-758 MHz, with a pilot tone at 12.9 kHz. The "signals are distinct from all signal types used in health-related research," write the appendix's authors, consultants Dr. Peter Polson of Cupertino, CA, and Louis Heynick of Palo Alto, CA. Drs. Asher Sheppard, a consultant based in Redlands, CA, and C.K. Chou of the City of Hope National Medical Center in Duarte, CA, also contributed to the bioeffects review. A second appendix, by San Francisco-based consulting engineers Hammett & Edison Inc. (H&E), states that each of the ten DTV stations that will be broadcasting from the site will have an average effective radiated power (ERP) of 500 kW. While Polson and Heynick estimate that the overall ERP from DTV will be about one-eighth of that from current TV transmitters, the two TV formats will broadcast simultaneously for at least nine years, leading to an anticipated 12% increase in ambient power densities. H&E calculates that the maximum RF power density will be 14.3% of the FCC standard, at a distance about 300 feet from the tower. The nearest residence is 250 feet from the base and 800 feet from the closest antenna. The draft was discussed at a public hearing on July 24. Comments will be accepted until August 11.

ELECTROMAGNETIC INTERFERENCE

Baby Broadcasts to Air Traffic Control...It seemed like a nice thing to do for the mother-in-law. The father of a Baltimore infant tinkered with a baby monitor to increase the power of its transmitter, so that the child's grandmother could listen in from her own home some distance away. But grandma was not the only one who could hear the baby's gurgles and cries. Pilots landing at the Baltimore-Washington International Airport picked up the signals, too, which interfered with communications with air traffic control. The incident was described in a Knight-Ridder dispatch published in the July 3 *Seattle Times*. The article noted that the FAA is encountering more and more such incidents, as the number and variety of wireless communications devices continue to grow.

EPIDEMIOLOGY

Testicular Cancer on the Job...Men with higher occupational EMF exposures were more likely to develop testicular cancer than were those in jobs with lower exposures, according to a new Swedish study. "The results for testicular cancer gave some support to the hypothesis of a hormonal link between [EMFs] and cancer," write Drs. Carin Stenlund and Birgitta Floderus, both of the Karolinska Institute in Stockholm. The 25% of men with the highest exposures were compared with the 25% with the lowest exposures: Their risk of testicular cancer was about

one-third greater. The 10% of men with the very highest exposures had an even greater risk, more than twice that of the 25% with the lowest exposures. Testicular cancer is most common among men under 40, and the study found that EMF exposure elevated that risk. In this age group, the 25% and the 10% with the highest exposures were twice and four times as likely, respectively, to get the disease as were those with the lowest exposures. Stenlund and Floderus conclude that their results are “in accordance with an exposure-response relationship,” and that this trend is statistically significant. Exposure assessment was based on an earlier landmark occupational study, by a team led by Floderus (see *MWN*, S/O92 and S/O93). Very few studies have examined EMFs and testicular cancer. Stenlund and Floderus cite only two, neither of which found evidence for an association. Their paper, which appears in *Cancer Causes and Control* (8, pp.184-191, 1997), also analyzes male breast cancer risks, which a number of other epidemiological studies have linked to occupational EMFs. (See, for example, *MWN*, N/D93 and M/J 94.) Stenlund and Floderus’s data do not support a male breast cancer connection. They note that “the possibility of an association cannot be rejected due to the limited numbers and limitations regarding the exposure assessment.” (For coverage of testicular cancer and police radar, see *MWN*, J/A93.)

MEDICAL DEVICES

EBI Loses \$150 Million Suit...In June, EBI Medical Systems Inc., a leader in EMF bone-growth stimulators, lost a \$150 million judgment to Orthofix International in a breach-of-contract lawsuit. Orthofix, which is based in Curaçao, had had an arrangement with EBI to distribute its own device in the U.S. The unit—called an external fixator—is used to treat fractures without the application of EMFs. Orthofix claimed that while their agreement was in force, EBI was stockpiling—instead of selling—Orthofix products and at the same time was developing a competing device. A jury at the U.S. District Court in Camden, NJ, awarded Orthofix nearly \$49 million in compensatory damages plus more than \$100 million in punitive damages. EBI, based in Parsippany, NJ, filed counterclaims, which apparently did not impress the court. While the jury decided in favor of EBI on some of these, it awarded EBI a total of \$2.00. “We are astounded by the jury’s decision,” said Dane Miller, president of Biomet Inc., EBI’s parent company. Biomet plans to appeal the decision.

