

## INSIDE...

### EMF NEWS pp.2-11

#### Power Line Talk:

*German Breast Cancer Studies Wow DOE Audience • Buffer's Dismissal of Health Risks Questioned • Delpizzo To Direct California Research • Trying To Explain Away Childhood Cancer Link • Workshop To Assess State and Local Needs • Michigan Utility Settles Lawsuit*

#### New Evidence for Tumor Promotion

*Gene Expression: JB-6 v. HL-60*

*Magnetic Field Limits Put on Hold in Sweden*

*Swedish Health Board Finds Little EMF Peril*

*AMA Sees No Evidence of Health Risks*

*Electric Blankets Not Linked to Breast Cancer*

*Firm Resolves EMF Allergies in Sweden*

*Severe Hypersensitivity Case*

*Joint Savitz-Sahl-Thériault Analysis Planned*

*Savitz-Loomis Abstract*

*Comments on Savitz-Loomis Study*

### HIGHLIGHTS pp.11-14

#### Cellular Phone Notes:

*SAG 1995 Budget: \$8 Million for Health Research • Plans for Validation Study of Comet Assay • Carlo Briefs EPA • NCI's Brain Tumor Study • Workshop in Israel*

*Motorola To Replicate DNA Breaks Study*

*Preemption Sought for Cellular Tower Siting*

*Suit Blames Police Radar for Fatal Cancer*

*Mobile Phone Dosimetry Abstracts*

### FROM THE FIELD p.15

*Clippings from All Over*

### UPDATES pp.15-18

*More on Assessing EMFs in Incubators • Farm Family Wins \$1 Million in Stray Voltage Suit • EBEA Proceedings • FDA Seeks Low EMF Lab Site • Australian VDT Meeting Papers • EMF Mitigation Manual • New Publications*

### CLASSIFIEDS pp.16-20

## Savitz and Loomis Find Brain Cancer Risk for Utility Workers Link to Leukemia Inconclusive

Drs. David Savitz and Dana Loomis have found that electric utility workers who are highly exposed to electromagnetic fields (EMFs) have a greater chance of dying of brain cancer than less exposed workers. The researchers, who are at the University of North Carolina School of Public Health, Chapel Hill, did not see a link between EMFs and leukemia mortality, except among electricians who had been on the job for more than 20 years.

"This study simultaneously provides evidence against an association of magnetic fields with leukemia and for an association between magnetic fields and brain cancer," Savitz said in a prepared statement. "It does not, however, resolve the fundamental question of whether magnetic fields cause cancer."

Both researchers pointed out that the risks from EMF exposure are likely to be small for most people. Loomis said that the study shows that, "There is not some huge risk out there that we have failed to discover."

Savitz and Loomis emphasized that the observed brain cancer link is stronger than that seen in previous studies of electric utility workers. They found that workers with the highest EMF exposures had more than a two-and-a-half times greater chance of dying of brain cancer than the least exposed workers. In addition, they observed a significant exposure-response relationship for brain tumors.

In a telephone interview, Dr. Anders Ahlbom of the Karolinska Institute

*(continued on p.8)*

## EMFs Boost Tree Growth at Exposures of 1-7 mG

A U.S. Navy submarine communications antenna slicing through the forests of northern Michigan has spurred the growth of some nearby trees exposed to its 76 Hz EMFs. Young red pines grew taller and mature aspens and red maples developed thicker trunks than similar trees growing at a control site 30 miles away.

Scientists at Michigan Technological University's (MTU) School of Forestry and Wood Products in Houghton monitored vegetation in the region from 1985 to 1994 and recorded enhanced growth as high as 74% in some red maples. These increases occurred at magnetic field levels of 1-7 mG among trees growing within 50-150 meters of the antenna. The researchers observed no changes in the growth of red oaks and paper birches.

The MTU research team was one of ten participating in a project to record changes in forest health and productivity due to the EMFs from the Navy's Project ELF in the Great Lakes region, which can send messages to

*(continued on p.13)*

## « Power Line Talk »

One of the most provocative papers presented in Albuquerque, NM, last November was not even on the official DOE program. Germany's Dr. **Wolfgang Löscher** announced his latest **breast cancer** results at an NIEHS-DOE workshop on *Research Directions for EMF Toxicology Studies* held on Sunday, November 6, the day before the DOE's annual EMF review got under way. "DOE felt that Löscher's work had to be included in any debate on animal toxicology studies," said Paul Gailey, the manager of the EMF program at the Oak Ridge National Lab. So, DOE sent Löscher a ticket and he did not disappoint his audience, previewing some of his forthcoming papers. In 1993, Löscher, Dr. **Meike Mevissen** and their colleagues at the School of Veterinary Medicine in Hannover had reported that a 1 G 50 Hz magnetic field promotes breast cancer in rats treated with a chemical carcinogen. (Löscher's group has published new details of the 1 G work in the January 1995 issue of *Carcinogenesis* (16, pp.119-125); see also, *MWN*, J/A93 and S/O94.) In Albuquerque, Löscher showed that he also saw a response at 100 mG and at 500 mG. And when he put all the data together, he found a dramatic, linear dose-response curve. The increase in the number of tumors was statistically significant at 500 mG ( $p=0.029$ ), while the effect at 100 mG was short of significance ( $p=0.1606$ ). He did not see a response for 3-10 mG exposures. In addition, the Hannover group is in the midst of a host of complementary studies. For instance, they have found a 35% decrease in nocturnal serum melatonin at 100 mG and a doubling of ODC activity in rats' breast tissue at 500 mG (ODC is a key enzyme related to cell growth). NIEHS's Dr. **Gary Boorman**, who is in the midst of his own animal studies, called the Löscher results "some of the most dramatic at the meeting," adding that, "We're looking at doing a similar study right now to confirm and extend the work." Dr. **Bo Holmberg** of Sweden's National Institute of Occupational Health commented that, "It's exciting," and Dr. **Claes Ramel**, the chairman of the Royal Swedish Academy of Sciences' Environmental Committee, called the dose-response "very impressive." Battelle's Dr. **Bary Wilson** found Löscher's experiments "the best executed set of EMF cancer studies with the most consistent results" ever. Wilson and others, such as Dr. **Raymond Neutra** of the California EMF program, want Löscher's studies to be repeated in the U.S. "If you can show promotion in two different animal systems, you will have the basis—together with the epidemiological data—to classify EMFs as a possible carcinogen," Neutra said. Whether Löscher can continue his own studies is unclear. He has secured only minimal funds since his 1993 paper appeared in *Cancer Letters*. "The predominant view in Germany is that the EMF issue is all nonsense," he said. This is no surprise to Dr. **Jan Walleczek**, a German researcher now at Stanford University, who observed that, "EMFs are as political in Germany as they are in the U.S."

«« »»

Some eyebrows were raised last year after Dr. **Patricia Buffler** dismissed all possible EMF health risks and refused to en-

dorse a policy of prudent avoidance. At a time when a number of utilities accept prudent avoidance, it seems strange that Buffler, the dean of the School of Public Health at the University of California, Berkeley, denounced the idea. "None of the 30 to 40 studies done in the last ten years has provided any convincing evidence that EMFs cause birth defects, childhood cancers, breast cancer in women or other problems," she told the *University of California at Berkeley Wellness Letter* (November 1994), a newsletter with a circulation of approximately 600,000. Thus, she concluded, advising prudent avoidance "would be in conflict with the scientific evidence, since we don't know that there is anything here to avoid" and "could result in spending millions of dollars...to avoid an unidentified 'phantom' hazard." Dr. **David Carpenter**, who, like Buffler, is a dean of a major public health school—at the State University of New York, Albany—told the *San Francisco Bay Guardian* (January 25, 1995) that her argument is "absolute nonsense." In an interview with the *Guardian's* Daniel Zoll, Carpenter said that, "To say that all of the studies [citing EMF health perils] have been seriously flawed is simply not true." Zoll raises the concern that Buffler's judgment may have been colored by her many years as an EPRI consultant. In an editorial, the *Guardian* called on Buffler to disclose her financial links to EPRI: "University officials are entitled to express their opinions and make a living—but not at the expense of the credibility of their schools by giving even the appearance of a conflict of interest. As the EMF affair shows, if these authorities are taking money from an industry, the public deserves to know who is paying them, how much and how that relationship may influence their opinions even remotely."

«« »»

On February 1, Australian epidemiologist and physicist Dr. **Vincent Delpizzo** became research director of the **California EMF Program** in Emeryville. He held a similar position at the Australian Radiation Laboratory in Yallambie. "This will be a great opportunity to address some of the unresolved EMF issues," Delpizzo told us. He will report to program chief Dr. Raymond Neutra.

«« »»

The debate continues over confounders that could cast doubt on the validity of the EMF-childhood cancer link. In a 1991 paper, Dr. **Dimitrios Trichopoulos** of the Harvard School of Public Health in Boston and Dr. **Charles Poole** of the Boston University School of Public Health contended that low-income families are "difficult to identify, contact and recruit as controls" by the random-digit dialing method used in most studies (*Cancer Causes and Control*, 2, pp.267-276, 1991). If poverty is related to high EMF exposures and if fewer low-income controls than high-income controls participate in a study, they argued, then any elevated cancer risks may be unrelated to magnetic fields. Dr. **Philip Cole** of the Univer-

---

sity of Alabama School of Public Health, Birmingham, has made the same argument. A group of Seattle researchers has now tested this hypothesis and concludes that it is not likely to explain away the power line cancer risk—though Dr. **James Gurney**, now of the Michigan Cancer Foundation at Wayne State University in Detroit, told us that he cannot completely rule out the role of bias. Gurney and his former colleagues at the Fred Hutchinson Cancer Research Center in Seattle and at Battelle PNL found that families earning less than \$15,000 a year were significantly more likely to live in homes with very-high-current-configuration (VHCC) wiring than high-income families. When they assumed that low-income controls participated at lower rates than high-income controls, risk estimates did rise, but not enough to explain the observed cancer–power line link. Gurney’s results appear in the January 1995 issue of *Epidemiology* (6, pp.31-35). The EPA reached a similar conclusion based on the Swedish residential study because Maria Feychting and Dr. Anders Ahlbom did not use random-digit dialing to select controls and still found a cancer risk among children living near power lines (see *MWN*, S/O92 and S/O94). In an interview, Trichopoulos conceded that, “Gurney’s paper shows that there can be a bias, but that it is not as big as we thought.” As this confounder recedes in importance, **Jack Sahl** of Southern California Edison Co. in Rosemead has proposed a new one. Writing in *Cancer Causes and Control* (5, pp.279-283, 1994), he presents the hypothesis that “residential proximity to electric utility transmission systems is a surrogate for viral contacts.” Sahl draws on U.K. studies that seek to explain excess childhood leukemia rates near nuclear power stations in remote areas of the country as actually caused by an infectious virus. He calls the failure to address the virus idea an “oversight” and predicts that rejecting the hypothesis “will help to remove uncertainties about the existing data.” Here we go again.

