In previous experiments, when he had a smaller exposure facility, Löscher observed similar effects using stronger (150 and 300 G) and weaker (3-10 mG) magnetic fields. But because he used fewer animals, these results are less statistically reliable. Nevertheless, when the rats were exposed to the 3-10 mG variable fields, the animals developed tumors more quickly. Löscher described the effect as "the hallmark of promotion."

Looking across all the studies he has completed to date, Löscher said, "My impression is that there appears to be a dose–response relationship. Clearly, there is something going on here."

Löscher's team also measured significantly lower concentrations of nighttime melatonin in the blood of the rats exposed to 3-10 mG. This could be the key to explaining the tumor results because melatonin is an oncostatic agent—that is, it can keep cancer cells in check. Löscher's team is the first to show a reduction in melatonin in the same EMF-exposed animals that have elevated breast tumor rates. Löscher plans to continue to look at melatonin levels in future studies.

"While conclusive evidence is still lacking, the pieces of the mosaic are filling in and the picture is becoming clearer and clearer," Dr. Alexander Lerchl, who ran Löscher's melatonin assays, told *Microwave News*. Lerchl, a former postdoctoral fellow in Dr. Russel Reiter's lab at the University of Texas, San Antonio, is now at the Institute of Reproductive Medicine at the University of Münster in Germany.

American scientists agreed with Lerchl. "The data are still sparse, but the tide is turning and the EMF–breast cancer hypothesis is gaining credibility," Dr. Richard Stevens of the Battelle Pacific Northwest Labs in Richland, WA, said in an interview. Similarly, Dr. David Blask, a senior research scientist at the Mary Imogene Bassett Hospital Research Institute in Cooperstown, NY, who has demonstrated melatonin's oncostatic properties, told *Microwave News* that there are "provocative data" on EMFs and breast cancer that need to be followed up.

Both Stevens and Blask expressed frustration over the cancer research establishment's lack of interest in pursuing the EMF trail. "If Löscher's work is replicated," Stevens said, "you'll see all the NCI types and other naysayers begin speaking in more respectful tones about the EMF–breast cancer hypothesis."

In fact, there are indications that researchers' attitudes are already changing. A recent paper on "etiologic hypotheses" in *Epidemiologic Reviews*, a companion publication to the *American Journal of Epidemiology*, put EMFs at the top of the list and concluded that, "Further exploration of whether residential or occupational [EMF] exposure affects breast cancer risk is warranted."

While Löscher's breast cancer experiments are the most detailed to date, they corroborate a similar study, published in 1991, by a group from the Oncology Research Center in Tbilisi, Republic of Georgia. The Georgians reported a promotional effect when they used NMU as the cancer initiator and a 50 Hz magnetic field of 200 mG (see *MWN*, M/A92).

And a Canadian team from the Bureau of Radiation and Medical Devices at Health and Welfare Canada in Ottawa has previously reported that a 20 G magnetic field can act as a co-promoter (with TPA) in mice, whose skin cancers were initiated with DMBA (see *MWN*, J/A91).

On the other hand, in a paper published in *Carcinogenesis* earlier this year, a Swedish-American group reported that 500 mG and 5 G magnetic fields failed to promote skin tumors in mice initiated with DMBA. But Löscher pointed out that this study also used only a small number of animals.

Although Löscher's and the previous experiments point to a promotional effect, Löscher himself has not ruled out the possibility that EMFs can cause genetic effects. "There could be mutations," he said. "We will try our study without DMBA." Dr. Jack McLean, a member of the Canadian study team, also believes that magnetic fields may do more than act as a promoter. "The role of initiation needs a closer look," he said in an interview.

That EMFs can undo the protective action of melatonin was recently shown by Dr. Robert Liburdy and coworkers at the Lawrence Berkeley Lab in Berkeley, CA. They found that breast cancer cells, which did not grow in the presence of melatonin, resumed proliferating when also exposed to magnetic fields (see

EMF–Breast Cancer Sources

D. Sh. Beniashvili, V.G. Bilanishvili and M.Z. Menabde, "Low-Frequency Electromagnetic Radiation Enhances the Induction of Rat Mammary Tumors by Nitrosomethyl Urea [NMU]," *Cancer Letters, 61*, pp.75-79, 1991.

M. Gammon and E. John, "Recent Etiologic Hypotheses Concerning Breast Cancer," *Epidemiologic Reviews, 15*, pp.163-168, 1993.

R.P. Liburdy et al., "ELF Magnetic Fields, Breast Cancer and Melatonin: 60 Hz Fields Block Melatonin's Oncostatic Action on ER+ Breast Cancer Cell Proliferation," *Journal of Pineal Research, 14*, pp.89-97, 1993.

W. Löscher et al., "Tumor Promotion in a Breast Cancer Model by Exposure to a Weak Alternating Magnetic Field," *Cancer Letters, 71*, pp.75-81, 1993.

M. Mevissen et al. [including W. Löscher], "Effects of Magnetic Fields on Mammary Tumor Development Induced by 7,12-Dimethylbenz(a)anthracene [DMBA] in Rats," *Bioelectromagnetics, 14*, pp.131-143, 1993.

M. Mevissen et al. [including W. Löscher and A. Lerchl], "Effects of AC Magnetic Fields on DMBA-Induced Mammary Carcinogenesis in Sprague-Dawley Rats," in *Electricity and Magnetism in Biology and Medicine*, (Martin Blank, ed., San Francisco: San Francisco Press, 1993), pp.413-415.

A. Rannug et al., "A Study on Skin Tumor Formation in Mice with 50 Hz Magnetic Field Exposure," *Carcinogenesis, 14*, pp.573-578, 1993.

R.G. Stevens, "Electric Power Use and Breast Cancer: A Hypothesis," *American Journal of Epidemiology, 125*, pp.556-561, 1987.

R.G. Stevens et al., "Electric Power, Pineal Function and the Risk of Breast Cancer," *FASEB Journal, 6*, pp.853-860, 1992.

R.G. Stevens, "Biologically-Based Epidemiological Studies of Electric Power and Cancer," *Environmental Health Perspectives, 101*, Supplement 4, 1993, in press.

M.A. Stuchly, J.R.N. McLean et al., "Modification of Tumor Promotion in the Mouse Skin by Exposure to an Alternating Magnetic Field," *Cancer Letters, 65*, pp.1-7, 1992.

MWN, J/A92). Blask said that he would like to repeat Liburdy's experiment as well as do animal studies.

Four studies showing that men exposed to EMFs on the job had high rates of breast cancer—a very rare disease in males—prompted increased interest in pursuing the EMF–breast cancer link among women (see *MWN*, N/D89, J/A90, J/F91, M/A91 and J/A92). Stevens, who first proposed the link in 1987 (see *MWN*, J/F87), is now collaborating with Dr. Scott Davis of the Fred Hutchinson Cancer Research Center in Seattle to pursue this idea under a grant from the National Cancer Institute (NCI) (see *MWN*, N/D91).

In addition, Dr. Anders Ahlbom and Maria Feychting of the Karolinska Institute in Stockholm, Sweden, are looking at breast cancer risks with the data collected for their landmark power line study. And Dr. Genevieve Matanoski of the Johns Hopkins University School of Hygiene and Public Health in Baltimore recently received a small grant to plan an epidemiological study of cancer among women who use video display terminals (VDTs), with special emphasis on breast cancer.

Löscher is the chairman of the department of pharmacology, toxicology and pharmacy at the School of Veterinary Medicine. His group includes Dr. Meike Mevissen, a postdoctoral researcher.

EPA Eliminates NIER Program *(continued from p.1)*

Sciences (see *MWN*, M/J92 and M/J93, respectively), as well as those sponsored by a number of individual states. McGaughy added that a complete revision of the 367-page report could not have been ready until 1995.

"We will write a scientific statement of knowledge detailing what is known and what is uncertain," McGaughy said. The review will cover the EMF–cancer literature through mid-1993, but will not address RF/MW radiation.

The EPA report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*, has been at the center of the EMF controversy since a draft was released three years ago. The report concluded that EMFs from power lines and appliances are a "possible, but not proven, cause of cancer in humans" (see *MWN*, N/D90). An earlier draft had classified EMFs as "probable human carcinogens" but this statement was deleted before the document was circulated for comment (see *MWN*, M/J90). A subsequent review by EPA's Science Advisory Board (SAB) concluded that the document had "serious deficiencies and should be rewritten" (see *MWN*, J/A91).

Senior EPA managers were reluctant to discuss the decision not to rewrite the report. OHEA Director Dr. William Farland, McGaughy's superior, did not respond to repeated calls for comment. And David Kleffman, the deputy director of the EPA Office of Health Research and a member of the original National EMF Research Program Steering Committee set up by New York State, would only say that he "was not involved in the decision."

McGaughy announced the change in plans at a meeting of the SAB's Radiation Advisory Committee (RAC) on July 19. The move came as a surprise since as recently as the previous month McGaughy was still saying that the rewrite of the original report was going forward.

"The decision makes sense," Dr. Genevieve Matanoski, the chair of the RAC, said in a telephone interview from her office at the Johns Hopkins University School of Hygiene and Public Health in Baltimore, referring to the agency's budget constraints. But, she added, "EPA has to do something for the public. This is an important health issue for the public and the public needs some guidance." Matanoski was also the chair of the SAB subcommittee that reviewed the EMF–cancer document in 1991.

McGaughy said that the summary report will address can-

Off EPA's Agenda, Onto Vice President Gore's

On July 13, Vice President Al Gore fielded questions on C-SPAN's Live Viewer Call-In Program, *which was moderated by Brian Lamb. Here is one exchange:*

Moderator: Rockland County, New York—
Caller: Mr. Vice President, would you please listen to me for a moment. In 1990, the Bush Administration killed an EPA report stating that the electromagnetic field is a probable carcinogen. We lost a grandchild at the age of five due to cancer. She suffered for two and half years.
Gore: I'm so sorry.
Caller: Since then, Mr Vice President, I have been begging and pleading that the electric blanket manufacturers please put a warning label on their product. My daughter went down to Sloan-Kettering Hospital and when she at random checked six out of six parents, that she checked with, all had this factor in common—that they all used an electric blanket when they were pregnant. I understand the government of Sweden just came out with long-term cause and effect on leukemia and power lines.
Moderator: Caller, what do you want the Vice President to do?
Caller: I want him to please make sure that he sees that we get a lot of research and that warning labels are put on these products because there are other governments that are doing—taking a strong stand and our government has been doing nothing.
Moderator: All right, thanks for your call. Mr. Vice President—
Gore: This is a really interesting topic, Brian. First of all, thank you very much, caller, for sharing that personal tragedy that your family has experienced. I know how painful it must be for you. And I know that you have probably experienced a great deal of frustration in trying to talk with officials about electromagnetic fields. I know just a little about this because I tried to study it and what I found was, Brian, that the state of the science is such that they don't really have answers for a lot of the questions posed by people who are worried about electromagnetic fields. The consensus in the scientific community right now, I think, is that the concerns about the power lines probably are much less than concerns about devices such as electric blankets for women who are pregnant and that is one of the worst cases that you can talk about because there the data apparently shows that there can be a health threat from electromagnetic fields in some cases. And so I don't want to minimize this at all. In cases like that, I think that more is required. And I have made notes here as a result of what the caller has said and I think that does warrant further action.

Gore held a hearing on NIER from VDTs and from RF heaters and sealers in 1981 when he was in the House of Representatives (see MWN, *Jun81). When he was in the Senate, Gore asked the EPA to measure the magnetic fields in his office.*

cer causation. "This is the central question of the new document," he said. But he stressed that the report will not deal with risk assessment. "What EPA should say to the public in the face of the scientific uncertainties will be left to [ORIA]."

Lynne Gillette, who works on EMFs at ORIA, questioned who will answer public inquiries after the cutbacks. "We get 10,000 calls a year—we counted," she said. "That's much more than for radon." She added that members of Congress are "always asking about EMFs."

Marty Halper, who until recently was the director of ORIA's radiation studies division, noted that the phones always ring after the news media highlight new research findings. "What happens when you get Swedish-type results? Who will keep up with the science? Who will answer the questions?" Halper is now a senior science adviser to EPA's environmental equity program.

Gene Durman, the acting director of Halper's former division and the deputy director of ORIA, said that the agency was considering developing a hot line to answer calls from the public.

In addition to responding to public inquiries, EPA's NIER staff does measurement surveys, sponsors literature reviews and publishes reports and booklets (see p.11 and *MWN*, M/J93). In addition, it has the authority to develop exposure guidelines, though it has never done so.

Most of those interviewed at EPA thought the NIER program should continue because EMFs could evolve into a major public health issue. Halper, for instance, said, "I believe that there is a 50-50 chance that EMFs could turn out to be a risk that dwarfs radon." He contrasted the lone EMF staff position to the approximately 90 people currently working on radon in EPA offices across the country. "It's a little bit ominous," said another staffer, who asked for anonymity. "They may regret the decision."

There is a general consensus within the agency that the EMF epidemiological cancer data have become stronger and more consistent since the 1990 draft was released—largely due to last year's Swedish cancer studies (see *MWN*, S/O92 and N/D92). When asked if the agency would be prepared if McGaughy's summary report pointed to a cancer problem, one senior official commented, "That will be a dilemma for us."

It is unlikely that EPA will return to RF/MW radiation issues, as was requested by the SAB (see *MWN*, J/A91). "Don't be surprised if we don't do anything on RF for the time being," Margo Oge, director of ORIA, said in an interview. "We would have to take resources from other programs. We must prioritize."

In what might be one of its last actions on RF/MW radiation, EPA is preparing detailed comments on the Federal Communications Commission's proposal to adopt the 1992 ANSI/IEEE limits (see *MWN*, M/A93).

EPA's Office of Research and Development stopped working on NIER in the mid-1980s (see *MWN*, N/D85 and S/O86). Since then it has refused to sponsor any health-related research. Earlier this year, EPA transferred all of its EMF research funds to the National Institute of Environmental Health Sciences (see *MWN*, J/F93).

UPDATES

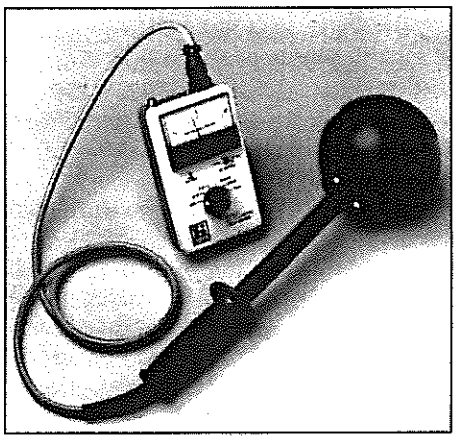
COMPATIBILITY & INTERFERENCE

Uncontrolled Wheelchair Movements... Tests conducted by the FDA have shown that certain electric wheelchairs are susceptible to EMI. The agency found that some electronically controlled wheelchairs would unexpectedly stop, start or turn when exposed to RF/MW radiation at strengths of 10 V/m or less, said Howard Bassen of FDA's Center for Devices and Radiological Health in Rockville, MD. Such field levels could occur in "real-world situations," such as near a police car radio or a hand-held walkie-talkie, he said. "There are numerous reports of injuries due to unintended wheelchair movement," Bassen explained, but he cautioned that there was no definitive proof that EMI was responsible, because tests were not performed on the actual chairs in the environments where the incidents occurred. But, Bassen noted: "Laboratory tests on the same wheelchair models did show that they were susceptible to low levels of RF/MW radiation." In a May 10 letter alerting wheelchair manufacturers, the agency explained that, "The chairs tested were found to be susceptible to interference from many different RF/MW frequencies." The agency asked the wheelchair makers to share any studies or reports of incidents that they have gathered. A similar notice, seeking reports of EMI problems directly from wheelchair users, was sent out on July 7. The FDA has proposed adding EMC testing requirements to the Rehabilitation Society of North America (RESNA) wheelchair standard. Approvals for a number of new wheelchairs—which are regulated by the FDA as medical devices—are being held up until the manufacturers provide adequate EMC testing results, Bassen said. This is the first time the FDA has addressed EMI susceptibility prior to approving a wheelchair for market.

MEASUREMENTS

TriField Meter Under Review... A new, inexpensive meter designed to measure 60 Hz magnetic and electric fields and RF fields "gives misleading results," according to a review in the May issue of *QST*, the magazine of the American Radio Relay League (ARRL). The TriField meter, made by AlphaLab Inc. in Salt Lake City, was put through its paces by Dr. Wayne Overbeck, a member of ARRL's Bioeffects Committee. He used the TriField to assess a low emission NEC computer monitor and found that it recorded magnetic fields of 5 mG 12 inches from the front of the display. "When the fields...were measured with a professional meter," he writes, "the 60 Hz magnetic fields turned out to be below 0.3 mG 12 inches from the monitor." For measuring RF fields, Overbeck also found the meter wanting. In a field stronger than 0.3 mW/cm^2, the meter fluctuated wildly. "Even in weaker fields, its accuracy leaves something to be desired," he adds. The manufacturer does address some accuracy issues in the meter's instruction sheet—which Overbeck compliments as "well written." The instructions warn that the meter is "frequency weighted," so that a field at other than 60 Hz will give higher readings: a 3 mG 120 Hz field will read 6 mG, Over-

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beck explains by way of illustration. Bill Lee, AlphaLab's president, suggested that the frequency-weighted meter serves a useful purpose: "I don't believe it's a good idea to only measure 60 Hz," he told *Microwave News.* A flat frequency response version is also available, he added, and might be more appropriate for VDT measurements. A more positive review of the TriField appeared in the January/February issue of *Scanning (15,* p.48, 1993), a journal devoted to scanning electron microscopy. The reviewer, David Joy of the University of Tennessee, Knoxville, notes that the meter "provides a convenient and realistically priced alternative" to the much more complex equipment commonly used to track down the source of magnetic fields that are interfering with the operation of an electron microscope. Joy also describes how the RF meter led to the discovery of a faulty seal on a microwave oven in his lab. Overbeck warns, however, that the TriField could cause undue alarm, and he suggests that the adage, "You get what you pay for," is applicable. The meter sells for $150. (For EPA's assessment of a number of other magnetic field meters, see *MWN,* M/A93.)

MEETINGS

Russian Symposium... On June 21-25, 100 experts from the former Soviet Union attended the *1st International Symposium on Electromagnetic Pollution of the Environment* at the Forest Technical Academy in St. Petersburg, Russia. In a letter to *Microwave News,* Dr. Eugene Lyskov of the Institute of the Human Brain at the Russian Academy of Science in St. Petersburg reports that papers addressed four general areas: (1) regulation and control of EMFs; (2) analysis, models and prediction of the electromagnetic environment; (3) the influence of EMFs on human beings and biosystems; (4) methods and devices for measuring EMFs. NIER from static fields up to microwaves were covered, with special attention on the influence of "EMFs on behavior, neuronal activity, immune and generative functions and cytogenesis." Surveys of residential and occupational EMF measurements were also discussed: for example, a map of EMFs from St. Petersburg's power lines developed by the Navy Research Institute was presented, as were data showing high EMF levels from subway engines. The proceedings of the conference will be published in the near future. A regional interdisciplinary council on EMF safety and compatibility is being established under the aegis of the municipality of St. Petersburg. A second conference will probably be held in St. Petersburg in 1995. For more information, contact: Dr. Eugene Lyskov, Institute of the Human Brain, Pavlov 9, St. Petersburg, 197376, Russia, fax: (7+812) 234-3247.

EBEA's Second Congress... The European Bioelectromagnetics Association (EBEA) will hold its second congress December 9-11, 1993, in Bled, Slovenia, about 20 miles from the international airport in Ljubljana. The site was selected to make it easy for researchers from Eastern European countries to participate. Topics to be covered include mechanisms, epidemiology, biological effects and medical applications. Invited talks will be given by Dr. Lojze Vodovnik of the University of Ljubljana on therapeutic applications of EMFs; by Dr. Clay Easterly of the

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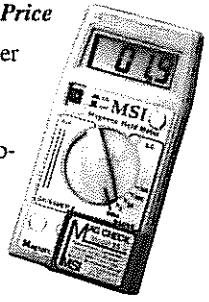
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Oak Ridge National Laboratory in Oak Ridge, TN, on EMF epidemiological studies; and by Dr. Niels Kuster of the Swiss Federal Institute of Technology in Zurich on dosimetry. Contact: Dr. Renata Karba, Faculty of Electrical and Computer Engineering, University of Ljubljana, Trzaska 25, 61000 Ljubljana, Slovenia, (38+61) 265-161.

PEOPLE

Dr. **Brian Maddock**, head of the "EMF Function" for research at the U.K.'s National Grid has retired. No replacement has been named. "It's a consolidation of management," Dr. **John Male** told *Microwave News*.....**John Adams**, an electrical engineer with the Fields and Metrology Group at NIST's EMF Division in Boulder, CO, died after an automobile accident on July 15.

SHIELDING

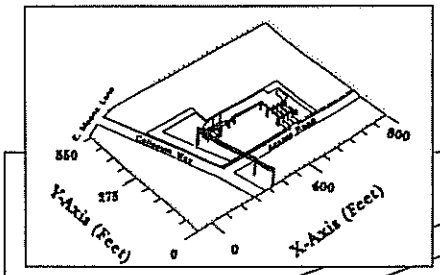
Microwave-Absorbing Concrete... Smart concrete may sound like an oxymoron but it is serious business at the State University of New York, Buffalo. Professor Deborah Chung of the university's department of mechanical and aerospace engineering has shown that adding carbon fibers to concrete increases its electrical conductivity, a property which can be harnessed to detect flaws and thereby give an early warning of the impending collapse of a bridge or a highway. An added benefit is that the carbon fibers also dramatically increase the concrete's ability to shield microwave radiation. A few millimeters of plain cement attenuate 1 GHz radiation by 0.4 dB, but when carbon fibers are added to the mix, the same thickness cuts the radiation by about 19.5 dB. In other words, the cement can reduce microwaves 80 times more effectively when doped with slivers of carbon. Chemicals such as sodium sulfate and potassium aluminum sulfate can be substituted for the carbon fibers, though they are not as effective, according to Chung. She published a paper on the electromagnetic shielding properties of reinforced concrete in the July 1989 issue of *Composites (20,* pp.379-381); see also, her forthcoming paper in *Smart Materials and Structures.*

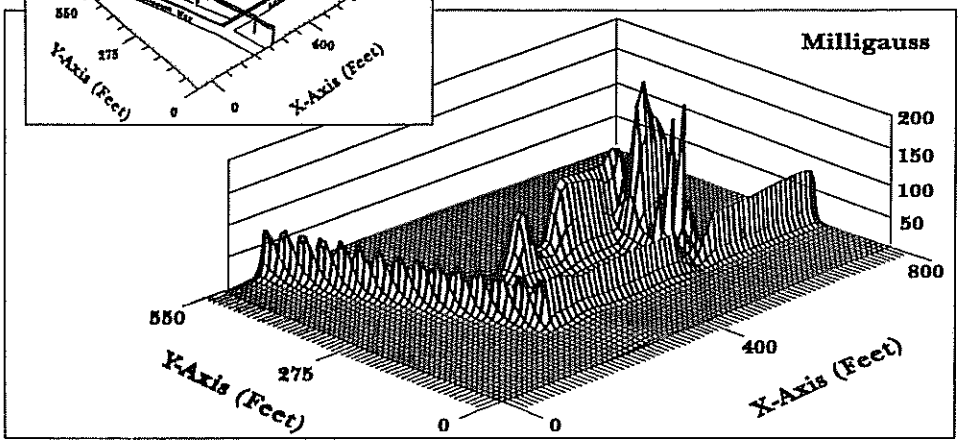
VDTs

EMX Keyboard... Honeywell Inc.'s keyboard division is preparing to market a keyboard that can "neutralize EMF emissions from computers." The keyboard, to be called the 101 EMX, is based on techniques devised by Dr. Ted Litovitz of Catholic University in Washington. It contains a coil that emits random EMFs, known as "noise," that the manufacturer claims can block the action of a constant EMF signal from a VDT or any other source. Honeywell notes that a "growing body of evidence" links weak EMFs to cancer, reproductive problems and mood disorders. Litovitz has shown that biological effects of EMFs—in certain well-defined systems—can be blocked by superimposing electromagnetic noise. Litovitz has applied for a patent and licensed the technique to EMX Corp. of New York City. EMX is a private company, formed in 1991, to commercialize technology developed at Catholic University. For more information, contact: Lou Vasquez of Honeywell at (800) 445-6939, or Robert Blessey of EMX at (800) 508-4040.

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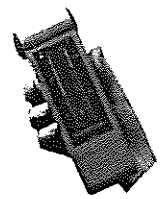
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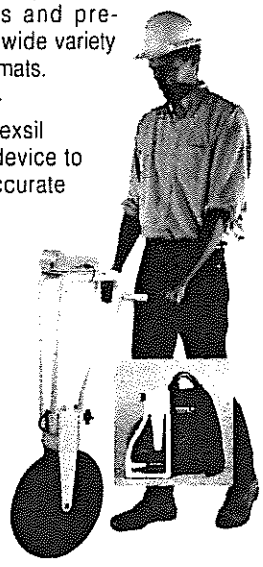
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MICRO WAVE NEWS

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Draft NCRP Report Seeks Strong Action To Curb EMFs

Committee Cites 2 mG Limit as Goal

The National Council on Radiation Protection and Measurements (NCRP) committee charged with evaluating the potential health effects of electromagnetic fields (EMFs) has completed a draft report that calls for strong action to curtail the exposure of the U.S. population. "It took us nine years but we finally reached agreement," committee chair Dr. Ross Adey, of the Veterans Administration Hospital in Loma Linda, CA, told *Microwave News.*

The draft report generally endorses a 2 mG exposure limit. It would take effect immediately for new day care centers, schools and playgrounds, as well as for new transmission lines near existing housing. A somewhat more flexible policy would be applied to new housing and offices.

For existing facilities, the committee recommends a more gradual approach, with stronger restrictions phased in over time if the evidence of a health risk continues to grow.

The report was funded by the Environmental Protection Agency (EPA). Dr. Joe Elder, EPA's program officer for the NCRP study in Research Triangle Park, NC, called the committee's report "the first comprehensive review of the world's literature on EMF health effects."

In sharp contrast to the NCRP report's conclusions, public television's "Frontline" sees no need for even a policy of prudent avoidance; see Commentary pp.6-10.

The EPA will release its own review this fall, limited to an analysis of the cancer risk. Dr. Robert McGaughy, the chief author of the EPA review, who has read the NCRP draft, said that, on the question of cancer, the two drafts "appear to be heading in the same direction."

Copies of the report's conclusions and recommendations (see pp.12-15) have already been widely circulated. In a letter to *Microwave News,* Dr. Charles Meinhold, the president of the NCRP, emphasized that the draft report is an internal document and that it has "no standing at this time."

"It's unfortunate that the report has been leaked," said Dr. Richard Lovely of the Battelle Pacific Northwest Labs (PNL) in Seattle, a member of the committee. "There is a process by which this document should have been reviewed and that process has been seriously compromised."

The 800-page draft will now undergo the NCRP review process. First a half-dozen "critical reviewers" will go over it and recommend changes, according to Dr. Constantine Maletskos, NCRP's liaison for the report. After the necessary revisions are made, it will be sent to the 75 members of the council. "We are aiming to complete it later this year," Maletskos said, "but that's unlikely." He predicted that the final report would be publicly available in the first half of 1996.

(continued on p.11)

« Power Line Talk »

The **American Medical Association** (AMA) doesn't believe in prudent avoidance any more—or does it? The AMA appeared to abandon its support for prudent avoidance in December 1994, but today no one can say exactly why. In mid-1994, the AMA's Council on Scientific Affairs (CSA) approved a report on EMFs containing the following recommendation:

> That the AMA urge manufacturers, home-builders, and employers to begin planning to reduce the exposures of workers and the public to electromagnetic fields, including those from power lines, appliances and equipment. The focus should be on strategies and techniques that are cost-neutral, or will not greatly increase costs.

This was not a new stand for the AMA, which in a 1990 report held that "prudent measures should be taken to reduce people's EMF exposures." But by the time the new report emerged from the AMA's House of Delegates in December 1994 (see *MWN,* J/F95), this recommendation had been deleted. Dr. **Douglas Skelton**, former chair of the CSA, confirmed in an interview that the CSA had approved the recommendation, as worded above, prior to the December House of Delegates meeting. Skelton added that this language was softer than in the staff's initial draft: "We felt the staff had too strongly urged expenditures to reduce exposures that might not be a very efficient use of resources. We'd support prudent and *economic* efforts to reduce exposures—but not putting demands on people to spend millions of dollars. That was the line we were trying to draw." When asked how the support for prudent avoidance came to be removed entirely, Skelton said, "I don't right now have any idea how that came about." In fact, the change was made by Reference Committee E, one of several working committees that hear testimony and report to the House of Delegates. Reference Committee E's report urged the House of Delegates to delete the recommendation on prudent avoidance, explaining that in testimony before the committee, "a general consensus was expressed that recommending specific 'preventive measures' when no health risks have been demonstrated might be premature and inconsistent." Who gave this testimony, which changed the policy of the AMA? The chair of Reference Committee E, Dr. **Richard Tompkins** of the Mayo Clinic in Rochester, MN, told *Microwave News* this July that he did not remember the name of a single person who had spoken, and that he did not think there was any way to find out. The committee's secretary, Dr. **Sona Kalousdian**, confirmed that there was no record of who had testified and also said that she did not remember. Dr. Tompkins said there was no discussion among the members of Reference Committee E about the fact that this represented a change in AMA policy. The committee's report said that "the CSA concurred with the proposed changes." However, Dr. **Theodore Doege**, who first drafted the report for the CSA, said that he did not learn of the change until two weeks after the December meeting of the House of Delegates. Even then, he told *Microwave News,* the rationale was not explained: "I thought it was fine the way it stood, and saw no reason at the time to change anything." Before being approved by the CSA, the report was reviewed by Drs. **David Brill**, **Jeffrey Greenawalt**, **John Peters** and **Thomas Tenforde**, with Tenforde as the major reviewer. But Doege said that none of their comments addressed the issue of prudent avoidance. Asked why Reference Committee E deleted this recommendation, Doege said, "I really don't know."

«« »»

Massachusetts Electric, a subsidiary of New England Electric System, has agreed to an out-of-court financial settlement to avoid a lawsuit by the family of a child stricken with leukemia. **Scot David** and his wife reached the settlement after their son contracted acute myeloid leukemia (AML), which is unusual in children. According to a report by a Wayland, MA, consultant, magnetic fields inside the front bedroom of the Davids' home reached as high as 37 mG (they have since moved). The report attributes this strong field mainly to the way the house was connected to the power distribution system. Also involved in the settlement was the case of the child's cousin, who regularly slept near the Davids' son and developed idiopathic thrombocytopenia, a deficiency of platelets with no known cause. Attorney Michael Mattchen of **Dangel & Fine** in Boston said that no lawsuit was ever filed, and that beyond that he could not "confirm or deny" anything. Susan Stevens, a spokesperson for Mass. Electric, said, "It's the company's long-standing policy not to comment on matters like this."

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With fiscal year 1995 (FY95) almost over, industry contributions to the national EMF research program, known as **RAPID**, have barely passed the halfway mark. The federal government has given $8 million, which is supposed to be matched dollar-for-dollar with industry funds. At the end of July, the nonfederal contributions totaled $4.3 million. **Rick Loughery** of the **Edison Electric Institute** in Washington said that, "I am confident that the electric utility industry and the **National Electrical Manufacturers Association** will reach roughly $5.7 million" by September 30, the end of FY95. The balance must come from non-utility sources, he said, adding that, "The health of the program is of interest to us, but we cannot make a further contribution for FY95 at this time." The utility industry is maintaining that it is only responsible for two-thirds of the nonfederal funds (see *MWN,* N/D93). The DOE has waged "a pretty intensive campaign" to solicit funds from other sources but so far without success, according to **Lynne Gillette**, DOE program manager for the RAPID program. Gillette said that the DOE has targeted 18 associations that should have an interest in EMFs. Six of the groups have said that they would not be contributing, including the **American Electronics Association**, the **Electromagnetic Energy Association** and the **Association of Home Appliance Manufacturers**. "We are still talking to the other 12," she said.

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The **Camas, WA, City Council** has set 4 mG as the target for maximum EMF exposures permitted for new transmission facili-

ties. The ceiling was established as one of several restrictions in a new ordinance which was approved 5-2 on July 10 in response to constituents' concerns about EMF health effects and property devaluation. Camas, a suburban community across the Columbia River from Portland, OR, is also requiring utilities to use prudent avoidance measures in constructing new transmission facilities and has established setbacks for new power lines near schools, churches, day care centers and playgrounds. It also has banned overhead power lines in residential areas. Violators may be fined or imprisoned. "I believe a lot of communities are looking into similar regulations," said Gwen Hahn, the Camas council member who proposed the restrictions. The ordinance grew out of a moratorium, approved in December 1994, imposed because of concerns that new power lines would be built on a right-of-way owned by Portland-based **PacifiCorp.**, which is working with **Clark Public Utilities**, headquartered in Vancouver, WA, to provide power for the area. The moratorium was in effect until the ordinance was approved. "We did not oppose the ordinance. We did not endorse it. We have some concerns that we may not be able to serve future growth in that area, but that's something we will address as time goes on," said Mike Shutt, a spokesperson for Clark Public Utilities. David Kvamme, a PacifiCorp. spokesperson, added, "Currently we have no plans to build, although we wanted to keep our options open." **Cindy Sage** of Sage Associates in Montecito, CA, who advised an *ad hoc* council committee studying the issue, supports the ordinance and sees it as "very mainstream." The 4 mG target was actually a compromise, she said. The proposed limit initially was 1 mG. As for the ordinance's overall effect, Sage said, "We all know that the utilities are worried about a patchwork of local regulations. I would expect this to set a precedent and give other communities the political will to establish good EMF land-planning principles in spite of utility opposition." Another community not far from Camas is also taking action to control power lines. On May 16, **Umatilla, OR**, in the northeastern part of the state, imposed a 90-day moratorium on new power line construction and is now reviewing a local utility's application for construction of two transmission lines that would pass through the city. "Our community is inundated with power lines," said Umatilla Administrator Bonnie Parker.

Mothers' Use of Sewing Machines Linked to Children's Leukemia

A McGill University professor believes that EMFs may have been a factor in an observed up-to-sevenfold increase in leukemia among children whose mothers used sewing machines during pregnancy. Her hypothesis follows a 1994 joint U.S.-Finnish report that showed a strong association between EMF exposures on the job and Alzheimer's disease among sewing machine operators and others.

Dr. Claire Infante-Rivard, a professor in McGill University's Department of Occupational Health in Montreal, Canada, said that it was Dr. Eugene Sobel's paper linking EMFs to Alzheimer's disease (see *MWN,* J/A94) that prompted her to consider the possible role of EMFs in her 1991 study of leukemia among children in Spain.

Infante-Rivard had studied 128 cases of acute lymphoblastic leukemia in children less than 15 years old. She found the highest risk for children of mothers working at home during pregnancy, most of whom sewed cotton, wool and synthetic fibers. In her original paper, published in the *Journal of Epidemiology and Community Health* (*45,* pp.11-15, 1991), Infante-Rivard and her colleagues suggested that exposure to organic dust and synthetic fibers could be responsible for the excess risk.