Single-Coil OrthoLogic Unit Approved...OrthoLogic Corp.—EBI’s primary competitor in the EMF bone-growth stimulator market—has received U.S. FDA approval for a variation on its model 1000 unit. The new device uses the same technology but relies on one coil, instead of two, to generate the fields. “The purpose of the single-coil device is to be able to treat harder-to-reach areas like the hips and hands,” Dr. James Koeneman, the company’s vice president for engineering, told *Microwave News*. Last year, OrthoLogic had to retract marketing claims for the original model 1000 that the FDA called “misleading” (see *MWN*, J/A96 and S/O96). Dr. Allan Weinstein, OrthoLogic’s chairman, has not yet named a replacement for George Oram, who this spring stepped down as president of the Phoenix-based company (see *MWN*, M/J97).

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New Scientist (U.K.), October 7, 1995



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“Digital Cellular Phones Can Disrupt Implanted Pacemakers”

“Cellular Phones May Affect Use of Pacemakers”

Wall Street Journal, April 28, 1995



Microwave News, November/December 1995

“Higher Leukemia Rates Among Those Living Near Australian TV Towers”

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Sydney Morning Herald (Australia), December 10, 1996

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MEETINGS

Beneficial Effects of Magnetic Fields...The Lawson Research Institute (LRI) in London, Ontario, Canada, will host a symposium November 14-16 on *Magnetic Fields: Recent Advances in Diagnosis and Therapy*, to be held at the LRI and at the London Convention Center. Saturday, November 15, is devoted to *The Therapeutic Uses of Magnetic Fields*. “The session is for those who believe that ELF magnetic field effects at levels on the order of 1 G can have effects and who are interested in how they can be used for beneficial purposes,” the LRI’s Dr. Frank Prato, one of the organizers of Saturday’s session, told *Microwave News*. The other two days will feature talks on magnetic resonance imaging and spectroscopy and on near-infrared spectroscopy, both the technologies and their applications. The LRI is affiliated with St. Joseph’s Health Center and the University of Western Ontario. For more information, contact: Liana Heaney, LRI, Rm. H410, St. Joseph’s Health Center, 268 Grosvenor St., London, ONT N6A 4V2, Canada, (519) 646-6100 ext.4530, Fax: (519) 646-6110, E-mail: <lianah@stj.stjosephs.london.on.ca>, Web site: <www.stjosephs.london.on.ca/LRI/bemw>.

PEOPLE

Lawrence Weinstock is the new acting director of the EPA’s Office of Radiation and Indoor Air (ORIA) in Washington. Weinstock previously headed the office’s Radiation Protection Division. **Ramona Trovato**, the former head of ORIA, is now the director of the newly created Office of Children’s Health Protection at the EPA....The Bioelectromagnetics Society has elected **Dr. Betty Siskin** of the University of Kentucky, Lexington, as its next president. She will succeed **Dr. Martin Blank** of Columbia University in New York City next June....**Dr. Ben Greenebaum** of the University of Wisconsin-Parkside in Kenosha is on sabbatical for the 1997-1998 academic year. He is spending it working with **Dr. Michael Repacholi** on the World Health Organization’s EMF Project in Geneva, Switzerland. Greenebaum will continue as editor of *Bioelectromagnetics*....After 33 years in the post, **Roger Ney** has stepped down as director of the National Council on Radiation Protection and Measurements (NCRP). Ney will continue his work for the International Commission on Radiation Units and Measurements, and he might also act as a consultant to the NCRP. **William Beckner**, Ney’s deputy, is serving as the council’s acting director....The CSIRO, Australia’s large research organization, has closed its ultrasonics lab. **Dr. Stan Barnett** has moved to the CSIRO’s Division of Telecommunications and Industrial Physics. He said that, while continuing to work on ultrasound, his “main emphasis” will be on RF health effects....On June 30, 1998, **Dr. Patricia Buffler** will step down as dean of the School of Public Health at the University of California, Berkeley. After a one-year leave, she will return as a professor of epidemiology....**Bob Hemstock**, the central figure in **Paul Brodeur**’s article “Calamity on Meadow Street,” has died. Brodeur’s report of a cancer cluster in Guilford, CT, originally appeared in the July 9, 1990, *New Yorker* and was later reprinted in his book, *The Great Power Line Cover-Up*....**Bill Croker**, Georgia Power’s EMF and occupational health specialist, died suddenly in April of a heart attack.

In a word, no. Dr. Robert Tarone of the NCI conceded that, "We cannot say that there is nothing going on at higher exposure levels." Yet the NCI is not discouraging anyone from sounding the "all clear."