«« »»

The EPA, the DOE and the American Public Health Association are cosponsoring a workshop to bring together repre-

sentatives from state and local governments, utilities and grass-roots organizations in an effort to explore common goals. The workshop is expected to be held in May in the Washington area and it will be by invitation only. **Dennis O’Connor**, a policy analyst and EMF team leader at EPA’s Office of Radiation and Indoor Air in Washington, said that the objective of the meeting is “to determine the policy, research and technical assistance needs of those who make decisions on EMF policies.” The meeting should also help to identify tools and techniques that work well in local settings. For further information, contact: O’Connor, (202) 233-9340.

«« »»

A settlement in the personal injury lawsuit between the **St. Francis Prayer Center**, Flint, MI, and **Consumers Power Co.**, Jackson, MI, was reached on February 2, the day the trial was to begin. Charles MacInnis, a spokesperson for the utility, would not comment about specifics of the settlement because of a confidentiality clause, although he observed that, “I don’t think anybody at Consumers Power believed that EMFs were in any way a factor in the illnesses that were claimed.” Late last year, the utility had rejected the recommendation of a mediation panel to pay \$250,000 to the prayer center and its codirector, Sister Joanne Chiaverini, to settle the lawsuit. The suit, filed on January 10, 1992, in the Seventh Judicial Circuit Court, Genesee County, MI, claimed that Chiaverini’s rare blood disorder and other health problems were caused by EMFs from nearby power lines. EMF levels ranged from 2.2 mG to 9.2 mG “in and about the plaintiffs’ property,” according to the complaint, which charged Consumers Power with battery, trespass, nuisance and negligence. The center relocated to another site in Flint eight months before the lawsuit was filed and was seeking to recoup relocation expenses. “We felt there was really no medical or scientific evidence to support the plaintiffs’ claims,” said James Dempsey, the utility’s attorney, explaining why the mediated settlement had been rejected. Arthur Swirtz, the plaintiffs’ attorney in Flint, declined to comment.

---

## ***Magnetic Fields Amplify Abnormal Cell Growth: New Evidence for Tumor Promotion***

New experimental results suggest that strong magnetic fields can act as tumor promoters and transform noncancerous cells into tumor cells. The studies could lay the groundwork for explaining how magnetic fields produce cellular changes leading to cancer.

Dr. Robert West of the National Center for Toxicological Research (NCTR) in Jefferson, AR, and coworkers have found that JB-6 cells, which originate from mouse skin, formed significantly more cell colonies when grown in the presence of an 11 G 60 Hz magnetic field, compared to control cultures. Reporting on a similar set of experiments, Dr. Jeffrey Saffer of the Battelle Pacific Northwest Labs in Richland, WA, said that EMFs appear to enhance the effect of a chemical tumor promoter.

West and his coworkers plan to continue their work with JB-6 cells. They have already completed experiments at lower field levels and expect a paper to be published in the fall. West declined to discuss these results until the paper has been accepted for publication. *Microwave News* has learned, however, that West has also found a robust effect at 100 mG.

Referring to both Saffer’s and West’s work, Dr. Nancy Colburn, chief of the Cell Biology Section at the National Cancer Institute in Frederick, MD, said that, “I am convinced that the effect is there. There is a tumor-promoting effect at the levels of EMFs to which the cells were exposed.” Colburn, who developed the JB-6 line to study tumor promotion, is collaborating with Saffer on his EMF studies.

Dr. Mays Swicord of the Center for Devices and Radio-

logical Health (CDRH) in Rockville, MD, advised that, "It is a big jump to go from these results right to cancer," but urged that the work be followed up. "If it is correct, there is the potential for adverse effects on human health," said Swicord, who is chief of the molecular biology branch at the Food and Drug Administration's (FDA) CDRH. The NCTR is also part of the FDA, and Swicord is working with West.

West cautioned that his results are preliminary. Magnetic fields caused changes similar to those induced by chemical tumor promoters, he explained. "But until we understand the mechanisms involved, I would strongly suggest that a simple model system showing growth promotion not be used for hazard assessment in humans."

A number of other animal and cellular studies have previously shown that EMFs can act as tumor promoters and copromoters (see *MWN*, J/A91 and J/A93). In the mid-1980s, Dr. Jerry Phillips, now a member of Dr. Ross Adey's lab in Loma Linda, CA, first showed that EMFs can increase the proliferation of tumor cell colonies in soft agar (see *MWN*, J/A86).

### **Gene Expression: JB-6 v. HL-60**

The new JB-6 findings are coming to light at a time when the bioelectromagnetics community is embroiled in a controversy over the possible effects of EMFs on gene expression.

At last summer's *Annual Meeting of the Bioelectromagnetics Society* (BEMS) in Copenhagen, Denmark, Battelle's Dr. Jeffrey Saffer and Adam Lacy-Hulbert of the U.K.'s University of Cambridge announced that neither could repeat the EMF-induced changes in gene expression in HL-60 cells, originally reported by Drs. Reba Goodman and Ann Henderson (see *MWN*, J/A94). This led to an acrimonious exchange that resumed at the DOE meeting in Albuquerque, NM, last November.

"We are looking at another example of changes in gene expression induced by magnetic fields," Goodman told *Microwave News*, referring to Dr. Robert West's JB-6 work. Goodman is at Columbia University and Henderson is at Hunter College, both in New York City.

Dr. Jerry Phillips commented that, "Many reports in the literature indicate that EMF-induced changes in gene transcription must be occurring, and it is these changes that we must identify and study in detail. JB-6 is an excellent model system for this purpose."

Saffer did not reveal his JB-6 findings at the BEMS meeting. He later conceded that he should have emphasized that his failure to see changes in gene expression in HL-60 cells did not necessarily mean that other cell lines would also fail to respond. He added that he regretted that others had jumped to this conclusion.

Saffer said that he feels that the JB-6 cell line is a "more sensitive system" than HL-60 for detecting tumor promotion. Unlike HL-60 cells, which are fully transformed, JB-6 cells need a promoter before they become tumor cells.

Cells go through several stages before they become cancerous. The JB-6 cells used by West and Saffer have taken the first step in the process and are known as initiated cells. They differ from normal cells genetically and in their susceptibility to tumor promoters. Promotion is the next step, leading to transformed or tumor cells, which may or may not go on to become malignant.

In her own lab, Colburn has used TPA, a known chemical promoter, to transform JB-6 cells into tumor cells. Colburn explained that tumor promotion involves changes in gene expression, but does not necessarily indicate that genes have been altered. Unlike normal cells, transformed or tumor cells do not need to be attached to a surface and will grow in soft agar. West and Saffer have grown JB-6 cells in soft agar following exposure to either EMFs or EMFs plus TPA.

West pointed out that, although cells grown in soft agar can usually form tumors, this is not always the case. Other tests are needed for verification. Colburn emphasized that she has shown that JB-6 cells grown in soft agar with TPA do form tumors in mice, but that, "It would be important to demonstrate this with EMFs as well."

West and his coworkers observed a 40-70% increase in the number of cell colonies when they cultured JB-6 cells in soft agar and exposed them to an 11 G 60 Hz magnetic field for 14 days. Writing in *Bioelectrochemistry and Bioenergetics*, (34, pp.39-43, 1994), they reported no association between increased growth and the strength of the induced electric field, suggesting that cells were responding to the magnetic field alone.

Saffer reported on some preliminary experiments with JB-6 cells cultured in soft agar at the Department of Energy EMF review in Albuquerque, NM, last November. He said that when he grew cells in the presence of a 10 G 60 Hz magnetic field and TPA, there seemed to be enhanced cell colony growth. In a recent interview, he said that, "There's something going on and it is worth pursuing, but a lot of work remains to be done."

Saffer pointed out that there are differences between his findings and those of West but he declined to be more specific. He did say that he is motivated by what West's lab has done but that he wants to get more supporting experimental results before commenting further.

Saffer was recently awarded a three-year grant for over \$1 million from the National Institute of Environmental Health Sciences under the national EMF research program, known as RAPID, to study tumor promotion by EMFs in JB-6 cells (see *MWN*, S/O94). Saffer and his coworkers plan to look at the role of certain proteins, such as AP-1, which may be involved in the promotion process. Since AP-1 is composed in part of the proteins of two oncogenes, *c-fos* and *c-jun*, Saffer will also investigate the expression of these oncogenes in JB-6 cells.

Colburn said that, "EMFs are not unusual in that they, like other tumor promoters, work on cells that are initiated." The changes seen in EMF-exposed JB-6 cells are small, but she believes that they are highly repeatable. She said they may be undetectable in the living animal, however, when superimposed on the much greater effects of ordinary hormones and growth factors.

## Swedish Magnetic Field Limits Put on Indefinite Hold

The Swedish National Electrical Safety Board (NESB) has no plans to recommend EMF exposure standards in the near future. "I cannot foresee any limits for long-term exposures to magnetic fields," Stefan Villa, a senior administrative officer at the board, told *Microwave News* in late January.

The position of the board, which has been working on EMF rules for two years, is outlined in its annual report to the Swedish government. The report was released in November 1994, two months before the National Board of Health and Welfare issued a report that downplays a possible link between EMFs and cancer, reproductive problems and other health effects (see box at right).

The NESB still favors a policy of prudent avoidance, however, and continues to advise that day-care centers, schools and playgrounds not be built where magnetic field levels exceed 2-3 mG. The board is currently surveying the number of schools, nurseries and similar facilities near power lines.

In addition, the possibility that EMFs promote cancer prompted the NESB to endorse a precautionary strategy—"if this can be done at a reasonable cost." Its three recommendations are to:

- Attempt to design/locate new power lines and power stations in such a manner that the magnetic fields are limited.
- Avoid locating new housing, schools, nurseries, etc. close to existing power stations generating considerable magnetic fields if alternative locations can be utilized.
- Attempt to limit fields of considerable strength in existing homes, schools and places of work.

The Swedish government began work on setting exposure limits in September 1992, shortly after the completion of two major epidemiological studies of EMFs and cancer (see *MWN*, S/O92). By the spring of 1993, the newly formed NESB was analyzing costs that would be associated with a 2, 5 or 10 mG standard, and it was expected to release a draft standard by the end of the year (see *MWN*, M/J93). In January 1994, the NESB pushed back its timetable, and by June the board said it probably would not recommend limits (see *MWN*, J/F94 and M/J94).

"Our knowledge of the effects of weak [EMFs] on humans is at present insufficient. We therefore have no basis on which to establish limits," the board's November report states.

Given the "present uncertain state of the art," the National Association of Swedish Electric Utilities does not consider it justifiable to modify existing lines with the sole aim of reducing fields, according to the report. Nevertheless, Vattenfall and Svenska Kraftnät, two electric utilities, and the association will continue to develop low magnetic field designs for power lines and other electrical installations.

The NESB suggests that scientific research on EMF health problems will not yield definitive answers any time soon: "It is quite possible that the knowledge required to scientifically support a link between weak magnetic fields and health risks will not be developed for many years." The board will continue to report to the government once a year.

## Swedish Review: Little Evidence of EMF Link to Health Problems

A working group of the Stockholm-based Swedish National Board of Health and Welfare has found little evidence linking EMFs with cancer, adverse reproductive outcomes or skin problems. Released on January 17, the group's 257-page report—*Evaluation of the Effects on Health of Electrical and Magnetic Fields*—concluded that neither epidemiological data nor experimental studies on animals or *in vitro* support an EMF-cancer connection. "However, the possibility of there being a link between exposure and risk cannot be ruled out, especially with regard to child[hood] leukemia."