"Our findings...could be reinterpreted as being EMF-related," Infante-Rivard wrote in a letter appearing in the July 15, 1995, issue of *The Lancet*. "Given the ergonomic features of work on sewing machines, fetal exposure is likely. Of course, continued exposure throughout childhood is also possible."

"We should look at this issue more closely. It might make a lot of sense," Infante-Rivard told *Microwave News.*

Sobel reported a "consistent" pattern of increased incidence of Alzheimer's among workers with "medium" and "high" EMF exposures in three different data sets—two Finnish and one American. Dressmakers and sewers were overrepresented among the cases in the study. Subsequent surveys showed that EMFs at the operators' heads were 2.7-5.2 mG for home sewing machines and 2-11 mG for industrial units, according to Dr. Joseph Bowman of the National Institute for Occupational Safety and Health, who worked on the study. The levels were about 200 mG at knee level, he said.

Infante-Rivard said that most of the women in her study used home sewing machines, not industrial models, but used them extensively.

Sobel, of the University of Southern California School of Medicine in Los Angeles, told *Microwave News* that his paper on the Alzheimer's–EMF link will appear in the September 1 issue of the *American Journal of Epidemiology*.

The McGill study supports an earlier report by Dr. David Savitz and colleagues at the University of North Carolina, Chapel Hill (see *MWN,* M/J90). In the Savitz study, children whose mothers used electric blankets during pregnancy were found to have higher risks of leukemia and brain tumors. Savitz reported that the incidence of brain tumors among the offspring had increased 250%. There was a 70% increase for leukemia and a 30% increase for all cancers. "Our findings for prenatal exposures to electric blankets are directly relevant to Infante-Rivard's observations," Savitz told *Microwave News.*

NAS-NRC Committee Reviews Navy's Project ELF Studies

The National Academy of Sciences' National Research Council (NAS-NRC) has formed a committee to evaluate studies that monitored the effects of EMFs from Project ELF. The controversial Navy system, which transmits 72-80 Hz signals to communicate with submerged submarines, uses a 56-mile-long antenna system in Michigan and one half as long in Wisconsin.

The Navy commissioned the NRC last fall to analyze 11 studies on the biological and ecological effects in the forests

around the antennas (research on soil amoebae is not completed). The 11-member committee met for the first time July 6-7.

"Our job is not to summarize but to critically assess the studies," said Raymond Wassel, an NRC program director working with the committee. Wassel said the group would write a report, expected by May 1996, that will review the objectives and design of the monitoring program, as well as data collection methods, analyses and interpretations.

The chair of the committee is Dr. Duncan Patten of Arizona State University, Tempe. The other members are: Drs. Om Gandhi, University of Utah, Salt Lake City; Thomas Getty, Michigan State University, Hickory Corners; William Gordon, Rice University, Houston; Woodland Hastings, Harvard University, Cambridge, MA; Peter Karieva, University of Washington, Seattle; James Lin, University of Illinois, Chicago; Robert Olsen, Washington State University, Pullman; John Pastor, University of Minnesota, Duluth; Beverly Rathcke, University of Michigan, Ann Arbor; and Antonio Sastre, AS Consulting and Research Inc., Suffern, NY.

Hastings served as the chair of a 1977 NAS study on the potential effects of ELF fields. One of the concerns at that time was whether the ELF antenna would have a serious effect on nearby vegetation and "in an extreme...cause a 'wasteland' throughout an area of several square miles." But the study concluded, in part, that available data on EMF effects on plants, though meager, indicated that there would not be any effect on vegetation growing near the antenna.

Hastings's participation with the 1977 review group is "one of the reasons he is on the NRC committee," said Bonnie Scarborough, an NRC research assistant working with Wassel.

The ELF communications system was built in the 1980s after years of dispute over its safety. Originally known as Project Sanguine (later Seafarer), the system, as proposed in the mid-1970s, would have used 6,000 miles of antennas. The target of a lawsuit, Project Sanguine/Seafarer was later scaled back. The 1977 NAS study recommended that a monitoring program be initiated if the system was ever built. In 1982, shortly after the Michigan site had begun initial operations, a monitoring program was started at both sites. The program has been managed by the IIT Research Institute (IITRI) in Chicago (see *MWN,* My81, J/A83, J/F84, Mr84, J/A84, My85 and J/F90).

One of the monitoring studies already has gained some publicity. Scientists at Michigan Technological University's School of Forestry and Wood Products in Houghton monitored vegetation in the region from 1985 to 1994. They recorded enhanced growth—as high as 74%—in some red maples. The increases occurred at magnetic field levels of 1-7 mG among trees growing within 50-150 meters of the antenna (see *MWN,* J/F95).

HIGHLIGHTS

NIOSH Urges Caution on Police Radar Use—But No Epi Study

The National Institute for Occupational Safety and Health (NIOSH) is calling for police radar to be used in ways that would "virtually eliminate" officers' exposure to microwave radiation. The recommendations are contained in a feasibility study that argues against attempting an epidemiological study of cancer among police officers who have used radar.

The NIOSH report, *Occupational Exposure of Police Officers to Microwave Radiation from Traffic Radar Devices,* does call for a broader study of health problems of police officers, which might lay the basis for a later examination of police radar. But funding of such research does not seem likely.

"It's not what we had hoped for," Gary Poynter, research officer of the National Fraternal Order of Police in Cincinnati, told *Microwave News*. "We wanted a recommendation for an epi study and some stronger recommendations for antenna use." Still, he said, "It's definitely a step forward."

NIOSH describes its recommendations on radar antennas as "prudent public health practice even in the absence of an identified health risk." It suggests that hand-held radar guns have a "dead-man switch"—in which the radar beam shuts off when it is not gripped by the user's hand—to avoid accidental exposure. As for two-piece radar units, the study states that antennas should be mounted so that they do not point at police officers inside the car, and that "the preferred mounting location would be outside the vehicle altogether."

Poynter found this guidance too weak: "We thought it should require that all antennas be placed outside the vehicle." On radar guns, Poynter said, *"My* recommendation is, if it doesn't have a dead-man switch, don't use it."

Dr. Gregory Lotz, chief of NIOSH's Physical Agents Effects Branch in Cincinnati and one of the report's authors, responded that, "A lot of small police departments don't have the resources to modify existing radar guns. If they take precautions, they can keep exposure to a minimum."

Lotz and his coauthors conclude that "conducting a definitive epidemiological study of health risks associated with traffic radar devices does not seem feasible at this time." They explain that the low incidence rate of the relevant cancers would require

EPA's EMR Programs Face Budget Ax

The House Appropriations Committee wants to cut the Environmental Protection Agency's (EPA) "low-priority radiation programs" from the agency's fiscal year 1996 (FY96) budget. This would eliminate EPA's EMF and RF/MW programs, according to Dennis O'Connor, EMF team leader at EPA headquarters in Washington.

Among the many budget cuts specified in the committee's report is $11,876,000 for radiation programs "involving criteria, standards, guidelines, program implementation and environmental impact assessments." The committee is trying to reduce the overall EPA FY96 budget to $4.9 billion, 34% less than President Clinton's request for $7.3 billion. The Senate will make its own recommendations when it returns from its recess in mid-August.

a large population of radar-exposed officers, combining those from several states. However, they found "that law enforcement agencies do not record traffic radar use in any systematic manner." Lotz told *Microwave News* that, "We have some genuine scientific concerns about whether we could come up with anything other than an equivocal result."

NIOSH's feasibility study is its response to a three-year-old congressional request, coming after hearings on police radar and cancer chaired by Sen. Joseph Lieberman (D-CT) (see *MWN,* S/O92). This July, Sen. Lieberman told *Microwave News* that while he was "disappointed" that NIOSH decided against an epidemiological study, he was "pleased that they nonetheless chose to make specific, practical recommendations" to limit exposure.

In late 1992, the then-head of NIOSH, Dr. Donald Millar, wrote to Lieberman, pledging, "We will [also] attempt to identify other occupational groups whose exposures to radar may be higher or better quantified. It is possible that such a group may provide the opportunity for a more precise epidemiologic evaluation of the biologic effects of radar."

This point is not addressed in the feasibility study. The report does note, however, that "there is very little epidemiologic data on the effects of RF/MW radiation on humans." Lotz added that, "There is a need for epi studies of people who may be microwave-exposed."

"I plan to follow up with NIOSH," Lieberman said, expressing hope that the agency would follow through on a study of other radar-exposed workers.

The NIOSH report does call for a broader study of occupational health risks for police officers, involving between 10,000 and 30,000 officers at a total cost of $1.4-2.6 million. Lotz said that this could lead to a follow-up investigation of radar use, but "would have value for the occupational health of police officers whether or not we could clarify the radar question."

Two studies involving police radar are now under way in Canada. Dr. Maurice Bitran of the Ontario Ministry of Labor said that the ministry is doing research along these lines, first looking at the overall health of police and later investigating radar exposure. The second study, coordinated by Ottawa Civic Hospital and the Canadian Police Research Center, is an initial investigation of radar use and illness among members of the Royal Canadian Mounted Police. Dr. George Wells of Civic Hospital said that the results will determine whether they move on to a full-scale epidemiological survey.

In the U.S., prospects appear dim for funding a general study of police health issues. The Clinton Administration's budget request for fiscal year 1996 does not include funding for such research, while the House of Representatives is seeking a 25% cut in NIOSH funding and the eventual elimination of the agency.

FDA's Swicord To Run EMR Research Program at Motorola

After 26 years at the Food and Drug Administration (FDA), Dr. Mays Swicord is leaving to become the director of Motorola's electromagnetic radiation (EMR) biological effects research program. Swicord will join Motorola on October 1 and will report to Dr. Quirino Balzano, a corporate vice president.

"The appointment of Dr. Swicord to our research team testifies to Motorola's ongoing commitment to bring the best possible science and scientists to bear on the issues related to the safety of our products," Balzano told *Microwave News*.

Swicord, chief of FDA's radiation biology branch, has led the agency's efforts to monitor the safety of cellular phones. "Appropriate steps will be taken by the FDA to make sure that the agency will continue its electromagnetic radiation programs," he said in an interview.

Motorola's research program, which focuses on cellular phones and other wireless technology, is made up of at least seven major projects that are now under way (see table below). In addition, the company sponsors other research through its membership in the Cellular Telecommunications Industry Association and in Germany's Research Association for Radio Applications (FGF).

Norman Sandler, a Motorola spokesperson, said the seven ongoing projects are those "we are in a position to acknowledge at this time with the consent of the principal investigators." He stressed that, "Our policy is to have *all* Motorola-sponsored research published in open, peer-reviewed literature upon completion."

Motorola's Ongoing Cellular Phone Health Studies

Principal Investigator	Location	Signal*	Type	Due Date
Dr. Ross Adey	VA Medical Center, Loma Linda, CA, U.S.	TDMA	Animals & Cells	1996
Professor Konstantin Hossman	Max Planck Institute, Cologne, Germany	GSM	Animals	1995
Professor Marika Kiessling	University of Heidelberg, Heidelberg, Germany	GSM	Animals	1995
Professor Niels Kuster	ETH, Zurich, Switzerland	GSM	Dosimetry	Open-Ended
Dr. Robert Morgan	Environmental Health Strategies, Redwood City, CA, U.S.	—	Epidemiology	Not Available
Dr. Joseph Roti Roti	Washington University, St. Louis, MO, U.S.	CDMA	Animals & Cells	1996
Dr. Bernard Zook	George Washington University, Washington, DC, U.S.	MIRS	Animals	1996

*CDMA = Code Division Multiple Access; GSM = Global System for Mobile Communications; MIRS = Motorola Integrated Radio Services; TDMA = Time Division Multiple Access.

COMMENTARY

Commentary from the Bioelectromagnetics Society Annual Meeting

The Science and Politics of the EMF Puzzle; The Missing Pieces in the "Frontline" Story

The irony is astonishing. On the very day that a committee of the National Council on Radiation Protection and Measurements (NCRP) completed its 800-page draft report asking regulatory agencies to pay "serious attention" to EMFs, public television station WGBH aired a one-hour show across the country comparing EMFs to cold fusion. While the NCRP committee called for "a national commitment to further research," the June 13 *Frontline,* "Currents of Fear," asked whether it was time to close down the research effort.

Of course, *Frontline* dominated the gossip circles at the annual meeting of the Bioelectromagnetics Society (BEMS) held later that same week in Boston, WGBH's hometown. Only a few insiders knew about the NCRP report.

It's too bad that Jon Palfreman, WGBH's producer of this show, did not bother to go across town to attend the BEMS meeting. If he had listened to some of the presentations and talked to members of the NCRP committee, he might have realized that his documentary for the *Frontline* series left out key facts —facts that conflict with his thesis that concern over EMF health effects has no scientific basis.

Then again, it might not have made a difference. There are good reasons to think that Palfreman never approached the EMF puzzle with an open mind. Much like Gary Taubes, whose own attack on EMFs appeared in last November's *Atlantic Monthly,* Palfreman started with an idée fixe and then went looking for like-minded people.

In a nutshell, Palfreman's thesis is that the animal studies show no effects, the cellular experiments are irreproducible, the best epidemiological evidence is specious and the postulated biophysical mechanisms of interaction contradict the laws of physics. Unfortunately, it isn't quite that simple.

* * *

Let's begin with what Palfreman left out:

Animal Studies

Palfreman only cited those experiments being carried out at Chicago's IIT Research Institute (IITRI) by Dr. David McCormick, whose first cancer study failed to show any effect. McCormick's results are so new that they have not yet been peer-reviewed or published. Even so, they already have their share of critics, who have raised questions about the study design.

Palfreman built up IITRI's exposure study as the definitive, best-controlled experiment ever. He let Dr. Gary Boorman of the National Institute of Environmental Health Sciences (NIEHS) make the case:

> As you refine your studies, if there really is an effect, the effect should increase, it should become stronger, it should become more focused, and if you cannot, with repeated studies and with better studies, you continue not to find an effect or find only marginal effects, then it becomes obvious that there's really nothing there.

Boorman's scientific logic is of course rational and correct, but, in this particular context, it makes no sense. Very few animal cancer studies have been done to date and McCormick has only completed a *single* experiment. It's hard to make a case for a trend with IITRI's one data point.

In a press release posted on the Internet, the WGBH public affairs office lost all control of the facts:

> Dozens of animal experiments have been carried out in which rats and mice are exposed to very large magnetic fields for long periods—some for their entire lives—but no animal has ever been proven to contract cancer due to this exposure.

If you add up all the animal–cancer studies ever done, you do not reach "dozens" and some of those that have been done show some adverse effects. What did Palfreman say when asked about this? Only that he did not write the press release. No apologies, no excuses, no interest in setting the record straight.

At BEMS, both Dr. Craig Byus[1] of the University of California, Riverside, and a Finnish team[2] reported seeing higher-than-expected rates of cancer in animals exposed to EMFs. For one set of exposures, Byus said that he found a "very, very significant" increase in tumor incidence. Byus's study is being sponsored by the NIEHS, where Boorman works.

But the most riveting talk on animal experiments was that given by Dr. Wolfgang Löscher of the School of Veterinary Medicine in Hannover, Germany. He and Dr. Meike Mevissen have completed a *series* of studies at four different exposure levels—much of which has already been published in respected peer-reviewed journals.[3] In Boston, Löscher concluded that the magnetic field "promotes the growth and increases the incidence of tumors in a dose-dependent fashion."

Boorman said that he is impressed by Löscher's animal studies not only because they show clear and reproducible effects but because Löscher also has confirming experimental evidence on the hormone melatonin and the growth enzyme ODC. It all adds up to a consistent and solid picture of EMF effects on a living organism.

Indeed, Boorman is so impressed with Löscher's work that he recently issued a request for proposals to repeat the animal studies at a cost well in excess of $1 million. Does this sound

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like a scientist who thinks that there is "nothing there," as Palfreman would have us believe? The Department of Energy (DOE) is so favorably impressed by Löscher that it will sponsor his work directly—one of the very few times the DOE has ever funded EMF research outside the U.S.

"The animal studies were incompletely and too simply presented" on *Frontline,* Boorman said in an interview. If Palfreman had used Löscher's studies as his example instead of IITRI's, he said, the audience would have reached a "very different conclusion."

Cellular Studies

Here again, Palfreman based his argument on one study—Battelle's Dr. Jeffrey Saffer's unsuccessful attempts to repeat Drs. Reba Goodman and Ann Henderson's experiments showing changes in gene expression in HL-60 cells. At this point, no one knows why the two (three, counting a British team that also found no response) labs got different results. But looking beyond this particular experiment, another picture emerges.

A number of researchers have shown that EMFs can affect gene expression. Among them is Saffer himself. At last November's EMF review in Albuquerque, NM, Saffer reported that he had turned his attention to another cell line, JB6, and found preliminary evidence of a response.[4] Saffer later parlayed that finding into a research grant of more than $1 million from the NIEHS.

As it turns out, at BEMS, Saffer said that so far he has been unable to reproduce the effect.[5] Nevertheless, another lab, at the Food and Drug Administration, has been seeing a robust response in JB6 cells.[6]

When asked about the JB6 work, Palfreman said that he knew nothing about it and that Saffer had never mentioned it. Saffer must have gone through a TV interview—never a short affair—without a word about his new million-dollar project on gene expression.

One of the best-known scientists at the BEMS meeting was struck by this omission: "If Saffer does not think there is anything there and doesn't have the scientific imagination to know where to look, why doesn't he give the money back?" he asked, expressing his own frustration on how hard research money is to find.

Epidemiological Studies

Most of the data supporting a cancer risk comes from studies of human populations, and many leading epidemiologists—including Drs. Anders Ahlbom, Birgitta Floderus, Sam Milham and Gilles Thériault—have found strong evidence for a link. They are all internationally known and respected and each has led large EMF studies.

Palfreman is unconvinced. He says that "most epidemiologists" regard the EMF field "as something of an embarrassment to their profession," but does not cite any sources. If he were right, why couldn't he find a single epidemiologist other than a longtime utility consultant to say this to the camera? And why are so many epidemiologists still working on the EMF puzzle if it so stigmatizes them?

Palfreman's experts on epidemiology were two electric utility consultants: Dr. John Moulder of the Medical College of Wisconsin in Milwaukee, an expert on using radiation to treat cancer, and, to a lesser extent, Dr. Patricia Buffler, an epidemiologist at the University of California, Berkeley. He used them to disparage the Swedish childhood cancer study by Drs. Maria Feychting and Anders Ahlbom. Moulder said that the Swedes made a fundamental error: They made so many comparisons that, by chance alone, they had to come up with some positive associations. Buffler agreed. The Swedish study, they argued, was simply an exercise in data dredging.

Ahlbom dismissed Moulder's and Buffler's criticisms. "It is absolutely necessary to look at a large number of analyses in any epidemiological study to look for consistencies and inconsistencies in the data," he said in an interview.

In a review[7] published earlier this year, Feychting and Ahlbom concluded, "The evidence on leukemia in children appears rather consistent." They went on to say that the hypothesis that EMFs lead to the development of cancer cannot yet be considered proven and that we "have to accept the uncertainty."

The *Frontline* interview with Dr. David Savitz made it clear that Palfreman is not interested in uncertainties. After talking to Savitz for more than an hour on camera, Palfreman only gave him some 20-30 seconds of airtime—and even then Savitz never got to say a word about epidemiology, only exposure assessment. Savitz thinks he knows why he was not allowed to say more: "Palfreman had his point of view and looked for quotes to support it," he said in an interview.

The data-dredging argument is "completely unsatisfying—it's no explanation at all," Savitz said, adding that, "It is a strength of the study to have investigated so many possibilities." As Ahlbom pointed out, "Suppose that we had not done this, but had been asked to do so after publication, should we have answered: 'This is an interesting question, but unfortunately we cannot do this because it is not in the study protocol'?"

The contribution of the Swedish study is not that it gave a definitive answer, but that it provided a new and persuasive piece of the EMF puzzle that fits neatly into the existing mosaic. But Palfreman has no patience for anything short of absolute proof.

The earlier Wertheimer-Leeper, Savitz and London-Peters studies all showed a link between childhood cancer and EMF exposures, as defined by the Wertheimer-Leeper wire codes. When measured fields were used, however, the link was weaker. Some observers, especially those from the utility industry, jumped on this apparent discrepancy and dismissed the studies as being internally inconsistent.

Using historical records of the current loads on Sweden's power lines, Feychting and Ahlbom calculated the magnetic fields when a child got sick—as well as one, five and ten years prior to diagnosis. (This partly explains why they made so many comparisons, which led to the charges of data dredging.) The Swedes found that the calculated historical fields did show a link to cancer. Making their case even stronger, they found a dose–response relationship. Further, like their predecessors, Feychting and Ahlbom did not see an association between present-day magnetic fields and leukemia. This suggested, as many epidemiologists had long speculated, that wire codes

are good indicators of long-term EMF exposures.

In short, the Swedes set out to see whether there was a link between power line magnetic fields and leukemia and that is exactly what they found. They improved on past studies and the link grew stronger: precisely the type of evidence that skeptics say they want to see. Feychting and Ahlbom did not answer all the questions, but epidemiology never does.

Biophysical Mechanisms of Interaction

This is the most important part of Palfreman's argument. Whether an experiment shows an EMF effect in humans, animals or cells becomes moot if it is possible to show that such interactions are theoretically impossible: Yale University physicists Drs. Robert Adair and William Bennett believe this, and, it appears, so does Palfreman. To use the metaphor conjured up by Adair on *Frontline,* worrying about EMF health effects is akin to being concerned that a cat will damage a tree by breathing on it during a howling wind storm.

Given the recent statement[8] by the American Physical Society (APS) that EMFs are of no concern—also cited by Palfreman on the show—one might conclude that all physicists agree with Adair and Bennett. But that would be a mistake.

There are many physicists working in the field of bioelectromagnetics. As Dr. Bill Kaune, a consultant based in Richland, WA, who has a doctorate in physics, put it: "We physicists who do research on EMFs have long been aware of the signal-to-noise problem, but, regardless of our concerns, experiments seem to show that EMFs affect living tissues. I don't see how one can justify flatly discounting the work of a large number of epidemiologists and laboratory biologists solely on the basis of signal-to-noise calculations on highly simplified models of living tissues."

A couple of years ago, Adair had the opportunity to make his case to the JASONs, a high-level group of physicists, whose advice is routinely sought by the Department of Defense. In his report on behalf of the JASONs, Dr. Steven Koonin of Caltech concluded: "The essential point to take away...is that a cellular-level coupling of magnetic fields to biological systems is physically plausible and does *not violate any physical principles.*"[9]

Koonin was a member of the APS council that approved the statement, and may well believe that "no plausible biophysical mechanisms" have been identified. But this does not mean, as Adair and Bennett (and Palfreman) contend, that such interactions are impossible.

As for the APS statement itself, it is as much a political as a scientific document. A look at Dr. David Hafemeister's slipshod background paper[10] that served as the basis for the statement is convincing evidence of his and the APS' political agenda. Hafemeister is well attuned to the world of politics and the power of a press release given to a responsive reporter, having spent many years in Washington working for the federal government and congressional committees.

Adair was at the BEMS meeting, and when asked how he could explain an organism's ability to sense magnetic fields as weak as 0.2 mG against the background of the earth's 500 mG field, Adair replied: perhaps if you have enough cats and enough trees....

Or to put it another way, biological systems are complex and are not easily captured by a simple model or a colorful analogy.

Implicit in these discussions is that when we talk about EMFs we are referring to one physical phenomenon. In fact, there are a huge variety of EMFs, each of which may have a different effect. Among the most intriguing are transients—short intense pulses of energy.

At BEMS, Dr. Antonio Sastre, a consultant based in Suffern, NY, and his colleagues showed that when it comes to EMF transients—common occurrences on power lines—the signal can rise above the background noise.[11] "The objection that environmental fields are too weak with respect to thermal noise need not apply to transients," Sastre said in an interview, pointing out that one needs to invoke only "pedestrian physics applied to realistic models of cells" to show this. Sastre's work is sponsored by the Electric Power Research Institute (EPRI).

Sastre's work on transients follows last fall's announcement by Thériault that he and his colleagues at McGill University in Montreal, Canada, had found a very strong association between exposure to transients and lung cancer among utility workers. Hydro-Québec's first reaction on learning of this result was to take the data away from the McGill research group.[12] Seven months later, the conflict remains unresolved and Thériault's team is still barred from probing further into this risk—one of the largest ever observed for any EMF-exposed population.

* * *

Palfreman is a serious journalist. He has won two AAAS science writing prizes, as he is not too bashful to tell his critics. But he clearly came to EMFs with his mind made up. He might have salvaged the show had he taken the trouble to talk to those whose work he is disputing.

Palfreman never interviewed Drs. Anders Ahlbom or Reba Goodman, two of the scientists he skewered on the program. He said that he exchanged faxes with Ahlbom and has the faxes to prove it. This made no impression on Ahlbom, who cannot remember Palfreman among the many reporters who have called him.

The Goodman story is different and more troubling. Palfreman said that Goodman refused to be interviewed, while Goodman maintained that no one from *Frontline* ever called her. Goodman is right. Palfreman let one of his assistants, Michaela Barnes, contact Goodman, but she conceded that she never did. When asked why not, Barnes cited "political reasons."

One set of *Frontline* interviews, left on the cutting room floor, involved the controversy over health problems among those living next to an electrical substation in Guilford, CT. Paul Brodeur used this as a case study in a 1990 article published in *The New Yorker,*[13] with Bob Hemstock serving as the protagonist. In the course of his interview with *Frontline,* Hemstock offered to contact Goodman on the program's behalf, since he was going to be talking to Goodman about a project of his own.

Goodman told Hemstock that it would not be a good idea for him to visit her lab with a television crew. Goodman was swayed, at least in part, by Hemstock's theories on EMFs, which

are somewhat idiosyncratic. In any case, by the time Hemstock relayed this message to Barnes, he had himself decided, for his own reasons, that he did not want to take the *Frontline* crew to Goodman's lab.

Hemstock never knew and therefore could not tell Goodman about *Frontline's* interest in Saffer's experiment. Nor did Goodman know that the public television crew Hemstock mentioned was from *Frontline*.

No one from *Frontline* ever called Goodman directly—even though Palfreman planned to tell the world that her results are worthless. Neither Palfreman nor anyone else from *Frontline* was interested in hearing Goodman's side of the gene expression story—a violation of one of the most basic rules of journalism. The omission is striking given Palfreman's statement that he is "interested in finding the truth in a world where, increasingly, scientific data is being abused and distorted for political ends."

* * *

One of the most revealing aspects of the *Frontline* episode is that so few members of the bioelectromagnetics community have spoken out to correct the obvious errors in the program. Palfreman said that the vast majority—approximately 95%—of the comments have been favorable. The reason for the silence is an important part of the EMF story.

EMF research is an underfunded backwater of the scientific community. Before the congressionally mandated $65 million RAPID program got under way last year, most of the available research funds came from the electric utility industry through EPRI and from the DOE, an agency not known for putting radiation safety ahead of its other program objectives. EPRI and the DOE do not look kindly on those who publicly highlight possible health risks.

This is the grubby side of science, where many researchers are as interested in securing contracts and grants—even if it means making compromises along the way—as they are in doing the actual scientific work.

This also explains why there has been no outcry—indeed we have yet to hear a single word of public protest—at Hydro-Québec's outrageous behavior in blocking Thériault's access to millions of dollars worth of data that could explain part of the EMF puzzle.

Among the possible casualties of this silence are the emerging biomedical applications of EMFs, for instance the use of pulsed EMFs to heal nonunion fractures. If low-level, nonthermal effects fall into disrepute, then, by definition, such medical devices are ineffective and should not be on the market. But even those who see a bright future for EMF therapies are not speaking up.

Before the New York Power Lines Project began in the early 1980s, neither EPRI nor the DOE moved to confirm or refute the Wertheimer-Leeper cancer study. As a result, it took nine years to repeat it. And as soon as Savitz had done so, EPRI, still unconvinced, decided that it had to be done all over again. This took another five years. Critics of the Feychting-Ahlbom study should not wonder why we don't know more, but rather should marvel that we know as much as we do.

When the Feychting-Ahlbom results were released in 1992, the Swedish government said that it believed that, more likely than not, the cancer link existed.[14] Two years later, the Swedes did not reject this conclusion, but decided that they could not rationalize the high economic costs of regulating EMFs given the rarity of childhood leukemia. Swedish government officials have made it clear that if the hypothesized EMF role in breast cancer were to be confirmed they would reconsider the decision.[15] Feychting and Ahlbom are now working on an epidemiological study of EMFs and breast cancer.

The significance of the epidemiological studies is not that they point to a cancer epidemic. But they raise the question: If EMFs can cause even a small change in cancer rates, what other biological effects could they have?

In the absence of detailed studies on breast cancer, Alzheimer's disease and depression, among other common health problems, no one knows how great the EMF health risk really is. Those who argue that we now have enough research to conclude that the risk is small, if it exists at all—as Dr. Jack Sahl of Southern California Edison does in a recent report[16]—are engaging in wishful thinking.

The reason the EMF problem has attracted so much attention is not because of pressure from the scientific community. It is the public that has propelled EMFs into the limelight. The Omaha housewives whose children have cancer want answers, as was shown on *Frontline*. Palfreman portrayed them as naïfs who have been brainwashed by Paul Brodeur. This is unfair because they have legitimate concerns and because they are victims of the scientific uncertainty that is a result, in large measure, of years of industry and government foot-dragging.

* * *

So, the animal, cellular and human studies all point to real risks. And physics does not put them out of the realm of possibility. To be sure, these risks have not been conclusively proven—but neither have they been convincingly dismissed.

As the NCRP committee concluded in its draft report: "[F]indings are sufficiently consistent and form a sufficiently coherent picture to suggest plausible connections between ELF EMF exposures and disruption of normal biological processes, in ways meriting detailed examination of potential implications in human health."

Yet Palfreman is sure he already has the answers. After a quick breeze through the literature and talking to a few like-minded scientists, Palfreman thinks he knows better than the expert NCRP committee that studied the issue for a decade. "The thesis is mine," he said in an interview. "It's very clear-cut, I don't feel any doubt."

Palfreman's show was simply an exercise in hubris. Only this can explain why Palfreman is willing to follow in Buffler's footsteps in waging a holy war against prudent avoidance. Neither sees the point, for instance, in telling parents that they may be protecting their kids simply by moving a bed across a room out of a 10 mG field. As Julie Larm, one of the mothers on the show, wrote to Palfreman on behalf of Omaha Parents for the Prevention of Cancer after the June 13 broadcast, "May God help you if you're wrong."

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14. See *MWN,* S/O92.
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FROM THE FIELD

Clippings from All Over

In 1988, shortly before he died, Andrei Sakharov commented on the fate of the earth. Interestingly enough, rather than comment on the hydrogen bombs that he coinvented, he stated: "...in fact, I am now inclined to regard the many-faceted ecological threat to our environment as our most serious long-term problem." Because I agree with this very long-term assessment, it is troubling to me to see environmental funds and political capital wasted on false threats. In particular, I am concerned that the quasi-legalistic concept of "prudent avoidance" is being used to chase the phantom risk of cancer caused by extremely low frequency (ELF) [EMFs] from power lines. This needless chase costs some $1 billion to $3 billion per year and unnecessarily frightens the public with "electrophobia." The burden of these fiscal and emotional costs placed on the American public are incommensurate with the risk, if any, being mitigated. This outcome is not a use of science for the public good.

—David Hafemeister, "The Imprudence of 'Prudent Avoidance'," *Physics & Society,* a publication of the American Physical Society, p.9, July 1995

[B]ut it is only a matter of time before a jury returns a favorable verdict to plaintiffs in an EMR case.

—Bruce DeBoskey, "Electromagnetic Radiation and Cancer: Recent Developments," *Trial,* a publication of the Association of Trial Lawyers of America (ATLA), p.21, July 1995

In March of 1994, alliance member Julie Larm met with President Bill Clinton and asked him to execute an executive order creating a buffer zone between homes, schools, day care centers and nursing homes and any electrical generating facility, such as transmission and distribution lines and electrical substations. The alliance has continued a year-long letter campaign urging Clinton to sign this executive order with hope that the White House would focus on this issue. However, over a year has passed since the White House promised to look into the health hazards surrounding exposure to EMF. The cover story of our spring 1995 issue of *Network News* was entitled "The White House White Wash: Clinton Ignores the EMF Issue" and prompted a letter from President Clinton to me a few weeks ago assuring me that the EPA was continuing to review the EMF issue. Although I am not from Missouri—I'll stand by Missouri's "Show Me" state motto. Show me, then I'll believe it. The Clinton Administration has continually taken the "ostrich" position on EMF, as did the Bush Administration before it. It has fallen to the shoulders of the citizen activist to resolve this issue at a grassroots level.

—Cathy Bergman-Venezia, "Introducing the EMR Alliance: Grassroots Group Looks for a Safe Environment," *1995 ATLA Annual Convention*, New York City, p.8, July 17, 1995

"We [epidemiologists] are fast becoming a nuisance to society," says Dr. Dimitrios Trichopoulos. "People don't take us seriously anymore, and when they do take us seriously, we may unintentionally do more harm than good." As a solution, epidemiologists interviewed by *Science* could suggest only that the press become more skeptical of epidemiologic findings, that epidemiologists become more skeptical about their own findings—or both.

— Gary Taubes, "Epidemiology Faces Its Limits," *Science,* p.164, July 14, 1995

"The worst aspect of mobile phones is that they probably interrupt my meal in restaurants."

—Dr. Michael Repacholi, chairman, International Commission on Non-Ionizing Radiation Protection, appearing on ABC-TV's (Australia) *Four Corners* in "Waves of Fear," aired July 10, 1995

"Don't put the antenna right against your head. Now that is the sort of information that should be imparted to the user [of cell phones]."

—Dr. Ross Adey, associate chief of staff for R&D, VA Hospital, Loma Linda, CA, also on *Four Corners,* July 10, 1995

The draft emphasizes that "mitigation of existing exposures...is likely to prove complex and costly." But with regard to new construction, committee members argue for "exercising these options now at a time when their implementation will carry minimal societal impact or fiscal burden." They underline the importance of "planning for the future of a society wherein use of electric power will continue to grow at every turn."

The committee concludes that "neither laboratory studies nor epidemiological findings...can yet establish well-defined thresholds for safety guidelines." Still, it contends:

> From available epidemiological and laboratory data, it appears both prudent and responsible to set limits on permissible future exposures.

Therefore it calls for "interim exposure guides," measures that "fall short of establishing either a standard or guideline, but offer guidance to limit exposure."

ALARA Policy Endorsed

While the report notes that committee members were not unanimous, it recommends a policy in which exposures would be "as low as reasonably achievable," known as ALARA. Over a three-year period, ambient exposures in homes, schools and offices would be reduced to 10 mG. After six years, there would be an option to establish a guideline of 5 mG. Each of these decisions would be based on whatever epidemiological and laboratory studies were then available. After ten years, a goal of 2 mG would be considered. The report stipulates that mitigation of the existing EMF environment to this level should be adopted only after "a careful evaluation of its socioeconomic impact, as well as its cost-effectiveness."