The NCI's results actually show that children exposed to more than 3 mG face a 72% increase in leukemia risk. Many other epidemiologists believe that this study provides evidence for an EMF effect. But you'd never know this from the NCI's press release.

How did the NCI arrive at a conclusion that seems at odds with its own data? First, there is the question of statistical significance. The researchers found a higher risk above 2 mG and indications of a dose-response relationship. But these results were not statistically significant, meaning that they could have happened by chance more than 5% of the time.

This is an important point—but no one should forget that the definition of "statistical significance" is a rule of thumb, not a law of nature. A finding with a significance level of 4% could still turn out to be due to chance. And one with a significance level of 10% could still reflect a real association.

Epidemiologists are arguing about whether the NCI team used the right kind of test to look for a dose-response relationship (see p.11). Regardless of who is right, the numbers tell us basically the same thing: There is some evidence of a dose-response relationship, but it is not conclusive.

The data that show a higher risk above 3 mG are statistically significant—but the NCI researchers discount this finding for another reason. The *a priori* hypothesis they had decided to test was that a child's leukemia risk would increase with exposures above 2 mG.

The use of *a priori* hypotheses has been adopted by epidemiologists for important reasons. It is a way for researchers to keep themselves honest since, if enough different comparisons are done, some false-positive findings will emerge due to chance. But it was never meant to be dogma.

The Chasm Between 2-3 mG and 1,000 mG

The selection of 2 mG rather than 3 as the cutoff point was somewhat arbitrary. Current international standards allow exposures up to 1,000 mG for children and 5,000 mG for workers. In this context, the difference between 2 and 3 mG almost seems a nonissue.

Had 3 mG been chosen instead, the headlines would have told a completely different story. As a *post hoc* finding, it is only limited evidence of a higher risk—but why is the NCI holding it up as evidence that there is no danger at all?

Epidemiologists have recently come under fire for acting as accomplices of an alarmist media in needlessly stirring public fears. But if epidemiologists need to take some responsibility for the headlines prompted by their studies, this has to cut both ways. When a study that suggests some risk leads to news reports that there is no danger, science is not well served. In this case, being too conservative in the interpretation of data is not an act of caution—rather, it leads to a reckless indifference to public health.

Millions of people live in the 5% of U.S. homes with EMFs above 3 mG. Add in the power company employees, telephone workers, sewing machine operators and others who routinely experience even higher exposures, and it is clear that a huge num-

ber of people are potentially at risk.

The NCI's Dr. Martha Linet has acknowledged that her conclusions are at odds with those of three previous studies. It is worth noting that none of the investigators in those studies feels that the NCI study is the last word. In fact, all three—Drs. Stephanie London, David Savitz and Nancy Wertheimer—feel that the NCI's results are either ambiguous or show a cancer link. And, in fact, the risks uncovered by the NCI are consistent with the range found in earlier investigations, and the weight of the evidence still favors an association between EMFs and leukemia in children.

But the *New England Journal of Medicine* is in a hurry to toss all these studies aside. Dr. Edward Campion's editorial asserts that "the better epidemiologic studies, including that by Linet," support the conclusion of no risk. These "better studies" are not identified, and what makes them better is not defined—unless it is the fact that Campion agrees with their conclusion.

The *Journal* does not stop there. It goes on to declare that "it is time to stop wasting our research resources" on EMF health research. In an interview, Campion said he saw no distinction between studies of residential EMFs and on-the-job exposures.

Never mind the higher risk ratios found in occupational cancer studies. Never mind the links to Alzheimer's disease, Lou Gehrig's disease, brain tumors and breast cancer. The *Journal* views any interest in the health effects of non-ionizing radiation as essentially without scientific foundation, blaming "activists and the media" for concerns about "microwave appliances, radar, VDTs, and even cellular telephones."

It is this kind of overreaching that betrays an ideological agenda. But sweeping statements will not make the EMF issue go away. Too many facts already litter the scientific landscape, and their number continues to grow. In this issue alone, we report on three new epidemiological studies pointing to health risks posed by EMFs, including a German study that contradicts the NCI's conclusions.

The issue of EMFs and human health is an unsolved puzzle. All the pieces do not fit together neatly, and that, of course, is frustrating. But the correct response to a frustrating puzzle is not to dump all the pieces on the floor, as Campion does.

The media have little tolerance for uncertainty. But good science requires dealing with uncertainty every day—having your curiosity spurred on by what you do not know, while avoiding a rush to judgment. It is unfortunate when national scientific and medical institutions, like the *New England Journal* and the NCI, show as little tolerance for uncertainty as the television news.

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