Further, the board found that there is no convincing support from epidemiology or animal studies connecting EMF exposure to miscarriages, low birth weights or malformations. Other studies, analyzing the effects of EMFs on VDT operators, did not report any pathological changes in the operators' skin, as has been hypothesized. As yet, there are no tests able to measure whether a person is electrically sensitive, the report noted.

Dr. Kerstin Hagenfeldt of the Karolinska Institute in Stockholm, who is the head of the Swedish Society of Medicine, chaired the working group that prepared the report. There are no plans to translate the report into English, a representative of the board told *Microwave News*. The National Board of Health and Welfare supervises social, public health and medical services in Sweden.

Last May, the board was one of four agencies that released an informational booklet stating that uncertainties in current scientific knowledge leave "no basis for establishing [exposure] limits" (see *MWN*, M/J94).

For a copy of the report, contact: National Board of Health and Welfare, Information Department, S-106 30 Stockholm, Sweden, Fax: (46+8) 783-3302.

## AMA Discounts EMF Health Risk, Suggests Further Studies

The American Medical Association (AMA) has concluded that no scientifically documented health risks have been associated with routine exposures to EMFs. However, the Chicago-based organization suggests that more research be done, supports setting exposure levels for the public and workers and will continue to monitor future developments.

These findings are in the AMA's new, but unpublished, assessment of health effects from exposure to extremely low frequency (ELF) EMFs. The report—*Effects of Electric and Magnetic Fields*—was written by Dr. Theodore Doege, a long-time AMA staff member, for the association's Council on Scientific Affairs (CSA). It was approved by AMA's House of Delegates at its interim meeting in December 1994. No publication date has been set, although copies of the report are

available from the AMA.

The report is the AMA's official position on EMFs and its conclusions should help physicians allay patients' fears about everyday exposures, Doege told *Microwave News*. It was reviewed by: Dr. David Brill of the Geisinger Medical Center in Danville, PA, on behalf of the Pennsylvania Medical Society, and Jeffrey Greenawalt, the medical society's director of educational and scientific affairs; Dr. John Peters of the University of Southern California in Los Angeles, on behalf of the California Medical Association; and Dr. Thomas Tenforde of the Battelle Pacific Northwest Labs in Richland, WA.

The report states that some studies in the past 15 years have associated exposure to 50 or 60 Hz EMFs with "slightly elevated risks of developing cancer or leukemia in children or adults." But Doege suggests in his report that there are inconsistencies in "most" of these studies in selecting study population groups, estimating exposures and accounting for other variables.

The same inconsistencies, however, prompted Doege to urge caution in the report: "...without stronger evidence [that] there is no problem, it would be unwise to dismiss the possibility that [EMFs] have adverse health effects."

Further, there is "an urgent need for a laboratory model of the response of cells to [EMFs]," Doege states. Such a model would aid in understanding physiological responses and could point to countermeasures.

Doege recommends the formation of an "authoritative, multidisciplinary" committee under the auspices of the National Academy of Sciences (NAS) or the National Council on Radiation Protection and Measurements (NCRP) to suggest EMF and radiation exposure levels for the public and workers. In an interview, Doege said he was unaware that the NCRP began a study on the biological effects of ELF fields more than a decade ago (see *MWN*, D83 and N/D92). Further, the NAS-National Research Council's (NRC) Board on Radiation Effects Research formed a committee in 1993 to review potential health risks from EMF exposures. Congress mandated the NAS-NRC study in 1991 (see *MWN*, S/O91 and M/J93).

Another AMA recommendation encourages the National Institutes of Health, the Department of Energy and the National Science Foundation to continue research on the effects of EMF exposure, average public exposure levels, occupational exposure and the effects of field surges and harmonics.

The AMA's report is its latest on non-ionizing radiation. Others cover: VDT use (see *MWN*, M/J87); medical device susceptibility to electromagnetic pulse (EMP) (see *MWN*, S/O88 and J/A89); and pulsed electromagnetic field (PEMF) stimulation for treatment of nonunion fractures (see *MWN*, M/A89).

The AMA's EMF report also notes that a 1980 CSA study concluded that significant biological effects can occur from intense exposures to non-ionizing radiation. A 1990 CSA report stated that the association between EMFs and cancer was weak and that more research was needed. Prudent measures should be taken to reduce exposure, the report noted. Neither review was published.

Copies of *Effects of Electric and Magnetic Fields* are available from: Brenda Stewart, CSA, AMA, 515 North State St., Chicago, IL 60610, (312) 464-5046, Fax: (312) 464-5841.

## **No Risk of Breast Cancer Among Female Electric Blanket Users**

Premenopausal women who reported using electric blankets did not have a significantly greater risk of developing breast cancer than similar women who did not use the blankets, according to Dr. John Vena and coworkers at the State University of New York, Buffalo.

Women who kept their blankets turned on all night had the greatest risk of developing breast cancer—a nonsignificant 43% increase over nonusers. In contrast, the group with the highest long-term exposure—those who had used the blankets nightly during the previous ten years—had a risk only 10% greater than expected. "Any strong association...should have been apparent" in this latter group if an EMF-breast cancer association existed, Vena and colleagues argued in the December 1 issue of the *American Journal of Epidemiology* (*AJE*, 140, pp.974-979).

Vena and colleagues interviewed nearly 300 women over 40 who were newly diagnosed with breast cancer. They wrote that the new results offered "little evidence" of a link between breast cancer and electric blanket use. This was a follow-up to a 1991 study of breast cancer among postmenopausal women, which found a similar nonsignificant increased risk of 46% for those who used an electric blanket throughout the night (see *MWN*, S/O91).

Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA, offered a different interpretation: "When you take the two papers together, it looks as if there is weak evidence in support of the EMF-breast cancer hypothesis." He emphasized that the two studies found similar risks and that results from both approached statistical significance. "I suspect that a combined analysis would be statistically significant," he said.

In a telephone interview, Vena countered that he did not want to combine the two studies. "You would need a strong biological rationale to do that," since the disease may have different mechanisms in different age groups, he explained.

In an exchange of letters in *AJE* in 1992, following the publication of the first electric blanket study, Stevens and Vena debated its relevance to the hypothesis of an EMF-breast cancer link (see *MWN*, J/A92). Stevens pointed out that if EMFs promote cancer by disrupting the flow of melatonin, it didn't make sense to study the use of electric blankets. The source of melatonin, the pineal gland, is located in the head, which is not highly exposed to EMFs from electric blankets. Stevens said recently, however, that if the mechanism of interaction involves a direct effect upon breast cells, as some cellular work suggests, then electric blanket studies may be a relevant test of the hypothesis. Stevens first proposed the melatonin hypothesis in a 1987 paper—Vena said it was this paper that prompted his study.

## Swedish Firm Resolves EMF Hypersensitivity Cases

In the late 1980s, a group of employees at Sweden's Ellemtel Telecommunication Systems Laboratories in Älvsjö reported that they were suffering from a mysterious ailment. While some believe that the symptoms—including rashes, burning skin, headaches, dizziness, nausea and fatigue—were triggered by high EMF exposures, others point to psychological causes. This phenomenon, now known as electrical hypersensitivity, was then only beginning to be recognized, although others throughout Scandinavia and in the U.S., Australia and other countries have since reported similar conditions.

Top management at Ellemtel, a research company owned jointly by Ericsson and Telia AB (formerly Swedish Telecom), decided to treat electrical hypersensitivity as a "legitimate complaint" and launched a three-year project to find practical solutions to the problem.

"The project was successful in that all personnel who suffer from this phenomenon have returned to meaningful work," Clairi Wiholm, a work environment coordinator for Ellemtel, told *Microwave News*, but added that, "We do not know why we had so many cases of hypersensitivity all at once."

Between 1988 and 1990, 27 staff members (out of approximately 1,000) developed symptoms after working at computers or near other electrical appliances—this number has since grown to over 50. "Several key figures in the company began to wonder whether these various inexplicable cases could eventually jeopardize some of the company's many vital development projects," according to a recently released 82-page English summary of a more detailed report in Swedish, written by Ellemtel's management. The fact that Ellemtel invested significant time and money in this problem "gave the individual the 'shot in the arm' which was needed to overcome his or her situation," the summary emphasizes.

In March 1990, Ellemtel began to seek ways to help its employees. The company based its policies on the premise that "hypersensitivity can be triggered by interacting factors in the physical and psychosocial environment and by the individual's personal [traits]," the report explains. Measures to lower EMF exposure for hypersensitive workers, as well as to improve the work environment, were implemented simultaneously.

Ellemtel reduced EMFs from equipment and wiring, because many of those with hypersensitivity believed that electricity was the root of their problem, according to the summary. In equipment-free offices, the 50 Hz magnetic fields were required to be less than 2 mG and electric fields less than 20 V/m.

To accommodate those who required even lower EMF levels, the company experimented with ways to create shielded offices. The fields in one room lined with aluminum sheets were 0.02-0.05 mG. Since this room was expensive to build and too small to hold everyone who needed a low EMF environment, another, conference-sized room was shielded with several layers of copper sheeting. The magnetic fields in this room were less than 0.2 mG, which the company found was comfortable for most hypersensitive employees.

Ellemtel engineers developed a variety of very low emission

### A Severe Case of EMF Hypersensitivity

Per Segerbäck, an electrical engineer who designs integrated circuits, was one of those at Sweden's Ellemtel Labs who developed a severe case of electrical hypersensitivity. He first experienced slight nausea and a sensation of "grit" in his eyes while working on his computer in the mid-1980s, but these symptoms disappeared when he used an antistatic spray and sat further back from the monitor. In 1989, after working long hours at a high-resolution monitor, Segerbäck developed more severe symptoms.

By early 1990, he had to go on sick leave and was unable to sleep inside his own home, which was heated electrically. He started spending nights in the family car, and later moved into a trailer parked in the garden. With the help of Ellemtel engineers, Segerbäck reduced the EMFs to a tolerable level in a room in his home by changing the wiring and plumbing, layering the entire room with ferrosilicon sheeting and placing aluminum blinds on the doors and windows.

Although he has now returned to work, Segerbäck's daily routine is severely limited; he is confined to a shielded room at home and a similarly protected office. He follows a route that avoids power lines and transformers. A few years ago, when he and his family tried to go on vacation to a cottage with no electricity on an isolated island, the trip had to be cut short when they found out that the sheep in the area were penned with electric fencing.

Segerbäck's story is included in Ellemtel's report on hypersensitivity at the company (see story at left).

computer monitors, including a plasma screen, several types of liquid crystal displays and a fully shielded CRT screen.

By the end of 1992, of 49 people who had developed hypersensitivity, 35% had recovered completely, 59% had improved and 6% remained the same. In the period between the 1993 publication of Ellemtel's project report and the release of the English summary, six more workers reported becoming hypersensitive. The symptoms were less severe than in previous cases and all cited stress as the most probable cause of their symptoms, according to the company.

Ellemtel spent more than \$900,000 on the project. Between 1991 and 1993, the Swedish Working Life Fund sponsored additional research on electrical hypersensitivity at Ellemtel, spending approximately \$1.2 million. Much of this work—covering such topics as the impact of the physical and the psychosocial environments, the role of amalgam tooth fillings and the effects of chemicals emitted by computers—was carried out by university researchers.