"We worked very hard to come up with a statement where we could say, these are the committee's recommendations, even though we don't agree on everything," said Dr. Mary Ellen O'Connor of the University of Tulsa, OK, a member of the committee. As another committee member, who asked not to be identified, said, "Some members felt it was important to set numerical limits, while others felt it was inappropriate at this time."

The committee rejected the option of not issuing any specific recommendations on exposures. It also rejected another option—to set a 2 mG exposure guideline immediately—on the grounds that "general compliance would appear impractical at this time." As Adey pointed out, "We must be realistic that we are not going to give up electric power. Its use will continue to grow in a civilized society."

Committee member Dr. David Carpenter, of the School of Public Health at the State University of New York, Albany, said, "In almost any other type of environmental exposures, if the evidence were as strong as the association between EMFs and cancer, there would be extensive government regulation. The major reason that many members of the committee were unwilling to set more rigorous standards was that it would be horrendously expensive and unrealistic to enforce them."

With respect to future construction, the report recommends observing a 2 mG exposure limit for schools and for new transmission lines near existing housing, with somewhat less strict guidelines for new housing and offices.

The report notes that its proposed benchmarks can serve as "a vehicle for public instruction." While large-scale education of individuals "may be difficult to achieve," the document stresses the importance of changing institutional practices "on such topics as grounding in electrical distribution systems [and] manufacturing of appliances."

Adey described the committee's members as "carefully selected to cover the great majority of societal interests on this scientific problem, including power industry engineers, epidemiologists, public health specialists as well as molecular and cellular biologists" (see box above for a list of members). Dr. Richard Stevens of the Battelle PNL in Richland, WA, commented that, "There were some differences of opinion on the weight of the evidence, but my impression is that there was agreement on the importance of the issue and that it deserves continued attention."

EPA Cancer Report Due Soon

The draft report is the culmination of work that began in 1983, when the EPA contracted with the congressionally chartered NCRP for a review of the biological effects of extremely low frequency (ELF) EMFs (see *MWN,* D83). Work was discontinued in 1986 because of funding cuts at the EPA, but resumed in 1991, according to EPA's Elder. "It took a million years," said O'Connor.

Adey noted that, "The committee's position evolved each year with the growing body of credible laboratory and epidemiological studies." In its review of the research, the report examines evidence for EMF effects on cancer growth, reproduction and embryo development, and neurobiology.

The NCRP committee's conclusions bolster the findings of a 1990 draft on EMFs developed by the EPA (see *MWN,* M/J90). That EPA report is now being revised, but the agency does not appear to be backing away from its most important conclusions (see *MWN,* S/O94). McGaughy, of EPA's Office of Health and Environmental Assessment in Washington, said that it would probably be completed by October or November and would be reviewed by EPA's Science Advisory Board after a 60-day public comment period.

Committee Members

The members of NCRP Scientific Committee 89-3 on Extremely Low Frequency Electric and Magnetic Fields are: Dr. Ross Adey (chair), VA Hospital, Loma Linda, CA; Dr. Larry Anderson, Battelle Pacific Northwest Labs (PNL), Richland, WA; Dr. Carl Blackman, EPA, Research Triangle Park, NC; Dr. David Carpenter, State University of New York, Albany; William Feero, Electric Research and Management Inc., State College, PA; Dr. Marvin Frazier, Department of Energy, Washington; Dr. Richard Lovely, Battelle PNL, Seattle; Dr. Richard Luben, University of California, Riverside; Dr. Martin Misakian, National Institute of Standards and Technology, Gaithersburg, MD; Dr. Mary Ellen O'Connor, University of Tulsa, OK; and Dr. Richard Stevens, Battelle PNL, Richland.

SPECIAL REPORT

NCRP Draft Recommendations on EMF Exposure Guidelines

Reprinted below is Section 8 of the June 13, 1995, draft of the report of NCRP Scientific Committee 89-3 on Extremely Low Frequency Electric and Magnetic Fields, which contains its conclusions and recommendations.

8.1.0 Conclusions and Recommendations for Interim Exposure Guidelines

In 1989, the International Radiation Protection Association (IRPA) approved interim EMF exposure guidelines prepared by its International Non-Ionizing Radiation Committee. The guidelines recommended the following limits for occupational exposure and for exposure of the general public:

Table 1

Exposure	Electric Field Strength	Magnetic Flux Density
Occupational:		
Whole Working Day	10 kV/m	0.5 mT (= 5,000 mG)
Short Term	30 kV/m	5.0 mT (= 50,000 mG)
Restricted to Limbs	—	25.0 mT (= 250,000 mG)
General Public:		
Up to 24 hours/day	5 kV/m	0.1 mT (= 1,000 mG)
Few hours/day	10 kV/m	1.0 mT (= 10,000 mG)

The IRPA committee based its recommendations on the premise that the existing literature does not provide evidence that EMF exposures at present-day levels have a public health impact that would require corrective action. Its summary position was that "although some epidemiological studies suggest an association between exposure to 50/60 Hz fields and cancer, others do not. Not only is this association not proven, but present data do not provide any basis for health assessment useful for the development of exposure limits."

Further, the IRPA guidelines were developed "primarily on established or predicted health effects produced by currents induced in the body by external [EMFs]," and those limits correspond to induced current densities that are generally at, or slightly above, those attributable to normal excitation currents occurring physiologically in the body. Thus, the IRPA-recommended exposure limits are orders of magnitude greater than field levels that may create a risk, in the light of extensive evidence reviewed in this report. Concerns about inadequacies of IRPA guidelines have been summarized in a review of international standards (Gibbs, 1991)[1]:

> Since the guidelines proceed on the basis that adverse human health effects from exposure to ELF electric fields at strengths normally encountered in the environment or in the workplace have not been established, it is apparent that they are not intended to provide protection against any adverse health effects that may be caused by such exposure, and they would not do so. The levels of exposure recommended are many times greater than the levels at which it has been suggested that the fields may create a risk.

In the U.K., the National Radiological Protection Board (1989) also set exposure guidelines for 50/60 Hz fields on the same basis as the IRPA committee in fixing its interim guidelines. For occupational exposures and for the general public, the recommended 50 Hz field levels were the same: for electric fields: 12 kV/m; for magnetic fields: 2 mT (20,000 mG).

In the USA, some states have established limits for electric field strengths on or at the edge of the rights-of-way for high voltage transmission lines. Only Montana has established magnetic field limits (Table 2).

Exposure criteria at these levels do not reflect epidemiological findings that suggest significantly enhanced cancer risks, particularly for childhood leukemia, in ambient power frequency fields exceeding 2 mG. This level is proposed for a Swedish general population guideline, based on correlates of incidence of childhood leukemia with annualized magnetic field levels in dwellings adjacent to high voltage transmission lines.

8.2.0 Rationale for Interim Exposure Guides

In reviewing available evidence, neither laboratory studies nor epidemiological findings, whether considered separately or jointly, can yet establish well-defined thresholds for safety guidelines that would encompass the temporal spectrum from short-term to lifelong ELF exposures. Although it might thus be justified to offer no specific guidelines, nevertheless it would appear prudent to offer interim guidance.

Population exposure to EMFs at power line frequencies involves not only the basic sine wave fields at 50 or 60 Hz, but also harmonics at higher frequencies. Secondary fields generated in the use of electric power are substantially more complex due to their harmonic content. Although this report focuses on the ELF spectrum from near-DC to 300 Hz, information has been included on studies as high as the kilohertz range, because of their widespread environmental occurrence and because they have not been reviewed elsewhere.

In key areas of bioelectromagnetic research, findings are sufficiently consistent and form a sufficiently coherent picture to suggest plausible connections between ELF EMF exposures and disruption of normal biological processes, in ways meriting detailed examination of potential implications in human health. These specific areas of research are briefly reviewed.

8.2.1 Carcinogenesis

Epidemiological studies in the USA and Europe cited elsewhere indicate a positive association between childhood cancers and exposure to magnetic fields, on the order of 0.2 $\propto$T, generated by electric power transmission and distribution systems. Evidence has accumulated in other epidemiological studies implicating exposure to ELF EMFs as a factor common to an increased incidence of leukemia and brain cancer in occupationally exposed adults.

In laboratory research, further studies will be necessary to determine existence of an unequivocal link between exposure to ELF EMFs and cancer. Nevertheless, reported EMF effects in animal and tissue models at critical steps in cell growth regulation are consistent with an initiation-promotion (epigenetic) model of tumor formation, and are consistent with results of epidemiological studies.

Table 2*

State	On ROW**	Edge of ROW
Florida§	8 kV/m	2 kV/m
Florida†	10 kV/m	2 kV/m
Minnesota	8 kV/m	—
Montana	7 kV/m	1 kV/m
Montana§	—	150 mG
Montana†	—	200 mG
Montana‡	—	250 mG
New Jersey	—	3 kV/m
New York	11.8 kV/m	1.6 kV/m
North Dakota	9 kV/m	—
Oregon	9 kV/m	—

*After Gibbs[1] ** ROW = Right-of-Way
§lines ≤ 230 kV †500 kV lines ‡500 kV double circuit lines

[1] H. Gibbs, *Inquiry into Community Needs and High-Voltage Transmission Line Development,* Report to Minister for Minerals and Energy, New South Wales State Government, Australia. 163 pp., 1991.

8.2.1.1 Gene induction: There is no evidence of gross chromosomal damage or sister-chromatid exchanges following exposure to ELF EMFs, interpreted as an indication that field exposure does not cause initiation as the first step in the initiation-promotion cancer model. However, ELF magnetic fields have been shown to alter gene transcriptional processes, with repression and derepression of portions of the genetic code, thus leading to changes in expression of proteins in cells. This process may represent an abnormal cell function, leading to reduced control of cell growth, and ultimately to unregulated growth. Such a loss of growth regulation would be consistent with a promotional role (or copromotional with other promoting agents) in the cancer process.

8.2.1.2 Biochemical changes: Intracellular biochemical changes following ELF magnetic field exposures. They include responses of messenger and cell growth-related enzymes, and alterations in gene expression, including modulation of activity of proto-oncogenes. These changes are consistent with actions of chemical cancer promoters, suggesting the possibility of combined actions of chemicals and ELF EMFs as cancer promoters.

8.2.1.3 Enhanced cell tumorigenicity: Increased tumor incidence and decreased tumor latencies have been reported in animal tumor models when 50/60 Hz magnetic fields at intensities of 0.1 mT or less were presented as promoters or copromoters. Increased concentrations of transferrin receptors have been reported on the surface of human colon cancer cells when exposed to 60 Hz magnetic fields, or to combined electric and magnetic ELF fields. A relationship to increased tumorigenicity may be suggested, since raised serum iron levels and an associated decrease in levels of transferrin iron binding have been described in human cancer. These findings are consistent with the possibility that prolonged exposures to ELF fields may progressively lead to recloning of already transformed cells to a more cancerous state.

8.2.1.4 Immune deficiencies: Accumulating epidemiological evidence from population studies and from the workplace now correlates environmental ELF EMF exposures with increased risks for leukemia in children and adults. Certain of these studies have suggested a dose-dependence in long-term exposures. In laboratory studies, the natural defense response of T-lymphocytes taken from the immune system of mice is reduced by exposure to ELF electric fields, and after exposure to combinations of electric and magnetic fields. It may be argued that if these exposures mitigate normal immune defense responses in the intact subject, there may ensue less efficient detection and elimination of aberrant cells, including cells undergoing recloning to more malignant states.

8.2.2 Reproduction/Teratology

Unlike the growing and increasingly consistent evidence linking ELF EMF exposure to increased risks of certain cancers, epidemiological evidence on human reproduction has remained limited. A single preliminary study has described a modest increased risk of pregnancy termination associated with use of electric blankets.

A series of studies in Scandinavia and the USA have reported increased risks of miscarriage associated with VDT use, including evidence of dose-dependency. Studies in mice, rats and swine have all reported teratological effects, but many lack consistency in site and type of teratology. Several independent studies have noted growth abnormalities in chick embryos exposed to similar types of magnetic fields. A single study in rats of neuroendocrine and psychosexual responses following intrauterine ELF magnetic field exposure in late pregnancy has described defective territorial marking in adult male offspring and increased gonadal organ weights.

Available evidence from these epidemiological and laboratory studies indicates needs for further research on possible reproductive anomalies, including studies of subtle neurobehavioral effects that may be revealed only after puberty and in later development.

8.2.3 Neurobiology

Limited human studies have addressed a spectrum of altered physiological responses that appear correlated with ELF electric and magnetic field exposures. This spectrum of bioeffects shades progressively into certain neuroendocrine and autonomic responses which, separately or collectively, may have pathophysiological implications. These human observations are supported and extended by a much larger body of laboratory animal research, with responses to ELF fields in species from fish to man. These fields may influence development of the nervous system. In the adult organism, they elicit neurochemical, physiological, behavioral and chronobiological responses.

There has been a strong focus on ELF field actions in the pineal gland, relating to effects on synthesis and secretion of the pineal hormone *melatonin,* and on a broad series of regulatory functions mediated by this hormone. Melatonin plays a key role in controlling the 24-hour daily biological rhythm. Disturbance of the normal diurnal melatonin rhythm is associated with altered estrogen receptor formation in the breast, a line of experimental evidence now under study for possible links between ELF field exposure and human breast cancer. Further, melatonin has general properties as a free radical scavenger, with the possibility of a preventative role in oxidative stress, recognized as a basic factor in a broad spectrum of human degenerative disorders, including coronary artery disease, Parkinson's and Alzheimer's diseases, and aging.

8.3.0 Conclusion

Although incomplete, available epidemiological and laboratory data share certain consistencies that would link ELF environmental EMFs with increased health risks. These findings appear to warrant a substantive national commitment to further research, and the serious attention of cognate regulatory agencies and of the general public. Some epidemiological studies relate health effects to broad measures of exposure levels. From these measures, there is an implication that a significant proportion of the world's population may be subjected to a low level of risk, but a risk factor with significant societal consequences, by reason of its pervasive nature and the serious consequences for affected individuals. Much additional research will be necessary to determine the complex nature of dose-response relationships, and the specific contributions of field frequency, intensity and waveforms. A deeper knowledge of mechanisms is needed to elucidate observed differences between intermittent and chronic ELF field exposures. In establishing safety guidelines, there may also be a need to identify populations with specific sensitivities, as is customary with certain chemical toxins. As yet, no research has examined possible synergisms between EMFs and other environmental agents. Further, many electrically operated appliances, such as television receivers, computer display terminals and certain types of electric motors, may generate substantial magnetic fields in their immediate vicinity at frequencies above the ELF spectrum. Although beyond the scope of this report, these fields may also be biologically active. A broader base of experimental data will be required before there can be regulatory implementation of comprehensive safety guidelines; but this considered approach in no way diminishes the desirability of interim standards.

8.4.0 Interim Exposure Guides

Based on available evidence, the committee concludes that it is desirable to reduce human exposure to electric and particularly to magnetic fields over the frequency range from near-zero to 3 kHz. This may be accomplished, particularly in areas with frequent and prolonged human occupancy, by recommending an exposure standard, or a set of safety guidelines; or by recommendations that fall short of establishing either a standard or guideline, but offer guidance to limit exposure.

The past century has seen exponential growth in the universal

use of electric power in every facet of civilized society. With this universal acceptance, engineering considerations have driven the developing technologies of power generation and distribution in ways offering few options for possible changes dictated in the hindsight of either environmental or medical concerns. The burden of fiscal investment alone may make unfeasible drastic modifications of existing systems in the short term.

The committee has therefore addressed these questions of safety in an historical perspective. What safety issues may arise from continuing exposure to existing environmental fields? And for the future, should these exposures be mitigated, and if so, to what levels? Beyond an evaluation of existing exposures, a more pressing issue involves planning for the future of a society wherein use of electric power will continue to grow at every turn.

On the one hand, mitigation of existing exposures may be appropriate in certain instances where exposures may be deemed excessive, based on available epidemiological and laboratory data. In planning for the future, societal impact of this mitigation is likely to prove complex and costly. Prior to implementing major mitigation programs, they will require rigorous evaluation of their risk/benefit ratios. An approach developed by cognizant federal agencies in handling some environmental toxic agents has involved incremental safety guidelines that reflect growth of medical knowledge and availability of improved or more cost-effective mitigation techniques over a period of years.

By contrast with deep-rooted problems inherent in mitigation of many existing exposures, plans for the future should address exposure guidelines in new construction of housing, schooling and industrial plants, with specification of acceptable interior electromagnetic environments, as well as proximity to existing electric power transmission and distribution systems. A second concern addresses construction of new power transmission and distribution systems, and their permissible proximity to existing houses, schools and industrial developments

Although precise numerical levels in safety guidelines covering current environmental exposures may require further research, there is a different perspective on needed guidelines for the future of an increasingly electrified society. From available epidemiological and laboratory data, it appears both prudent and responsible to set limits on permissible future exposures, exercising these options now at a time when their implementation will carry minimal societal impact or fiscal burden.

8.4.1 The Existing ELF Electromagnetic Environment

With respect to the existing electromagnetic environment, four options were considered:

8.4.1.1 Option 1: No recommendation for use of specific field levels to define an exposure safety guideline: *EMFs from distribution and use of electric power have created new exposures in the human environment. Virtually no one in Western society escapes some form of exposure. For that reason, there should be a continuing aggressive pursuit of possible adverse health effects from these exposures. However, the existing evidence bearing on health effects is inadequate to offer exposure guidelines at this time. There is not sufficient consistency among epidemiological studies, and with very few animal studies reported, it is premature to assume a causal relationship between EMF exposure and cancer risk.*

Though not sufficient to conclude causality, the epidemiological studies have raised concern. In addition, animal models for skin and breast cancer are in the early stages of evaluation and preliminary results have been provocative. Despite their logical complexity, further rigorous testing of animal models may offer one of the few options for full elucidation of a possible role of EMFs in tumor formation, since it is unlikely that these data will be derived from epidemiological studies alone.

It must be emphasized that epidemiological studies completed to date do not rule out effects of EMFs on cancer risk, even large ones. This is because of limitations in exposure assessment and undoubted misclassification of exposure, as well as the absence of truly unexposed subjects.

8.4.1.2 Option 2: An exposure guideline of 0.2 ∝T and 10 V/m: *Epidemiological evidence points to human health hazards in exposure to ambient power frequency magnetic field environments exceeding 0.2 ∝T. A dose-dependence for childhood leukemia is suggested for power frequency fields in the range 0.2-0.4 ∝T. Assessment of the ambient magnetic environment in these studies at sites near power transmission and distribution lines has generally not taken account of much higher but more focal fields in the immediate vicinity of operating devices in the home and workplace. Resulting risk estimates may thus underestimate the true exposure levels from all sources. Although largely neglected in the emphasis on magnetic field bioeffects, there is also a body of laboratory evidence relating biologically significant effects, particularly in cerebral tissue calcium binding, to ELF electric field exposures in the range 10-100 V/m. Neurobehavioral effects, including a regulatory role in biological rhythms of man and animals, have been attributed to ELF environmental electric fields at intensities in the range 10-100 V/m.*

Safety guidelines established at the low levels of Option 2 could be expected to have a major impact on lifestyles and working conditions in homes and in most occupational settings. Mitigation of existing fields needed to achieve general compliance would appear impractical at this time.

8.4.1.3 Option 3: An exposure guideline of 1 ∝T and 100 V/m: *A considerable body of observations has documented bioeffects of fields at these strengths across the gamut from isolated cells to animals, and in man. Although the majority of these reported effects do not fall directly in the category of hazards, many may be regarded as potentially hazardous. Since epidemiological studies point to increased cancer risks at even lower levels, a case can be made for recommending 1 ∝T and 100 V/m as levels not to be exceeded in prolonged human exposures. Most homes and occupational environments are within these values, but it would be prudent to assume that higher levels may constitute a health risk.*

In the short term, a safety guideline set at this level would have significant consequences, particularly in occupational settings and close to high voltage transmission and distribution systems, but it is unlikely to disrupt the present pattern of electricity usage. These levels may be exceeded in homes close to transmission lines, distribution lines and transformer substations, in some occupational environments, and for users of devices that operate close to the body, such as hair dryers and electric blankets. From a different perspective, adoption of such a guideline would serve a dual purpose: first, as a vehicle for public instruction on potential health hazards of existing systems that generate fields above these levels, as a basis for "prudent avoidance"; and second, as a point of departure in planning for acceptable field levels in future developments in housing, schooling, and the workplace, and in transportation systems, both public and private, that will be increasingly dependent on electric propulsion.

8.4.1.4 Option 4: The ALARA concept (as low as reasonably achievable): *The ALARA concept derives from guidelines for exposure to ionizing radiation. In that context, it first requires acceptance of a specific numerical guideline, and thereafter, due diligence in seeking progressive exposure reduction to levels at or below the guideline. Although the aggregate evidence suggests a significant health risk from these fields, there is as yet inadequate information to establish thresholds that would implicate specific field levels as safe or hazardous. Therefore, in the interval required for further research, individuals, industries and govern-*

ment agencies would have responsibilities to make human exposures as low as reasonably achievable in meeting a postulated numerical exposure guideline developed as part of an ALARA scheme.

An ALARA approach also offers an avenue to safety guidelines to be implemented incrementally. An incremental approach to dealing with potential environmental hazards is a model successfully employed by the Environmental Protection Agency, in joint actions with other federal agencies, in dealing with toxic waste cleanup. Appropriate benchmarks are established that project realizable goals at stated future times. An incremental approach on a large scale has been applied by EPA to the control of automobile emissions in Southern California, under the federal Clean Air Act.

Based on Option 3, a set of ALARA goals may be defined with benchmarks projected over a minimum of six and a maximum of ten years, as a template for an incremental guideline. In homes, schools, nonindustrial workplaces, and in suburban environments, *a first ALARA benchmark* at three years should reduce ambient exposures to 1.0 ∝T [and] 100 V/m (Option 3). Thereafter, *a second benchmark* at six years would set a goal at 0.5 ∝T [and] 50 V/m. Beyond this point, implementation of the *third benchmark* in an incremental safety guideline for the general public at a further sharply reduced level (as in Option 2) at 0.2 ∝T [and] 10 V/m will require a careful evaluation of its socioeconomic impact, as well as its cost-effectiveness. It would not be expected to occur until about seven years after implementation of benchmark 1. Its justification would also be based on new correlated laboratory and epidemiological data expected to be available over the next decade.

For individuals, educational requirements inherent in this ALARA scheme may be difficult to achieve; but at the societal level, there should be a technological focus on such topics as grounding in electrical distribution systems, manufacturing of appliances designed to reduce stray field levels, and elevation of consumer awareness of possible hazards associated with particular appliances.

8.4.2 Conclusion on an Interim Exposure Guideline for the Existing Electromagnetic Environment

Though not unanimous, the predominant view of the committee is to recommend the ALARA approach. It is proposed that this ALARA guideline be progressively implemented over a ten-year period. It is recommended that specific field levels cited here be regularly reviewed as more information becomes available that might suggest either more or less stringent figures as the basis for a continuing ALARA policy. Specifically, the pathophysiology of cumulative dose has yet to be defined, and with it, the relevant parameters in long-term EMF exposure.

The proposed initial benchmark for a safety guideline would be developed under Option 3. After three years, maximum acceptable field levels would not exceed 1.0 ∝T and 100 V/m over the spectrum from near-zero to 3.0 kHz in homes, schools, and other nonindustrial environments. In a review after six years, there would be an option to establish a guideline at 0.5 ∝T and 50 V/m. Thereafter, at ten years, and only after full review of socioeconomic as well as its technical implications, there would be an option to establish a guideline at 0.2 ∝T [and] 10 V/m. There would be options to truncate both lead times and acceptable field parameters if favored by availability of appropriate laboratory or epidemiological evidence.

With respect to occupational exposures, the committee reviewed the composite nature of exposures in the workplace, where EMFs, often at high levels, coexist with a variety of chemical factors known to be hazardous, including neurotoxins, pesticides, herbicides and organic solvents. Although there is evidence that EMFs may promote actions of these chemical factors in pathogenesis of human disease, particularly in relation to joint exposures over many years, these data are insufficient for evaluation of their joint or separate roles. Moreover, in most instances, economic considerations would render unfeasible a major reduction in existing industrial field levels through engineering approaches. These exposures may also involve high levels of static magnetic fields, for which there is very little relevant laboratory or epidemiological data.

In typical office environments, ambient field levels may differ very little from domestic ambients. The committee therefore recommends use of the incremental ALARA guideline described above. However, the industrial workplace may involve intermittent or continuous exposure to fields orders of magnitude higher. In these situations, the committee also recommends an ALARA approach for 60 Hz fields, but with an awareness that neither major reductions in existing field levels, nor options to significantly reduce operating personnel exposures are immediately feasible on technical or economic grounds. As a long-term (ten-year) goal, an ALARA approach to mitigation in existing industrial environments would envisage a time-limited personnel exposure not exceeding one hour in any eight-hour workshift, and with time-averaged fields not to exceed 10 ∝T and/or 1 kV/m for any one hour in an eight-hour workshift. This guideline does not address magnetic transients associated with starting or stopping large inductive devices. Its development towards time-limited exposures is suggested by laboratory reports of ELF and RF exposures that modulate immune cell functions in a time-dependent manner.

The committee recommends further research into field mitigation, including the possibility of developing protective clothing capable of magnetic shielding, as a possible option in personnel protection in high-level industrial magnetic fields.

8.5.0 Exposure Guidelines Relating to Future Developments Affecting the ELF Electromagnetic Environment

There may be important societal options in considered planning for the future of electric power transmission, distribution and use. Planned development may avoid hazards and pitfalls of existing systems, and by offering guidance in new construction, may avoid much of the heavy economic impact inevitable in retrofitting and mitigating suspected health hazards associated with past and present technologies.

As safety guidelines for future planning, the committee recommends that: *1) New day care centers, schools and playgrounds should not be built where ambient 60 Hz magnetic fields exceed 0.2 ∝T; 2) New housing should not be built under existing high voltage transmission lines, or in such close proximity to these lines that measured ambient field levels would exceed 0.2 ∝T for periods longer than two hours daily; 3) New transmission and distribution lines should not be built in locations where they would produce fields exceeding 0.2 ∝T in existing housing; 4) In new office and industrial environments, design considerations should encompass problems of personnel exposure to high magnetic field levels, with the aim of reducing intermittent and ambient exposures to a 0.2 ∝T level, over the spectrum from near-zero to 3.0 kHz.*

8.5.1 Conclusion

In arriving at the proposed guidelines, the committee has considered available laboratory studies on bioeffects and epidemiological reports of health hazards from electric and magnetic field exposure. Lacking a basis for calculation of cumulative dose, these guidelines have been determined without drawing distinctions between acute and chronic exposure. They have not determined exposure levels from safety factors frequently used with other agents, nor has there been special consideration for sex, age or potentially sensitive populations, such as pregnant women, because current knowledge of mechanisms of field interactions does not allow identification of those likely to be affected. In medical diagnostic and therapeutic applications, these guidelines would exclude patients, but would apply to physicians, nurses and to all other health providers.

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UPDATES

BOOKS

Technical Primer on EMFs...A new book from CRC Press, *Power Frequency Magnetic Fields and Public Health,* explains how to estimate the strength and distribution of magnetic fields produced by the use of electric power. Coauthors William Horton and Saul Goldberg, both professors of electrical engineering at California Polytechnic State University in San Luis Obispo, write that they wanted the book to be accessible to "a nontechnical reader," but equally of interest to an engineer, scientist or architect. "The book focuses on characterizing the various kinds of field sources—transmission lines, transformers, ground currents, appliances, and so on—and allows readers to determine what their exposure might be," Horton told *Microwave News*. A number of two- and three-dimensional contour maps provide clear descriptions of different kinds of fields, from those in a typical residential living room to those around a pad-mounted transformer. The book leads the reader through the equations needed to calculate field strengths, with the most complicated technical material reserved for the appendixes. There is an extensive glossary of technical terms, and a section on how to apply prudent avoidance in one's daily life. Also on the Cal Poly faculty is Dr. David Hafemeister, author of the background paper for the American Physical Society's recent statement on EMFs (see *MWN,* M/J95). Hafemeister has recently spoken out against the concept of prudent avoidance (see p.10). Horton said that he and Hafemeister are friends and he downplayed any differences in their views: "His conclusion was that it would not be a good use of public funds to make big expenditures to reduce EMFs, and I would have to agree with that. I would just do the simple things, where you can reduce exposure without spending a lot of money." He added that, "I personally don't think there's much danger due to power frequency fields, but if I had a child I wouldn't put the crib next to the incoming power service. Who knows what the next study's going to show?" *Power Frequency Magnetic Fields and Public Health* costs $59.95. Order from: CRC Press, 2000 Corporate Blvd., NW, Boca Raton, FL 33431, (800) 272-7737 or (407) 994-0555, Fax: (800) 374-3401 or (407) 998-9114.

CALL FOR PAPERS

RF/MW Medical Applications... The October 1996 issue of *IEEE Transactions on Microwave Theory and Techniques* will deal with medical applications and biological effects of RF/MW radiation. Those interested in contributing papers on medical therapies, diagnostic techniques or safety issues should contact: Arye Rosen, David Sarnoff Research Center, 201 Washington Rd., CN 5300, Princeton, NJ 08543, or Andre Vander Vorst, Hyperfrequences, UCL, Bâtiment Maxwell, B-1348 Louvain-la-Neuve, Belgium. Manuscripts are due by this October.

CELLULAR PHONE INTERFERENCE

Astronomers' Concerns... New forms of mobile telecommunications technology could close the heavens to radio astronomers, according to the European Science Foundation (ESF) in Strasbourg, France. Concerned by plans for mobile phone sys-

tems using satellites in low earth orbit (for instance, Motorola's Iridium system), the ESF warned that, "To succeed, this potentially billion-dollar industry will need access to several frequency bands which are also crucial to the world's radio astronomers." The ESF said that cell phone interference with astronomy is already "a growing problem which the International Telecommunications Union (ITU) appears reluctant to recognize." Dr. James Cohen of the U.K.'s Jodrell Bank radio telescope explained the effects of interference: "It's like [being] a professional photographer who, despite being equipped with the latest in modern cameras, finds that just as he presses the shutter someone else shines a flashlight into his lens." Dr. Peter Napier of the U.S. National Radio Astronomy Observatory in Socorro, NM, said that the ESF's concerns are shared by U.S. astronomers. Napier praised some companies, including Motorola and the American Mobile Satellite Corp., for seeking the input of astronomers as they plan for satellite systems. This November, the ITU will decide which frequencies to allocate to satellite-linked phones.

CELLULAR PHONE TOWERS

When Is a Tree Not a Tree?... The telecommunications industry is branching out into aesthetics. With siting problems plaguing cellular phone companies throughout the country, the industry is looking for a way to camouflage its towers. Arcnet Inc. of Holmdel, NJ, may have the answer with its tree look-alike tower. Modeled after a white pine, the antenna can be 10 feet to 200 feet tall. The "limbs" of the pine tree vary from 2 feet to 14 feet and are made of polyvinyl chloride pipe coated with epoxy resin "bark." Not to worry if you want to erect an antenna tower in the tropics or the desert. Arcnet also is marketing royal palm and saguaro cactus look-alike towers.

COMET ASSAY

Lai-Singh Paper Published... The report by Drs. Henry Lai and Narendra Singh, which has attracted so much attention in the cellular phone community, is now in print (see *MWN,* N/D94). "Acute Low-Intensity Microwave Exposure Increases DNA Single-Strand Breaks in Rat Brain Cells" appears in *Bioelectromagnetics (16,* pp.207-210, 1995), which came out in early July. Lai and Singh, both of the University of Washington, Seattle, used the comet assay to measure DNA damage, a technique that Singh helped develop. In a recent review, Drs. Daryl Fairbairn and Kim O'Neill of Brigham Young University in Provo, UT, and Dr. Peggy Olive of the British Columbia Cancer Research Centre in Vancouver, Canada, conclude that, "The versatility of applications of the comet assay indicates its usefulness in addressing a wide range of questions in biology, medicine and toxicology." See "The Comet Assay: A Comprehensive Review," *Mutation Research, 339,* pp.37-59, February 1995.

MEETINGS

Hypersensitivity Conference... The proceedings of the *2nd*

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PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION
CHIEF, RADIATION BIOLOGY BRANCH

The Center for Devices and Radiological Health, Food and Drug Administration (FDA) is seeking a qualified individual to serve as Chief, Radiation Biology Branch, Division of Life Sciences, Office of Science and Technology. Responsibilities include direction and development of intra- and extramural FDA-related scientific programs in radiation biology; developing regulatory, educational, and other strategies concerning radiation-emitting products; representing FDA with national and international organizations; and establishing the technical basis for regulatory and policy matters.

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Research Opportunities

The California Public Health Foundation, fiscal manager for the California EMF Program, will soon issue Requests for Proposals (RFPs) for the following projects:

- Prospective Epidemiological Study of Spontaneous Abortion ($1,200,000);
- Power Grid and Land Use Policy Options ($550,000);
- Utility Workers Employees Policy Options ($170,000);
- Engineering Options Review ($97,000);
- Risk Assessment Guidelines ($130,000).

Later, the program will contract epidemiology consultants to write articles on selected topics of EMF epidemiology.
For further information or for a copy of these RFPs, contact: Dr. Vincent DelPizzo, EMF Program, 5900 Hollis St., Suite E, Emeryville, CA 94608, Tel: (510) 540-3657, Fax: (510) 540-2673.

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Copenhagen Conference on Electromagnetic Hypersensitivity, held in May 1995, are now available. Edited by Drs. Jyrki Katajainen of the Department of Computer Science at the University of Copenhagen, Denmark, and Bengt Knave of the Department of Neuromedicine at the National Institute of Occupational Health in Solna, Sweden, the 138-page book is comprised of 23 papers. The paperback volume, which costs 210 Danish Kr. (approximately $40), can be ordered by contacting: Danish Association for the Electromagnetically Hypersensitive, c/o Aase Thomassen, Lunden 1, Ålum, DK-8900 Randers, Denmark; (45) 86 46 61 14.

PEER REVIEW

Latest NIH Panel... Paul Strudler of NIH's Division of Research Grants in Bethesda, MD, convened a peer-review panel to examine EMF proposals, June 29-30. The members of the panel were: Drs. Deborah Cory-Slechta, University of Rochester, NY; Christopher Davis, University of Maryland, College Park; Amato Giaccia, Stanford University, Stanford, CA; David Grdina, Argonne National Laboratory, Argonne, IL; Sek-Wen Hui, Roswell Park Cancer Institute, Buffalo, NY; Howard Liber, Harvard School of Public Health, Boston; David McCormick, IIT Research Institute, Chicago; Steven Miller, SRI International, Menlo Park, CA; William Morgan, University of California, San Francisco; Keith Paulsen, Dartmouth College, Hanover, NH; Terry Pellmar, Armed Forces Radiobiology Research Institute, Bethesda, MD; Charles Polk, University of Rhode Island, Kingston; Joseph Roti Roti (chair), Washington University, St. Louis; Robert Ullrich, University of Texas, Galveston; and Peter Valberg, Gradient Corp., Cambridge, MA.