*Hypersensitivity in the Working Environment: Summary of a Project Report on a Swedish Company's Handling of a New Working-Environment Problem (1994)* is available for 95 Kr. (approximately \$12.75) from: Ellemtel, Box 1505, S-12525 Älvsjö, Sweden, (46+8) 727-3520, Fax: (46+8) 647-8276. (See also, *MWN*, J/F87, M/A87, M/J91 and N/D94.)

in Stockholm, Sweden, said, "I am quite impressed with the brain tumor results. My feeling is that they are quite reliable."

Savitz and Loomis did not find any increase in the overall leukemia risk and they saw only nonsignificant, slightly elevated risks for acute myeloid leukemia (AML) and chronic lymphocytic leukemia (CLL) among some of the more highly exposed workers. But they cautioned that misclassification of leukemia and brain tumor subtypes on death certificates—which they relied upon for diagnoses—could be substantial.

A number of epidemiologists commented that they were not surprised that a mortality study like the Savitz–Loomis one had failed to support a leukemia risk. They said that they put more faith in a morbidity or incidence study for leukemia.

Savitz and Loomis measured exposures with an AMEX meter, which provides time-weighted average magnetic field levels. They did not measure transients—or other kinds of fields—which have been the focus of recent attention (see *MWN*, M/A94 and N/D94). William Feero said in an interview that the study was "the best done to date," but that, "We are still doing a terribly poor job on exposure assessment." Feero, of Electric Research and Management Inc., based in State College, PA, added that more needs to be learned about the different types of magnetic field exposures. "There are a hell of a lot of different field characteristics," he said.

Dr. Gilles Thériault of McGill University in Montreal, Canada, said he believes that there are a small number of people exposed to a specific, and so far unidentified, component of the field. He stressed that he is convinced that there is some connection between EMFs and cancer. "We keep seeing smoke, but we have not identified the fire. And there is a fire out there. One day we will put our finger on it."

With respect to the results of his study, Savitz explained that there is either a small risk to all workers or a large risk to a very small group of workers who are exposed to a specific type of field. Loomis said that an effect might depend on specific exposure conditions or specific characteristics of a population that have not yet been identified.

The Savitz–Loomis study, which was sponsored by the Electric Power Research Institute (EPRI) in Palo Alto, CA, included 138,905 men who had been employed full time for at least six months between January 1, 1950, and December 31, 1986, at one of five utilities—Carolina Power and Light Co., Pacific Gas and Electric Co., PECO Energy Co., the Tennessee Valley Authority and Virginia Electric Power Co. Exposures were assigned to 28 job categories on the basis of a sampling of recent measurements of nearly 3,000 workers wearing AMEX meters. Exposures for individual workers were based on these measurements and on the length of time they worked at a particular job.

This is the fourth large occupational study with detailed exposure assessments to appear in the last couple of years. In 1992, Dr. Birgitta Floderus and colleagues at the National Institute of Occupational Health in Solna, Sweden, found an increase of CLL and brain tumors among exposed workers from a variety of industries (see *MWN*, S/O92). A study of utility workers at Southern California Edison Co. (SCE), led by Jack Sahl, found no overall association between leukemia or

## **Savitz–Sahl–Thériault: Joint Analysis Planned**

Jack Sahl, Dr. David Savitz and Dr. Gilles Thériault may soon start working together to sort out apparent inconsistencies among their three studies of utility workers. But details of the joint project, including its funding, have yet to be resolved.

"We are still trying to determine an approach," Dr. Stanley Sussman, EPRI's EMF project manager, told *Microwave News*. EPRI is acting as the facilitator for the project.

Savitz said that he favors the collaboration, but that he is not optimistic that it would clarify the differences in results. And Sahl said he thinks it could be an important next step.

Dr. Claude Cardinal, Hydro-Québec's EMF program manager, said that while he likes the idea, "We will have to see if it is feasible." Thériault and the Canadian utility are at odds over the control of the data collected for his study (see *MWN*, N/D94).

brain cancer and EMFs (see *MWN*, M/A93 and J/A93). A three-utility Canadian–French study, headed by Thériault and published last March, found a significant association between EMFs and some leukemia subtypes as well as one type of brain tumor (see *MWN*, M/A94).

A number of earlier occupational studies, including one on electrical workers by Loomis and Savitz published in 1989, have pointed to a brain cancer risk from EMFs (see *MWN*, N/D89 and M/A90). In a much smaller study than the 1995 Savitz–Loomis study, Dr. Susan Preston-Martin and colleagues at the University of Southern California School of Medicine in Los Angeles found a more-than-fourfold increased risk of astrocytomas, a brain tumor type, among EMF-exposed workers (see *MWN*, M/A90).

Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, said, "There is a sense of frustration in the lack of clarity with previous studies, but they are not wildly inconsistent. The results lend more evidence in the direction of an association between magnetic fields and cancer." Like Savitz, Wartenberg is a member of the National Academy of Sciences-National Research Council's EMF committee (see *MWN*, M/J93). Dr. Jan Stolwijk of Yale University in New Haven, CT, a third epidemiologist on the panel, did not respond to a call for comment.

The brain cancer link seen by Savitz and Loomis is generally consistent with the one found by Floderus. Savitz said that their brain cancer data at the highest exposures are also "quite compatible" with those reported by Thériault's group. Writing about their study in the January 15 *American Journal of Epidemiology*, Savitz and Loomis concluded that, "Our risk estimates of 1.5-2.5 are not markedly discordant from [Thériault's] reported relative risks of approximately 1.5."

And some epidemiologists see the Savitz–Loomis leukemia results as not inconsistent with past studies because their use of death certificates may have led to an underestimation



of the risk as well as the misclassification of subtypes.

Floderus told *Microwave News* that she is not “surprised” by the apparent differences in leukemia results. “Very few mortality studies have found an association for leukemia, and very few morbidity studies did not obtain elevated risk estimates, so something in the morbidity/mortality study designs seems to be important.” And Ahlbom commented, “The question for leukemia is whether we can identify features in the study designs that explain the apparent inconsistencies.”

“Savitz is short 15-20% of the cases because not everyone will die of leukemia and that may explain the difference between his and our studies,” Thériault said. In their paper, Thériault and coworkers pointed out that if they had analyzed only overall leukemia and ignored subtypes, their conclusions would have been similar to those of Sahl’s group. Thériault found a threefold elevated risk of AML among highly exposed workers, but, like Sahl, saw no significant risk of leukemia overall.

Dr. Samuel Milham Jr., a consulting epidemiologist based in Olympia, WA, agreed that a mortality study does not tell the whole leukemia story. “You would miss half of the CLL,” he said. He added that, “I don’t think the Savitz study dismisses the leukemia-EMF connection. There is something going on.” He pointed to the study’s finding that longtime electricians were two-and-a-half times more likely to die of leukemia than other electricians.

Savitz said that he felt that the death certificate data were a reasonable reflection of the incidence of overall leukemia and brain cancer. But he allowed that, “We did not do an extra-high-quality study for leukemia subtypes.” He explained that because the U.S. does not have a national cancer registry, they were unable to collect data on cancer incidence for the study’s large and geographically diverse group of workers.

Dr. Nancy Wertheimer, based in Boulder, CO, said that, “While the Savitz-Loomis, Thériault and Floderus studies show different patterns of subtype risk, all three seem to show a significant risk for brain tumors and leukemia combined, when exposure is high in the 10-20 years before diagnosis.”

With respect to estimating EMF exposures, Savitz and Loomis wrote that “relative to the ‘gold standard’ of accurate historical information, we undoubtedly fell short.” Savitz said their historical reconstruction was limited by the lack of available utility records. He also said that while it would have been useful to have a meter with broader capabilities, they also needed one that nontechnical people could use easily. “In hindsight, we made the right choice,” he said.

Standardized mortality ratios (SMRs), which compare the workers’ cancer rates with those of the general population, showed that the utility workers were at a lower risk for both leukemia and brain cancer. Savitz and Loomis attributed this to the “healthy worker effect”—that is, people who have jobs are among the healthier members of the population.

Dr. Dimitrios Trichopoulos of the Harvard School of Public Health in Boston countered that he does not think that the healthy worker effect can be invoked to explain the lower SMRs for brain cancer. He explained that an employer has no way to predict whether a person who is healthy when hired

## Savitz-Loomis Abstract

“Reports of leukemia and brain cancer among men in electrical occupations suggest a small increase in risk, but most previous studies have failed to classify magnetic field exposure accurately or to consider potential confounders. The authors conducted an historical cohort mortality study of 138,905 men employed at five large electric power companies in the United States between 1950 and 1986 with at least 6 months of work experience. Exposure was estimated by linking individual work histories to data from 2,842 workshift magnetic field measurements. Mortality follow-up identified 20,733 deaths based on 2,656,436 person-years of experience. Death rates were analyzed in relation to magnetic field exposure history with Poisson regression. Total mortality and cancer mortality rose slightly with increasing magnetic field exposure. Leukemia mortality, however, was not associated with indices of magnetic field exposure except for work as an electrician. Brain cancer mortality was modestly elevated in relation to duration of work in exposed jobs and much more strongly associated with magnetic field exposure indices. Brain cancer risk increased by an estimated factor of 1.94 per microtesla-year of magnetic field exposure in the previous 2-10 years, with a mortality rate ratio of 2.6 in the highest exposure category. In contrast to other studies, these data do not support an association between occupational magnetic field exposure and leukemia but do suggest a link to brain cancer.” David Savitz and Dana Loomis, “Magnetic Field Exposure in Relation to Leukemia and Brain Cancer Mortality Among Electric Utility Workers,” *American Journal of Epidemiology*, 141, pp.123-134, January 15, 1995.

*Reprinted with permission.*

### Related papers:

H. Kromhout et al., “Assessment and Grouping of Occupational Magnetic Field Exposure in Five Electric Utility Companies,” *Scandinavian Journal of Work, Environment and Health*, in press, 1995.

Dana Loomis et al., “Organization and Classification of Work History Data in Industry-Wide Studies: An Application to the Electric Power Industry,” *American Journal of Industrial Medicine*, 26, pp.413-425, 1994.

Loomis et al., “Sampling Design and Field Methods of a Large, Randomized, Multisite Survey of Occupational Magnetic Field Exposure,” *Applied Occupational and Environmental Hygiene*, 9, pp.49-52, 1994.

may later get a brain tumor. He said that he would conclude that the utility workers in the Savitz study were “in an environment associated with a lower risk of brain tumors.” Savitz agreed that the effect applies more to some diseases than to others, but he maintained that it applies to a whole range of cancers, including brain cancer.

In addition to a joint analysis with Sahl and Thériault (see p.8), Savitz and Loomis plan to analyze further the data on prostate cancer as well as a number of other diseases. Loomis pointed out that even a small elevated risk for prostate cancer could be important, since it is a common disease. Savitz also plans to look at the lung cancer data. Thériault’s group recently reported a strong association between lung cancer and

## Comments on Savitz–Loomis Study

“Large studies such as this one are expensive and time-consuming. Future studies need to be designed to efficiently evaluate more refined ideas about what aspects of exposure, if any, are important and which individuals might be susceptible.”

—Dr. **David Savitz**, quoted in *Carolina News Services*, University of North Carolina, Chapel Hill, news release, January 6, 1995

“It is disappointing that our results do not provide a clearer picture [of the cancer–EMF link] when combined with the previous studies of electrical workers and particularly electric utility workers.”

—Drs. **David Savitz** and **Dana Loomis**, *Magnetic Fields in Relation to Leukemia and Brain Cancer Among U.S. Electric Utility Workers: Summary for a General Audience*, January 11, 1995

“I don’t want to downplay the adverse aspects of our findings, but one thing our study does is show once again there is not some public health disaster lurking out there.”

—Dr. **David Savitz**, quoted in “Study of Electrical Workers Has Mixed Findings on Cancer,” *Washington Post*, January 12, 1995

“I really feel that this issue should have at this point a rather limited effect on the way people live their lives. I argue that where there are easy opportunities to reduce exposure, it’s only reasonable to do so. But to make major changes, whether in the work of a lineman or where people live, there’s a real possibility that no benefit would result.”

—Dr. **David Savitz**, quoted in “Study Examines Risks of Electromagnetic Fields,” *Charlotte Observer* (NC), January 11, 1995

“The IBEW continues to believe that changes in the work environment at utilities to provide further protection against the still unproven effects of EMF must not elevate the degree of risk associated with energized electric lines. We have pressed for and will continue to press for protection against the well-known, documented dangers inherent in work on or in close proximity to live lines.”

—**John Barry**, president, International Brotherhood of Electrical Workers (IBEW), quoted in *IBEW News Release*, January 11, 1995

The cancer risk factor found in the Savitz–Loomis study and earlier studies is much lower than that for cigarette smoking—“miles and miles away.” Still the Savitz–Loomis findings “strengthen the idea that electromagnetic fields produce some risk of cancer.”

—Sir **Richard Doll**, Imperial Cancer Research Fund in Oxford, U.K., quoted in “New Study of Electromagnetism Clouds Hunt for Cancer Link,” *New York Times*, January 12, 1995

“Among the many strengths of the study are its large sample size, a cohort design, a thorough identification of the study population, nearly 100% follow-up of subjects, long follow-up period, blind (on exposure status) coding of the death certificates, an extensive exposure measurement program which was based on a random sample, homogeneity of jobs, focus on an industry with the potential for high exposure, detailed occupational histories for all workers, development of specific *a priori* hypotheses, and a detailed assessment and control of potential confounding by other occupational exposures. All of these aspects are likely to minimize bias and enhance the validity of the study. Limitations related to interpretation of the study include: reliance on death certificates for diagnoses, inability to rigorously examine cancer subtypes, and the use of an instrument that was able to record only average exposures. To obtain precise and stable estimates of risk for rare cancers, such as leukemia and brain

cancer, the study covered a long period of time. Reconstruction of 30 years of exposure to a complex and highly variable agent is very difficult and has likely led to misclassification. Furthermore, as with other studies of the potential health effects of magnetic fields, uncertainty as to the appropriate characteristic of the magnetic field is of concern....Of special interest are three studies of utility workers [Sahl, Savitz, Thériault]. These studies incorporate a number of methodological improvements, including *a priori* hypotheses, extensive measurements, large sample size and assessment of potential confounding. Improvements in study quality, unfortunately, have not clarified the relationship between EMF exposure and cancer. In particular, the inconsistencies in results among studies underscore our limited understanding of the risks of exposure to EMF among utility workers and suggest the need for further analyses and additional studies.”

—**Electric Power Research Institute** (EPRI), *Comments*, January 1995

“I truly believe this is the best study we have to date of this question. I don’t think more epidemiologic studies of larger populations with our current techniques are going to clarify this any further...until we understand more about actual mechanisms [whereby EMFs might cause cancer] and whether it is electric or magnetic fields.”

—Dr. **Patricia Buffler**, University of California, Berkeley, quoted in *Washington Post*, January 12, 1995

“The question is how many more studies do we need to start protecting workers exposed to [EMFs] and people’s residences?...You have to cut through all that smoke and say (the threat from the fields) is real, and we’ve got to start protecting people. You don’t need conclusive scientific proof before you take protective health measures.”

—**Michael Withey**, Seattle attorney, quoted in “Electromagnetic Fields Linked to Brain Cancer,” *Seattle Post-Intelligencer*, January 13, 1995

“I think everybody recognizes we’re not going to get the answers from epidemiological research.”

—**Kirvil Skinnarland**, environmental affairs chief, Seattle City Light, quoted in *Seattle Post-Intelligencer*, January 13, 1995

“One of the hallmarks of what we look for...is consistency in studies, the same outcome from the same kind of exposure. We haven’t been able to achieve that to date.”

—**Jack Sahl**, Southern California Edison Co., quoted in *Seattle Post-Intelligencer*, January 13, 1995

“Definitive answers to the questions surrounding magnetic fields and human health are of the utmost importance to our members, their employees and customers. We must further our understanding of the similarities and differences between EMF studies. And future studies need to consider elements other than magnetic fields present during electricity production, transmission and use. We believe the National EMF Research Program could concentrate on these areas.”

—**Thomas Kuhn**, president, Edison Electric Institute (EEI), quoted in *EEI News Release*, January 11, 1995

“The implications of this study are not clear. Since leukemia and brain cancer are both rare diseases, even a doubling of risk for these diseases implies only small increases in the total number of people affected. These utility workers were exposed to high magnetic fields for a long period of time, and we are not sure how that exposure relates to the general public.”

—**Environmental Protection Agency**, *News Release*, January 1995

---

transients (see *MWN*, N/D94).

Savitz said that, "We've done about as well as we can do with the broad hypothesis that EMFs can affect health—now we need more refined ideas."

Loomis concurred: "We need to go back to the theoretical drawing board." He said that new ideas are needed about specific conditions but that without them he would not do a long-

term average exposure study again.

Thériault emphasized the need for more research: "We should not quit halfway—before we have the answer. If we did, we would lose what we have learned so far. We are gaining ground." He encouraged researchers to look to the laboratory as well: "The promoter/copromoter concept is bound to lead us to a conclusion" (see p.3).

---

## HIGHLIGHTS

---

### « Cellular Phone Notes »

Dr. **George Carlo** reports that the Cellular Telephone Industry Association's (CTIA) Scientific Advisory Group (SAG) on Wireless Technology has a 1995 budget of over \$10 million, of which \$8-8.5 million is targeted for health and safety research grants. The SAG spent close to \$3 million in 1994, primarily on workshops and on scientific consultants, establishing what Carlo called a "very solid foundation" for the research program. The SAG is still in negotiations on two dosimetry contracts: one with Dr. **Om Gandhi** of the University of Utah, Salt Lake City, to create a certification program for cellular phones and another with Dr. **C.K. Chou** of the City of Hope National Medical Center in Duarte, CA, for exposure assessment studies and a head-only exposure system (see *MWN*, J/F94). These projects were first announced in December 1993. "I've tried to do everything humanly possible to give C.K. the financial support he needs to get going with the project," Carlo explained, but an agreement with the medical center over a number of issues, including the use of good laboratory practices, has not yet been reached. Chou said that he remains optimistic that a contract will be signed soon, but added, "It's very frustrating." Gandhi is equally frustrated, though more pessimistic. "I really don't know what is going on," he said. (In January, the SAG changed its name—to better reflect its expanded role. Originally, the SAG was only concerned with cellular phones and brain cancer, Carlo said, while it now addresses cellular towers, electromagnetic interference and PCS systems.)

«« »»

Dr. **Ray Tice** of Integrated Laboratory Systems in Research Triangle Park, NC, who is coordinating the **international validation study** of the use of the comet assay to measure DNA breaks, expects more than 20 labs to participate (see p.12 and *MWN*, N/D94). Some 15-20 labs will work on *in vitro* experiments and approximately eight on *in vivo* exposures; there will be some overlap between the two sets of labs. Tice said they will test five readily available chemicals in one type of cell culture, probably mouse lymphoma cells—with and without metabolic activation. Microwave exposures are not planned because of the scarcity of exposure systems. Tice said that all participants will pay their own way and that anyone who is interested can join the project. They will meet on March 12 in St. Louis at the *1995 Meeting of the Environmental Mutagen Society*. He expects results in about a year. Tice

can be reached at (919) 544-4589, ext.223.

«« »»

On January 17, Dr. George Carlo briefed **Carol Browner**, the administrator of the Environmental Protection Agency (EPA), on the SAG's proposed research program. Carlo said that he had assured Browner that the SAG program was "consistent and complementary" to the two-year study by the National Council on Radiation Protection and Measurements—commissioned by the EPA—on the potential effects of weak, modulated RF/MW radiation (see *MWN*, S/O94).

«« »»

At a February 1993 congressional briefing, Dr. **Richard Adamson**, then director of the **National Cancer Institute's** division of cancer etiology, announced that a study was under way to investigate the possible links between brain tumors and cellular telephones, among other agents (see *MWN*, J/F93). Results are not anticipated until 1997-1998, according to Dr. **Peter Inskip**, who is in charge of the study, which, he said in a recent interview, is in the data collection phase. Dr. Adamson left the institute last year to head the Washington office of the National Soft Drinks Association; Dr. **Jerry Rice** is currently serving as acting director of the division.

«« »»

A workshop on **Health Protection in Personal and Cellular Communication Systems** was held in Eilat, Israel, on January 25 as part of the *International Symposium on Future Telecommunications and the Electromagnetic Environment*, sponsored by URSI and the ITU. The workshop was organized by Dr. **Paolo Bernardi** of the University of Rome, Italy. On January 23, Motorola's Dr. **Quirino Balzano** presented a plenary paper, coauthored with Dr. **Ross Adey** of the VA Hospital in Loma Linda, CA, on "Mechanisms of Interaction of RF/MW Fields with Living Tissues." Among the speakers at the workshop was CTIA-SAG's **Kelly Sund** on the U.S. health research program. In addition, Dr. **Paolo Vecchia** of the Istituto Superiore di Sanita in Rome reviewed epidemiological studies on long-term exposures to RF/MW radiation and Dr. **Yngve Hamnerius** of the Chalmers Institute of Technology in Göteborg, Sweden, discussed microwave-induced changes in the permeability of liposomes.

### **Motorola Sponsors Replication of Lai–Singh DNA Breaks Study**

Motorola has contracted with Dr. Joseph Roti Roti of Washington University in St. Louis to repeat and extend recent experiments showing that microwave radiation can cause breaks in the DNA of animal brain cells.

In a paper to be published this spring, Drs. Henry Lai and Narendra Singh of the University of Washington, Seattle, report that athermal levels of microwave radiation can cause single-strand breaks in the DNA of rat brain cells (see *MWN*, N/D94). Lai and Singh used a technique called the comet assay to measure DNA breaks.

“We want to determine whether the comet assay is a repeatable and reliable test for DNA damage,” said Dr. Quirino Balzano, a Motorola corporate vice president in Fort Lauderdale, FL. Balzano noted that within a week after visiting Lai and Singh’s lab last August, he began negotiations with Roti Roti to replicate their study. That contract was formalized in mid-December.