PEOPLE

Dr. **Richard Luben** of the University of California, Riverside, is the president-elect of the Bioelectromagnetics Society. He will take over from Dr. **Kjell Hansson Mild** of Sweden's National Institute of Occupational Health in Umeå, next year....**Frank Young** has taken a leave of absence from Enertech Consultants in Campbell, CA, where he is a senior vice president, to go to Jilin City in the People's Republic of China. He will be teaching electrical engineering at the invitation of the Northeast China Institute of Electric Power Engineering....The NCRP has reorganized its activities into nine scientific program areas. Dr. **Tom Tenforde** has been appointed vice president for non-ionizing radiation....**Michael Withey** is the new president of Trial Lawyers for Public Justice....Dr. **John Osepchuk** has retired from Raytheon Co. He has set up Full Spectrum Consulting, based in Concord, MA. In addition, he will continue to serve as the acting chairman of SCC28 on Non-Ionizing Radiation Hazards.

RESOURCES

Review Paper... Drs. Eugene Goodman, Ben Greenebaum and Michael Marron have published "Effects of Electromagnetic Fields on Molecules and Cells," in the *International Review of Cytology, 158,* pp.279-338, 1995.

CLASSIFIEDS

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Both Electric and Magnetic Fields Seen as Critical to Cancer Risk

Ontario Hydro Worker Study Links Combined Exposures to Excess Leukemia

Workers exposed to high levels of magnetic *and* electric fields had leukemia rates that were up to 11 times greater than expected, according to researchers at the University of Toronto in Canada. This result indicates that electric field exposures may play a crucial role in the link between cancer and power frequency electromagnetic fields (EMFs). The leukemia risks found by the Toronto team are some of the highest reported in a major epidemiological study.

"Up until now, people have tended to pursue the notion that any cancer effects were likely to be from magnetic fields," said Dr. Anthony Miller,

See Commentary on Exposure Assessment, p.7

lead author of the Toronto paper, published in the July 15 issue of the *American Journal of Epidemiology (144,* pp.150-160, 1996). "However, this study suggests that electric fields are potentially critical to cancer risk."

Dr. David Agnew, a senior safety scientist at Ontario Hydro in Toronto and a member of Miller's team, agreed that the findings are "important." He predicted that they will prompt "future research to explore this further."

The Ontario Hydro results have put electric fields back in the limelight.

(continued on p.5)

FCC RF/MW Rules Favor NCRP Limits; Cell Phones To Be Tested for Safety

The Federal Communications Commission (FCC) has adopted final health and safety regulations for exposures to radiofrequency and microwave (RF/MW) radiation. The new rules are based in large part on those recommended by the National Council on Radiation Protection and Measurements (NCRP) in 1986, although the FCC adopted some provisions from the 1992 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE) guidelines.

"We believe that the exposure criteria we are adopting will protect workers and the general public from potentially harmful RF emissions due to FCC-regulated transmitters," stated the FCC in its August 1 *Report and Order.* In favoring the NCRP limits, the FCC sided with the Environmental Protection Agency and against the communications and electronics industries, which had mounted a massive lobbying campaign in favor of the ANSI/IEEE standard (see *MWN,* M/J94 and M/A96).

The FCC will now require that all new cellular and personal communi-

(continued on p.13)

EMF NEWS

« Power Line Talk »

Are power line EMFs as harmless as moonlight? Last June's PBS television program ***Frontline*** (see *MWN,* J/A95) made this comparison, and this argument is becoming common among those seeking to downplay the EMF issue. The *Frontline* narration, which was written by **Jon Palfreman**, who also produced the show, stated that, "Physicists have calculated a person standing under a power line at night would get some 10,000 times more electromagnetic energy from moonlight than from the power line." The figure recently resurfaced in an interview for an ABC-TV special on scientific controversies hosted by **John Stossel** and scheduled to air this fall. **Marc Dorian**, the ABC program's producer, did not know the origin of the moonlight argument, but said it was a standard point in the EMF debate. When *Microwave News* asked Dr. **Robert Adair** of the Yale University Department of Physics in New Haven, CT, one of the physicists in the *Frontline* piece, about it, he replied that it was new to him. Later, after doing the math, he called back and said, "The calculation is in the ballpark." Dr. **Charles Polk** of the University of Rhode Island in Kingston, a coeditor of CRC Press' *Handbook of Biological Effects of Electromagnetic Fields,* agreed that the calculation may be accurate, but he was nevertheless harshly critical: "It is a propaganda argument and it's totally irrelevant—it has nothing to do with the possibility or impossibility of biological effects." Palfreman's assistant credited the statement to Dr. **Peter Valberg**, a utility consultant with the Gradient Corp. in Cambridge, MA. Valberg said in an interview that some of the points that led him to this calculation came from a 1994 report he wrote for **EPRI** on possible EMF mechanisms of interaction (see *MWN,* J/F96). When Stossel posed the moonlight question on June 28 to **Joan Tukey** of the **California Alliance for Utility Safety and Education** (CAUSE), a citizens group based in San Diego, she asked **Michael Silva** of Enertech Consultants in Campbell, CA, to join the discussion. Tukey told *Microwave News* that when Silva—who was also scheduled to appear on the show—approached the cameras, Stossel ordered them turned off. "I tried to explain to Stossel the problems with that argument," Silva said. Tukey, who had grown increasingly frustrated by the tone and direction of Stossel's questions, walked away from the interview. In a July 1 letter to ABC News Executive Producer Victor Neufeld, Tukey pointed out that, prior to the interview, readings of up to 85 mG were measured in a power line corridor in a residential neighborhood. Stossel himself is no stranger to controversy, having been called by consumer advocate **Ralph Nader** "the most dishonest journalist" he ever met. Stossel's 1994 ABC special, "Are We Scaring Ourselves to Death?" prominently featured Dr. **John Graham**, director of the Harvard Center for Risk Analysis in Boston, which established an EMF risk assessment program that is being funded by industry groups including EPRI (see *MWN,* J/A94). Stossel has also been referred to as "the darling of conservative and industry groups" by the *Washington Post* and has received as much as $22,000 per lecture. He claims to be giving proceeds from his speaking engagements to charity since an ABC policy took effect in 1994 barring correspondents from accepting money from corporations and trade associations. But while Stossel gave about $135,000 from 1994 lectures to charity, he pocketed some $25,000, according to the April 17, 1996, *Corporate Crime Reporter,* a Washington-based newsletter.

«« »»

"They treated me like a pig," **Father Shay Cullen** said of the Philippine police who arrested him on June 13 in Olongapo. The 53-year-old priest told the ***Philippine Daily Inquirer*** that he and a colleague, Lowell Maglaqui, were brutally beaten before being arrested without warrants for protesting the routing of high-voltage power lines near a home for destitute children (see *MWN,* M/J96). In a press release issued on July 3, Cullen said police forced their way onto the platform he had built atop a 40-foot pylon, where he had been staging his protest since April. The priest noted that the police then closed its curtains and began beating him up. He also claimed that his radio, cellular phone and camera were confiscated and not returned. Cullen's statement on the incident also alleged that an officer approached Alex Hermoso, a bystander who was taking photographs of the arrest, and ordered him at gunpoint to hand over his radio and camera. Police Chief Nicasio Radovan denied the charges, reported the *Daily Inquirer* on June 15, and claimed that his officers had patiently tried to convince the priest to climb down from the pylon for his own safety. Radovan said that he was following the orders of the town's mayor, Katherine Gordon, to remove the priest from the pylon. Cullen told *Microwave News* that these events show "the cost of protest in the Philippines." But he vowed that, "We will continue on with court actions and public awareness raising."

«« »»

The melatonin hypothesis got a big boost when ***Cancer Research*** featured Dr. **Richard Stevens** on the cover of its July 15th issue. Below a photograph of Stevens, the prestigious journal featured a flow diagram that outlines how light-at-night and/or EMFs from electric power could lead to low levels of melatonin, which in turn could lead to increased breast cancer risks. Dr. **Sidney Weinhouse**, the cover editor of *Cancer Research,* commented that the "direct evidence" for Stevens's hypothesis, first proposed in 1987 (see *MWN,* J/F87), "is sparse but provocative." Weinhouse, a member of the National Academy of Sciences since 1979 and formerly the editor of the jour-

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nal, added that the "body of evidence is sufficient to bind electric power over for trial, but not nearly adequate to render a verdict." The hypothesis' next big test will come next spring, when Stevens and Dr. Scott Davis of the Fred Hutchinson Cancer Research Center in Seattle announce the results of their major epidemiological study, which tests Stevens's theory (see *MWN,* N/D91). "I'm delighted," Stevens told us from his office at the Battelle Pacific Northwest Labs in Richland, WA. "*Cancer Research* is one of the most respected journals in the cancer research community and this is a real honor." He added that he is pleased with the recognition, not only for himself but also for the field of bioelectromagnetics: "This is a mainstream and highly visible recognition of the EMF research effort."

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The **DOE** and the **Fetzer Institute** are sponsoring a small by-invitation-only workshop on ***Self-Organized Biodynamics and Control by Chemical and Electromagnetic Stimuli,*** which will be held at the institute in Kalamazoo, MI, August 10-14. Those who do not attend will have a chance to cover some of the same ground in San Antonio on Sunday, November 17. The Texas meeting—***The Emerging Science of Nonlinear Dynamics and Self-Organized Systems: Can It Help Explain Reported EMF Bioeffects?***—is scheduled for the afternoon before the start of DOE's annual EMF research review. For more information on the DOE review, contact: Dr. William Wisecup, W/L Associates, 7519 Ridge Rd., Frederick, MD 21702, (301) 663-1915, Fax: (301) 371-8955. Special room rates at the St. Anthony Hotel in San Antonio are available for those who reserve by October 13.

«« »»

Dr. **Leonard Sagan**, who led EPRI's EMF program for many years before his retirement, has published ***Electric and Magnetic Fields: Invisible Risks?*** The 214-page paperback was issued in June by Gordon and Breach, which is based in Amsterdam, The Netherlands. In a foreword, Dr. **Donald Kennedy**, the former head of the FDA and the president emeritus of Stanford University, urges readers not to "accept at face value either the apocalyptic visions presented in the media, or the bland reassurances they receive from self-appointed experts." The book is available in the U.S. for $19.95 from: International Publishers Distributor, Attn: Marketing, c/o PO Box 200029, Riverfront Plaza Station, Newark, NJ 07102.

«« »»

The first damage award in an EMF personal injury case just got bigger. **John Altoonian** and his wife had won a jury verdict of $762,524 against **Atlantic Electric**, most of it for emotional distress (see *MWN,* M/J96). But in the official final judgment on June 25, New Jersey Superior Court Judge Charles Previti added interest charges of $174,873, as well as $8,870 that the utility had already agreed to pay for trespass, bringing the total amount to $946,267. The award is under appeal.

NAS-NRC EMF Report Watch

This time, the National Academy of Sciences - National Research Council (NAS-NRC) sounds quite certain. Its report on EMF health effects is now due out in early September—most likely the week of September 9.

"It's in post-review editing," said Dr. John Zimbrick, the director at NRC's Board on Radiation Effects Research in Washington. He noted that all the scientific reviews have been completed. The board will soon start working with the news office to schedule a press conference.

Cancer Plaintiffs' Lawyers Must Pay for Utility's Experts

The law firm representing plaintiffs in a major EMF–cancer suit has been ordered to pay all expert witness fees—past and future—for the defendants, which include Southern California Edison Co. (SCE). A higher court put the case on hold on June 20, so that it could consider an appeal of the unusual sanction.

The lawsuit, *Younkin v. SCE,* was brought by employees of an Orange County real estate firm who developed cancer while working in an office located over a set of SCE transformers (see *MWN,* J/A94, M/J95 and J/F96).

Superior Court Judge Dennis Choate imposed the penalty when an expert witness for the utility refused to testify after receiving a letter of complaint from the plaintiffs' lawyers. At a February 1 hearing, Choate emphasized that dissuading a witness "is a crime in this state," and angrily compared the case to another, in which a gang member had drawn his finger across his throat while staring at a witness in the courtroom. "This is a dumb move," said Choate, according to hearing transcripts. "Felony dumb move. Misdemeanor dumb move. This should be reported to the state bar....I don't know whether I am obligated to refer it to the district attorney."

"It's a pretty strong sanction," commented SCE lawyer Joel Lamp, of O'Connor, Cohn, Dillon & Barr in San Francisco. "I've never seen it imposed before. The judge actually thought it was more serious than we did—he was very upset." Lamp said that this penalty was all the more striking because SCE had not requested it.

"It's just a disaster," said Annee Della Donna of the Santa Ana, CA, firm of Wylie Aitken. She contended that the ruling had created a conflict of interest that made it impossible to represent the plaintiffs fairly. Della Donna stated that her firm had already spent over $100,000 in costs—a figure that does not include any payment for the attorneys' time.

"Every decision concerning this action is now an ethical struggle between counsel's interest in reducing expert costs and their duty of undivided loyalty owed to the clients," Della Donna argued in court papers filed on March 28. If the sanctions ruling is not overturned, she told *Microwave News,* her firm will be required by state bar association rules to withdraw from the case. "Then the clients will be left to represent them-

Expert Witnesses and Fees in Office Cancer Suit

Listed below are selected expert witnesses in Johsz v. Koll, *an EMF–cancer lawsuit brought by a group of office workers against the Grubb & Ellis real estate firm, building owner Koll Co. and Southern California Edison Co. (see below). Witness lists have not yet been submitted in a related case,* Younkin v. SCE, *but attorneys for both sides say that they expect to retain the same experts on EMFs.*

For ***Plaintiffs:***		
John Bobis, PE	Engineering consultant, Rancho Cordova, CA	$1,100 first hour; $275 each additional hour
Dr. Wayne Lancaster	Economics consultant, Fullerton, CA	$360 first hour; $180 each additional hour
Dr. Abraham Liboff	Oakland University Physics Department, Rochester, MI	$2,000/day
Dr. Samuel Milham Jr.	Epidemiology consultant, Olympia, WA	$350/hour testimony; $100/hour standby
Gerard Moulin	Expert Technical Consultants, Thousand Oaks, CA	$275/hour
Dr. David Ozonoff	Boston University School of Public Health, MA	$3,200/day
For ***Defendants:***		
Dr. Hoda Anton-Culver	College of Medicine, University of California, Irvine	$150/hour
Dr. Patricia Buffler	University of California School of Public Health, Berkeley	$400/hour
Dr. Philip Cole	University of Alabama School of Public Health, Birmingham	$400/hour
Bill Eisinger, PE	Power Engineers Inc., Hailey, ID	$175/hour
Dr. Edward Gelmann	Lombardi Cancer Research Center, Washington, DC	$300/hour
Dr. Victor Levin	Anderson Cancer Research Center, University of Texas, Houston	$600/hour
Dr. Judith Luce	Oncology Services, San Francisco General Hospital, CA	$350/hour
Dr. Saul Allen Rosenberg	Oncology Division, Stanford University Medical Center, Stanford, CA	$400/hour
Dr. Jack Sahl	Southern California Edison, Rosemead, CA	(defendant's employee)
Michael Silva, PE	ENERTECH Consultants, Campbell, CA	$185/hour
Dr. Peter Valberg	Gradient Corp., Cambridge, MA	$180/hour

selves," she said, "and the case will go down in flames."

The expert witness involved is Dr. Hoda Anton-Culver, an epidemiologist at the University of California, Irvine, and the head of the Orange County Cancer Registry. She had been retained by SCE in *Younkin* and a related lawsuit, *Johsz v. Koll,* which grew out of the same cluster of cancer cases. The two actions involve different groups of workers but the same defendants—the Rosemead, CA-based utility, the real estate firm and the building owner. Both cases also involve the same attorneys on each side and substantially the same list of expert witnesses (see table above).

By coincidence, a plaintiff in *Johsz* named Mary Ann Stewart has a sister who is part of an unrelated breast cancer study being conducted by Anton-Culver. As part of that study, Anton-Culver asked Mary Ann Stewart to come to her office to be interviewed and provide a blood sample. Stewart did so on December 10.

When Della Donna learned what had happened, she accused Anton-Culver of improper conduct. "My feeling was that Dr. Anton-Culver had disqualified herself and would have to withdraw," she explained, noting that Anton-Culver had obtained "confidential medical information" without revealing that she was working for SCE. Della Donna said that the lawsuit was discussed during the office visit, and since Anton-Culver had read the plaintiffs' depositions, she "would have had to have her nose buried in the ground not to know that it was the same case."

Della Donna then wrote a letter to all defense attorneys demanding the return of the blood sample, insisting that Anton-Culver withdraw from the case and threatening legal action if she tried to take the stand. Della Donna also sent copies to Anton-Culver and her dean at UC Irvine. Soon afterwards, Anton-Culver informed SCE's attorneys that she would not testify.

SCE complained to Judge Choate about Della Donna's contact with its witness and asked that he dismiss the case. Choate rejected this request but ordered that a report which Anton-Culver had prepared for SCE be entered into evidence, even though she would not testify in support of it. He announced that he would tell the jury that her absence was the fault of the plaintiffs. And he ordered the plaintiffs' law firm to pay for all the defendants' expert witnesses as compensation for what he called "the kill shot inflicted upon witness Anton-Culver."

At the February hearing, Choate scolded Della Donna for taking action independent of the court: "Why didn't you...say, 'Judge, we have a problem here'?...Why don't you go through the route you are supposed to go through? Why do you have direct contact with the witness to the point where the witness has refused to testify?" The appeal of Choate's ruling will be heard by a three-judge panel on January 21, 1997.

Meanwhile, Della Donna filed a brief appealing the dismissal in the *Johsz* case on June 24. That case had been thrown out on December 8 of last year, in a dispute over admissible evidence and proof of causation (see *MWN,* M/J95 and J/F96).

In another major California EMF suit, the state's Supreme Court heard oral arguments on June 6 in the *Covalt* property-devaluation case (see *MWN,* N/D95). A decision is expected by the end of the summer. In May of 1995 an appeals court ruled that the state's public utilities commission had exclusive jurisdiction over all EMF issues, and that the *Covalt* case therefore did not belong in court.

New Support for Railway Exposure–Leukemia Link

Two new studies of Swedish railway workers provide further support for a link between EMF exposure and excess cancer risk. Building on Dr. Birgitta Floderus's 1993 study of railway workers, Dr. Lars Alfredsson's new research found a significantly higher rate of lymphocytic leukemia among these workers. Similarly, Dr. Ingrid Nordenson's study of railway employees detected a significantly higher incidence of chromosome breaks among the workers.

The study of engine drivers and conductors by a team from the Karolinska Institute in Stockholm led by Dr. Alfredsson showed that the incidence of chronic and acute lymphocytic leukemias was more than double that for the average Swedish male—a statistically significant finding. Published last May in *Cancer Causes and Control (7,* pp.377-381, 1996), the report described the data as uncertain, because of the small number of cases involved. There were ten cases of lymphocytic leukemia—eight chronic and two acute—observed in the railway workers from 1976 to 1990. Alfredsson said that it should be kept in mind that the 230 percent increase in lymphocytic leukemia among the workers corresponds to "about four extra cases...in a cohort of more than 9,000 engine drivers and conductors over a period of up to 14 years." He also pointed out that there was no increase in brain tumors observed in the cohort.

The study by Nordenson and her coauthors showed that engine drivers had a significant increase in chromosome breaks, which, the team argued, are associated with future cancer risk. It was conducted by the National Institute for Working Life (NIWL) in Umeå and presented at the Bioelectromagnetics Society annual meeting in June. The 18 drivers comprising the cohort were compared to a control group of seven dispatchers and 16 office workers.

The high and fluctuating EMF levels the drivers were exposed to occasionally reached into a range of 20 mG to 400 mG, with peak values at times exceeding 1300 mG. The mean value of occupational exposure for the control group was 2 mG.

While the study showed that the level of chromosomal aberrations overall was not significantly high, a significant number were found when only chromosome breaks were examined. In contrast to the 1.3% of drivers' cells with chromosomal breaks, the controls had only 0.3%.

Alfredsson's study agrees with the findings of Birgitta Floderus's epidemiological study of railway employees *(Cancer Causes and Control, 5,* pp.189-194, 1994), which showed cancer increases in workers exposed to EMFs. Alfredsson's study overlaps Floderus's, in that data from about 50% of the subjects, compiled between 1976 and 1990 and included in the new study, were initially used in the analysis of railway workers by Floderus, who is with the NIWL in Solna (see p.7 and *MWN,* S/O92, M/J94 and S/O95). Indeed, Alfredsson relates that both studies indicate that "this disease has persisted over time."

As early as 1985, the same team led by Nordenson was finding similar effects in substation workers (see *MWN,* J/F 85). This previous study showed that spark discharge pulses elicited chromosome breaks.

NIOSH Seeks Better Data for Railroad Worker Health Study

The National Institute for Occupational Safety and Health (NIOSH) will not embark on a study of railroad track workers because existing employee records are insufficiently detailed to gauge EMF exposures. The institute may, however, study railroad conductors—whose numbers are larger and whose exposure levels, NIOSH believes, may be higher.

In its *Electromagnetic Fields and Rail Maintenance Workers: Final Report of an Exposure Survey and Feasibility Investigation,* NIOSH found that employee records are not complete enough to estimate track workers' exposure levels. The feasibility study, which was released earlier this year, came in response to requests from Senator John Kerry (D-MA) and three congressmen—Frank Pallone Jr. (D-NJ), Robert Andrews (D-NJ) and Robert Borski (D-PA). In his March 6, 1993, letter to NIOSH, Pallone called the study "necessary," and stressed the "compelling need to further investigate this matter." His letter was prompted by a Pennsylvania railroad union's concerns over the health of its members.

Average exposures of rail maintenance workers are believed to be "slightly higher than the exposures of workers in other industries," according to NIOSH. These workers had higher exposures when a train was nearby. For example, average exposures rose from 12 mG to 80 mG as a train approached. Peak levels ranged from 34 mG to 185 mG when the train was passing the measurement location.

"We hope to take further measurements to learn if conductors have higher exposures than rail maintenance workers," said NIOSH's Dr. Thurman Wenzl in Cincinnati. "If so, rail passengers may also have elevated exposures on trains powered by overhead lines."

Dr. Birgitta Floderus has found that engine drivers had a threefold increased risk of chronic lymphocytic leukemia (see story on left), while Dr. Tore Tynes of the Cancer Registry of Norway in Oslo found no elevated leukemia risk among track workers.

Ontario Hydro Worker Study *(continued from p.1)*

They were the principal focus of attention in the 1970s and early 1980s, but in the mid-1980s researchers shifted their attention to magnetic fields. Earlier this year, a U.K. group suggested that electric fields could explain EMF–cancer risks through the concentration of radon by-products (see *MWN,* M/A96 and M/J96).

"There is no question after seeing Miller's study that I would be willing to put more effort into studying electric field exposures," Dr. David Savitz said in an interview from his office at the University of North Carolina, Chapel Hill. Savitz's 1995 report for the Electric Power Research Institute (EPRI) linked electric utility workers' EMF exposures to brain cancer (see *MWN,* J/F95).

Electric fields are now on EPRI's research agenda. "Further studies are needed to examine the relationship between occupational exposure to electric fields and leukemia," Dr. Leeka Kheifets, manager of EPRI's EMF research program in Palo Alto, CA, told *Microwave News.* "EPRI is exploring the availability of other survey measurement data to evaluate the relationship between magnetic fields and electric fields in occupa-

tional environments," she said.

One of the notable features of the Miller study is its detailed exposure assessment (see "Commentary," p.7). EMF exposures were estimated not only with job titles but also with where employees did their work.

Miller's team showed striking increases in leukemia risk for cumulative exposures to high electric and magnetic fields. Indeed, the adjusted risk ratio for all leukemia was 1.6 (nonsignificant) when the analysis was limited to magnetic field exposures only. But when electric fields were included as well, the risk ratio rose to 11.2, a significant result.

In the published paper, Miller's team concluded that the data point to "associations for all leukemia and its subtypes with increasing electric field exposure," especially when electric and magnetic fields were considered together.

Those exposed to the highest levels of both electric and magnetic fields were primarily power line maintenance workers and those who do jobs that put them close to electricity-generating equipment and high-voltage transformers.

The Ontario Hydro project is part of a three-utility study that also included Hydro-Québec and Electricité de France (EDF). While much of the magnetic field data for all three utilities was published in 1994 (see *MWN,* M/A94), the electric field analysis released in July is new. Although all three utilities recorded electric field data, the analysis for the other two utilities, as well as that for the three utilities combined, dealt only with magnetic fields.

The University of Toronto researchers asserted that their exposure estimates are more accurate than those used in past research or in the Hydro-Québec and EDF components of the three-utility study. In their paper, they wrote that, "There may have been greater opportunity for misclassification of exposure in the other two utilities than in Ontario Hydro."

Dr. Gilles Thériault of McGill University in Montreal, who led the Hydro-Québec study, confirmed that information on job location is critical. "I agree that exposure can vary more with location than with job title," he said. "We came across this in our study, too."

Over 30,000 present and former Ontario Hydro male employees were included in the study. Among these there were 50 cases of leukemia, 35 of brain cancer and 58 of malignant melanoma. Miller found elevated risks for both leukemia and skin cancer but not for brain tumors. With respect to brain cancer, he allowed that, "We may have failed to see a significant ...[statistical] association because of low power."

There was "a suggestion of a dose–response relation" for leukemia and melanoma, but the test for a trend did not produce a significant result, the Ontario team noted.

At the highest level of exposure to both magnetic and electric fields, the odds ratio jumped from 3.51 to 11.2 when the researchers included the interaction of the effects of the two types of fields. When asked which estimate was more indicative of the actual cancer risk, Miller replied, "The correct way to think about it is the 11.2, because what you're actually looking at is the combined effects."

Ontario Hydro is now investigating the reliability of the electric field exposure data. Ruth Greey, EMF issue manager at Ontario Hydro, told *Microwave News* that the next step will be to examine the relationship between the electric fields measured by the Positron monitor and the ambient electric field strengths in the workplace.

In addition, work is under way to see whether cumulative EMF exposures (that is, ∝T-years and V/m-years) are the best ways to gauge cancer risks. "We're looking at different metrics, including intermittent, peak and average exposures," Greey noted.

For his part, Miller would like to see the extent to which electric field exposures play a role in the residential environment. Two studies involving childhood leukemia, which are also using the Positron personal exposure meter, are due out next year. Miller is leading one of these and Dr. Richard Gallagher of the Cancer Control Agency of British Columbia is the principal investigator for the second study, which is being sponsored by BC Hydro.

"What worries me is that so much of the experimental cellular work that has been done has screened out electric fields," Miller said.

Canadian unions are expressing concern about the new findings—in contrast to American labor groups, which have generally been indifferent to EMF health risks. "It's alarming. This is cause for immediate employer and government action to protect workers," John Murphy of the Power Workers' Union told Ontario's *Windsor Star* (July 11) after the publication of the Miller study.

Savitz noted that the results of the Ontario Hydro study were released too late to be included in the NAS-NRC report due out in September (see p.3).

Transient Analysis Still on Hold

Work on the EMF transient data collected by the Canadian and French utilities is still at an impasse. "Pulsed [EMF] exposure has so far not been evaluated with [the] Ontario Hydro data," Dr. Anthony Miller and coworkers reported in their July 15 paper.

Ontario Hydro's Ruth Greey said that there is as yet no commitment to go forward with the transient analysis. "It's not scheduled now," she told *Microwave News*. She echoed others' concerns over what the Positron meter is actually measuring.

For his part, Miller wants to move forward. "Just give us the data and we'll analyze it," he said in an interview. He explained that whatever the sources of the transients may be, the data may reveal new information about EMF and/or RF health effects.

In November 1994, Dr. Gilles Thériault's group at McGill University reported an up-to-tenfold increased risk of lung cancer among Hydro-Québec and Electricité de France workers exposed to high-frequency transients (see *MWN,* N/D94). Thériault also reported a "very clear" exposure–response relationship.

In his paper, Miller noted a "suggestion of association"—a nonsignificant 80-90% increase—between lung cancer and high exposures to combined 60 Hz electric and magnetic fields.

As soon as the McGill paper was published, Hydro-Québec, which owns the data set, barred further study by Thériault (see *MWN,* N/D94). The stalemate continues. "I still believe that the pulsed magnetic fields are an important issue and that someone should follow it up," Thériault told *Microwave News* in July. "People may be suffering from something that could be brought under control."

Commentary

The Three Keys to EMF Epidemiological Studies: Exposure Assessment, Exposure Assessment, Exposure Assessment

The Ontario Hydro study (see p.1) puts a spotlight on the key issue for future epidemiological work: Are we measuring the relevant EMF exposures? Dr. Anthony Miller's results point to the importance of electric fields and show how sloppy exposure assessment can mask significant risks.

"When people say they've done a study that looked at magnetic fields and there's nothing there, I can't agree," Miller told *Microwave News*. "What our study says is, 'Well, you should have looked at electric fields, too.'" The Ontario Hydro study reveals that workers exposed to the highest levels of *combined* electric and magnetic fields had leukemia rates that were 11 times greater than expected.

"Miller's results support the notion that induced electric currents can affect human health, whatever their origins," commented Dr. Paul Héroux of McGill University, noting that both electric and magnetic fields can induce current flows in the human body.

Why have electric fields been ignored? Héroux offered an explanation: "These new results point to the troubling conclusion that the focus on magnetic fields may have resulted from political improvisation rather than thoughtful science." Héroux designed the Positron dosimeter used by Ontario Hydro, the only one that easily logs both electric and magnetic fields.

Miller also once again shows how job titles alone are at best vague measures of EMF exposures. "When you're assigning exposures retrospectively, you've got to be very careful not to rely only on job titles," he stressed. At least part of the solution lies in adding information on job location.

Miller makes this point elegantly in his paper with respect to high magnetic—but not electric—field exposures and leukemia risks. The odds ratio was 1.56 when he coupled job titles with job locations. In contrast, when only job titles were used, the risk fell to 0.97.

This is not the first time that researchers have documented how job titles can lead to erroneous results. For example, Dr. Birgitta Floderus of the National Institute for Working Life (NIWL) in Solna, Sweden, found that her study of EMF-exposed railway workers (see p.5) contradicted a similar report by Dr. Siv Törnqvist, also of the NIWL, completed the year before. While Floderus found excess cancers among railway workers, Törnqvist had not.

In 1994, the two researchers, working together, discovered that the types of work done by railway employees had changed between 1961 and 1979. In the early years, there were two engine drivers on each train. Later, there was only one. The displaced drivers either retired or were transferred to low-exposure jobs—but they retained their job title. On paper, they were still engine drivers.

Floderus and Törnqvist's joint assessment indicated higher chronic lymphocytic leukemia risks among drivers from 1961-69, but not from 1970-79. They concluded, "[T]his structural change of the industry...could dilute a potential effect."[1]

Later the same year, a team led by Dr. Patrick Breysse of Johns Hopkins University's public health school in Baltimore made a similar point regarding telephone linemen. Detailed measurements indicated that in the "lineworker" category, those with the "cable splicer" job title had distinctly higher EMF exposures, with average peaks of 99.2 mG, compared to 29.1 mG for "non-lineworkers." Central office technicians, categorized as linemen as well, also had elevated exposures, but other linemen had exposures similar to those in the non-lineworker job category.

Using job titles alone, Breysse's team had initially lumped workers with low- and high-exposure jobs together under the rubric of linemen. He found that the exposures of telephone lineworkers, thought to be higher than those of other workers, were often similar to those of non-lineworkers.

The Johns Hopkins group concluded further analyses should focus on cable splicers, and the use of vague job titles such as telephone lineworkers and non-lineworkers was "not appropriate."[2]

Importantly, the team had previously shown that it was the cable splicers and, to a lesser extent, the central office technicians who had elevated rates of leukemia.[3]

The elevated leukemia risk observed in the Ontario Hydro study may still be imprecise because of the difficulties associated with measuring electric fields—they are easily perturbed by body movements and by the location of the dosimeter. "Small electric field sensors worn on the body are not that reliable," said Michael Silva of Enertech Consultants in Campbell, CA. Ontario Hydro's Dr. David Agnew agreed: "As people move about, they move their arms and bend over. All these things influence the electric field measurement that you get on the monitor."

But Miller's study is still a wake-up call. The EMF–cancer risk may not necessarily be small for those who are exposed to relatively high electric and magnetic fields, which are still much lower than the exposures allowed by most health standards. If anything, the risks could be larger than the 11-fold increases reported by Miller.

In an interview, Dr. Gilles Thériault of McGill—who led the Hydro-Québec study—repeated one of the most basic lessons of epidemiology: "If there is an actual real association, then the more precise the estimate of exposure, the greater chance we have of seeing the real risk."

1. Birgitta Floderus, Siv Törnqvist and Carin Stenlund, "Incidence of Selected Cancers in Swedish Railway Workers, 1961-79," *Cancer Causes and Control, 5,* pp.189-194, March 1994. See *MWN,* M/J94.
2. Patrick Breysse et al., "60 Hertz Magnetic Field Exposure Assessment for an Investigation of Leukemia in Telephone Lineworkers," *American Journal of Industrial Medicine, 26,* pp.681-691, November 1994. See *MWN,* N/D94.
3. See *MWN,* N/D89 and J/A91.

Bioelectromagnetics Society Takes Stronger Stand on EMF Bioeffects After Members Criticize First Statement

The Bioelectromagnetics Society (BEMS) has issued a strongly worded statement in defense of research on EMF bioeffects. In a June 24 letter sent to all members of Congress, top BEMS officials point to public concern about links between EMFs and leukemia, breast cancer and Alzheimer's disease. They warn that "public statements by those...lacking in the requisite multidisciplinary expertise" might lead to cutbacks in research before these issues are resolved (see box at right).

Two months earlier, BEMS had staked out a much weaker public position in the controversy over EMF bioeffects and human health (see box at right). The society's board of directors adopted a statement on April 9 that was criticized by many members as too cautious. Criticisms were aired in public at BEMS' annual meeting June 9-14 in Victoria, Canada, as the board grappled with the research funding issue.

On the eve of the Victoria conference, Shirley Linde, chair of the National EMF Advisory Committee (NEMFAC), warned the BEMS board that funding for EMF bioeffects research was in serious danger. Linde attributed this to recent media coverage of the EMF issue, particularly the reporting on the statement by the American Physical Society (APS) and public television's *Frontline* show, both of which suggested that there are better ways to spend research money (see *MWN,* M/J95 and J/A95, respectively).

"I had members of Congress telling me that they had heard there are no biological effects, so why continue EMF research?" Linde told *Microwave News*. "I was getting statements from various funding sources that EMF scientists were either charlatans or prostitutes. Someone needed to provide a more balanced view." Linde is associated with a Los Angeles citizens group concerned about EMF risks.

The BEMS letter to Congress points out that EMFs can affect hormone levels, the immune system and the growth rate of cancer cells. It warns that if research is cut back while new communications and electronic technologies are being introduced, "international standards may be imposed before adequate scientific knowledge is available," adding that, "Failure to continue this research could ultimately result in extensive costs to the energy and communications industries, both in litigation and product development."

Both House and Senate appropriations committees later passed budgets that preserve most funding for EMF bioeffects research for fiscal year 1997, which begins on October 1, 1996.

The letter was signed by the newly installed president of BEMS, Dr. Richard Luben of the University of California, Riverside; his predecessor, Dr. Kjell Hansson Mild of the National Institute for Working Life in Umeå, Sweden; and the society's president-elect, Dr. Martin Blank of Columbia University in New York City. Luben succeeded Mild at the meeting in Victoria, and Blank will take over at next summer's conference.

Luben told *Microwave News* that the society is now working on a new public statement, which he hopes will be ready by the fall. "We were asked by the membership to make it more forceful," he explained. "The presidents' letter was a way of clarifying our position in the time between the previous and future statements."

The original statement was discussed by the BEMS board of directors for a few months before its adoption in April. It noted that concern about power line EMFs and cancer has been raised by epidemiological studies since 1979, and that "strong criticism" of these studies was "due primarily to [the] variability of results as well as the incomplete nature of laboratory data to support the specific cancer findings." It advocated further research to determine "whether adverse effects are (1) real and significant, (2) real but of minor importance or (3) nonexistent."

Even before the June meeting, some BEMS members were criticizing this statement as "extraordinarily weak" and "pretty bland." Board member Dr. Indira Nair of Carnegie Mellon University in Pittsburgh, who had worked on drafts that she considered weak, asked, "Why are we behaving like lawyers?"

In an outcry at BEMS' annual membership meeting on June 12, speakers described the board's statement as "very disappointing" and "less than inspiring" and insisted that it "should have been stronger." Several members argued that while there might be no consensus within BEMS on EMFs and cancer, it was important that the society challenge the idea that EMF bioeffects are either nonexistent or unimportant. Some called for "a strong rebuttal" to the APS statement. Mild closed the debate by saying that the board would discuss the issue when it met two days later. It then decided on the June 24 letter.

In an interview in May, Mild had noted that the society "includes respectable scientists with a wide variety of opinions" on EMF health risks. "The current body of evidence can reasonably be used to support...different tentative conclusions," he added, "depending upon one's assumptions and personal feelings on how to handle risk calculations in the absence of data." Board member Dr. Paul Gailey of Oak Ridge National Lab in Oak Ridge, TN, gave a similar assessment and said that the April statement had been "an effort to represent the diversity of views within BEMS."

Both Gailey and board member Janie Blanchard of Bechtel Corp. in San Francisco described the board's April statement as a response to the APS. But Dr. James Lin of the University of Illinois, Chicago, who helped to draft it, told *Microwave News,* "It was not intended to refute or confront any other statements, including the APS one." Luben offered that, "It was not necessarily a direct response to the APS statement, but that was part of the stimulus for it."

At the same time, Lin made a point of stating that, "Despite the recent arguments by some physicists that such effects are not possible and thus the health issue does not exist, the biological and epidemiological evidence continues to mount and the public concern does not decrease."

"It is necessary to clearly separate the official [APS] statement from all the other things that accompanied it," emphasized Mild, citing the background report written by Dr. David Hafemeister of California Polytechnic State University in San

Bioelectromagnetics Society: Two Statements

BEMS Board of Directors on EMF Issue

The following statement was unanimously adopted by the BEMS board of directors on April 9, 1996. The board is now working on a new statement (see opposite page).

The Bioelectromagnetics Society [BEMS] is a scientific society which was established in 1979 to promote the study of the interaction of electromagnetic energy with biological systems. The board of directors of [BEMS] is issuing this statement because we believe it is our responsibility to inform interested parties of the fundamental scientific issues that form the basis for public concern about possible health risks from exposure to electric and magnetic fields.

The health questions associated with exposure of individuals to extremely low frequency (ELF) electric and magnetic fields have been driven largely by cancer epidemiological studies. The first such study was reported in 1979 and a number of studies have appeared since with variable results. Strong criticism of these epidemiological studies has been due primarily to this variability of results as well as the incomplete nature of laboratory data to support the specific cancer findings. Additional difficulties in the evaluation of the epidemiological data are that the apparent increases in cancer are relatively low, and that there is at present no proven mechanistic explanation to support the epidemiological findings. The answers to these exposure and health questions can only be clarified through a well-coordinated and funded research program.

Both public concern and the potential cost of engineering mitigation are considerable. A large portion of the population of industrialized nations is exposed and thus potentially at risk. However, it is yet to be determined whether there is cause for concern or what the appropriate mitigation, if any, should be. Whether adverse effects are (1) real and significant, (2) real but of minor importance or (3) nonexistent must be determined by current and future research to allay public fears and to provide to industry a basis for appropriate response or action.

There have been many occasions in the history of science when distinguished scholars have argued that an observed phenomenon must be invalid on the basis of current understanding. A great deal is yet to be discovered about the interaction of EMFs with biological systems. These discoveries will only come through careful, competent investigation. It is imperative that good science be sponsored and conducted to answer these important health questions. These questions will continue to be important in public debate and continuation of good scientific research will significantly help to clarify these issues.

BEMS Presidents on EMF Bioeffects Research

The following letter was sent to all members of the U.S. Congress on June 24, 1996.

Public concern continues to grow about possible connections between exposure to electric and magnetic fields and such diseases as childhood leukemia, breast cancer and Alzheimer's disease. At the same time, daily exposure of the public to electric and magnetic fields is increasing rapidly due to new electronic and communications technology, more use of electric power and new medical applications of electric and magnetic fields. As leaders of the largest international scientific society studying biological effects of electric and magnetic fields, we are concerned about a potential decline in research in this area, due in part to public statements by those who we believe are lacking in the requisite multidisciplinary expertise.

The biological processes involved in human diseases are complex and multifaceted. Moreover, electric and magnetic fields, unlike many other environmental agents, are not characterized by a single quantity but involve many different factors. Proper approaches to such complex scientific questions can be achieved only by a multidisciplinary collaboration of biologists, physicians, engineers and biophysicists. A wealth of published, peer-reviewed scientific evidence indicates that exposure to different combinations of electric and magnetic fields consistently affects biological systems in the living body as well as in laboratories, including:

- Altering the function of nerve cells.
- Changing the density and healing rate of bone.
- Disturbing the balance of important hormones.
- Changing the growth rate and drug sensitivity of cancer cells.
- Modifying the immune system's ability to fight disease.
- Altering the heart rate.

There is a potential for benefits from these fields, as well as the possibility of adverse public health consequences. Understanding their biological effects may allow us to increase the benefits as well as mitigate the possible hazards. But these processes cannot be well understood without further research.

Major strides have been made in the past 20 years of research in this area. The program has only recently expanded to a critical mass of interdisciplinary and multi-laboratory effort that, in our opinion, must be continued. In this still emerging area of scientific research, controversy about reported results is a natural and healthy part of the scientific process. Such controversy should not be the basis for discarding programs of research before the important questions are answered conclusively.

We believe it is essential that research in this area be continued. Without U.S. government funding, the remaining available sources of funds are too limited, too focused by discipline and may in some cases carry questions of bias. The governments of other industrialized countries such as Sweden, Japan, Germany and Norway are presently spending significant amounts of money to further research in this area. But without U.S. leadership, the task of determining the potential health risks and benefits involved in the distribution and use of electric and magnetic energy will be difficult to complete.

We are also concerned that international standards may be imposed before adequate scientific knowledge is available. Failure to continue this research could ultimately result in extensive costs to the energy and communications industries, both in litigation and product development. Public concern can be reduced only when the issues and questions are resolved by careful research.

We ask that you take these views into account when making decisions regarding the future of research into the effects of electric and magnetic fields. The undersigned will be happy to confer with you in detail or provide any further information you may need in order to make an informed decision.

Sincerely yours,

Kjell Hansson Mild, PhD
President 1995-1996

Richard Luben, PhD
President 1996-1997

Martin Blank, PhD
President-Elect 1997-1998

Luis Obispo, the Internet news bulletin put out by APS information director Dr. Robert Park, who works in the Washington office of the APS, and other comments by individual APS members. Hafemeister's report was released along with the APS statement but was not endorsed by the APS Council (see *MWN,* M/J95), while the opinions in Park's bulletin are explicitly his own and not those of the APS (see also *MWN,* S/O 95).

"It is those [other] statements that sometimes make or imply the accusation that all of the positive low-field results in bioelectromagnetics are violations of physical law, artifacts or pseudoscience," Mild explained. "Most of the people making these statements have never done work in bioelectromagnetics, nor even in biophysics."

Linde voiced the same opinion, noting that funding officials "were coupling the statements of Hafemeister, Park and the APS Council as if they were the same thing." She said that while "the APS statement itself didn't say that much, the Hafemeister report was full of innuendos, half-truths and distortions."

Unlike the APS statement, which received widespread coverage, both BEMS statements have so far been completely ignored by the press.

« *Cellular Phone Notes* »

On June 5, the **CTIA** announced that it had approved a $6.7 million budget for its research organization, **WTR**, in its current fiscal year (which began on June 1). The press release stressed that this amount would keep the CTIA on schedule with its five-year, $25 million commitment for health research. But it will apparently take more than a press release to settle the CTIA/WTR financial dispute (see *MWN,* M/J96). WTR spokesperson **Michael Volpe** said in an interview that WTR has received only $2.4 million of this money, which "did not go much beyond enabling us to pay off our back debts." According to Volpe, WTR has spent $1.7 million on pacemaker research and $600,000 on litigation, a total of $2.3 million, "which the CTIA has stated will not have to come out of our research budget." CTIA President **Thomas Wheeler** confirmed that only $2.4 million was paid in June. The rest will be provided "on a quarterly schedule jointly agreed to by the CTIA and WTR," he wrote in response to questions from *Microwave News*. "It's perfectly true that WTR has legal bills and expenses on the pacemaker work," said CTIA spokesperson **Tim Ayers**. "But they haven't billed us for that yet." When the bill is received, he added, "That'll be paid right away." Volpe would not comment further, noting only that, "The money determines the amount of work that WTR does."

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A **WTR** meeting on electromagnetic interference (**EMI**) from cellular phones to **cardiac pacemakers** has been postponed from July 16 to September 30. A WTR statement attributed the postponement to a need for "greater input from federal regulatory agencies and the pacemaker and cellular phone industries." WTR's Michael Volpe explained that researchers at the FDA, the Mayo Clinic in Rochester, MN, and the Mt. Sinai Medical Center in Miami Beach, FL, had "asked for more time so that they could complete some of their studies." WTR plans to issue a final report on its pacemaker research at the symposium (see *MWN,* M/J96). The meeting will take place in Washington. Contact: Mary Supley at (202) 833-2800, or look up WTR's Web site at <http://www. WTRLLC.com>.

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Interference with pacemakers will also be discussed on September 11 at a forum sponsored by the University of Oklahoma's **Center for the Study of Wireless Electromagnetic Compatibility** (EMC), which was established in 1994 by a number of telecom companies (*MWN,* J/A94). The session will address not only pacemakers but also medical devices in hospital settings and hearing aids. The meeting will be held in Washington, and the featured luncheon speaker will be **CTIA** President **Thomas Wheeler**. The next day the center will host a workshop at the offices of the CTIA on how to develop hospital EMI policies. The center has just issued Part I of a report titled *EMI Management in the Hospital Environment*. "The issue was brought to public attention by cell phone use," said Dr. **Ravi Ravindran**, the center's director, "but less than 5% of all medical equipment failures are due to cellular phones." Walkie-talkies used by emergency personnel, security guards, police and firefighters are a bigger problem because they use higher power levels, Ravindran said in an interview. "Electrostatic discharge is a bigger problem, too," he added. "Some hospitals are reacting by banning the use of cell phones and thinking the problem has been solved—when it has not. It takes a lot of work to develop more specific policies." The recommendations in Part I include: restricting the use of wireless devices in critical-care areas with a high concentration of medical instruments; establishing areas where wireless phones and walkie-talkies *can* be used; installing microcells within the hospital to make possible more widespread use of low-power wireless devices; and encouraging hospital staff to report all incidents of EMI to the FDA at (800) FDA-1088. Part II of the report, due out in the fall, will focus on how to develop a hospital EMI policy. The center will also provide computer software that can help make these decisions. To request the report, send a fax to (405) 325-2556, or e-mail to <shawkins@mailhost.ecn.uoknor.edu>. For more information on the Washington sessions, call Ravindran at (405) 325-2429.

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Another group has joined the fray over cellular tower siting regulations. The **Helicopter Association International** (HAI) wants legislation to give the Federal Aviation Administration and local zoning boards "uncompromised authority" in cellular tower siting cases. The industry group, based in Alexandria, VA, contends that the telecom act will facilitate the spread of cellular towers, posing a serious risk to helicopter safety. "What

Bulletin from BEMS

Motorola Keeps a Low Profile on Adey Animal Study Showing Tumor-Inhibiting Effect of Cellular Phone Radiation

Dr. Ross Adey's paper was arguably the most important presentation at the annual meeting of the Bioelectromagnetics Society (BEMS), held in Victoria, Canada, June 9-14. A press release was prepared, edited and reedited. A room was reserved for a press conference, which was canceled at the last minute.

It soon became apparent that Motorola in fact wanted to *avoid* publicity for this, its own major study, which showed that at least one type of cellular phone radiation does not promote brain cancer in lab animals.

With all the scare stories in the media about cellular phones and brain tumors, some were surprised that Motorola was not shouting the news from every hilltop.

Yes, Motorola was pleased with Adey's results, but there was a rub. The five-year animal study suggested that 836 MHz radiation, designed to mimic signals from a digital cellular phone, could in fact inhibit brain tumor development in rats (see *MWN,* M/J96). That is, there might be some kind of protective effect at work. And if so, the long-awaited paradigm shift could be at hand: Low-level RF/MW radiation could no longer be treated as biologically neutral.

A desire to downplay the results was apparent when Adey showed his slides. He said that rats given a cancer-inducing drug and exposed to the digital cellular phone signals had only four brain tumors, as compared to nine such tumors among the rats that were only given the cancer drug. The difference was suggestive but not statistically significant.

But the data in Adey's abstract, published before the meeting and distributed to attendees on registration, showed four additional tumors among the unexposed rats. When these are included in the statistical analysis, the difference between the two groups becomes 4 to 13—which *is* significant.

In his talk, Adey explained that the four other tumors were in the rats' spinal cords. And he stressed that "one can legitimately include spinal cords" in the comparison between the two groups of rats—as he had done in the abstract. After all, all the tumors arose from the same cell type (glial), and dosimetric analysis by Dr. Niels Kuster of the ETH in Zurich, Switzerland, had shown that the rats' spinal cords were exposed to the cellular phone radiation.

The apparent protective effect was also observed when no cancer drug was administered. In this case, too, Adey saw fewer tumors among radiation-exposed rats compared to controls.

Adey avoided the phrase "protective effect," explaining that the Food and Drug Administration (FDA) had warned that it would fall into "the snake oil category." The FDA had suggested "tumor-inhibiting" as preferable, Adey said.

But even this made the Motorola lawyers nervous. (One of them was at the BEMS meeting to keep a watchful eye on the presentation.) There were even rumors that the lawyers did not want Adey to mention the possibility that the radiation could have enhanced DNA repair. But if so, Adey did not play along. He speculated on various mechanisms that could explain the decrease in brain tumors.

In the end, however, Motorola's efforts at spin control won the day. The company issued no press release, and Adey's VA hospital in Loma Linda, CA, had only a three-paragraph statement. Only one small newspaper, *The Press Enterprise* in Riverside, CA, ran a story on the results—probably because Dr. Craig Byus, one of Adey's collaborators, is at the University of California, Riverside. And, other than a story in the trade newspaper *RCR* and a short item on CNN's financial network (and an article in the last issue of *Microwave News),* there was no further coverage of the results.

The significance of the Motorola study was not lost on those at the BEMS meeting. As Dr. Abraham Liboff of Oakland University in Rochester, MI, told the audience after Adey's presentation, such low-level effects fly in the face of the conventional wisdom that only thermal effects are relevant to public health. "This makes me absolutely sure that there could be a coupling between fields and tumor development," he said.

we're trying to prevent is the proliferation, without proper oversight, of dangerous obstacles to low-level flight....We can minimize this new and ominous threat to aviation and public safety if we can get the Congress to act quickly and responsibly," HAI President Frank Jensen Jr. said in a statement.

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Add another medical device to the list of items cellular phone users should be wary of: **aneurysm clips**, which are implanted in the brain to reinforce blood vessels. In a paper presented at the June Bioelectromagnetics Society meeting in Victoria, Canada, a group led by Dr. **Niels Kuster** of the **Swiss Federal Institute of Technology** (ETH) in Zurich reported that metallic implants can enhance the absorption of RF energy by a factor of four, when averaged over one gram of tissue. But, they warned, over smaller volumes, the energy absorbed can be enhanced by "a factor of several hundred." They cautioned that metallic eyeglasses and jewelry can, in certain cases, also cause significant enhancements. An aneurysm clip is probably the most common type of metallic implant in the head. **Janine Morris** of **FDA's Center for Devices and Radiological Health** in Rockville, MD, estimated that 15,000-18,000 clips are put in place each year in the U.S. She said that it is hard to say how many Americans have aneurysm clips because of the lack of long-term records and the fact that some people have had more than one clip implanted. "Until the health implications of strong, locally concentrated fields inside the human body are known, I would advise those with such implants against extensive use of mobile phones," Kuster told *Microwave News.*

New Cell Phone–Brain Cancer Epidemiology Study by WTR

Wireless Technology Research (WTR), the cellular telephone industry's research organization, announced on June 28 that it would fund a $419,000 case–control study of cell phone use and brain cancer risk. Results from the study, which will be conducted by the American Health Foundation (AHF) in New York City, are expected in about two years.

"We should be able to answer the question of whether short-term use of cellular telephones is related to the incidence of brain tumors," said AHF's Joshua Muscat, the project's director. Five hundred brain cancer patients and 500 controls will be interviewed at participating hospitals. The research design was developed in an AHF pilot study, funded by a $75,000 grant from the National Cancer Institute (NCI).

Last May initial results were released from an ongoing WTR-sponsored epidemiological study, a survey of 256,000 cellular phone customers being conducted by Drs. Kenneth Rothman and Nancy Dreyer and others at Epidemiology Resources Inc. (ERI) in Newton Lower Falls, MA (see *MWN,* M/J96). The ERI team found no increase in overall mortality from short-term use of hand-held cellular phones. The ERI and AHF studies have different designs and are each intended to shed light on the issue from a different angle. "Theirs is a population-based cohort study, while ours is a hospital-based case study," Muscat noted, "so the two should complement each other nicely."

Work on the ERI study was suspended in the spring due to an interruption in funding and privacy issues raised by the passage of the new telecom law. Dreyer, president of ERI, said that ERI is still waiting for its WTR money to be restored.

"We are trying to prioritize and balance WTR's research funding needs based on the amount of money we have received and which has been promised by the CTIA," said WTR spokesperson Michael Volpe. He said ERI should get more money once funding issues with the Cellular Telecommunications Industry Association (CTIA) and privacy questions are resolved.

Volpe stressed that sufficient funds are definitely available for the AHF study. "I checked with the lawyers and the bank before I sent out the press release," he told *Microwave News.* "This was ready to go for a couple of months—we were just waiting for an infusion of money into our escrow account."

Last year, an NCI research team pointed out that "the introduction and widespread use of cellular telephones are very recent phenomena," and that this limits what can now be learned from epidemiological research on cellular phones and brain cancer risk (see *MWN,* M/A96 and M/J96; also S/O95). Volpe argued that, "WTR would be remiss in its public health responsibility if it didn't study this issue." He explained that, "Since we don't know what kinds of cancer mechanisms might be involved here, it makes good scientific sense to look at brain cancer, no matter what the latency period."

"The etiology of brain tumors remains largely unknown," said Muscat, "and we know little about the possible health effects of EMFs. So we don't know enough to conclude that it's too early for epidemiological studies." He added that potential long-term effects will need to be studied in the future.

Norwegians Study Possible RF/MW Link to Birth Defects

Norway's defense department has begun a study of a potential link between RF/MW radiation and birth defects among children of 30,000 naval officers over the last 30 years. Onboard radio transmitters, radar and electronic equipment are all under investigation, navy Captain Stig Morten Karlsen in Oslo told *Microwave News.*

The study was spurred by a chance discovery in which two officers from the motor torpedo vessel *Kvikk* met at a clinic in Bergen and found that they each had a child with clubfoot, according to the Swedish newspaper *Svenska Dagbladet* (July 4). The two men brought this to the attention of the Norwegian navy, which then ordered an investigation. Soon, three more officers from the *Kvikk* were found to have children born with clubfoot. To date, 82 cases of birth defects, including clubfoot, heart and central nervous system defects, brain dysfunction and hydrocephalus, have been identified among children of navy personnel.

"We are working from the hypothesis that electromagnetic radiation is responsible," Jan Helge Halleråker, a naval captain and chief medical officer, told *Svenska Dagbladet.* Interestingly, the study has received very little attention in the Norwegian press.

When the cluster was reported at a recent NATO meeting in Brussels, Belgium, a decision was made to use radio transmitters at half-power on all ships, *Svenska Dagbladet* reported. After the investigation began, the Norwegian navy took RF/MW radiation measurements on the ships and marked potential "danger" areas for the crews to avoid, Karlsen said.

The data analysis is under way but is not expected to be completed until 1998. The research is being coordinated with a larger RF/MW study, which includes other NATO countries.

In spite of the discovery of the *Kvikk* cluster, Karlsen remains cautious about linking it to RF/MW radiation: "So far, no one in Norway or anywhere else in the world can say that this has anything to do with birth defects."

The incident is similar to one reported 25 years ago in the United States. In 1971, Dr. Peter Peacock, then chairman of the Department of Public Health and Epidemiology at the University of Alabama, Tuscaloosa, identified 17 cases of clubfoot among helicopter pilots' children born between July 1969 and November 1970 at the Lyster Army Hospital in Fort Rucker, AL.

In a report for the Environmental Protection Agency, Peacock noted that one of Fort Rucker's "unique characteristics" is the prevalence of radar—46 installations within 30 miles of the base. He theorized that helicopter pilots would have relatively high RF/MW exposures, because they fly at low altitudes, where radar radiation is greatest, for long periods of time. In addition to clubfoot, Peacock turned up defects in the infants' hearts, genitals and circulatory and respiratory systems.

Peacock repeatedly sought to follow up this work, but each time he was denied access to military records and documents by the Army Medical R&D Command. "The Army closed down on us—they refused to give us access to their records," Peacock said in an interview in July. Peacock, now retired, speculated,

"My guess is that the Army was afraid of the possibility of someone suing them if a link was found." His travails were reported in detail in Paul Brodeur's 1977 book, *The Zapping of America.*

Some are optimistic that the Norwegian study will not meet the same fate as Peacock's effort. "Norway is a small and 'open' country, where these kinds of facts are hard to cover up," according to Leif Södergren of the Association for the Electrically- and VDT-Injured in Göteborg, Sweden.

FCC Adopts RF/MW Rules *(continued from p.1)*

cations services (PCS) hand-held telephones be tested to assure that users are not exposed to a specific absorption rate (SAR) over 1.6 W/Kg. Compliance may be shown with laboratory measurements or by computer modeling. The FCC followed the recommendation of the Food and Drug Administration and rejected an exclusion clause for low-power devices—allowed under the ANSI/IEEE standard.

"We are not routinely going to require SAR data for phones already on the market," Dr. Robert Cleveland, who led the FCC's effort to write the new rules, told *Microwave News.* "However, if we have reason to believe that any of these phones are not in compliance, we may ask for more information from the manufacturers."

In other major provisions of the new RF/MW rules, the FCC:

• Denied requests to extend federal preemption of state and local RF/MW health regulations for personal wireless services to all communications facilities—for instance, radio and television towers. Preemption of state and local RF/MW rules for cellular and PCS towers was mandated by the Telecommunications Act of 1996 (see *MWN,* M/J95 and M/A96).

• Acted "out of an abundance of caution" to require routine evaluation of cellular and PCS antennas if they are mounted lower than 10 meters above the ground and have a total power output over 1 kW.

• Generally endorsed the distinction between "occupational" and "general population" exposures used by the NCRP instead of the "controlled"/"uncontrolled" dichotomy cited by ANSI/IEEE.

• Set limits of 1 mW/cm^2 for public exposures and 5 mW/cm^2 for occupational exposures above 1500 MHz (which are up to ten times more stringent than those recommended by ANSI/IEEE) for continuous exposures.

• Rejected special consideration of modulation effects as "premature."

Although all four sitting members of the FCC approved the new rules, Commissioners Rachelle Chong and James Quello issued a separate statement, noting that their decision "does not in any way diminish our support for the ANSI standard-making process or the latest 1992 ANSI standard."

The new FCC RF/MW rules, which take effect on August 6, were issued as *Microwave News* went to press. Further coverage will appear in our next issue. All 108 pages of the FCC rules are available on the Internet in the Office of Engineering and Technology section of the FCC's World Wide Web site at <http://www.fcc.gov>.

Cell Phone RF Tests Required—But Who and How To Do Them?

All cellular phone manufacturers must now certify that their products comply with the FCC's new RF/MW rules (see p.1). What the commission does not specify, however, is how to demonstrate compliance.

The two main methods of RF exposure assessment—both allowed by the FCC—are computer modeling and direct measurement. "The results of numerical techniques differ sometimes from experimental results," noted Ron Petersen of Lucent Technologies in Murray Hill, NJ. Until this spring, the Cellular Telecommunications Industry Association (CTIA) was funding a research program designed to resolve these discrepancies. But after the CTIA cut off funding for this work, its research group, WTR, canceled all related contracts (see *MWN,* M/J96).

Two days before the FCC decision was announced, the CTIA took the position that it is not important which technique is used. CTIA President Thomas Wheeler refused to be interviewed, but gave this written response to questions from *Microwave News:* "There are multiple exposure-measurement techniques which have been developed. The important fact is that all phones must meet the [new] standards."

Another unresolved question about certification is who will do it. CTIA spokesperson Tim Ayers had predicted that if the FCC allowed manufacturers to do it themselves—as it now has—then the CTIA would not conduct industry-wide RF testing. "If self-certification is an option, then it's probably not worth it for us to get into it," Ayers said, adding, "We'll only do the testing ourselves if there's a market for it."

This represents a shift for the CTIA, which had told the FDA in 1994 that it planned to add RF exposure testing to its existing equipment certification program. In 1995, the CTIA asked Aprel Labs of Nepean, Canada, to get ready to perform these tests—but on January 26, 1996, the CTIA abruptly put the project on hold.

"It was a 'go' one day and a 'no go' the next," Aprel President Kathy MacLean told *Microwave News.* MacLean said that she had sent her staff to a training course at Motorola to learn how to use the robot measurement system developed by Dr. Niels Kuster of the ETH in Zurich, Switzerland. MacLean contended that reliance on mathematical calculations is "not acceptable when it comes to handsets."

An observer, who asked not to be identified, offered this explanation of the CTIA's changing plans: "The CTIA viewed RF certification as a revenue source. But it underestimated how strongly manufacturers felt about handling this themselves."

Petersen said that Lucent is now planning to fund research by Dr. Kenneth Foster that was halted when WTR cut off his funds in April (see p.10, p.15 and *MWN,* M/J96). WTR will not be involved, and, Foster told *Microwave News,* that he prefers it this way. Petersen maintained that Lucent is still interested in helping WTR to raise industry money for dosimetry research. "But we haven't got a commitment from other manufacturers yet, and we feel we have to get this work moving."

WHO Launches $3 Million Project on EMF and RF/MW Health Effects

The World Health Organization (WHO) has embarked on a five-year, $3.3 million project to examine the status, and plan the future, of EMF health effects research. The decision was announced shortly after a May 30-31 preparatory meeting at WHO headquarters in Geneva, Switzerland, which was attended by representatives from 23 countries, including Mary Beth Jacobs of the U.S. Food and Drug Administration (FDA).

The study, which will cover research on both extremely low frequency (0-300 Hz) and radiofrequency and microwave (300 Hz-300 GHz) radiation, will be led by Dr. Michael Repacholi, on leave from the Royal Adelaide Hospital in Adelaide, Australia.

"For the first time, we will have an international focus to clarify the science of EMFs," Repacholi told *Microwave News*. The project will involve a number of steps—for example, meeting to gain an overview of the science, identify gaps in knowledge, prioritize needs, produce generic research protocols and encourage support for future studies, Repacholi said.

The WHO has scheduled a seminar, titled *Biological Effects on Nonthermal Pulsed and Amplitude-Modulated RF Electromagnetic Fields and Related Health Risks,* for November 20-22 in Munich, Germany. Speakers will include Drs. Martin Blank, Kenneth Foster, Konstantin Hossman, Kenneth Rothman and Thomas Tenforde.

Financial support for the project has been pledged by Australia, Ireland, Sweden and the U.K., with Austria and Germany funding specific activities. Repacholi noted that the U.S. has yet to give money, but he is still optimistic that the FDA and the FCC will contribute. France has not decided whether it will support the project.

For more information, contact: Repacholi, Office of Global and Integrated Environmental Health, WHO, 1211 Geneva 27, Switzerland, (41+22) 791-3427, Fax: (41+22) 791-4123, E-mail:<repacholim@who.ch>. The WHO can now be reached on the World Wide Web at: <http://www.who.ch>, but Repacholi is planning a separate home page for the EMF project.

FROM THE FIELD

Clippings from All Over

"Alexander Graham Bell didn't have to go before a zoning board and describe a telephone pole or put on the kind of show we're being forced to.... It's an incredible impediment—an incredibly unnecessary impediment."

—Priscilla Triolo, attorney for Bell Atlantic–Nynex, on community opposition to a proposed cellular phone tower in Wyckoff, NJ, quoted by John Keller in "Bad Reception: With Cellular Towers Sprouting All Over, Towns Begin To Rebel," *Wall Street Journal,* p.1, July 2, 1996

Yesterday I saw a man standing bareheaded in the midday sunshine while using a mobile phone and smoking a cigarette. Would anyone care to estimate his life expectancy?

—Tom Baldwin, in a letter, "Risk Assessment," to *The Times* (U.K.), July 2, 1996

The question about radiotelephones' impact on human health remains unanswered. Practically all groups insist on continuing experiments to determine the causative connection between use of radiotelephones and changes in human health. We think that the research will cost less than curing "fried" brain and compensating thousands of people.

—Aleksey Savin, "Could a Cellular Phone Be a Cause of Brain Cancer?" *Izvestia* (Moscow, Russia), p.9, June 19, 1996

[I]f Iridium goes ahead as planned, it will be piracy in the radio spectrum, it will make a mockery of the [International Telecommunication Union] and its radio regulations, and it will be a disaster for radio astronomy.

—John Ponsonby, Onsala Space Observatory, Onsala, Sweden, in a letter, "Motorola Versus Radio Astronomy," to *Nature* (U.K.), p.550, June 13, 1996 (see p.15)

Until clarifying results are obtained, governments must make a decision as to which, if any, regulations or policies are warranted. Formal risk assessments, as some call for, are difficult to interpret in light of the imprecise and sometimes contradictory study results. In my view, in light of the positive data, limited action is called for. Whether the underlying risk factor for the observed childhood leukemias is magnetic field exposures or not, the evidence shows that these cancers are indeed correlated with high wire codings and thus possibly with the presence of magnetic fields. Therefore, where we can reduce exposures at low cost and low inconvenience, we may substantially reduce future disease. Even if the association proves spurious, this strategy of limited, low-cost action will not have had a large impact on society.

—Dr. Daniel Wartenberg, Environmental and Occupational Health Sciences Institute in Piscataway, NJ, "EMFs: Cutting Through the Controversy," *Public Health Reports,* p.216, May/June 1996. Wartenberg is a member of the NAS-NRC EMF committee.

...EMF personal injury litigation is likely to continue for many years to come. An esteemed scientist once explained that public health issues do not die a sudden death, but rather die from years of neglect. We cannot and should not expect one study or several studies to put an end to either the EMF health debate or EMF litigation. Nor is the "neglect stage" anywhere in sight. We should instead expect a protracted battle over EMFs. The science of EMFs is a critical weapon for both sides in most, if not all, aspects of this battle.

—Mark Warnquist, Russell Yates and Chad Neuens, lawyers at LeBoeuf, Lamb, Greene & MacRae in Denver, CO, "The Role of Science in EMF Litigation," *IEEE Engineering in Medicine and Biology,* p.69, July/August 1996

Don't count on melatonin to make you live longer, improve your sex life, cure cancer or lower your cholesterol. There is little scientific basis for sensational claims for melatonin's health benefits reported recently in the popular press. These claims are based on anecdotal reports ("I tried it and it worked"), animal research—some of it flawed—and pure speculation.

—From "Melatonin—1996: Frequently Asked Questions," a brochure published by the *Society for Light Treatment and Biological Rhythms,* based in Wheat Ridge, CO, July 15, 1996

Letter to the Editor

WTR v. NYPLP

June 27, 1996

To the Editor:

The well-publicized problems with Wireless Technology Research Inc. (WTR)—which is leading an industry-sponsored research program on health effects of cellular phones—raise the question as to whether there might be another model for such an effort. Indeed there is: the New York State Power Lines Project (NYPLP).

This five-year program was established in February 1980 with $5 million in research funds from the settlement of a lawsuit against a proposed 765 kV power line. It funded 16 research projects, including two major epidemiology studies (the studies by Dr. Richard Stevens and by Dr. David Savitz), a long-term animal study, a human study, primate studies, a variety of *in vitro* studies and important studies on dosimetry. A series of lengthy final reports was published in 1987. In addition, I counted nearly two dozen papers in peer-reviewed journals citing funding from this source. By and large, the quality of these studies was very high.

How could the project accomplish so much with fewer resources than those promised to WTR (even taking inflation into account)? It had much less infrastructure. The project was administered by Dr. David Carpenter, a talented scientist-administrator, with the help of an advisory committee of eight scientists. No doubt, New York state provided considerable in-kind administrative support. In contrast, WTR has a large infrastructure to support. Carpenter also had a guaranteed source of funds, which WTR apparently lacks.

But there are also differences in scientific philosophy as well. Carpenter came from a background of research science (he was briefly my boss at the Armed Forces Radiobiology Institute, and before that he was at the National Institutes of Health). Dr. George Carlo, the head of WTR, came from a background in regulatory science. Regulatory science differs from research science in the strict bureaucratic controls it imposes on research (such as the insistence on Good Laboratory Practices), which naturally drive up costs and reduce flexibility. The NYPLP enforced scientific quality by carefully selecting projects to fund, scheduling occasional site visits and providing engineering support to investigators.

The ultimate success of WTR can only be judged according to its goals—what information it is supposed to produce, at what level of reliability and for whose use. But in terms of the amount of high-quality research it supports on an issue that the public views as important, the NYPLP will certainly come out ahead by a large margin. The public, I suspect, would judge the NYPLP to be far more effective, and I suspect that the industry sponsors of WTR would also.