In an interview with *Microwave News*, Roti Roti explained that his project is more than an “outright replication” of the Lai–Singh experiment. “We plan to use two other assays in addition to the comet assay so that if we find an effect, we might understand what is going on,” he said. The two other techniques are the fluorescent halo assay and pulsed field gel electrophoresis.

Roti Roti will investigate the effects of microwave radiation on the DNA in rat brains and on three different cell lines, including rat and human brain tumor cells. He noted that he plans a “complete anatomical dissection of the rats’ brains” in order to see if there are effects on different types of brain cells.

“Our strategy is to first try to repeat the Lai–Singh experiment without talking to them,” Roti Roti said. “But, if we have trouble, we will work with them.” The microwave exposure system is being designed and built by Dr. William Pickard of Washington University’s electrical engineering department.

The first step is to repeat the Lai–Singh experiment at 2450 MHz, Balzano said, and then do the study again at cellular phone frequencies. Previously, Motorola commissioned a series of animal and cellular studies in Roti Roti’s lab on the possible carcinogenicity of cellular phone signals.

Meanwhile, as we went to press at the end of January, Dr. George Carlo of the Cellular Telephone Industry Association’s Scientific Advisory Group (SAG) on Wireless Technology in

Washington was awaiting a response from the Harvard Center for Risk Analysis peer review board on cellular phones on whether the SAG should sponsor its own replication of the Lai–Singh study—or wait for the results of the international project to validate the comet assay (see p.11). Carlo said that Dr. John Graham, the director of the Harvard center, will present the peer review board’s views at its February 16 meeting. In a separate talk, Dr. Ray Tice of Integrated Laboratory Systems in Research Triangle Park, NC, will review the use of the comet assay in genetic toxicology.

### **Industry Asks FCC To Preempt Local Rules for Cellular Towers**

Two trade associations have called on the Federal Communications Commission (FCC) to preempt state and local regulations on the licensing of cellular telephone towers. The Electromagnetic Energy Association (EEA) and the Cellular Telecommunications Industry Association (CTIA) argue that federal rules are necessary for the advancement of the communications industry in general and the cellular phone industry in particular.

Concerns over the potential health hazards associated with exposure to microwave radiation from cellular phone towers have prompted many siting battles and, in some cases, have led to restrictions on where they can be located. Some communities have set microwave exposure standards that are more stringent than those used by the FCC, and some localities have prohibited towers near schools and day-care centers (see *MWN*, N/D93).

In its December 22 petition, the EEA cites examples of local and state regulations that have set tighter emissions standards than the FCC’s. Such regulations, it states, have hampered the construction and operation of FCC-licensed facilities. The EEA claims that federal preemption is needed to allow the development of advanced television, digital audio broadcasting, personal communications services and cellular telephones.

CTIA’s petition, filed on December 27, addresses tower siting restrictions that are not concerned with radiation hazards—for instance, aesthetic concerns. The petition cautions that the intervention of 38,000 local jurisdictions could impede the completion of the country’s cellular network and raise user costs.

Because it deals specifically with radiation issues, the EEA’s request will be considered as part of the FCC’s still pending proposal on whether to adopt the ANSI/IEEE C95.1-1992 microwave exposure standard (see *MWN*, M/A93). “The problem will be considered by the commissioners in February or March,” said Dr. Robert Cleveland of FCC’s Office of Engineering and Technology in Washington. In comments on the FCC proposal, several communications companies specifically asked for federal preemption; these included: Capital Cities/ABC Inc., CBS Inc., GTE Service Corp., Hammett & Edison Inc., McCaw Cellular Communications Inc. and the National Association of Broadcasters (see *MWN*, M/J94).

CTIA’s request for preemption will be considered as a separate proceeding. Notice of CTIA’s petition to the FCC

*MICROWAVE NEWS* is published bimonthly. • ISSN 0275-6595 • PO Box 1799, Grand Central Station, New York, NY 10163 • (212) 517-2800; Fax: (212) 734-0316 • Editor and Publisher: Louis Slesin, PhD; Senior Editors: Teresa Moogan, Gail Roberts, Susan Wensley; Associate Editor: Lara Schoeberlein; Assistant Editor: Christopher Doherty; Copy Editors: Jim Feldman, Roy Thomas Jr.; Production Coordinator: Joe Munglioli; Circulation Assistant: Diana Cooper • Subscriptions: \$285.00 per year (\$315.00 Canada & Foreign, U.S. funds only); single copies: \$50.00 • Copyright © 1995 by Louis Slesin • Reproduction in any form is forbidden without written permission.

---

was announced in a January 18 public notice. No formal announcement appeared in the *Federal Register*. Comments are due by February 17. Reply comments are due by March 6.

Citizens groups are organizing to stop the CTIA and EEA initiatives. The failure of the FCC to publish the petition in the *Federal Register*, said activist Kathy Hawk of Butler, PA, reinforces the "general impression that the FCC is nothing more than a front organization for its licensees."

Folks for Appropriate Cellular Tower Sites (FACTS), a citizens group based in Great Barrington, MA, also opposes the CTIA proposal, according to Cochair Honey Sharp Lippman. FACTS is concerned that a proposed 13-story cellular tower will destroy the Berkshires' natural beauty, affecting quality of life and tourism. "Preemptive power by the FCC would rob local communities and states of the right to local scrutiny through carefully thought-out zoning bylaws."

In 1985, responding to a number of requests, the FCC decided not to preempt state and local regulations (see *MWN*, Ap 85). Two years later, it exempted cellular towers from having to prepare environmental impact statements under the National Environmental Policy Act (see *MWN*, M/A87).

The EEA is a coalition of electronics and communications companies. CTIA, the national trade association of the wireless industry, is a member of the EEA; both are located in Washington.

## **Officer's Widow Refiles Police Radar Cancer Suit**

The family of an Ohio highway patrolman has filed a new suit against the manufacturers of the radars that they blame for his fatal brain tumor. The suit was filed on December 14, 1994, in the U.S. District Court for the Southern District of Ohio in Cincinnati. More than 20 similar cases have been filed in the U.S., but none successfully.

In its \$20 million lawsuit, the family of Wayne Vessels Jr. charge that the radar equipment he used for 15 years—from 1972 to 1987—was defective in its design, manufacture and operating instructions. They also argue that the radar guns "emitted dangerous, unhealthy and harmful microwave energy and electromagnetic radiation" at power densities sufficient to cause his cancer.

The three defendants named in the suit are Kustom Signals Inc. of Lenexa, KS, Kustom Electronics Inc. of Overland Park, KS, and MPH Industries of Owensboro, KY. Vessels filed a similar suit in March 1992; that suit was withdrawn after his death later that year (see *MWN*, M/A91, M/J92 and S/O93).

Vessels, who served with the Ohio State Patrol for 25 years, was first diagnosed with basal and squamous cell carcinoma in 1977. In January 1992, he learned that the cancer had spread to his brain; he died that December. According to the complaint, Vessels did not suspect the causal connection between the radar equipment and his illness until February 1991.

Michael Cassity of Mt. Orab, OH, an attorney representing the Vessels family, anticipates a court date late this year. He said he has identified expert witnesses who will link the radar guns to Vessels's cancer but would not comment further.

John Wykoff, an attorney for MPH Industries, is skeptical of the merits of the case. "We'll see if it goes to trial," he told *Microwave News*. "There isn't any evidence yet linking police radar with cancer." Wykoff is with the firm of Cash, Cash, Eagen & Kessel in Cincinnati.

Only one case involving police radar has gone to trial. A claim by Eric Bendure, who argued that his non-Hodgkin's lymphoma was caused by a radar gun, was rejected by a jury in January 1993 (see *MWN*, J/F93). (For a compilation of legal cases involving police radar, see *MWN*, S/O93.)

---

### **EMFs Boost Tree Growth** (continued from p.1)

submerged submarines. The program, which concluded in 1994, was managed by the IIT Research Institute (IITRI) in Chicago.

MTU's Dr. David Reed told *Microwave News* that two other participating research teams observed similar changes in plant cycles: Dr. Thomas Burton of Michigan State University, East Lansing, observed more chlorophyll production and greater biomass in benthic algae at the bottom of the Ford River, which the antenna crosses. And Dr. Johann Bruhn at the University of Missouri, Columbia, found faster decomposition rates in plant litter near the 56-mile-long antenna.

Reed acknowledged that nothing in the literature prepared them for his finding of faster growth: "Our reaction was 'Holy Smokes! What does this mean?'" And MTU's Dr. Glenn Mroz commented that the increased tree growth surprised people "to the point that they didn't believe us."

"Most likely the trees aren't producing greater biomass at the site—just reallocating their carbon resources differently, shifting some from their roots to their leaves and branches," Reed said. He also speculated that red oaks and paper birches did not show the growth effect because they transport nutrients differently than the other types of trees. Finding the mechanisms that produce these changes was beyond the scope of the Navy project, but the MTU researchers compared the observed effects to those induced by fertilizer.

In addition to checking the trees' growth patterns, the MTU team monitored the volume and quality of fallen leaves and pine needles and the development of annuals growing below the trees. "They revealed no abnormalities," said Reed.

Although the MTU article was published over a year ago (*International Journal of Biometeorology*, 37, pp.229-234, 1993), the results were not publicized until the university issued a press release last December. Stories have since appeared in the January 14 *New Scientist* and in the January 27 *Science*.

All the data from the ten studies are now with the Board on Environmental Studies and Toxicology of the National Academy of Sciences' National Research Council (NRC) in Washington. A review committee is expected to be announced in February, according to the NRC's Raymond Wassel.

The Navy's Project ELF in northern Michigan and Wisconsin has sparked heated controversy and protests continue unabated. In response to a suit brought by the state of Wisconsin, a federal judge stopped the project in January 1984, until the Navy agreed to prepare a revised environmental impact statement (see *MWN*, J/A83, J/F84, Mr84 and J/A84). The Navy then instituted the monitoring program managed by IITRI.

## Mobile Communications Dosimetry Abstracts

**Hsing-Yi Chen and Hou-Hwa Wang, "Current and SAR Induced in a Human Head Model by the Electromagnetic Fields Irradiated from a Cellular Phone," *IEEE Transactions on Microwave Theory and Techniques*, 42, pp.2249-2254, December 1994.**

Using a near-field finite-difference time-domain (FDTD) computer model, these Taiwanese electrical engineers at the Yuan-Ze Institute of Technology calculated the maximum SAR in the head to be 1.48 W/Kg when the 835 MHz, 0.6 W phone is at a distance of 2 cm—just below the peak partial-body SAR of 1.6 W/Kg recommended in the 1992 ANSI/IEEE standard. They found that the SAR fell to 1.31 W/Kg when they used the recent, but unpublished, estimates from the U.K. that the dielectric properties of bone may be close to those of muscle at microwave frequencies. Dr. Chen and Wang also note that the absorption of electromagnetic energy varies "drastically" with polarization.

**H.-R. Chuang, "Human Operator Coupling Effects on Radiation Characteristics of a Portable Communication Dipole Antenna," *IEEE Transactions on Antennas and Propagation*, 42, pp.556-560, April 1994.**

According to Chuang's calculations, the peak SARs in the head increased from 0.21 W/Kg to 1.34 W/Kg as the separation between an 840 MHz, 0.6 W dipole antenna and the head decreased from 5 cm to 1 cm. At 2 cm, the peak SAR was 0.9 W/Kg. Chuang is with Taiwan's National Cheng Kung University.