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Dr. Foster's research contract with WTR was abruptly canceled in April (see p.13 and MWN, *M/J96). For more on the NYPLP, see* MWN, *F81, Ap82, J/A87, N/D88 and M/A90.*

UPDATES

BREAST CANCER

Battelle Visits Löscher's Lab... In late July, Dr. Larry Anderson of the Battelle Pacific Northwest Labs in Richland, WA, began a set of six-month studies to examine the combined effects of magnetic fields and the carcinogen DMBA on the incidence of breast cancer in rats. Animals were treated with a single 10 mg dose of DMBA and are being continuously exposed to fields of 50 Hz at 1 G, or 60 Hz at either 1 or 10 G. In a set of three-month studies, which Anderson plans to start in August, the animals will be exposed under the same conditions but will be given four 5 mg doses of DMBA. The three-month study at 50 Hz will be an exact replication of the work of Dr. Wolfgang Löscher and colleagues at the School of Veterinary Medicine in Hannover, Germany, who found that EMFs can promote the action of DMBA, increasing the risk of breast cancer in rats (see *MWN,* J/A93, J/F95, M/A95, J/A95 and M/A 96). In preparation for these experiments, Anderson's colleagues, Drs. James Morris and Richard Stevens, visited Löscher's lab to ensure that the conditions at Battelle would be as similar as possible to those in Germany. Stevens told *Microwave News* that his intent had been to record the strain of rats, the DMBA doses and the magnetic field exposures. He noted that he was impressed by what he had seen in Hannover. "Löscher has done these experiments very carefully and very well," Stevens said. Meanwhile, Löscher and Dr. Meike Mevissen are completing the data analysis of a replication of their 1 G, 50 Hz study with funds from the U.S. Department of Energy. In an article published in the May 1996 issue of *Carcinogenesis (17,* pp. 903-910), Löscher and Mevissen concluded that rats exposed to 500 mG had a higher incidence of breast cancer than did rats exposed to 100 mG, but a lower incidence than those exposed to 1 G, providing evidence for a dose–response relationship.

CELLULAR PHONE INTERFERENCE

Astronomers Wrangle with Iridium... Motorola's Iridium satellites are based on a flawed design that will cause unacceptable interference with neighboring parts of the radio spectrum, according to a letter in the June 13 issue of *Nature*. Dr. John Ponsonby of the Onsala Space Observatory in Onsala, Sweden, warns that the resulting interference with radio astronomy will violate the rules of the International Telecommunication Union (ITU), which allocates frequency use on a global basis. Ponsonby explains that the problem stems from Iridium's use of high-efficiency power amplifiers together with composite signals, which combine several transmissions destined for different subscribers. He states that, "This inevitably leads to 'intermodulation distortion'—spurious frequency components

are generated both inside and outside the band occupied by the intended signals." Ponsonby concedes that an output filter on each amplifier could remove the "out-of-band" signals. But he notes that since each Iridium satellite uses many individual amplifiers, this would probably add too much weight to be practical. How much out-of-band interference will there be? Since it depends on the level of phone traffic, Ponsonby calls it "hard to estimate," but contends, "Typically, it might be 1,000 times above the level acceptable [for radio astronomy], and it therefore would amount to total jamming of the band." On April 18, *Nature* reported that Europe's Committee on Radio Astronomy Frequencies (CRAF) had asked Motorola to limit the number of Iridium users on the system at times of peak traffic in order to minimize this type of interference. "But such a solution is clearly not compatible with a commercial aim of maximizing revenue," wrote correspondent Alison Abbott. In a 1994 agreement with the U.S. National Radio Astronomy Observatory (NRAO), Motorola promised at least four hours of zero interference per day—during times of least phone use. "We have coordinated with radio astronomy sites in the U.S. and have every intention of coordinating with radio astronomers worldwide," John Windolph, Iridium's director of marketing and corporate communications, said in a telephone interview from the company's headquarters in Washington. He explained that Iridium will pay for a beacon at each radio astronomy site: "When the subscriber's phone detects the beacon, it ratchets up to a higher part of the spectrum so it won't interfere." How will this change Iridium's downlink—the satellite-to-earth transmissions that are the focus of Ponsonby's critique? "If you take the handset out of the equation, you don't have a problem," Windolph asserted. "The satellite transmission alone doesn't cause the interference. It's the interaction between satellite and handset transmissions, which are in the same bandwidth, that causes a potential problem." However, NRAO spokesperson Dave Finley, in Socorro, NM, maintained that, "It is expected that intermodulation products of the Iridium downlink will appear within the radio astronomy band during times of high satellite usage." Finley told *Microwave News* that the NRAO will be "working with Motorola on tests to measure the interfering emission levels" when the Iridium system enters its test phase. (See p.14 and *MWN,* J/A95.)

ELECTRIC BLANKETS

Mothers' Use Not Linked to Childhood Cancer...A recent study of exposures to electric blankets and water bed heaters *in utero* and after birth suggests that they do not promote brain tumors in children. A team led by Dr. Susan Preston-Martin of UCLA's medical school investigated 540 children under the age of 19 living on the West Coast of the United States who were diagnosed with cancer between 1984 and 1991. The report, published in the *American Journal of Epidemiology (AJE, 143,* pp.1116-1122, June 1, 1996), indicates that the risk of brain cancer did not depend on the trimester of the pregnancy in which the exposure occurred. Similarly, there was no rise in the rate of brain cancer among children directly exposed to water bed heaters or electric blankets—compared to the 801 children in the control group. These results stand in contrast to the findings of the first study of this kind: Six years ago, Dr. David Savitz of the University of North Carolina, Chapel Hill, reported *(AJE, 131,* pp.763-773, May 1990) that children exposed *in utero* to electric blanket EMFs had a two-and-a-half times greater than expected risk of developing brain tumors (see *MWN,* M/J90). "Their study provides credible evidence against an association," Savitz told *Microwave News,* "just as ours provided some evidence in support."

MEDICAL DEVICES

OrthoLogic Under Scrutiny... On May 31, the FDA issued OrthoLogic Corp. a "warning letter" threatening regulatory ac-

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• A former radar repairman wins a $200,000 out-of-court settlement from General Electric Co. and Western Electric Co. after he charged that his deafness, bleeding eyes and systemic hemorrhaging were due to 14 years of RF/MW radiation exposure from a Nike Hercules radar.

• A NIOSH RF/MW criteria document is delayed by the Reagan administration's proposal to move the institute from Washington to Atlanta.

Years 10 Ago

• Shipbuilders at the Bath Iron Works in Portland, ME, report facial burns, headaches, irritated eyes, nausea and exhaustion after spending a rainy March morning working near a U.S. Navy ship with its radar accidentally turned on.

• The EPA proposes four options for public RF/MW exposures: maximum SARs of 0.04, 0.08 or 0.4 W/Kg, or setting no limit at all.

• Human tumor cells exposed to power-frequency EMFs proliferate more easily and are more immune to attack, according to Dr. Jerry Phillips of the Cancer Therapy and Research Foundation in San Antonio, TX.

Years 5 Ago

• An animal study by Drs. Jack McLean and Maria Stuchly of Health and Welfare Canada in Ottawa and a cell-culture study by Dr. Chris Cain of the VA Hospital in Loma Linda, CA, independently show that ELF magnetic fields can act in concert with the carcinogen TPA to promote cancer development.

• The U.S. Congress, the General Accounting Office and the FDA investigate scores of fatalities that occurred after apnea monitors—devices that detect respiratory failure—did not respond due to EMI.

• Telephone line workers have higher mortality rates from leukemia than other telephone company employees, according to Dr. Genevieve Matanoski and colleagues at Johns Hopkins University in Baltimore.

tion if the company did not retract "misleading" information about its Model 1000 Bone Growth Stimulator, which uses magnetic fields to increase the synthesis of growth factor IGF-II. In the letter, Lillian Gill, director of the Office of Compliance at FDA's Center for Devices and Radiological Health in Rockville, MD, questioned the company's claims that the device has a 78% success rate with an average treatment time of 4.1 months and that it was approved by the FDA for areas other than the arms and legs. Dr. Allan Weinstein, CEO of OrthoLogic, did not make the letter public, telling the *Wall Street Journal* that he did not believe it would have a "material adverse effect" on the company. Nevertheless, he later admitted to the *Journal* that while the letter was still under wraps, he sold 50,000 shares of OrthoLogic, claiming to have done so in the interest of "portfolio diversification." When the warning letter was leaked to the press in mid-June, the price of OrthoLogic shares tumbled—falling from $23.75 to $14.88 over a two-day period (all prices are adjusted to reflect a two-for-one stock split in late June). The shares, which had risen from $2.50 to $26.75 in the last year (see *MWN,* M/J96), leveled off at about $8-$9 at the end of July. Meanwhile, Weinstein has been replaced as president and chief operating officer by George Oram Jr.—who was previously with OrthoLogic's competitor, EBI Medical Systems Inc. in Parsippany, NJ. Weinstein remains with the company as chairman and CEO. OrthoLogic now faces lawsuits from disgruntled shareholders who charge that Weinstein and other company officials sold their shares to avoid losses totaling over $2 million.

MEETINGS

Coghill Congresses... The *1st World Magnetotherapy Congress,* which was held at the headquarters of the Royal Society of Medicine in London, U.K., May 7-8, attracted 60 delegates from 12 countries. The event, which included 16 papers on the use of magnetic fields to aid the body's healing processes, was sponsored by Coghill Research Labs in Gwent, U.K. Dr. Martin Blank of Columbia University's medical school in New York City, the president-elect of BEMS, chaired the meeting. He praised Roger Coghill for having "brought together a lot of new and not-so-new ideas." Coghill is already planning his next conference: the *1st World Congress on Bioelectromagnetics in Nature,* to be held in London, May 8-9, 1997. For more information, or to order the proceedings of the Magnetotherapy Congress ($60.00), contact: Coghill Research Labs, Lower Race, Gwent, Wales NP4 5UH, U.K., (44+1495) 763-389, Fax: (44+1495) 769-882, E-mail: <100771.1170@compuserve.com>.

Bioeffects Symposia... As the *25th General Assembly of the International Union of Radio Science* (URSI), to be held in Lille, France, draws near, presentations from a 1993 symposium in Fukuoka, Japan, which was held after the 24th assembly in Kyoto, have been published. The 243-page volume, titled *Biological Effects of Magnetic and Electromagnetic Fields,* was edited by Dr. Shoogo Ueno of the University of Tokyo and is comprised of 16 papers. Several Japanese authors are featured, including Drs. Ueno and Masakazu Iwasaka on "Magnetic Nerve Stimulation and Effects of Magnetic Fields on Biolog-

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ical, Physical and Chemical Processes" and Drs. Masamichi Kato and Tsukasa Shigemitsu on "Effects of Exposure to a 50 Hz Magnetic Field on Melatonin in Rats." To order a copy, contact Plenum Publishing Corp. at (800) 221-9369, or send $79.50 to Plenum, 233 Spring St., New York, NY 10013.

Workshop on Interaction Mechanisms...COST 244 on Biomedical Effects of EMFs—part of the European Cooperation in the Field of Scientific and Technical Research—is organizing a workshop on *Delineation of Differences in the Mode of Energy Coupling and Mechanisms of Interaction at ELF and RF,* to be held in Zagreb, Croatia, October 5-6. Also on the agenda is a roundtable discussion comparing various measurement standards. The official language of the workshop will be English, and there will be no registration fee. For more information, contact: Dr. Dina Simunic, Faculty of Electrical Engineering and Computing, University of Zagreb, Unska 3, HR-10000 Zagreb, Croatia, (385+1) 6129-789, Fax: (385+1) 6129-606, E-mail: <dina.simunic@fer.hr>; or look up <http://pubwww.srce.hr/cost244/zgwork> on the World Wide Web.

Lawyers Unplugged... The Environmental Law Center at Vermont Law School is holding a conference, *Unplugged: Health and Policy Implications of the Wireless Revolution,* at the Killington Ski Resort, November 15-16. Among those speaking will be Dr. Stanislaw Szmigielski and attorney Anthony Roisman. For more information, contact: Clare Kelsey, Public Interest Law Cooperative, PO Box 1, Strafford, VT 05072, (802) 765-4409, Fax: (802) 765-4509, E-mail: <cckelsey@sover.net>.

PEOPLE

After turning 65, writer **Paul Brodeur** has retired from *The New Yorker.* His three books on EMFs, *The Zapping of America* (1977), *Currents of Death* (1989) and *The Great Power Line Cover-Up* (1993), were all excerpted in the pages of the magazine prior to their publication. A novelist before he began to write about EMFs, Brodeur was on the staff of *The New Yorker* for 38 years. He is now finishing a memoir, which is slated for publication next year....Dr. **Martin Blank** of Columbia University's medical school in New York City is the new president-elect of the Bioelectromagnetics Society. Blank won a three-way election, beating out Dr. **Q. Balzano** of Motorola and Dr. **John Osepchuk**, who recently retired from Raytheon Co. Blank takes over from Dr. **Richard Luben**, the current president, next June....**Thomas Maney**, a former chairman of the board of directors of the EMR Alliance, died on June 5 of a heart attack at the age of 72. Maney, who lived in Fort Walton Beach, FL, was vice president of the Florida Undergrounders Inc. Most recently, he was the author of "Benefits of Urban Underground Power Delivery," which appeared in the spring 1996 issue of *IEEE Technology and Society Magazine*....**Gary Taubes**, a contributor to *Science* and *Discover* magazines, is making news, rather than just writing about it. Taubes has long been a skeptic and critic of EMF health effects, most notably in "Fields of Fear," which appeared in the November 1994 issue of *The Atlantic*. But the spotlight now shining on him has nothing to do with EMFs—rather the controversy cen-

ters on a profile of Dr. **Stanley Prusiner** written by Taubes a decade ago. Prusiner, a neurologist, has spearheaded the prion hypothesis—that there exist infectious proteins. When first proposed, the theory was regarded as heresy, but it is now mainstream science. Some still maintain that the prion hypothesis is the "cold fusion" of infectious diseases, according to a detailed special report in the July 12 issue of *Science*. But Prusiner, the world's leading prion scientist, refused to be interviewed by *Science*. The reason, according to several of his colleagues, is that Prusiner has never gotten over a decade-old profile by Taubes, in *Discover,* "The Name of the Game Is Fame, But Is It Science?" *Science* correspondent Rosie Mestel explained that, "Taubes reported in his story that Prusiner's forceful personality and a flair for public relations, rather than the scientific merit of his work, was behind the growing prominence of the hypothesis." Prusiner won the Lasker Award two years ago and is said to be on the short list for a Nobel Prize.

POLICE RADAR

Another Lawsuit Voluntarily Dismissed... On May 29, a federal court in South Carolina agreed to the dismissal of a lawsuit against Kustom Signals Inc., a manufacturer of police radar equipment—a dismissal requested by the plaintiffs. The suit had been brought on behalf of the wife and child of Danny Farr, who had worked for the South Carolina Highway Patrol and died of testicular cancer in May 1995. Attorney John Kassel of Suggs & Kelly in Columbia, SC, asked that the suit be dismissed without prejudice, meaning that it could be refiled at a later date. Judge Joseph Anderson granted the request, but with certain conditions. Before Farr's family could refile such a suit in the future, they would have to pay Kustom for its court costs to date, plus an additional $2,000 for what the judge called "a partial attorney's fee." Kustom attorney Mark Oium, of O'Connor, Cohn, Dillon & Barr in San Francisco, said that he knows of no personal injury lawsuits now pending against Kustom or any other police radar makers. "I think the bloom is off the radar litigation rose," he commented in a telephone interview. "There doesn't seem to be a lot of enthusiasm out there for filing these lawsuits." Kassel did not return phone calls requesting comment. In January he told *Microwave News* that "these are tough cases," noting that there is a lack of research on the health effects of radar.

STANDARDS

Hearing Aid EMI...IEEE committee C63.19 is preparing two standards addressing compatibility between hearing aids and wireless technology. One of these, *Method of Measurement for Hearing Aid Compatibility with Wireless Communications,* is a protocol for making measurements, while the other, *Limits for Hearing Aid Compatibility with Wireless Communications,* is a set of guidelines to prevent interference. The committee had an organizational meeting in late June in Minneapolis and will convene again in August in Santa Clara, CA, according to one of its cochairs, Dr. Stephen Berger of Siemens Rolm Communications in Austin, TX. Berger told *Microwave News* that he expects the standards to be finished by fall 1998.

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NCI Dismisses Leukemia Risk for Children Living Near Power Lines

Measured Magnetic Fields Stir Debate

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

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

More Coverage of the NCI Study on pp.10-14
Germans and Swedes Find Links • Dose-Response Flap • Wertheimer-Leeper vs. Kaune on Wire Codes

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

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

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

(continued on p.10)

Views on the News: The NCI Study

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

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

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

(continued on p.19)

HIGHLIGHTS

At the World Congress

The Talk of Bologna: Wireless Comes Home

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

« Wireless Notes »

Opposition to tower siting from wireless industry employees is not common. One reason why may be found in the case of **Ann Shirreffs**: When she tried to keep a **PCS** tower from her children's school, she lost her job as a cellular phone sales rep. On June 1, the Cleveland *Plain Dealer* reported that Shirreffs was asking parents of children at the school in suburban Pepper Pike to petition the school board against an **AT&T Wireless** tower. Early that same Sunday morning, her boss called and they "mutually agreed" that she should look for another job, Shirreffs told *Microwave News*. Two weeks later, Pepper Pike Mayor Bruce Akers announced that the school board had voted down the AT&T tower—in large part due to the petition, which had been signed by 950 parents. "I have truly risked my job and my career," Shirreffs said. "I wouldn't have done it if I didn't have doubts about the safety of this technology." She sees no inconsistency between selling hand-held phones and opposing the tower. "The difference is very clear. The person who buys a phone has choices—when and how to use it," Shirreffs said. "The minute we place a cell tower on school property, we eliminate choices for the students." The lack of long-term RF/MW exposure studies prompted her decision to oppose the tower at the school, which runs from pre-K through high school. Still, the decision has been unpopular in some quarters because AT&T would have paid $100,000 up-front and $1,000 per month after five years. One of those in favor of the tower was school board member David Noble, who was absent for the deciding vote, according to the June 26 *Chagrin Valley Times* (OH). "You cost us money for certain towers that are not a health hazard," the paper quoted him as telling residents. "They've given up thousands of dollars a month," Kathleen Riehle, a spokesperson for AT&T in Cincinnati, said in an interview. "I think that's kind of sad." AT&T is proceeding with a plan to locate the tower at a nearby electrical substation, according to Riehle. Shirreffs, meanwhile, has put her job hunt on hold while she helps nearby communities keep towers away from their schools.

«« »»

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

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

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

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

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

Dr. Jukka Juutilainen of the University of Kuopio exposed mice to 902 MHz radiation—50 mice each to analog and to pulsed signals—after the mice were initiated with ionizing radiation. A mortality analysis found no difference between the RF–exposed mice and the controls. In an interview, Juutilainen said that a final report, which will include the results of a histopathological analysis, should be finished early next year.

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

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

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

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

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

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

Cell Phone EMI with Pacemakers Confirmed, Seen as Manageable

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

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

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

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

In Hayes's view, there is no need for further study of pacemaker EMI unless a new phone technology is introduced. But he believes that more research is needed on the possible vulnerability of implanted defibrillators to cellular phone interference (see *MWN,* M/J97). The Mayo Clinic and the New England Medical Center in Boston are seeking funding to study this question.

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

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

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

IEEE Reaffirms Its RF/MW Exposure Standard

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

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

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

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

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

Australian Insurance Company Opposes Wireless Antennas

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

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

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

"We objected because of community concerns including the school nearby," David Sinclair, a spokesperson for Mercantile, told *Microwave News*. "We're sympathetic to those concerns and worry that there might be health effects."

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

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

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

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

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

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

Q1: What does this say about the safety of mobile phones?
A1: In a word, nothing. That's not our position, but the position of the scientists who did this study. Their clear position is that it can't be directly related to human health. And that means it definitely can't be related to the safety of mobile phones.

Q2: But weren't these animals exposed to mobile phone signals?
A2: The animals were exposed to a type of radio signal common to some digital phone systems. However, the conditions and levels of exposure were quite different from the use of those phones.

Q3: How so?
A3: In short, the animals were in cages at a certain distance from an antenna operating at higher power than mobile phones. They were exposed in a way and at levels unlike those of mobile phones. In fact, in humans, whole-body exposures of this kind would be in excess of recognized safety standards.

Q4: You seem to be dismissing this study as completely irrelevant?
A4: Not at all. As the researchers have said, it raises some interesting questions. Those questions involve the use of a certain genetically engineered mouse in research of this kind. That warrants further independent, focused investigation. But as the researchers say, their findings cannot and should not be interpreted as bearing on human health or the safety of cellular phones.

Q5: You say this raises "interesting questions." What do you mean?
A5: Well, there seems to be general agreement that issues about the kind of mouse used, the exposure conditions and other factors need further investigation to more fully assess the significance of this study.

Q6: But in the meantime, that's not a cause for concern by cellular phone users?
A6: Not at all. The researchers themselves have said their findings cannot be directly related to human health. In fact, they stated that *no* single study can yield qualified judgments about human health risks. The scientific community understands that, government and international health authorities understand that, and the public should understand that.

Q7: What's going to be done to follow up on this research?
A7: That remains to be seen, but the Australian government is in the process of developing priorities for its own research program in this area and I suspect this latest study may be a subject for consideration in those deliberations.

Q8: What do you say to those who contend there has been far too little research to conclude the safety of cellular phones?
A8: I say they're wrong. The safety of cellular phones is supported by a broad and expanding body of scientific knowledge. Anyone claiming evidence of risk in this latest study ignores the fact that it was done with a highly experimental model and produced results contrary to other animal studies. Research continues and more will be done. We anticipate it will provide further support for the safety of cellular phones.

EMF NEWS

« Power Line Talk »

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

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

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

NAS–NRC Reviews, Criticizes Navy Studies of Project ELF

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

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

The report concludes that, "The few small possible effects that were found were often too readily dismissed" by researchers. It warns that "concerns arose about the scientific credibility" of such interpretations.

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

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

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

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

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

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

> The committee's analysis of the primary data indicates misuse of the data. When the analysis is corrected, the growth effect disappears.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The 11 studies in the Navy's ecological monitoring program began between 1982 and 1984 and were completed by 1996. In 1994, the Navy asked the NAS–NRC to evaluate the program's activities and findings, and work began the following year (see *MWN*, J/A95). The NAS–NRC had conducted a review of EMF bioeffects for Project ELF in 1977, when it was known as Project Seafarer. Dr. Woodrow Hastings of Harvard University in Cam-

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

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

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

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

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

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

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

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

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

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

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

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

"The feedback I've heard from others in the industry is that they think this report is pretty good," Janina Clark, editor of the trade magazine *Reinsurance* in London, told *Microwave News. Reinsurance* hosted a roundtable discussion on July 11 with representatives of the different groups in the British EMF debate—activists, trial lawyers, scientists, utility experts and insurance executives. Both British and German insurance companies have recently expressed concern about the EMF issue (see *MWN,* M/J 95 and N/D96).

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

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

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

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

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

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

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

What is at stake, according to the report, is broader than the EMF issue: "There is a socio-legal problem: How should society deal with technologies which cannot be used with absolute safety and which therefore may represent a hazard?" New technologies often bring with them potential risks that cannot be clearly assessed or measured. So, Swiss Re contends, if society wants to employ these technologies, "we must...focus on how much *uncertainty* we are prepared to accept."

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

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

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

Glazer, Jordan Lawsuits Both Withdrawn Voluntarily

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

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

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

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

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

Glazer's wife, Elsa, died of chronic myelogenous leukemia (CML) in 1988. In 1992, Leonard Glazer was also diagnosed with CML; he filed the lawsuit in January 1994. Several power lines ran across the Glazers' property, where they had lived since 1969 (see *MWN,* J/F94, M/J94 and S/O95). But most of the EMFs in their home were due to ground currents flowing through the household plumbing system. In May 1996, FPL convinced a circuit court judge that ground currents were not their responsibility, and he dismissed the case (see *MWN,* M/J96; also J/F97). Glazer then appealed to the state Supreme Court. At the time he decided to end his suit, the Supreme Court had not yet indicated whether it would hear the case.

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

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

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

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

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

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

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

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

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

In a 1993 reanalysis of the 1986 Savitz data, Savitz and Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, found that by shifting the cutoff point from 2 mG to 3 mG, the relative risk of ALL jumped from 1.6 to 5.3 and achieved statistical significance, albeit with only a very small number of cases. They concluded that, "Future studies should seek subject populations with a greater proportion of subjects" with exposures above 3 mG.

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

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

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

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

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

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

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

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

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

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

Increased risks for younger children and for those with high nighttime exposures showed up in both the Berlin and Lower Saxony data. In the combined analysis, these odds ratios become more significant. The researchers suggest that these measurements "may reflect the actual exposure best." They note that "very young children are more likely to be at home full-time," and that overnight bedroom measurements would closely track the exposure of a sleeping child.

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

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

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

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

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

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

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

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

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

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

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

Using a two-tail test, the NCI found that the observed dose-re-sponse relationship between measured magnetic fields and childhood leukemia would occur only 9% of the time by chance—a little short of the standard 5% criterion.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Dr. Lawrence Fischer of Michigan State University in East Lansing, chair of the NCI's advisory committee, agrees with Campion. "This study tips the scale," he said, "Exposure to magnetic fields is not a major, and probably not even a minor, cause of cancer." He added that it would be "more productive" to pursue other avenues of research.

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

EMF Exposure at Both Home and Work Raises Leukemia Risk

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

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

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

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

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

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

Wertheimer and Leeper

The Wertheimer-Leeper (W/L) wire code was designed to estimate magnetic field exposures in Denver during the 1950s and 1960s, and one should not expect it to work well for other locales and times—as we pointed out in a memo[1] circulated in 1986, as well as in a 1991 article[2] and in numerous verbal communications before and since then. This caveat certainly applies to the National Cancer Institute's (NCI) goal of discerning any modest but real risk that may have existed for the 816 children whose 1980s-1990s homes were wire-coded in dozens of different areas in nine states.

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

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

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

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

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

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

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

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

Interestingly, the Feychting-Ahlbom study[11] also provides good evidence that the better a surrogate predicts high magnetic fields, the better it predicts cancer risk. Their surrogate, which calculated historical magnetic field levels, did an excellent job of predicting high fields at single-family houses, but a mediocre job of predicting them at apartment houses. Using that surrogate, they found clear evidence of cancer risk at the former, but none at the latter.

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

What They Are Saying

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Kaune Replies

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

By 1989, Wertheimer and Leeper had already argued in several venues that it was inappropriate simply to apply their wire coding system to other areas of the U.S. without "tuning" it for local wiring and plumbing practices. Since the geographical area covered by the NCI study was served by more than 200 electric utility companies, we concluded that it was not feasible to carry out this prescription. However, by 1989, we knew that the W/L wire coding system was being used in Los Angeles without modification.[4] (This study subsequently reported a significant association between childhood leukemia and wire codes, in an area with wiring practices substantially *different* from those used in Denver.) We thus decided to include unmodified W/L coding in a pilot study that we performed in 1990 to provide data to guide the design of the final exposure assessment protocol for the NCI study. This study, conducted in the greater metropolitan Washington, DC, area, provided evidence of an association between contemporaneously measured magnetic fields and wire codes.[5] When this result was combined with other observations of associations between wire codes and measured magnetic fields in Denver[6] and Seattle,[7] it appeared to us that the unmodified W/L wire coding system might be a rather geographically robust surrogate for residential magnetic fields. Based on these results, we decided to include wire codes in the exposure assessment protocol used in the full NCI study.

Data published after 1990 provided additional evidence for our hypothesis that W/L wire codes were associated with contemporaneously measured magnetic fields over a broad geographical area. In the Los Angeles study mentioned earlier, an association was found between wire codes and measured fields.[4] Zaffanella[8] examined a sample of 991 homes that spanned the entire U.S. and observed a clear relation between measured residential magnetic fields and wire codes. And, Bracken[9] studied 396 residences occupied by employees of 39 U.S. electric utility companies and also observed an association between wire codes and measured magnetic fields. Indeed, I can think of no study in the U.S. that has examined wire codes and magnetic fields and has *failed* to find an association between them.

My colleagues and I have also examined the NCI data to ascertain the relation between magnetic fields and wire codes. A paper reporting these results is currently undergoing journal review. All I can say at this time is that we observe a relation between wire codes and contemporaneously measured magnetic fields similar to those observed in other studies. Even so, it is possible that wire codes were a less effective surrogate for contemporaneously measured (and historical) magnetic fields in the area covered by the NCI study than in Denver, so perhaps we should have observed an association between childhood ALL and residential wire codes somewhat reduced in strength compared to that observed in Denver. However, in actual fact, the NCI study[10] found *no relation whatsoever* between childhood ALL and residential wire codes.

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

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FROM THE FIELD

Letter to the Editor

July 16, 1997

To the Editor:

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

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

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

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

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

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

Clippings from All Over

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

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

"When in doubt, obfuscate."

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

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

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

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

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

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• Dr. Samuel Milham Jr. finds a link between occupational exposure to EMFs and elevated leukemia rates among workers in Washington state—the first time such an association is reported.

• A plan to extend a highway under the Omega radio navigational antenna on Oahu, HI, leads to public concerns over shock hazard and interference with pacemakers.

• Attendees of the BEMS conference express concern that severe cuts in spending on EMF research could imperil their research and lead to the dissolution of the society.

Years 10 Ago

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

• Researchers at the Swedish University of Agricultural Sciences in Uppsala find that exposure to VDT-type radiation increases the incidence of miscarriages and resorptions in pregnant mice.

• Scientists in Sweden and the U.K. challenge the finding that aqueous solutions of DNA can absorb 1-10 GHz microwaves.

Years 5 Ago

• Dr. Keith Florig of Resources for the Future in Washington estimates that concerns over EMFs are costing over $1 billion per year.

• Dr. Dana Loomis of the University of North Carolina, Chapel Hill, notes a doubling of male breast cancer rates among electrical workers under 65, but he also sees a decrease in the rates among older workers.

• At the *1st World Congress for EMFs in Biology and Medicine,* the Army and the Air Force spar over the adequacy of the ANSI/IEEE RF/MW exposure standard.

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UPDATES

DIGITAL TELEVISION

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

ELECTROMAGNETIC INTERFERENCE

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

EPIDEMIOLOGY

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

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

MEDICAL DEVICES

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

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

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MEETINGS

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

PEOPLE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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NIEHS Panel Finds EMFs Are "Possible" Human Carcinogens

Power frequency electromagnetic fields (EMFs) are "possible human carcinogens," according to a working group assembled by the National Institute of Environmental Health Sciences (NIEHS).

On June 24, the 30-member panel voted 19 to 9 in favor of categorizing extremely low frequency (ELF) EMFs, such as those from power lines and electrical appliances, as possible carcinogens. The decision followed ten days of review and debate at a conference center in an industrial park outside Minneapolis.

The panel's decision was based largely on the results of epidemiological studies of children exposed at home and workers exposed on the job. The results of animal *(in vivo)* and cellular *(in vitro)* experiments provided less support for designating EMFs as possible cancer agents.

More on the EMF–Cancer Decision Inside

• Overall conclusion of the working group, p.5
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The evaluation of the EMF literature—as well as the specific votes—followed procedures developed by the International Agency for Research on Cancer (IARC), based in Lyon, France. Dr. Lorenzo Tomatis, the former director

(continued on p.4)

Views on the News: the EMF–Cancer Decision

NIEHS Spins the News, Downplays the Health Risks

It was the press release that gave the game away. Up to that point, the NIEHS had run a remarkably open process. But when its working group voted to list EMFs as possible human carcinogens, NIEHS managers moved quickly to control the message the public would hear.

Dr. Michael Gallo, who chaired the Minneapolis working group meeting, was picked to calm things down. "This report does not suggest the risk is high. It is probably quite small," he said in the NIEHS press release. Gallo is a toxicologist and the director of an NIEHS-sponsored Center of Excellence at the University of Medicine and Dentistry of New Jersey in Piscataway.

The sound bite worked like a charm. It was the only direct quote offered by the NIEHS and every reporter assigned to the story dutifully reprinted it. A Divided NIH Panel Agrees Power Lines May Pose Small Cancer Risk, ran the *Boston Globe* headline (June 25).

(continued on p.19)

EMFs Shown To Change Human Cardiac Rhythms; Predicted Rise in Heart Disease Supported by Epi Study

EMF exposure can alter heart rhythms and may lead to elevated cardiac risks, according to Dr. Antonio Sastre of the Midwest Research Institute (MRI) in Kansas City, MO.

In recent clinical studies of EMF effects, Sastre observed changes in heart rhythms that have been linked to increased risks of heart disease. This led him to predict that utility workers would have a higher rate of two specific types of heart disease. He then collaborated with Dr. David Savitz on a new epidemiological study to test this hypothesis.

The epidemiological results supported Sastre's prediction. "If you look at the hypothesis among 140,000 utility workers, it pans out," MRI's Dr. Charles Graham, a coauthor of the clinical studies, told *Microwave News,*

Savitz, of the University of North Carolina, Chapel Hill, noted that while epidemiological studies of EMFs have found some associations with leukemia and other kinds of cancer, "without any strong mechanistic hypothesis it's unclear how to follow up." But in this case, he said, "There are some immediate opportunities for further testing, both in clinical experiments and using the tools of epidemiology."

Sastre's clinical studies found that EMF exposure can reduce the extent of heart-rate variability (HRV), a measurement used by cardiovascular specialists as a diagnostic tool.

"A metronome beats at a constant rate; a healthy heart does not," Sastre, Graham and MRI's Dr. Mary Cook write in *Bioelectromagnetics (19,* pp.98-106, 1998), in their paper on the clinical studies. Beat-to-beat variations in heart rhythm are a natural result of the interactions of reflexes that control blood pressure, body temperature and respiration. "This type of variability is not consciously perceived by a person," they note; it is different from changes in heart rate in response to exertion or anxiety.

Cardiologists have found that changes in HRV can predict the risk of several important heart conditions. According to Sastre, reduced HRV is known to be linked to increased risk of sudden cardiac death, and to increased mortality in heart attack survivors.

The three clinical studies, with a total of 77 volunteers, found that HRV was significantly reduced during exposure to an intermittent 60 Hz circularly polarized magnetic field at 200 mG.* No such changes were observed during nighttime exposure to a 10 mG intermittent field, or to a 200 mG continuous field.

Based on these findings, Sastre proposed that workers with high EMF exposure should show increased mortality from two types of cardiovascular conditions—arrhythmia and heart attacks. In a paper that Savitz and he wrote on the epidemiological study, they explain that no increase would be expected in deaths from chronic coronary heart disease and atherosclerosis, because these are "the culmination of processes which develop over extended periods of time" and are unlikely to be as affected by poor control of cardiac reflexes.

*The field was intermittent in two ways: First, the field was "on" every other hour (for example, from midnight to 1 a.m. was on, from 1 to 2 a.m. was off, etc.). Second, during the hours designated as "on," the field was switched on or off every 15 seconds.

Epi Study Gets Fast Track for NIEHS EMF Working Group

Savitz and Sastre's new epidemiological study on EMFs and heart disease was regarded as important enough to be considered by the NIEHS EMF working group (see p.1) even prior to its acceptance for publication. A paper on the study is now under review at the *American Journal of Epidemiology.*

The NIEHS considered only research results that had been published in a peer-reviewed journal—but an exception was made in this case. The subcommittee on epidemiology reviewed the study, but in the end decided that current evidence is "inadequate" to say whether EMFs can increase cardiac risk.