**Richard Cooper and Roger Radcliff, "The Effects of a Nearby Biological Body on the Parameters of a Small Hand-Held Transmitter Operating in the HF Band (3 MHz-30 MHz)," *IEEE Transactions on Broadcasting*, 40, pp.91-97, June 1994.**

Cooper and Radcliff, both of the Department of Electrical and Computer Engineering at Ohio University, Athens, show with the aid of computer models that, as expected, the efficiency of the transmitter changes with its location relative to the human body. They conclude that, "When operating in the HF band, the current distribution on the radio antenna remains essentially constant in spite of the presence of a biological body."

**P.J. Dimbylow and S.M. Mann, "SAR Calculations in an Anatomically Realistic Model of the Head for Mobile Communication Transceivers at 900 MHz and 1.8 GHz," *Physics in Medicine and Biology*, 39, pp.1537-1553, 1994.**

The most recent in a series of dosimetry papers from the U.K.'s National Radiological Protection Board (see *MWN*, N/D94).

**O.P. Gandhi, "Some Numerical Methods for Dosimetry: ELF to Microwave Frequencies," *Radio Science*, 30, pp.161-177, January/February 1995 (forthcoming).**

Gandhi, of the University of Utah, Salt Lake City, covers a number of different types of sources of EMFs and radiation, including electric blankets, EMP and cellular phones. The cellular phone dosimetry data were commissioned by McCaw Cellular Communications Inc. (now part of AT&T) and were released in December 1993 and later corrected (see *MWN*, J/F94 and S/O94).

**O.P. Gandhi, J.Y. Chen and Ding Wu, "Electromagnetic Absorption in the Human Head for Mobile Telephones at 835 and 1900 MHz," presented at the *International Sym-***

**posium on Electromagnetic Compatibility, Rome, Italy, September 13-16, 1994.**

More FDTD calculations and experimental measurements for ten different mobile telephones. Gandhi shows that the head, neck and hand absorb more power from a phone with a quarter-wavelength antenna than one with a three-eighths-wavelength antenna—approximately 70% and 45%, respectively: "This is due to the fact that the peak current region for the longer antennas is higher up on the antenna. Unlike the high current region for quarter-wavelength antennas, which is very close to the ear, [the three-eighths-wavelength antenna's] high current region is further from the head, which reduces the coupling, and hence, the SARs."

**Michael Jensen and Yahya Rahmat-Samii, "EM Interaction of Handset Antennas and a Human in Personal Communications," *Proceedings of the IEEE*, 83, pp.7-17, January 1995.**

Jensen and Dr. Rahmat-Samii also used an FDTD model to calculate SARs for users of hand-held communication devices and found that, for a head-handset separation of 2 cm and an input power of 1 W, the peak and average SARs in the head were 0.9-3.8 W/Kg and 0.06-0.1 W/Kg, respectively, at 915 MHz. (For a 0.6 W phone, the peak levels were 0.54-2.28 W/Kg.) In addition, they report that, "The head and the hand absorb between 48% and 68% of the power delivered to the antenna." The researchers, from the Electrical Engineering Department at the University of California, Los Angeles, compared four types of antennas: a simple monopole and three kinds of flush-mounted designs. They found that integrating a planar inverted-F antenna (PIFA) in the transceiver, especially on the back of the unit, reduces the SARs. For all configurations, they note that, "The peak SAR in the head occurs either in the ear tissue or in the skin/fat layer in the antenna vicinity."

**Klaus Meier, Oliver Egger, Thomas Schmid and Niels Kuster, "Dosimetric Laboratory for Mobile Communications," to be presented at the *11th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, March 7-9, 1995.***

Describes a measurement system to test cellular phones for compliance with safety standards. Among the conclusions of this group at ETH in Zurich is that, "Measurements on various different cellular telephones confirm that partial-body exposure depends to a great extent on the construction of the device. Our experience has revealed that even internal design details of the devices can significantly affect the absorbed SAR values." (See also, *MWN*, J/F94.)

**Gert Frølund Pedersen and Jørgen Bach Andersen, "Integrated Antennas for Hand-Held Telephones with Low Absorption," *Proceedings of the 44th IEEE Conference on Vehicular Technology*, 3, pp.1537-1541, June 10, 1994. (The conference was held in Stockholm, Sweden.)**

These researchers, from the Center for PersonKommunikation at Aalborg University in Denmark, show that a full short-circuit PIFA—which concentrates the current near the antenna and has a relatively higher gain directed away from the user's head, "thereby reducing the losses in the human body"—causes local SARs of 0.1-0.2 W/Kg at 954 MHz and 1 W of input power. They used both FDTD calculations and measurements in phantoms. (See also, Jørn Toftgård, Sten Hornsleth and Jørgen Bach Andersen, "Effects on Portable Antennas of the Presence of a Person," *IEEE Transactions on Antennas and Propagation*, 41, pp.739-746, June 1993, and *MWN*, N/D94.)

# UPDATES

---

## EXPOSURE ASSESSMENT

**More on Infant Incubators...**A new magnetic field survey supports earlier reports that premature infants can be exposed to high fields when placed in incubators, and a new set of measurements indicates that those working nearby may also

receive relatively high exposures. Writing in the September/October 1994 issue of *Archives of Environmental Health* (49, pp.352-354), Dr. Cynthia Bearer of the Northeastern Ohio Universities College of Medicine in Rootstown reported magnetic fields of up to 126 mG in one type of incubator and up

(continued on next page)

# FROM THE FIELD

---

## Clippings from All Over

Both McGill and Hydro-Québec agree that much work remains to be done with the data collected to pinpoint whether there is any cause-and-effect relationship between exposure to pulsed electromagnetic fields and lung cancer. The utilities have stated that they intend to make all of the study documents available to their employees, the public and public-health authorities.

—**Joint statement by McGill University and Hydro-Québec, Montréal, Canada, December 16, 1994**

Wind shear is one of the major banes of air travel, a killer held responsible for causing 18 crashes and 575 deaths since 1970. Aviation authorities have recently found a way to combat this menace through Terminal Doppler Weather Radar, which can provide precious minutes of advanced warning....But two of the nation's largest airports, JFK and LaGuardia on Long Island, won't be enjoying its life-saving benefits any time soon. Politicians and activists have stopped its installation there, since Long Island residents—wrongly convinced that they are already suffering an epidemic of breast cancer—have been terrified into believing that [EMFs] from the radar would afflict the area with even more cancer. This terror—indeed, most of the nation's terror of EMF in general—can be readily traced to one person. If and when a plane crashes into Long Island because of wind shear, you should know who is responsible. Meet Paul Brodeur....The evidence [for the EMF-health threat] appears to be largely based on fear, conspiracy-mongering, ignoring contrary evidence and statistical gerrymandering.

—**Michael Fumento, "Shock Journalism: The Junk Reporting Behind the Power Line-Cancer Connection," Reason, pp.23-24, January 1995**

A new study from the University of Washington has reopened a two-year-old debate on whether cellular-phone use can cause brain tumors. Though the findings are inconclusive, they show that rats experienced breaks in brain DNA tissue after being exposed to microwave radiation that some experts claim is similar to cellular-phone emissions. But Motorola, the largest maker of cell phones, argues the rats were exposed to at least 10 times the energy a cell phone transmits. "It's therefore an extremely weak comparison," says Quirino Balzano, Motorola's director of electromagnetic research.

—**"Cyberscope: More Studies on Cell Phones," Newsweek, p.8, January 16, 1995**

Results of the childhood studies have proven frustrating for epidemiologists. They expected that, as study design improved and became more sophisticated, clearer evidence of risk would emerge, say, a ten-fold risk, or evidence of no risk. Instead, the risk ratios continue to hover near 1.5 to 3. Some regard this low level of risk as evidence that there is no problem. Said Eleanor Adair, chair of IEEE's Committee on Man and Radiation: "As studies become better controlled, and study larger populations, the risk ratios are getting smaller. I would be ready to draw a conclusion right now—that there is no link there." Others see the slight growth in risk demonstrated by current

data as the tip of an iceberg. One of the theories now under review is that average field strength is not the problem. Instead, it might be some variation that correlates better with wiring patterns and long-term average exposure than it does with spot field measurements. This variation could be time rate of change or suddenness of transition or peaks in field strength or certain windows of intensity or frequency. "The hypothesis itself is perhaps not the right one," Gilles Thériault, a professor and department chair at McGill University in Montréal, told *Spectrum*. "We discuss magnetic field strength, but the real culprit could be another component of the fields, for which the magnetic field is a surrogate. Perhaps we are not studying the right parameter, but only a parameter close to the right one."

—**Tekla Perry, "Today's View of Magnetic Fields: Can Reducing Exposure to Low-Frequency Electromagnetic Fields Be Part of a Prescription for Health, or Is All the Commotion Just the Birth of Another Fad?" IEEE Spectrum, pp.15-16, December 1994**

It is easy to prove that the thermally generated electric fields in human tissue are indeed much smaller than those caused by typical power line sources....The electric field in tissue is 12 orders of magnitude smaller than Adair's estimate and certainly negligible compared with the electric field induced by power lines, even if a wider bandwidth is assumed....The thermodynamically generated fields are random in phase and direction, in contrast with the external field induced by power lines. In commenting on self-organization in living cells, Benno Hess and Alexander Mikhailov [*Science*, 264, pp.223-224, April 8, 1994] point out that energy from external sources that is far from thermodynamic equilibrium, as is the field of power lines, can organize thermal fluctuations within cells. Whether this effect exists for power line fields remains to be seen. **James Fay, Massachusetts Institute of Technology, Cambridge, MA (pp.13-14)**. Accepting the [April 1994 *Physics Today*] article by [Bennett] as guidance on the question of health effects of [EMFs] seems to me analogous to accepting the advice of the village blacksmith on how to fix your Swiss watch. There is no doubt that Bennett's calculations are impressive. They are probably sound and correct as well. However, the question remains, Are they relevant to the question being addressed?...There are many ways to ill-spend the public money. In my view, trying to get at the bottom of this particular health issue is not one of the major offenders. **Lynn Trainor, University of Toronto, Canada (pp.15,71)**. *Bennett Replies*: James Fay assumes that biological material at body temperature only reaches thermodynamic equilibrium through radiative processes. That simply is not even approximately true, and Fay's calculations are irrelevant....Lynn Trainor raises a barrage of "questions" that appear mostly to be statements of a personal point of view....As I stated in my *Physics Today* article, I most certainly did not conclude that no further research should be conducted on biological interactions with ELF fields. The question is, How much public money should really be spent on this problem? **William Bennett Jr., Yale University, New Haven, CT (pp.71-72)**.

—**Exchange on: "Does Physics Really Rule Out Power-Line Cancers?" Physics Today, January 1995**



**Now Available...  
The 1995 EMF  
Resource Directory  
from Microwave News**

Completely revised and updated for 1995, this indispensable guide lists hundreds of EMF contacts—researchers, utility representatives, consultants, state and federal government officials, citizens groups and more.