"Because this group had a deadline, I thought they should have the opportunity to consider it before publication," Savitz told *Microwave News.* He added that, "I explored it with the journal to make sure there weren't any misunderstandings."

Following discussions with Sastre, Savitz examined data on male employees of five U.S. electric utilities, compiled for his previous EMF study for the Electric Power Research Institute (see *MWN,* J/F95). Savitz found significant increases in deaths related to arrhythmia and from heart attacks, but not from the other two types of heart disease. Their paper on these findings is currently in peer review at the *American Journal of Epidemiology* (see box above).

Savitz and Sastre report that in analyzing the utility worker data, "a dose-response gradient was observed for cumulative career magnetic field exposure." The highest exposure category showed about a doubling of risk for arrhythmia-related and heart attack deaths. Elevated risks were also found for duration of employment. This pattern was especially notable for electricians and power plant operators, and less strongly for line workers.

Previous EMF epidemiological studies have looked at cardiovascular disease in the aggregate, and most have not found significant increases in risk. The new study by Savitz and Sastre is the first to distinguish between specific types of heart disease.

"Although these epidemiological results are very intriguing, this does not necessarily mean that the hypothesis is true," Sastre told *Microwave News.* "But the beauty of this approach," he added, "is that we know how to get the data that are needed to either confirm or disprove it."

One immediate way to follow up would be to reanalyze available data from other utility worker studies to see if the same patterns emerge. Savitz said that the studies of workers at Southern California Edison (see *MWN,* M/A93) and those at Hydro-Québec and Ontario Hydro (see *MWN,* M/A94) would be good candidates. Graham noted that data from these and two other existing data sets could be analyzed within six months.

Sastre said that to test his hypothesis fully will require long-term prospective studies of HRV in people with real-world EMF

exposures. The changes in heart rhythm observed in his clinical studies were short-term and reversible, while the epidemiology points to a long-term risk. The idea that EMF exposures could permanently change HRV "is still speculative," Sastre said.

Fourth Lab Finds 12 mG Field Blocks Anticancer Effect

A team at the Battelle Pacific Northwest Labs in Richland, WA, has found that a 12 mG magnetic field can block the protective action of melatonin against the growth of cancer cells. Battelle is now the fourth lab to observe this effect.

Human breast cancer (MCF-7) cells whose proliferation had been inhibited by melatonin resumed growing in the 12 mG 60 Hz field. A 2 mG magnetic field did not affect the melatonin-stabilized cells.

"We believe it," said Dr. Larry Anderson, referring to the low-level *in vitro* magnetic field effect. The Battelle team, led by Anderson and Dr. James Morris, presented the new replication results at the *20th Annual Meeting of the Bioelectromagnetics Society* (BEMS) in St. Pete Beach, FL, June 7-11. "We are still on the cautious side, but we are confident enough to report our results," Anderson said.

The effect does not occur in all breast cancer cell lines, however. It has only been observed in a particular subtype—and not in others that are quite similar.

Battelle is the latest lab to repeat the EMF–melatonin experiment, which was first reported by Dr. Robert Liburdy in 1992 (see *MWN,* J/A92). In his paper published in the *Journal of Pineal Research (14,* pp.89-97, 1993), Liburdy wrote that, "These results provide the first evidence that [extremely low] frequency magnetic fields can act at the cellular level to enhance breast cancer proliferation by blocking melatonin's natural oncostatic action."

In 1996, Dr. Carl Blackman of the Environmental Protection Agency in Research Triangle Park, NC, and, later, Dr. Richard Luben of the University of California, Riverside, each reported replication of Liburdy's experiment (see *MWN,* M/A96).

"It's hard to argue with the third replication," Dr. Russel Reiter of the University of Texas Health Science Center in San Antonio told *Microwave News*. Reiter is the editor in chief of the *Journal of Pineal Research.*

Liburdy and his collaborator, Dr. Joan Harland, both of the Lawrence Berkeley National Lab in Berkeley, CA, have also found that 12 mG magnetic fields can block the growth inhibition of tamoxifen, a drug used to control breast cancer. The Battelle group confirmed this finding, too.

"This is the golden nail that drives the point home to all the skeptics," said an obviously delighted Liburdy in an interview. He added that these experimental results "should drive future animal and epidemiological work because it is mechanism-based and hypothesis-driven."

Liburdy's experiments and their subsequent replications have attracted a great deal of interest because of past failures to repeat observed magnetic field effects in other labs—for instance, EMF-induced changes in gene expression (see *MWN,* M/J95). Three English researchers recently wrote of the "overriding need to demonstrate a single, unequivocal [extremely low frequency] EMF-induced response that will be consistently reproducible in independent laboratories" (see A. Lacy-Hulbert, p.11).

In addition, there is as yet no accepted explanation for a possible magnetic field effect at 12 mG or less from pure 50/60 Hz sine waves. Many physicists have been especially outspoken on this point, and if such an effect were to win widespread acceptance, it would put pressure on them to rethink their models.

The new Battelle study "may be the most significant paper at this year's BEMS meeting," said Dr. Gregory Lotz of the National Institute for Occupational Safety and Health in Cincinnati.

Managers at other federal agencies were equally impressed: "I'm excited about it," commented Dr. Russell Owen of the Food and Drug Administration in Rockville, MD. And Dr. Imre Gyuk of the Department of Energy in Washington said that, "It's getting harder and harder for skeptics to deny low-level effects."

French Link Workplace EMFs to Immune and Nervous System Ills

Workers exposed to EMFs from nearby transformers and power lines were more prone to fatigue and immunological disorders, according to a recent French study.

The study's results are "evidence that chronic human exposure to environmental low frequency EMFs...can cause neurovegetative, hematological and immunological disorders," wrote Dr. Laurence Bonhomme-Faivre and colleagues at Paul Brousse Hospital in Paris. Their report appeared in the March/April issue of *Archives of Environmental Health (53,* pp.87-92, 1998).

The study was small: 13 EMF-exposed subjects, who had worked near electrical transformers and 13 kV power lines for at least a year; and 13 matched controls, who had worked in other areas at the same site for the same length of time.

Two exposed workers spent eight hours daily in a lab situated directly above transformers and high-voltage wiring. Measured magnetic fields in the lab ranged from 3 mG to 66 mG. The other exposed workers divided their time between this lab and adjoining rooms, where magnetic fields were 0.9-3 mG.

The exposed group reported significantly more frequent occurrence of several subjective conditions—mental and physical fatigue, depression, melancholy, irritability, fainting and diminished libido—than did controls.

Blood samples from the two groups were also compared. The exposed workers' total lymphocyte (white blood cell) levels were significantly lower.

Especially significant, the French scientists believe, are the histories of the two people who worked full-time above the transformers. Both were found to have depressed white blood cell counts, which quickly returned to normal when they stopped working in this lab. On returning to the lab, one subject's white cell count fell again. Both now work elsewhere and have normal blood counts.

These fluctuations "strongly incriminate" chronic EMF exposure in the onset of hematological disorders, the researchers concluded.

But it is unclear if the skeptics will agree. Dr. Steven Miller of SRI International in Menlo Park, CA, noted that the observed melatonin effect is small. "It's within the variability of the system," he said. Miller, who was funded by the EMF RAPID program, has been unable to repeat a number of other scientists' *in vitro* experiments. He coauthored an editorial in the July *Radiation Research* on the importance of publishing negative results.

More Evidence on Lou Gehrig's Disease Among Utility Workers

The risk of amyotrophic lateral sclerosis (ALS) among Danish utility workers is twice as high as that among the general population, according to researchers at the Danish Cancer Society. ALS is a neurodegenerative disorder that is also known as Lou Gehrig's disease.

Drs. Christoffer Johansen and Jørgen Olsen report that the increase in mortality from ALS is statistically significant. They describe their results in the August 15 issue of the *American Journal of Epidemiology (148,* pp.362-368, 1998). The risk of ALS increased with the number of years on the job, and there was a dose-response relationship with estimated EMF exposure, but these trends are not significant.

"We think we found something," Johansen told *Microwave News*. "Savitz also found it," he said, referring to a study of 140,000 U.S. utility workers by Dr. David Savitz of the University of North Carolina, Chapel Hill (see *MWN,* M/J97). Savitz's study was published this July in *Epidemiology (9,* pp.398-404, 1998).

But while EMFs might be the cause, Johansen and Olsen point to another possibility: electric shock. Their study found an 18-fold increase in deaths due to electrocution, and they point out that in animal experiments, electric shocks have been shown to cause deterioration of the myelin sheath around nerve cells, which can kill the cells. They suggest that the elevated risk of ALS observed in their study "may be due to repeated electric contusions, rather than to exposure to high levels of EMFs."

"Interestingly," the Danish researchers write, "one patient [had] reported two episodes of electric shocks 19 and 26 years prior to diagnosis." But in this study, "it was not possible to construct an alternative exposure scale that could better distinguish exposure to shocks from EMF exposure." They note that while some previous studies have linked ALS to working in EMF-exposed jobs, others have found that the disease is associated with electric shock. Johansen told *Microwave News* that his data do not favor one explanation over the other.

Dr. Eugene Sobel of the University of Southern California (USC) in Los Angeles said in an interview that, "Severe electric shock, the kind that can lead to unconsciousness, is probably associated with a risk for ALS; it's been found enough times in small studies that this seems likely." Last year, Sobel and Dr. Zoreh Davanipour, also of USC, published evidence of a link between EMFs and ALS (see *MWN,* N/D95 and J/F97).

Sobel said it would be hard to distinguish the effect of many small shocks—which are less likely to be remembered than large ones—from that of EMF exposure. "Perhaps one way to disentangle these two factors," he suggested, "would be to study an occupation in which electric shocks are very unlikely, like airline pilots or garment workers."

Johansen and Olsen examined the primary cause of death for 21,236 people employed by Danish electric utilities between 1900 and 1993. Mortality from ALS rose along with estimates of EMF exposure: Those with background exposure had slightly fewer cases than expected; those with low exposure had nearly twice the expected number; while for medium exposure the risk ratio was 2.3 and for high exposure it was 2.8. Taken together, workers with high or medium exposure to EMFs had a significantly increased mortality from ALS, with a risk ratio of 2.5.

High exposure was defined as working in an environment that typically had fields of 10 mG or more, while medium exposure was defined as 3-9 mG. Estimates were based on a job-exposure matrix that combined 25 different job titles with 19 kinds of work areas.

In an earlier study based on the same cohort, Johansen and Olsen found no consistent link between EMF exposure and leukemia, breast cancer or brain cancer (see *MWN,* M/A98). This June, Johansen said that he had completed a paper on EMFs and multiple sclerosis, which has been submitted for publication.

Special Report: EMFs Found To Be Possible Carcinogens *(continued from p.1)*

of IARC, and two current IARC staffers were members of the NIEHS panel—all three voted with the majority for the possible carcinogen designation.

The working group's detailed, 523-page report will be the basis for NIEHS Director Dr. Kenneth Olden's report to Congress on the EMF Research and Public Information Dissemination program, known as EMF RAPID. This five-year research program was established by the Energy Policy Act of 1992 to investigate the potential health effects of EMFs associated with the production and distribution of electricity (see *MWN,* N/D92).

Exposure Guidelines Would Be Premature

The Minneapolis meeting closed with a debate as to whether the decision to categorize EMFs as possible carcinogens might be used as the basis for exposure guidelines. Panel member Dr. Paul Gailey drafted a statement that, after some editing, was endorsed by the working group and inserted into the closing paragraphs of the report. It read:

> Because of the extreme complexity of the electromagnetic environment, the review of epidemiological and other biological studies did not allow precise determination of the specific ELF EMF critical exposure conditions associated with the disease end points studied.*

*In the report as published, the word "extreme" was dropped. Also, instead of being placed immediately before the panel's final conclusion, as originally planned, this statement appears at the end of a section titled "non-cancer adverse health effects." NIEHS' Dr. Christopher Portier said that he did not know the reason for the change in placement.

In an interview with *Microwave News,* Gailey explained the motivation for his cautionary language: "The working group was not making a statement about safe and unsafe levels of exposure, because we don't know enough about what types of fields are biologically active, or at what levels."

"This lays the agenda for future research," commented Dr. Michael Gallo, the panel's chair, after Gailey's proposal was adopted. He noted that it captures the task before the EMF—and the larger scientific—communities. Gallo is a toxicologist who has done extensive work on dioxin, but has little EMF experience.

An outside observer, Dr. Leslie Robison of the University of Minnesota, Minneapolis, took a different view. "I actually believe that a great deal will not be learned from more research," he told the Minneapolis *Star Tribune* (June 25). Robison was a member of the team that conducted last year's National Cancer Institute (NCI) EMF–childhood cancer study.

Gailey's paragraph became part of the summary chapter of the report, which was drafted by the NIEHS' Dr. Christopher Portier with Gallo's assistance. It had been brought before the working group as the meeting was drawing to a close and members of the panel were leaving to go home. The NIEHS at first attempted to hurry the drafting of the final statement. A sometimes heated discussion followed on the importance of the panel's summary statement and the accompanying press release.

At this point, Dr. Daniel Wartenberg, a member of the working group, walked out of the meeting room with a feeling of déjà vu. As a member of the National Academy of Sciences (NAS) EMF panel, Wartenberg had been frustrated by the academy's decision to limit the participation of its committee members in deciding how the NAS would deliver to the public what turned out to be a dismissive view of EMFs.

How Big Are the Health Risks?

"This report does not suggest that the risk is high. It is probably quite small, compared to other public health risks." These were the words of Dr. Michael Gallo in the NIEHS' June 24 press release announcing the working group's decision to designate EMFs as a "possible human carcinogen." The quote, which went on to urge that EMF research continue, was widely reproduced in the subsequent media coverage—indeed, it was the only one the NIEHS included in its press release.

Dr. Christopher Portier, the chief of the NIEHS Laboratory of Computational Biology and Risk Analysis, who organized the Minnesota meeting, acknowledged, however, that no one had discussed EMF health risks during the ten days of deliberations. "We do not know the extent of the risk in human populations," he told *Microwave News* after the meeting.

Portier declined to comment further on the extent or nature of EMF health risks, noting only that, "In the next two months, we will be estimating the degree of risk in the human population."

When asked by *Microwave News* about his quote, Gallo replied: "When I think of public health risks, I think of AIDS, TB and benzene. I think of the whole public health spectrum."

Working Group's Overall Conclusion

A majority of the working group concluded that classification of ELF EMFs as possibly carcinogenic (Group 2B) is a conservative, public health decision based on limited evidence for an increased occurrence of childhood leukemias and an increased occurrence of chronic lymphocytic leukemia associated with occupational exposure. For these particular cancers, the results of *in vivo, in vitro,* and mechanistic studies do not confirm or refute the findings of the epidemiological studies. The overall body of evidence has, however, laid a foundation for furthering our understanding of the biological effects, mechanisms and exposure circumstances that may be related to the possible carcinogenicity and other adverse human health effects of exposure to ELF EMFs.

"Given that the NIEHS' goal was to inform the public of the working group's assessment of EMFs, the NIEHS should have involved us in the process," Wartenberg told *Microwave News.* The NIEHS did not consult the working group on the wording of the press release sent out that same afternoon. (See "Views on the News," p.1.)

Decision on EMF–Cancer Link Was Expected

Very few of those who were at the Minneapolis meeting were caught off guard by the decision to categorize EMFs as possible carcinogens. "I anticipated the vote," said Portier, who organized the meeting with the assistance of the NIEHS' Dr. Mary Wolfe. Portier and Wolfe, both based in Research Triangle Park, NC, had previously organized three EMF science review symposia to prepare for the Minneapolis meeting (see *MWN,* M/A97, J/F98 and M/J98).

Douglas Bannerman of the National Electrical Manufacturers Association in Washington, who came to Minneapolis to observe the working group's deliberations, said that he was "very disappointed" with the panel's overall conclusion. But in an interview with *Microwave News,* he conceded that he was not surprised by the recognition of a possible EMF–childhood cancer link.

"Now the public will know what the members of the EMF research community have known for years," commented Dr. Michael Marron of the Office of Naval Research in Arlington, VA. Marron is a member of the EMF Interagency Advisory Committee, which must submit its own report on the EMF RAPID program to Congress.

In a June 26 statement, the U.K.'s National Radiological Protection Board (NRPB) in Chilton noted that the views of its Advisory Group on Non-Ionizing Radiation—chaired by Sir Richard Doll—are "consistent with those of the NIEHS expert panel."

Interestingly, three of the four members of the working group who were also on the NAS EMF review committee—Wartenberg, Dr. Larry Anderson and Dr. Richard Luben—voted with the majority to endorse a possible cancer association. The fourth, Dr. Jerry Williams, believed that the data could not justify such a conclusion.

The 1996 NAS report has been widely interpreted as dismissing an EMF–cancer link, but a number of those in Minne-

apolis saw no conflict between the two assessments, because the NAS committee had based its decision on the absence of "conclusive and consistent evidence" of a cancer risk (see *MWN,* N/D96). The NIEHS panel agreed that the available evidence did not support that type of definitive statement.

Luben noted that the working group had reached essentially the same conclusion as had the Environmental Protection Agency (EPA) nearly ten years ago (see *MWN,* M/J90; more recently, the EPA reaffirmed this finding, see *MWN,* J/F98). "I think it's time to look to the future," commented Luben.

Votes on the Epidemiological Evidence

Earlier this spring, the NIEHS had commissioned 13 review chapters, some on the possible health impacts of EMFs and others on theoretical and engineering issues (see *MWN,* M/A98). The health effects were not limited to cancer—they included miscarriages, Alzheimer's disease, ALS, depression and heart disease, among other effects.

In Minneapolis, members of the working group were assigned to one of five small groups to review and edit the chapters. The revised chapters were then reedited, line by line, by the full working group and a number of NIEHS staff members.

Each small group voted to categorize the evidence it had reviewed using the IARC cancer criteria. The votes were then repeated by the full working group meeting in plenary session.

IARC has four categories for classifying associations between EMFs and cancer: "1: sufficient," "2: limited," "3: inadequate" and 4: evidence of "lack" of carcinogenicity (see p.7). The "limited" evidence category is divided into two subcategories: "2A: probable" and "2B: possible" evidence of carcinogenicity, a distinction that the NIEHS working group used in its final summary vote.

The epidemiology small groups were unanimous that there was "limited" evidence of an association between residential magnetic field exposures and childhood leukemia. In plenary session, the vote was 22 to 4, with 2 abstentions and 1 member absent.* (Fred Dietrich and Drs. James Felton, Steven Miller and Paul Zweiacker found the evidence to be "inadequate"; Williams and Dr. Martin Misakian abstained.) There was near unanimity that there was "inadequate" evidence to judge the carcinogenicity of adult residential exposures. (Only Zweiacker favored the "lack" of evidence designation.)

Dr. Maria Feychting, who chaired the small group on childhood epidemiology, noted that its decision was not based on a meta-analysis, but rather on an evaluation of the individual studies. "We see trends," she said. Addressing the NCI's recent childhood leukemia study, she noted that, "It's a very good study, but it's not superior to the others" (see *MWN,* J/A97). She added that the childhood study by Dr. David Savitz also has its merits (see *MWN,* N/D86) and pointed to the specific problem of low participation rates in the NCI study, especially for the wire code populations.

The link between EMFs and occupational cancers was deemed to be more uncertain. The panel voted 14 to 11, with 2 abstentions and 2 members absent, that there was "limited" evidence of a link to chronic lymphocytic leukemia (CLL). This finding was based to a large degree on the persuasive epidemiological study by Sweden's Dr. Birgitta Floderus, now at the Karolinska Institute in Stockholm (see *MWN,* S/O92 and M/J94).

In the working group vote, Dr. Leeka Kheifets agreed with the majority that there was "limited" evidence of a link to childhood cancer, but sided with the minority with respect to the possible link to CLL among EMF-exposed workers. "For me, the consistency is not there" across occupational studies, she said (see also *MWN,* N/D97).

For acute myeloid leukemia, brain tumors and breast cancer (both female and male) among workers, the panel voted by an overwhelming majority that there was "inadequate" support for an association with EMFs.

The EMF animal studies provoked some of the working

*In a later vote on slightly stronger language, the working group voted 20 to 6 that there is "limited" evidence that EMFs are "carcinogenic to children." This time, Drs. Jean Harry and Walter Rogers joined the minority.

NIEHS EMF Working Group Members: How They Voted

The final vote to classify EMFs as possible human carcinogens was 19 in favor and 9 against, with 1 abstention. Listed below are the members of the working group divided into their small groups. Those who voted against are listed in italics.

Adult Epidemiology: Drs. Joseph Bowman, National Institute for Occupational Safety and Health, Cincinnati; Elisabeth Cardis,†‡ International Agency for Research on Cancer (IARC), Lyon, France; Charles Graham, Midwest Research Institute (MRI), Kansas City, MO; *Leeka Kheifets, Electric Power Research Institute (EPRI), Palo Alto, CA*; Richard Stevens, Battelle Pacific Northwest Labs (PNL), Richland, WA.

Childhood Epidemiology: Drs. Maria Feychting,† Karolinska Institute, Stockholm, Sweden; Antonio Sastre, MRI; Claire Sherman, University of California, Davis; Louis Slesin, "Microwave News," New York City; Daniel Wartenberg, University of Medicine and Dentistry of New Jersey (UMDNJ), Piscataway.

Exposure Assessment: *Fred Dietrich, Electric Research and Management, Pittsburgh*; Drs. Martin Misakian,* National Institute of Standards and Technology, Gaithersburg, MD; Michael Yost,† University of Washington, Seattle.

In Vivo: Drs. Larry Anderson, Battelle PNL; *Arnold Brown,† University of Wisconsin, Madison (emeritus)*; *James Felton, Lawrence Livermore National Lab, Livermore, CA*; *Jean Harry, NIEHS*; *Walter Rogers, consultant, San Antonio*; Lorenzo Tomatis, Istituto per l'Infanzia, Trieste, Italy; *Paul Zweiacker, TU Services, Dallas*.

In Vitro: Drs. Margarita Dubocovich, Northwestern University, Evanston, IL; Paul Gailey, Oak Ridge National Lab, Oak Ridge, TN; Richard Luben, University of California, Riverside; Mats-Olof Mattsson, Umeå University, Umeå, Sweden; Kenneth McLeod,† State University of New York, Stony Brook; *Steven Miller, SRI International, Menlo Park, CA*; Charles Polk, University of Rhode Island, Kingston; *Jerry Williams, Johns Hopkins University, Baltimore*; Hiroshi Yamasaki, IARC.

Chairman: Dr. Michael Gallo,§ UMDNJ; ***Coordinator:*** Dr. Christopher Portier,¶ NIEHS.

†Chair of small group. ‡Chair of adult and childhood combined small group. *Abstained from voting. §Would have voted in the event of a tie. ¶Nonvoting.

group's most heated exchanges. In the *in vivo* small group vote, six members favored the "lack" of evidence classification for EMF-induced animal carcinogenicity. (Only Anderson and Tomatis dissented; the NIEHS' Dr. Gary Boorman was a member of this small group, but did not vote in the plenary session.)

The full working group disagreed with the small group and instead voted that the animal evidence was "inadequate" to reach any conclusion. (The vote was 19 to 8, with 1 member abstaining and 1 member absent.)

Williams then announced that he would file a minority opinion. When drafted the following day, it stated in part that the German studies by Drs. Wolfgang Löscher and Meike Mevissen indicating an EMF–breast cancer risk are "fundamentally flawed" and that the bulk of the other animal results are "completely negative" (see also p.15 and *MWN,* M/A98 and M/J98).

None of the panel members argued that the animal data actually supported an EMF–cancer risk, but many were not convinced that the available data provided a complete picture of the problem. Gailey pointed out that the complex electromagnetic environments encountered in daily life bear little resemblence to the 50 Hz or 60 Hz sine waves used in laboratory studies of EMFs. He compared such studies to trying to assess drinking water toxicity by testing only two out of dozens of possible contaminants. In addition, he said, "History tells us that we don't always pick the right animal model."

The working group was in general agreement in its evaluation of the laboratory studies. There was consensus that effects above 1 G were possible, or even probable, but less likely at lower magnetic field levels.

Specifically, the working group unanimously agreed (with one abstention) that:

> A limited number of well-performed studies provide moderate evidence for mechanistically plausible effects of ELF EMFs *in vitro* at intensities greater than 100 ∝T [1 G] on end points generally regarded as reflecting the action of toxic agents.

For exposures below 100 ∝T, the panel agreed unanimously in a separate vote to replace the word "moderate" with "weak."

While the cellular studies were not evaluated in terms of the IARC criteria, Dr. Hiroshi Yamasaki, who works at IARC, noted that, "There was weak or moderate evidence" from the *in vitro* work in support of carcinogenicity."

There were many other votes on the level of evidence implicating EMFs in other, noncancer, disease end points. There was, in general, overwhelming agreement that the data were inadequate to reach any conclusion—using modified IARC criteria.

Early in the meeting, a sharp disagreement emerged as to whether the working group's votes would be by secret or open ballot. Some participants on both sides even threatened to leave if they did not get their way. In the end, all the votes were open and no one walked out.

How To Order and Comment on the Working Group Report

The working group report, *Assessment of Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields,* is available free, both in print and on CD-ROM. The full text of the report is also posted on the Internet at: <www.niehs.nih.gov/emfrapid/home.htm>.

Written comments on the report can be submitted to the NIEHS by mail, fax or E-mail. The deadline is October 9, 1998. The public will also have an opportunity to make comments in person at meetings in Tucson, AZ (September 14-15), Washington (September 28), San Francisco (October 1) and Chicago (October 5). Tucson is the site of this year's Department of Energy EMF research review (see *MWN,* M/A98).

To order the report, to register for the meetings or for more information, contact: EMF RAPID Program/LCBRA NIEHS, PO Box 12233, MD EC-16, Research Triangle Park, NC 27709, Fax: (919) 541-0144, E-mail: <emf-rapid@niehs.nih.gov>.

IARC Classifications for Evidence of Carcinogenicity

1: Sufficient	2A: Limited—Probable	2B: Limited—Possible	3: Inadequate	4: Lack
Sufficient evidence of carcinogenicity. Exceptionally: less than sufficient evidence in humans, but sufficient evidence in experimental animals and strong human evidence that the agent acts through a relevant mechanism.	*Limited evidence in humans and sufficient evidence in experimental animals.* Also: inadequate evidence in humans and sufficient evidence in experimental animals, and strong evidence that the mechanism also operates in humans. Exceptionally: only on the basis of limited evidence in humans.	*Limited evidence in humans and less than sufficient evidence in animals.* Also: inadequate evidence in humans, but sufficient evidence in experimental animals. Sometimes: inadequate evidence in humans, but limited evidence in experimental animals, with supporting evidence from other relevant data.	*Inadequate evidence in humans and inadequate or limited evidence in experimental animals.* Exceptionally: inadequate evidence in humans, but sufficient evidence in experimental animals, with strong evidence that the mechanism in experimental animals does not operate in humans.	*Evidence suggesting lack of carcinogenicity in humans and in experimental animals.* Sometimes: inadequate evidence in humans, but evidence suggesting lack of carcinogenicity in experimental animals, consistently and strongly supported by a broad range of other relevant data.
Examples: asbestos, benzene, dioxin, hepatitis C virus, radon, vinyl chloride. Total number of agents: 75.	*Examples:* benzo[a]pyrene, formaldehyde, PCBs, ultraviolet (A, B & C) radiation. Total number of agents: 59.	*Examples:* carbon tetrachloride, chloroform, DDT, lead, PBBs, saccharin. Total number of agents: 225.	*Examples:* coal dust, fluorescent lighting, mercury, parathion, phenol, xylene. Total number of agents: 474.	*Only example:* caprolactam.

Sources: for IARC evaluation criteria: <http://193.51.164.11/monoeval/eval.html>; for lists of agents in each category: <http://193.51.164.11/monoeval/crthall.html>. For information on IARC, see: <www.iarc.fr>.

« Wireless Notes »

On July 14, **Australia's health minister, Michael Wooldridge**, announced three grants totaling Aus$215,000 (approximately US$133,000) for research projects on mobile phone safety. In late 1996, the Australian government committed Aus$4 million (US$2.5 million) to wireless safety research (see *MWN,* N/D96). The three grants are the first, and so far only, funding announced under the initiative. The largest grant, about Aus$90,000, will go to Dr. **Bruce Armstrong** of the **New South Wales Cancer Council** for a pilot epidemiological study of mobile phones and tumors of the brain, salivary gland or auditory nerve. Dr. **Pamela Sykes** of **Flinders University** in South Australia will get about Aus$75,000 to study the effects of RF/MW radiation on DNA, while Dr. **Con Stough** of the **Swinburne Institute of Technology** in Victoria will receive Aus$50,000 to investigate whether mobile phones affect users' memory, concentration or problem-solving abilities. "The overwhelming weight of scientific evidence says there's actually not a problem," Wooldridge said on Australian television, "but as health minister I've got to be vigilant."

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Dr. **Joseph Brain** of the **Harvard School of Public Health** in Boston has asked the **National Academy of Sciences-National Research Council** (NAS–NRC) to examine the possible effects of RF/MW radiation on human health, with a focus on cellular phone towers. In a March 19 letter to the council's Commission on Life Sciences, Brain noted that the NAS–NRC had "already deliberated on EMF[s] and ELF" (see *MWN,* N/D96), and suggested that an NAS–NRC report on wireless radiation would be helpful. "These towers are being scattered across urban and suburban areas throughout the U.S.," wrote Brain. "As chair of the Department of Environmental Health at Harvard, I am repeatedly asked for my advice. I would like to point to an authoritative study [by] the NAS–NRC to give individuals and communities guidance." In a May 18 reply, Dr. Evan Douple, director of the NRC's Board on Radiation Effects Research, agreed that the subject is important and noted that both the **FDA** and Rep. **Edward Markey** (D-MA) want to see more research on cellular phone safety (see *MWN,* N/D97). This summer, Douple wrote, his board will discuss a proposal for a study of wireless safety and explore whether industry, government agencies or Congress is interested in supporting it.

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As they prepare to square off in court against the **FCC** over federal preemption of antenna siting and the commission's RF/MW rules, two citizens groups are at odds with each other. At issue is Washington telecom lawyer **James Hobson**, who is handling the FCC suit for the **Ad Hoc Association** (AHA) of Parties Concerned About the FCC's RF Health and Safety Rules, based in Olympia, WA. In a June 28 letter, **Arthur Firstenberg**, president of the **Cellular Phone Taskforce** (CPT) in Brooklyn, NY, argued that Hobson has a conflict of interest and cannot effectively represent cell tower opponents while doing other work for the wireless industry—for instance, the Telecommunications Industry Association. The AHA's **David Fichtenberg** and **Libby Kelley** disagree. In a July 6 response, they expressed confidence in Hobson, noting that his background qualifies him "to address the complex and demanding issues we are placing before the court." Hobson, of Donelan, Cleary, Wood & Maser, has not stepped aside. (He declined to comment on the dispute.) In separate briefs submitted to the U.S. Court of Appeals in New York City in May, the AHA and the CPT charge that the FCC's RF/MW rules are inadequate (see also *MWN,* N/D97). Oral arguments had been scheduled for August but were postponed. A new date has not yet been set. Meanwhile, Firstenberg told *Microwave News* that he has now "made peace" with Hobson. The AHA and Firstenberg's relationship has remained cool, however. He "is not communicating with us," the AHA's Kelley said in an interview in mid-July.

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It may not be the Nobel Prize, but those looking for a bit of extra cash might want to respond to the challenge laid down by **James Kaplan** of **EDX Engineering Inc.** in Eugene, OR. In a letter appearing in the July 20 issue of the trade magazine *Wireless Week,* Kaplan contends that regulating RF/MW exposures is "an absurdity." He is offering "a month's pay" (his, presumably) to anyone who can present human or animal evidence of a nonthermal health hazard of RF/MW radiation. Kaplan can be contacted by E-mail at: <jamesk@edx.com>.

George Carlo vs. Q. Balzano: Two Views of WTR's Record

"I stand by what we have done," Dr. George Carlo, the chair of Wireless Technology Research (WTR) in Washington, told *Microwave News.* Carlo was reacting to criticism that his research program, sponsored by the Cellular Telecommunications Industry Association (CTIA), has failed to produce any biological results over the last five years.

When asked to contrast his record with that of Motorola, which has completed many cellular phone safety experiments over the same time period, Carlo responded: "The Motorola program is different, and I don't want to comment on it."

Motorola's Dr. Quirino Balzano was not so reticent. Addressing WTR's record in an interview with *Microwave News,* Balzano said, "We have lost five critical years, and money can't buy those five years back." In breaking his long official silence on the WTR program, Balzano, the director of the company's Electromagnetics Research Laboratory in Fort Lauderdale, FL, stressed that he was speaking for himself and not for Motorola.

Carlo has long argued that he could not have begun his biological studies until he had developed the right exposure systems. But Balzano counters that that should have taken only a year: "For a good experiment, dosimetry was there for anyone who wanted it."

Carlo and Balzano were interviewed in St. Pete Beach, FL, the site of this year's *Annual Meeting of the Bioelectromagnetics Society,* June 7-11.

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It's been a bad summer for mobile phones in England. The **British press** has been blaming them for everything from hypertension to miscarriages—often with sensational headlines. **Do Mobile Phones Fry Your Brains or Just Eggs?** (July 13), wondered the tabloid *Evening Standard,* while the *Independent* sought to appeal to its more upscale readers: Why Mobiles Could Be the Rolls Royce of Disease (June 9). Every major paper in the U.K. covered the blood pressure story from Germany in mid-June (see below). A week later, the *Daily Telegraph* followed up with word of a French study under the headline Mobile Phones 'Put Pregnant Women at Risk' (June 29). Interference from cell phones may also be putting the London subways at risk, warned the *Daily Mail* on June 24 in a story headlined Mobile Phones Linked to Rail Signals Chaos. Some of the stories featured campaigner Roger Coghill—Why I Believe That All These Items Should Carry a Health Warning, *Daily Mail* (July 17)—while others hawked devices that promised some degree of protection: Health Scares Ring Out ran in the *Telegraph* on July 9. When word filtered out about military experiments showing loss of cognitive function, the *Mail* ran the story on its front page in large bold type: Mobile Phones in New Health Warning (July 16). Even the generally more cautious BBC chimed in with Mobile Phones in Brain Scare in its Internet edition (July 16). The phones have not been doing too well in other parts of Europe, either. On the front page of the tabloid *Aftonbladet,* two Swedes blamed cell phones for their loss of vision (Cell Phones Made Us Blind, We Are Sure, July 2).

Digital Mobile Phone Radiation Causes Rise in Blood Pressure

Short-term exposure to digital cellular phone signals significantly increased the blood pressure of participants in a new German study, according to researchers at the University of Freiburg and at Deutsche Telekom.

Dr. Stefan Braune of the University Neurological Clinic in Freiburg told *Microwave News* that the increase in resting blood pressure was not due to stress. "There is accumulating evidence that these high frequency signals may influence the sympathetic nervous system," he said.

In a research letter published in the June 20 issue of the *Lancet (351,* pp.1,857-1,858, 1998), Braune and colleagues at Deutsche Telekom in Darmstadt report that they also observed a significant increase in constriction of the blood vessels, which may in turn have been responsible for the increase in blood pressure.