**Just \$35.00, plus \$3.50 shipping.**

MICROWAVE NEWS • PO Box 1799 • Grand Central Station  
New York, NY 10163 • (212) 517-2800 • Fax: (212) 734-0316



“A publication recognized for its authority on health and safety issues.”  
—Fortune

**Subscribe Today!**

- \_\_\_ 1-Year Subscription (6 issues)—\$147.00  
(Outside the U.S., \$170.00)
- \_\_\_ 2-Year Subscription (12 issues)—\$250.00  
(Outside the U.S., \$290.00)

Name \_\_\_\_\_  
Organization \_\_\_\_\_  
Address \_\_\_\_\_  
City/State/Zip \_\_\_\_\_

Enclosed is my check for \$ \_\_\_\_\_

*Prepaid Orders Only.*

*U.S. Funds or International Money Order, Please.*

VDT NEWS • PO Box 1799 • Grand Central Station  
New York, NY 10163 • (212) 517-2802 • Fax: (212) 734-0316

to 27 mG in a second model. These readings fall between those by Dr. Charles Polk of the University of Rhode Island, Kingston, and those by Dr. Gert Anger of the Swedish Radiation Protection Institute in Stockholm, who found maximum fields of 289 mG and 48 mG, respectively (see *MWN*, M/A94). Anger noted in a talk at the annual DOE EMF review in Albuquerque, NM, in November that the beds inside incubators can be adjusted to different levels, thus changing exposures. In the “high bed position,” maximum fields are reduced by almost half—to 25 mG, he said. Similarly, Bearer observed that increasing the distance between the infant and the incubator’s heating unit or fan by 20.5 cm can reduce fields in the second model from 27 mG to less than 2.5 mG. Nurses who take care of premature infants work in an elevated magnetic field environment, according to a study by Dr. Maureen Paul and colleagues at the University of Massachusetts Medical Center in Worcester (*Bioelectromagnetics*, 15, pp.519-529, 1994). Paul found that neonatal intensive care nurses are exposed to fields of up to 30 mG near incubators and spend significantly more time (10.6%) in fields over 4 mG than nurses who work with normal infants (2.5%). Anger’s work has prompted Maria Feychting and Dr. Anders Ahlbom of the Karolinska Institute in Stockholm, Sweden, to study the possible risks from incubator EMFs for premature infants (see *MWN*, S/O94).

**GOVERNMENT**

**High EMF Locations Need Not Apply...**The FDA is looking for a suitable site in Orange County, CA, to build a 185,000-square-foot testing laboratory. Most of the requirements, specified in a December 4 advertisement in the *Los Angeles Times*, are not unusual; for instance, 10-13 acres, near transportation, clear title to the property and full disclosure of adverse geological conditions. One specification not usually seen in commercial real estate advertisements, however, requires that 8.5 acres of the site be at least 300 yards from high-power lines, electrical substations and microwave relay stations. Patricia Calhoun, contract specialist for FDA’s Division of Construction and Facilities in Rockville, MD, explained that the FDA is concerned that EMFs and RF/MW radiation generated by electrical and microwave equipment will interfere with the testing of medical devices, such as pacemakers. The buffer area has nothing to do with the potential health effects of EMFs, she said.

**MEETINGS**

**EBEA Proceedings...**The proceedings of the *2nd Congress of the European Bioelectromagnetics Association (EBEA)*, held in Bled, Slovenia, December 9-11, 1993, have now been published. The 137-page volume contains 21 of the 148 conference papers and is available in the U.S. for \$244.00 from: Elsevier Science, PO Box 64484, Baltimore, MD 21264. In Europe, contact: Elsevier Science, avenue de la Gare 50, PO Box 564, CH-1001 Lausanne, Switzerland, (41+21) 320-7381, Fax: (41+21) 323-5444. The *3rd Congress of the EBEA* will be held in Nancy, France, February 29-March 2, 1996.



**Australian VDT Conference...**The July 1994 issue of *Radiation Protection in Australia* (Vol.12, No.3) features papers presented at VDTs, *Electromagnetic Fields and Health*, a conference held in Australia last February. The journal is published by the Australian Radiation Protection Society. Among the authors: Drs. Patrick Breysse of the Center for VDT and Health Research at the Johns Hopkins University School of Hygiene and Public Health in Baltimore; Bruce Hocking of Telecom Australia in Melbourne, Victoria; Ken Joyner of Telecom Australia Research Laboratories in Clayton, Victoria; Michele Marcus of the Emory University School of Public Health in Atlanta; and Dave Sawdon of IBM U.K. Ltd. in Winchester. Single issues of the journal are A\$15.00 (approximately U.S.\$11.50). For more information, contact: Dr. Colin Roy, Editor, *Radiation Protection in Australia*, PO Box 128, Rosanna, Victoria 3084, Australia, (61+3) 433-2211, Fax: (61+3) 432-1835.

**RESOURCES**

**Overview of Bioeffects Research...**Plenum Press has released *Advances in Electromagnetic Fields in Living Systems* (1994), edited by Dr. James Lin of the University of Illinois, Chicago—the first volume in a series intended to highlight current research on the biological effects and health implications of non-ionizing radiation. The contributors are: Lin on early EMF research; Dr. Kjell Hansson-Mild and Monica Sandström, both of the National Institute of Occupational Health in Umeå, Sweden, on the potential health effects of VDT EMFs; Dr. Henry Lai of the University of Washington, Seattle, on the neurological effects of RF radiation; Dr. Raphael Lee of the University of Chicago on tissue injury from ELF electric fields; and Dr. Charles Polk of the University of Rhode Island, Kingston, on therapeutic applications of EMFs. The 196-page volume costs \$69.50 and is available from: Plenum Press, 233 Spring St., New York, NY 10013, (800) 221-9369, Fax: (212) 807-1047.

**Policy Issues Reviewed...**The fall 1994 issue of *Land Use & Environment Forum*—published by Continuing Education of the Bar • California (CEB)—features a collection of articles on EMF policy, planning and litigation. Among the authors are: attorneys Kenneth Bley of Cox, Castle & Nicholson and Susan Odell of Latham & Watkins, both in Los Angeles, on property value cases; Robert Merritt of the law firm of McCutchen, Doyle, Brown & Enersen in San Francisco on ways for public agencies to respond to EMF concerns; Cindy Sage of Sage Associates, a consulting firm in Montecito, CA, on litigation trends and the plaintiff's perspective; and Jack Sahl of Southern California Edison Co. in Rosemead on his utility's policies. Single copies are available for \$56.25 each (prepaid) from: CEB, 2300 Shattuck Ave., Berkeley, CA 94704, (510) 642-8000, Fax: (510) 642-3788.

**EMF Mitigation Manual...**Karl Riley of Magnetic Sciences International (MSI) has published *Tracing EMFs in Building Wiring and Grounding* (1995), which offers technical instructions for electricians, among others, on ways to lower EMF levels in the office and in the home. The 126-page guide explains how certain wiring practices generate high magnetic

**MICROWAVE NEWS**

**Subscribe Now!**

*A Report on Non-Ionizing Radiation*

**Please send me the following:**

- 1-Year Subscription (6 issues)—\$285.00  
(Outside the U.S., \$315.00)
- 6-Month Trial Subscription—\$150.00  
(Outside the U.S., \$170.00)
- Sets of Back Issues—\$95.00/calendar year  
1981-1994 (Outside the U.S., \$100.00)

Enclosed is my check for \$ \_\_\_\_\_

*Prepaid Orders Only.*

*U.S. Funds or International Money Order, Please.*

Name \_\_\_\_\_

Organization \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

Country \_\_\_\_\_

**MICROWAVE NEWS • PO Box 1799 • Grand Central Station  
New York, NY 10163 • (212) 517-2800 • Fax: (212) 734-0316**

**MICROWAVE NEWS**

*Now Available!*

*A Report on Non-Ionizing Radiation*

Three reprints from the pages of *Microwave News*:

- **Cellular Phones/Towers**
- **EMFs & Breast Cancer**
- **Police Radar**

\$25.00 Each (Outside the U.S., \$30.00)  
Circle Your Selection(s).

Name \_\_\_\_\_

Organization \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

Enclosed is my check for \$ \_\_\_\_\_

*Prepaid Orders Only.*

*U.S. Funds or International Money Order, Please.*

**MICROWAVE NEWS • PO Box 1799 • Grand Central Station  
New York, NY 10163 • (212) 517-2800 • Fax: (212) 734-0316**

fields, methods of locating the problem and techniques for reducing the fields. It costs \$27.50 (plus \$2.50 for postage and handling) and is available from: MSI, HCR-2, Box 850-295, Tucson, AZ 85735, (800) 749-9873, Fax: (602) 822-1640.

**New Popular Books...**Three books written for the general public are now available. Paul Brodeur has updated his 1993 book, *The Great Power-Line Cover-Up: How the Utilities and the Government Are Trying To Hide the Cancer Hazard Posed by Electromagnetic Fields* (see *MWN*, S/O93). The 352-page paperback includes two new chapters. It costs \$12.95 and is available from: Little, Brown and Co., 1271 Avenue of the Americas, New York, NY 10020, (800) 759-0190. Laurie Tarkan's *Electromagnetic Fields: What You Need To Know To Protect Your Health* (1994) is an easy-to-read review of EMF potential hazards. The 142-page paperback, available for \$4.99, assesses emissions levels from dozens of sources and suggests ways to reduce exposures. Order from: Bantam Books, 1540 Broadway, New York, NY 10036, (212) 354-6500. *The EMF Book: What You Should Know About Electromagnetic Fields, Electromagnetic Radiation, and Your Health* (1995), by Mark Pinsky, covers the risks of different types of non-ionizing radiation. Like Tarkan, Pinsky offers tips on how to reduce exposures, and an appendix provides short summaries of epidemiological studies. The 246-page paperback costs \$9.99 and is available from: Warner Books, 1271 Avenue of the Americas, New York, NY 10020, (800) 343-9204.

**NRPB Issues New EMF Brochure...***Electric and Magnetic Fields from the Use of Electricity* provides a basic introduction to the subject, covering definitions, typical exposures and a brief explanation of epidemiological and biological research. The four-color leaflet opens out into a poster and is available at no charge from: Press and Public Information, National Radiological Protection Board, Chilton, Didcot, Oxon OX11 0RQ, U.K., (44+235) 831600, Fax: (44+235) 833891.

**STRAY VOLTAGE**

**Jury Awards Dairy Farm Family \$1 Million...**Consumers Power Co., based in Jackson, MI, must pay \$1.01 million to a Michigan couple who claimed that they lost their farm because stray voltage caused milk production to decline, according to a court order signed on January 9 by Judge Edward Post of the Ottawa County Circuit Court. The order was based on a jury verdict reached on December 20, 1994. The utility has not yet decided if it will appeal the decision, a Consumers Power spokesperson told *Microwave News*. The award will allow Melvin and Della Molyneux to buy back their 240-acre farm, which they lost through foreclosure, a member of the family told the *Flint Journal* (January 3). Consumers Power's lawyers maintain that stray voltage did not affect the Molyneux's dairy cattle and that it was the family which was responsible for the productivity drop, according to the *Journal*. The utility also said it was not notified of the problem until December 1992 and corrected it three months later. Four years ago, a Minnesota jury awarded a family of dairy farmers \$1 million in another stray voltage case (see *MWN*, N/D90).



# ***CLASSIFIEDS***

---