Braune noted that electrical stimulation of an area in the right side of the brain (the right side of the insula) produces a rise in blood pressure. Since the phones in this experiment were mounted on the right side of the head, Braune wants to investigate whether the insula is involved in the observed effects.

The researchers exposed ten healthy volunteers between 26 and 36 years old to GSM mobile phone radiation, which was on or off for 35 minutes at a time. The increase in blood pressure was 5-10 mm Hg (millimeters of mercury), which is not considered large.

"In general, an increase like that would not be clinically significant," said Dr. Richard Stein, spokesperson for the American Heart Association in New York City. "People normally vary by that much in the course of a day."

The *Lancet,* one of the world's leading medical journals, stated in its press release that, "Such an increase could have adverse effects on people with high blood pressure." But Braune himself is not urging people with high pressure to avoid mobile phones. "At present, we don't have a clue as to what effect cellular phones would have on these patients," he explained. "Their blood pressure might even decrease." He said it would be premature to give advice to mobile phone users.

The U.S. Cellular Telecommunications Industry Association (CTIA) discounted Braune's results as inconclusive. The CTIA argued that stress, noise and heat from the telephones' circuitry were more likely causes of the reported rise in pressure. "In a 35-minute test, a normal cellular phone will increase in temperature by 4-5°C," CTIA spokesperson Tim Ayers said in an interview. "It's possible that this could result in increased blood pressure." But Ayers conceded that, "This is all speculation." The main point, he said, is that the study was too small to serve as the basis for any definite conclusions.

"Stress is certainly not the cause," Braune responded in a telephone interview, pointing out that heart rate showed a decrease, not an increase. He noted that the volunteers "were in a comfortable, supine position" and that there was "no evidence for the idea" that they experienced stress.

"As for noise—I don't know where they get this from," said Braune. "There was no noise." As the research letter and the *Lancet* press release both explained, the experiment was designed to expose the subjects to a radio signal without producing any sound from the phones. No phone conversations took place, and the volunteers did not know when the signal was being transmitted.

Heating also could not have been the cause, Braune contended. He noted that there was a 2.5 cm distance between the phone and the skin, "so we have no reason to believe that any heating of the skin would occur." In any case, he said, such heating would not cause blood pressure to rise: "What you'd expect would be just the opposite. If the skin gets hotter, you have a dilation of the blood vessels in response, which would tend to *decrease* blood pressure."

Braune said that the small number of subjects did not in itself cast doubt on his results. "If you have a high inter-individual variation, then you need a big group to see the effect; but our results were very consistent from one individual to another," he explained. "And the effect is strong enough that it shows up clearly even with a small number of people."

These results were observed in a pilot study designed to detect changes in the bowel reflex, which is also controlled by the sympathetic nervous system. No such changes occurred, but the consistency of the changes in blood pressure was striking and the researchers felt that the results should be published.

"Now we know better what to look at," Braune said. "In the pilot study, we had only electrophysiological evidence of the rise in blood pressure. In our ongoing research, we are looking at several biochemical markers as well."

A German Dairy Farmer's Complaints Prompt Major Health Study of Cows near Cell Phone Towers

The Bavarian state government in Germany will investigate whether mobile phone antennas cause health problems in dairy cattle, announced Bavaria's Minister for Land Development and the Environment, Dr. Thomas Goppel, at a June 29 press briefing in Munich. The study will encompass 30 farms at a cost of nearly 650,000 marks (approximately $360,000), according to the ministry.

The impetus for the research effort came from a preliminary inquiry that pointed to RF/MW radiation from a mobile phone base station as the cause of reduced milk yields, abnormal behavior and other ailments among cattle on a Bavarian farm.

The evidence suggests that RF/MW radiation is "the sole cause" of the health problems on the farm in Traunstein, Bavaria, concluded Dr. J. Schmid, a local veterinarian, in an internal report to the Bavarian government. But a follow-up investigation ordered by Goppel rejected Schmid's findings.

The farmer first suspected something was wrong with his herd of some 30 cows in the fall of 1995, soon after a mobile phone base station was installed on a 500-foot communications tower about 300 yards from his farm. The intensity of the resulting RF/MW radiation is very low, however, especially in comparison to the levels of the television signals being broadcast from the same tower.

The cattle's RF/MW exposure is more than 1,000 times below the limits set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), Rüdiger Matthes of the Federal Office of Radiation Protection in Oberschleißheim told *Microwave News*. Matthes, who is also ICNIRP's scientific secretary, joined Goppel at the June 29 press conference.

Dr. Wolfgang Löscher of the School of Veterinary Medicine in Hannover, who has investigated the complaints of the Traunstein farmer, is skeptical that radiation from the base station could be harming the cows. "I cannot believe that these weak fields could have caused these effects," he said in an interview.

But Dr. Theodore Litovitz of the Catholic University of America in Washington believes that the mobile phone signals could be to blame, because they are digital. "I am absolutely *not* surprised" by the observed effects in the cows, Litovitz told *Microwave News*. "They are predicted by our ODC work at RF frequencies." Last year, Litovitz reported that while analog cellular phone radiation did not affect ornithine decarboxylase (ODC) activity in cell cultures, digital signals did do so. These results appeared in *Bioelectromagnetics (18,* pp.132-141, 1997).

The animals began to behave abnormally in the spring of 1996, Schmid reported, and have continued to do so. Several animals turn their heads away from the tower. Some cattle constantly shift from side to side and lift their feet as if in pain and one cow swings her head constantly.

Löscher characterized the observed health and behavioral effects as "typical of cows under stress." In addition to lower milk yields, there have been five miscarriages with no known cause over a 15-month period and severe weight loss in two cows.

The farmer and his family also began having unexplained health problems when the mobile phone antennas were activated. Goppel also discounted the possibility that RF/MW radiation could be harming the health of the farmer and his family.

After details of the case became public earlier this year, Löscher noted, several other farmers complained of similar problems in other locations near communications towers.

In his report, Schmid cautioned that he was unable to establish a "definitive cause" of the herd's problems, although he had eliminated alternative explanations such as improper feeding or inadequate care. Especially compelling, he wrote, was the fact that when two of the cows with behavioral abnormalities were moved to a farm some 12 miles away, their symptoms disappeared within a few days. When they were brought back to the farm, the symptoms returned.

The farmer angrily denied suggestions that his herd's poor health is due to improper care: "I have run this operation for over 20 years. I had above-average milk yields with the highest quality. Now I have to listen to people saying I am too stupid to keep cows and milk them," he declared in the July 4 *Bayrisches Landwirtschaftliches Wochenblatt,* a leading agricultural newspaper.

Both Dr. Günter Käs, a radar electronics engineer formerly with the Federal Military University in Munich, and technicians from the Federal Office of Post and Telecommunications measured the power levels of RF/MW radiation on the property. Their findings are similar to those of Elekluft GmbH, which made new measurements at Goppel's request.

In a room on the upper floor of the farmhouse, with the window closed, Käs measured 0.3 $\propto W/m^2$ and 0.5 $\propto W/m^2$ for the 464 MHz analog and the 935 MHz digital telephone signals, respectively. At the same location, the power densities of the 512 MHz and 734 MHz TV signals were 0.44 mW/m^2 and 0.4 mW/m^2, respectively. Outside the farmhouse, the levels were as high as 7 mW/m^2, at 512 MHz.

Before announcing the 30-farm study, Bavarian officials had sought to avoid publicity about the Traunstein farmer's concerns. Schmid launched his investigation in November 1996 and submitted his report in April 1997, but state officials did not publicly acknowledge them until Germany's Green Party and the national news media, including the magazine *Der Spiegel,* began asking questions later last year.

Löscher told *Microwave News* that Bavarian officials asked him and Käs not to publish a paper documenting the Traunstein herd's problems until the government had completed its inquiry. They later approved its publication on condition that the farm could not be identified as being in Bavaria. The paper, "Striking Behavioral Disturbances in Cows in Proximity to Transmission Stations," appears in the April issue of the veterinary journal *Der Praktische Tierarzt (79,* pp.437-444, 1998).

The case has generated intense interest among anti-tower activists in Germany, the U.S. and elsewhere. An English translation of Schmid's report is posted on the Internet at: <www.reach.net/~scherer/p/vetrepde.htm>. Information in German on the multi-farm study is at: <www.bayern.de/stmlu>.

Testicular & Skin Cancer Findings Put Spotlight on Police Radar

Elevated rates of testicular cancer and melanoma have been found in a study of police officers in Ontario, Canada.

These cancers have been a focus of concern over the possible effects of police radar, Dr. Murray Finkelstein writes in the August issue of the *American Journal of Industrial Medicine (34,* pp.157-162, 1998). "The important thing to emphasize, though," he said in an interview, "is that at the moment we have no information on exposure. So we can't draw any conclusions about causes."

Although the increase in melanoma was statistically significant, Finkelstein said that it may turn out to be a chance finding. He is currently reviewing pathology reports to determine where the melanomas were located. "The question is, which of these might plausibly be located in the beam from a traffic radar device," he said. "If it's on the back of the leg, that's different than if it's on the thigh."

Finkelstein is with the Ontario Ministry of Labor in Toronto, which conducted the research in response to a request from a police health and safety group. The study drew on employment records for 22,197 officers, from 83 out of the 91 police departments in the province, and on data from the Ontario Cancer Registry. Finkelstein found that the incidence of testicular cancer

Hot New Papers

Deborah Barnes and Lisa Bero, "Why Review Articles on the Health Effects of Passive Smoking Reach Different Conclusions," *Journal of the American Medical Association, 279,* pp.1,566-1,570, May 20, 1998.

"The odds that a review article with tobacco industry-affiliated authors would conclude that passive smoking is not harmful were 88.4 times higher than the odds for a review article with non-tobacco-affiliated authors, when controlling for article quality, peer review status, article topic, and year of publication (95% CI, 16.4-476.5; $p<0.001$)."

Maria Feychting et al., "Magnetic Fields and Breast Cancer in Swedish Adults Residing near High Voltage Power Lines," *Epidemiology, 9,* pp.392-397, July 1998.

"Our results indicated a higher relative risk for cases with ER-positive breast cancer, especially for younger women, but the number of cases in these analyses was small." (See *MWN,* N/D97.)

C.M. Furse and O.P. Gandhi, "Calculation of Electric Fields and Currents Induced in a Millimeter-Resolution Human Model at 60 Hz Using the FDTD Method," *Bioelectromagnetics, 19,* pp.293-299, 1998.

"Proposed safety guidelines would allow external electric fields of 10 kV/m and 25 kV/m for exposure to 60 Hz fields of the general public and workers, respectively. For this external electric field exposure of 10 kV/m, local induced current densities as high as 20 mA/m^2 are found in the head and trunk with even higher values (above 150 mA/m^2) in the legs. These currents are considerably higher than the 4 or even 10 mA/m^2 that have been suggested in the various safety guidelines."

S. Kwee and P. Raskmark, "Changes in Cell Proliferation Due to Environmental Non-Ionizing Radiation: Microwave Radiation," *Bioelectrochemistry and Bioenergetics, 44,* pp.251-255, 1998.

"Contrary to popular assumptions, our results showed that there can be an effect at very low SAR values." (See *MWN,* J/A97.)

Adam Lacy-Hulbert, James Metcalfe and Robin Hesketh, "Biological Responses to Electromagnetic Fields," *FASEB Journal, 12,* pp.395-420, 1998.

"The absence of an identified mechanism whereby ELF EMFs can exert biological effects clearly constitutes a problem in that experimental protocols are devised and measurements are made on the basis of complete ignorance about the suceptibility of biological systems. The recurring theme of this review has been the overriding need to demonstrate a single, unequivocal ELF EMF-induced response that will be consistently reproducible in independent laboratories. Only then will the normal process of scientific development of the field become possible. Until this is achieved, the topic of biological responses to ELF EMFs will continue to be regarded with great skepticism by the scientific community at large." (See also p.3 and *MWN,* M/J95)

Russell Owen, "*MYC* mRNA Abundance Is Unchanged in Subcultures of HL60 Cells Exposed to Power Line Frequency Magnetic Fields," *Radiation Research, 150,* pp.23-30, July 1998.

"Using either cells from a commercial source or cells supplied by the original investigators, no evidence was obtained to support the hypothesis that EMF exposure could induce *MYC* expression."

Jerry Phillips et al., "DNA Damage in Molt-4 T-Lymphoblastoid Cells Exposed to Cellular Telephone Radiofrequency Fields in Vitro," *Bioelectrochemistry and Bioenergetics, 45,* pp.103-110, 1998.

"It was found that: 1) exposure of cells to the iDEN® signal at an SAR of 2.4 ∝W/g for 2 hours or 21 hours significantly decreased DNA damage; 2) exposure of cells to the TDMA signal at an SAR of 2.6 ∝W/g for 2 hours and 21 hours significantly decreased DNA damage; 3) exposure of cells to the iDEN® signal at an SAR of 24 ∝W/g for 2 hours and 21 hours significantly increased DNA damage; 4) exposure of cells to the TDMA signal at an SAR of 26 ∝W/g for 2 hours significantly decreased DNA damage. The data indicate a need to study the effects of exposure to RF signals on direct DNA damage and on the rate at which DNA damage is repaired." (See *MWN,* J/F98.)

David Savitz, Harvey Checkoway and Dana Loomis, "Magnetic Field Exposure and Neurodegenerative Disease Mortality Among Electric Utility Workers," *Epidemiology, 9,* pp.398-404, July 1998.

"The accumulation in the literature of sporadic indications of an association between Alzheimer's disease and occupational magnetic field exposure may have reached a threshold for warranting a more rigorous study, but it does not provide a coherent body of research to suggest that an association is present." (See p.4 and *MWN*, M/J97.)

Robert Tarone et al., "Residential Wire Codes: Reproducibility and Relation with Measured Magnetic Fields," *Occupational and Environmental Medicine, 55,* pp.333-339, 1998.

"Wire codes provide a proxy measure of exposure to residential magnetic fields. If magnetic fields were a risk factor for leukemia, however, there would be some attenuation of risk estimates based on wire codes because of misclassification of exposure to magnetic fields at both extremes of the wire code range. The lack of an association between high categories of wire code and risk of leukemia cannot be explained by a failure of the wire code classification schemes to estimate exposure to magnetic fields in the study area." (A follow-up paper on the NCI EMF study; see *MWN,* J/A97.)

Roger Yew-Siow Tay, Quirino Balzano and Niels Kuster, "Dipole Configurations with Strongly Improved Radiation Efficiency for Hand-Held Transceivers," *IEEE Transactions on Antennas and Propagation, 46,* pp.798-806, June 1998.

"This paper demonstrates that reduction of the magnetic field strength at the surface of the user's head is the key parameter to improve the efficiency of the transmitter."

was 30% higher than in the province as a whole, and that of melanoma was 45% higher.

These two elevated rates occurred even though the overall cancer rate among the police officers was lower than the provincial average, which Finkelstein cites as an example of the "healthy worker effect" (the tendency for those who are employed to have better-than-average health, since those who are ill often cannot hold a job).

Testicular cancer, leukemia and cancers of the brain, eye and skin were identified as the sites of greatest concern in a 1995 feasibility study on police radar health research by the U.S. National Institute for Occupational Safety and Health (NIOSH; see *MWN,* J/A95). The new Canadian study found no increases in leukemia or brain cancer, and only one case of ocular cancer among the officers.

The 1995 NIOSH report came in response to a 1992 Congressional inquiry (see *MWN,* S/O92). The report proposed a large cohort study that would broadly examine police officers' occupational health. "If disorders for which police appear to be at higher risk (e.g., testicular cancer) are identified," the report explained, studies of specific diseases could then follow. But no such study, either broad or narrow, was ever carried out.

"It was a matter of priorities," said Dr. Gregory Lotz, chief of NIOSH's Physical Agents Effects Branch in Cincinnati. "NIOSH has a small staff and wide responsibilities. Non-ionizing radiation continues to be a topic that we're interested in, but at the same time it's not a really high priority." Lotz said that people who worked on the 1995 report had hoped Congress might respond by allocating the funds for a police health study, but this did not occur.

In 1995, NIOSH put the cost of a cohort study of 10,000-30,000 officers at US$1.4-$2.6 million. Finkelstein said that his 22,000-person study had cost only C$3,000 (about US$2,000). Asked about the sharp discrepancy between the two cost figures, Lotz said that having a centralized cancer registry, like the one in Ontario, can make research less expensive. He also noted that NIOSH often hires outside contractors to gather data for large-scale studies, and this can be costly. This was especially true in this case, said Lotz, because interviews with cohort members would be needed to get information on radar usage.

Finkelstein plans to use interviews for exposure assessment in a smaller, nested case-control study that would follow up on his testicular cancer and melanoma findings. He has asked the U.S. National Institutes of Health for funding, and estimates that such a study would cost US$80,000-$100,000.

"If he can do it for $100,000, that's still a significant cost difference," Lotz conceded. He said he did not think that the Canadian study's lower costs had compromised its quality in any way, and commented, "I'm encouraged that someone else was able to make some progress on this."

Magnetic Fields Seen as Possible Treatment for Malaria: In the Lab, EMFs Can Be Toxic to Parasites

Researchers at the University of Washington, Seattle, believe that EMFs may prove to be an effective and low-cost treatment for malaria.

In preliminary experiments, a low frequency magnetic field had a potent antimalaria effect—comparable to that of chloroquine, the drug most often used to fight the disease. The oscillating field makes the iron in human blood vibrate, which ultimately kills the malaria parasite.

"It's a promising approach," Dr. Henry Lai told *Microwave News*. "With most drugs the parasite eventually develops resistance, but we don't think that will be the case for magnetic fields."

According to the World Health Organization, 300 million people are currently infected with the disease. Malaria kills more than one million people a year, and drug-resistant strains are becoming widespread.

Malaria parasites feed on human blood. They split the hemoglobin molecule into protein (the globin) and an iron compound (the heme). The parasites break down the protein so they can consume its amino acids, but they find free heme to be highly toxic. To eliminate this danger, they turn the soluble heme molecules into hemozoin, an insoluble polymer formed by linking the iron of one heme molecule to the oxygen in the next.

"This arrangement makes the hemozoin molecule highly magnetic," said Lai. "It behaves like a small bar magnet." He pointed out that magnetic fields have been used to separate malaria-infected red blood cells and isolate hemozoin particles. "We proposed the use of an oscillating magnetic field to shake the hemozoin in the parasites," Lai explained. The hypothesis was that this would disturb the process of polymerizing heme into hemozoin, resulting in an accumulation of free heme molecules that would poison the parasite.

Lai said that preliminary results show promise. In his first experiment, observations by microscope confirmed that the hemozoin particles can be made to oscillate according to the frequency of an applied magnetic field. In a second experiment, malaria parasites cultured in human blood were subjected to a 5 Hz, 15 G magnetic field for 48 hours, after which the percentage of blood cells infected with malaria was about half as great as in a non-EMF-exposed control.

The second experiment has been repeated by Dr. Jean Feagin, also of the University of Washington. In addition to examining the percentage of infected cells, Feagin measured the synthesis of a protein made by the malaria parasite. This was reduced by about the same proportion, further confirming the initial results.

"This antimalaria potency is equivalent to 1 micromolar of chloroquine in culture," Lai observed, "which suggests a rather potent effect of the magnetic fields."

Chloroquine is also thought to interfere with the parasite's processing of iron by inhibiting the enzyme heme polymerase. "But since EMFs act directly on the hemozoin," Lai said, "and not on an enzyme or other gene products, it is unlikely that the parasites could develop resistance to magnetic fields."

Although malaria is on the rise worldwide, research on the disease is not well-funded—in part because it is most virulent in

very poor countries. More effective treatments are costly to develop, and do not offer much opportunity for profit. But if EMFs can be used as effective treatment for humans, Lai said it could be very cost-effective.

"It is relatively easy and inexpensive to generate oscillating magnetic fields over a large area," he noted. "Several patients could be exposed at one time."

Lai and Feagin now plan to try EMFs at different frequencies and intensities, with support from a $15,000 grant from the Fetzer Institute in Kalamazoo, MI. "We want to see if we can find a more efficient exposure combination," said Lai. "If this is promising, then we'll try to get money to do animal studies."

WTR Gives Spending Summary, Specifics Still Hazy

This June, Wireless Technology Research (WTR) released a summary of its spending over the last five years. As of March 1998, WTR had spent about $23.5 million of the $28 million pledged by the Cellular Telecommunications Industry Association (CTIA). Both WTR and the CTIA are based in Washington.

WTR Chair Dr. George Carlo revealed the five-year spending summary in a poster presentation at the *20th Annual Meeting of the Bioelectromagnetics Society* in St. Pete Beach, FL, in June. While the figures are broken down into 16 categories (see below), the amount of money that went to research grants remains a mystery. WTR has consistently refused to disclose this information (see *MWN,* M/J96, M/J97 and N/D97).

Dr. Donald McRee, who heads WTR's program of extramural research, explained that the "clinical" category consists of WTR's pacemaker research, while "certification" refers to testing emissions from different models of phones (later taken over by the CTIA). "Scientific community," "government" and "industry" refer to WTR's coordination with these groups, while "scientific outreach" includes such activities as travel to its 1995 Rome conference on wireless safety research (see *MWN,* S/O95).

WTR did not provide breakdowns of spending within each category, and only partial information was available from other sources. For example, two organizations are carrying out epidemiological studies for WTR: the American Health Foundation (AHF) in New York City and Epidemiology Resources Inc. (ERI) in Newton Lower Falls, MA. The head of the AHF project, Joshua Muscat, said in an interview that the AHF had received a total of $469,000 from WTR, while ERI's Dr. Nancy Dreyer told *Microwave News* that her group had received "well under $2 million." This leaves more than $1.2 million in WTR's epidemiology budget that has been spent elsewhere.

All of WTR's clinical research has been devoted to the question of interference with implanted cardiac pacemakers, and total spending for this category is listed at about $2 million. A total of $353,000 in grants went to the Mayo Clinic in Rochester, MN, the New England Medical Center in Boston and the University of Oklahoma in Norman, which jointly carried out the WTR pacemaker study. Cost figures have never been released for other aspects of WTR's pacemaker work, such as the development of research protocols and recommendations for pacemaker users.

Where the Money Went: History of Spending at WTR

	1993	1994	1995	1996	1997*	1998*†	Totals	%
Ongoing Surveillance	$46,000	$269,171	$294,251	$157,028	$69,852	$18,004	$854,307	3.63
Dosimetry	126,000	489,130	1,085,064	671,867	711,960	159,450	3,243,471	13.78
Toxicology	180,000	813,989	1,266,756	248,504	599,396	259,801	3,368,446	14.32
Epidemiology	149,000	637,139	1,284,827	641,134	754,617	273,784	3,740,501	15.90
Clinical	54,000	95,782	897,833	946,832	0	0	1,994,447	8.48
Base Stations	0	0	114,737	3,446	0	0	118,183	0.50
Certification	24,000	160,453	216,008	179,057	0	0	579,518	2.46
RMR‡ Other	0	0	12,191	198,192	38,544	4,033	252,960	1.08
Scientific Community	26,631	73,609	1,002,182	538,091	186,515	43,215	1,870,244	7.95
Government	52,439	144,942	430,745	287,281	144,742	37,727	1,092,876	4.64
Industry	15,241	42,125	148,350	129,026	143,167	29,265	507,174	2.16
Other Scientific Outreach	39,689	109,699	304,816	258,541	291,181	44,584	1,048,510	4.46
Program Management	56,000	73,935	793,702	1,014,748	1,341,475	277,791	3,557,651	15.12
Litigation	0	0	395,596	200,616	170,676	33,517	800,406	3.40
Audit Committee	0	0	4,355	44,091	33,054	550	82,051	0.35
PRB§	16,000	29,000	123,672	122,300	66,857	61,920	419,749	1.78
Totals	$785,000	$2,938,974	$8,375,087	$5,640,756	$4,552,036	$1,238,641	$23,530,494	100%

*Not audited. †As of March 1998. ‡RMR=Risk Management Research. §PRB=Peer Review Board, based at the Harvard Center for Risk Analysis, Boston.
Source: WTR, June 1998.

Memo from Moscow: East Meets West

Dr. Ben Greenebaum, a professor of physics at the University of Wisconsin-Parkside in Kenosha and the editor of Bioelectromagnetics, *recently returned to the university after spending a sabbatical year with the World Health Organization's (WHO) International EMF Project in Geneva, Switzerland. He filed this report after attending* Bioelectromagnetic Research and Hygienic Standards in Eastern Europe *in Moscow, May 18-22 (see* MWN, *N/D97 and M/J98). The meeting was hosted by the Russian Academy of Medical Sciences' (RAMS) Institute of Occupational Health (IOH) and jointly sponsored by the institute and the WHO project. The Russian Academy of Sciences' (RAS) Institute of Biophysics in Moscow, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the U.S. Air Force's (USAF) Armstrong Laboratory in San Antonio also helped arrange the meeting. Greenebaum may be reached on E-mail at: <greeneba@uwp.edu>.*

Research into the biological effects of electromagnetic fields (EMFs) by scientists in Russia and other parts of the former Soviet Union began in the late 1950s, predating many of the Western efforts. Since most of these results were published in Russian, however, they have not been easily accessible to scientists in other parts of the world. A major purpose of the meeting was to review this science and, by publishing the full proceedings in both English and Russian, to make this information more widely available.

Additional goals were to discuss the scientific basis for, and the procedural background of, the Russian exposure standards—as well as those in other parts of the world—and to facilitate international exchanges and collaborations for scientists from Eastern Europe, including the countries of the former Soviet Union.

Approximately 90 people from 17 countries, including about 25 from outside Eastern Europe, participated in four days of discussion, with interpreters providing simultaneous translation between Russian and English. Papers were presented by 20 Russian scientists, as well as three from the U.S., two from Germany and one from Bulgaria. There were an additional 25 poster presentations. One day was devoted to a visit to the RAS' Institute of Biophysics in Puschino.

The formal papers were a mixture of broad surveys of the work of an institute or a research group and detailed discussions of recent findings by individuals or teams of scientists. While the surveys were short on experimental details, the references in the published proceedings should fill these gaps. The posters presented more specifics, though many were in one language only; translations are planned for the proceedings.

Lively discussions ranged from dosimetry and other aspects of research design to the relationship between biological effects and hazards. (More often than not, the closest questioning came from one Russian colleague to another.) Although many Russian-language papers omit details on dosimetry, it was clear that this issue has long been a concern within this community.

At times, it was apparent that Eastern and Western scientists were laboring under different paradigms. Some of the health-related pathways identified by the Russians as being affected by EMFs were unfamiliar to the Western attendees. And ideas were sometimes invoked that were foreign to Western medicine, though they appeared to be related to those used in some types of "alternative medicine"—for example, the need to balance internal energies or fields within the human body.

One group presented experimental effects due to shielding of the Earth's magnetic field and argued that exposure standards should include a minimum level below which DC magnetic fields should not fall.

The latter part of the meeting focused on exposure standards. In Russia, standards are drafted by the IOH. The biological literature is examined for evidence of a threshold at which health-related effects begin to appear. Appropriate extrapolations and safety factors are then applied. Drafts are circulated for comment.

The Ministry of Health then formulates formal rules that are considered for adoption by the Russian government. The health ministry is also responsible for monitoring and enforcing compliance. The current severe economic difficulties in Russia have jeopardized these efforts, however. The adequacy of its monitoring equipment was also questioned.

Dr. Martin Meltz of the University of Texas Health Science Center in San Antonio and Dr. Jürgen Bernhardt, chair of ICNIRP, talked about how standards are set in the West. The USAF's Armstrong Laboratory's Dr. Michael Murphy described its initiative for collaboration with Eastern European institutions.

As part of the concluding panel discussion—which featured significant audience participation—Dr. Michael Repacholi of the WHO compared the current Russian and ICNIRP exposure standards, expressing both in terms of both incident power and specific absorption rates (SARs). At RF/MW frequencies, the Russians rely on incident power densities, while ICNIRP emphasizes SARs.

The Russian standards call for integrating the amount of incident energy over a day (e.g., occupational ELF exposures of 5 kV/m for 8 hours or proportionately more for shorter time periods up to an absolute maximum of 25 kV/m). This approach was contrasted to the ICNIRP guidelines, which essentially only consider power absorbed over a short time. Reduced to the same practical situation, the Russian and ICNIRP limits are similar, except at the higher RF/MW frequencies.

There was some support for a single worldwide standard, which is one of the objectives of the International EMF Project. A number of members of the Russian standards community noted that, for both scientific and political reasons, the time was ripe for a reassessment of their current exposure standards.

Many times, Russian participants challenged the Western standards' emphasis on thermal impacts to the exclusion of other types of effects. While several speakers stated that the Western process is open to nonthermal effects, they concluded that, for practical purposes, the available evidence only allows standards to be based on short-term thermal effects—at least above 10-100 MHz. Everyone agreed that there had been little research into the health effects of long-term, low-level exposures.

In the end, the Russian researchers gained more appreciation of the need for giving a more prominent role to methodology in their reports, and the Western scientists were more aware of those issues that concerned their Russian colleagues. Those present agreed on the following recommendations for further action:

1. A Russian Commission on Non-Ionizing Radiation Protection with an interdisciplinary membership, as existed in the days of the Soviet Union, should be established. It would address the need for further research into possible EMF health effects, particularly with reference to the WHO project's research agenda.
2. That commission should help the WHO project develop internationally acceptable exposure guidelines and produce a glossary of EMF terminology, based on existing international usage.
3. Russian and Western collaboration should increase, in part to help complete the WHO research agenda. This would build on existing relationships between the WHO, the Armstrong Laboratory and the RAS' Institute of Biophysics in Moscow and take advantage of the new USAF collaboration initiative.

The scientific program was organized by Dr. Nikolai Izmerov, the head of the IOH, Dr. Yuri Grigoriev of the RAS' Institute of Biophysics in Moscow and the WHO's Repacholi. The IOH's Dr. Nina Rubtsova made all the necessary arrangements. All the Russians, scientists and administrative staff alike, gave their out-of-town visitors a most gracious welcome in the finest tradition of Russian hospitality.

Clippings from All Over

"In Italy, each person has more of them. They keep three. One for the family calls, one for business. And the other one, well, that's for the girlfriends."

—An unidentified young man on his friends' fondness for cellular phones, quoted by Monique Yazigi in "The Party Line: 'What's Your Cell?'," *New York Times,* Sunday Styles, p.2, July 19, 1998

Since many research papers on the safety of mobile phones are conducted on behalf of the mobile phone companies, and not objective bodies, it is important to press the Government to run independent studies that take into consideration that the use of mobiles is a moving target. What was safe yesterday is not necessarily going to extrapolate for our mobile phone use of today.

—Eva Pascoe, columnist, in "Is Your Mobile Giving You a Real Ear-Bashing?" *Independent* (U.K.), Monday Review, p.11, July 27, 1998

"It's huge! It will scare people. If we had a campaign that featured our product, we'd lose."

—John Windolph, executive director of marketing communications, Iridium LLC, reacting last fall to the new Iridium hand-held phones, with which users will be able to place and receive calls anywhere in the world, quoted by Quentin Hardy in "Iridium's Orbit," *Wall Street Journal,* p.A1, June 4, 1998

"You have a well-known American corporation that is renting space within one of the church's most sacred symbols. The cross is a symbol of God's life for the world and that's exactly what we are trying to use the cross to do."

—Rev. Ross Goodman, pastor, St. Paul Evangelical Lutheran Church, Arlington, MA, on the church's contract with AT&T Wireless and Omnipoint to install cellular antennas on the 20-foot cross atop its steeple, quoted by Jennifer Babson in "Cell Phone Firms Target Higher Power," *Boston Globe,* p.A1, June 8, 1998

Although research on this speculative hypothesis continues, our judgment is that this potential hazard is best regarded as a "phantom risk."

—Dr. John Graham, Harvard Center for Risk Analysis, Boston, on possible health hazards of power line EMFs, in "Ranking Risks in the Home," *Risk in Perspective* (the center's newsletter), p.4, April 1998 (Graham's EMF-related work is sponsored by the Electric Power Research Institute in Palo Alto, CA, and by the Edison Electric Institute in Washington.)

Yet despite an enormous number of studies conducted over the past three decades examining many possible putative relationships between environmental factors and cancer, few correlations have been found. From electromagnetic fields and pesticides to microwaves and smog, credible studies have shown little evidence of links between environment and cancer risk.

—Drs. Brian Henderson and Susan Preston-Martin, University of Southern California School of Medicine, Los Angeles, in an op-ed piece, "Real Risks of Cancer Are Not in Environment But in Ourselves," *Los Angeles Times,* p.B5, June 8, 1998

"It was not a matter of replicating our experiments; rather, they were only similar experiments."

—Dr. Wolfgang Löscher, Hannover School of Veterinary Medicine, Germany, on the differences between his animal studies on the promotion of breast cancer with 50 Hz magnetic fields and those led by Dr. Larry Anderson of the Battelle Pacific Northwest Labs in Richland, WA, quoted in "Replication of the Löscher Studies in the U.S.," *Elektrosmog-Report* (Germany), p.7, June 1998 (translated from German; see below and *MWN,* M/A98 and M/J98)

"I pop melatonin like Tic-Tacs."

—Michael Kors, head designer for Celine, the French fashion house, whose recent travels have "taken him to Japan, Paris, Milan, Dallas, Paris again," quoted by William Norwich in "Style Diary," *New York Observer,* p.28, July 20, 1998

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• A team led by Henry Kues of JHU–APL reports that pulsed 2450 MHz radiation damages tissue in the cornea at 10 mW/cm^2, but that the effects first appear 24-72 hours after exposure.

• The state of Wisconsin sues the U.S. Navy to block its extremely low frequency submarine communications system, Project ELF, until the Navy updates its 1977 environmental impact statement.

• Dr. Herman Schwan, chair of the panel that wrote ANSI's 1966 exposure standard (10 mW/cm^2) for RF/MW radiation, rejects charges that the panel was tilted toward industry and the military.

Years 10 Ago

• In a class action suit against Boeing, where he worked for 27 years, electronics technician Robert Strom charges that the company failed to inform its workers of the hazards of electromagnetic pulse (EMP) radiation, which he believes caused his leukemia.

• Dr. David Lange finds that 2450 MHz radiation at specific absorption rates of 2 W/Kg causes significant leakage through the blood-brain barrier. The finding parallels Henry Kues's work showing similar leakage from blood vessels in the eyes.

• The U.S. Air Force considers relocating its high-power PAVE PAWS radar in Georgia, because its main beam may detonate munitions aboard aircraft approaching Robins Air Force Base.

Years 5 Ago

• The CTIA abandons its proposal to have the FDA lead the industry's cell phone research program. The agency's Dr. Elizabeth Jacobson criticizes the wireless industry for "unwarranted confidence" in the safety of cellular phones.

• Drs. Wolfgang Löscher and Meike Mevissen in Hannover, Germany, report on a series of experiments showing that 50 Hz magnetic fields promote breast cancer in rats. In one experiment, the exposed animals also had decreased melatonin levels.

• People should be wary when phrases such as "no scientific proof" or "no objective evidence" are used to sum up the epidemiological evidence of an EMF–cancer connection, advises Canadian epidemiologist Dr. David Bates.

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UPDATES

BROADCAST RADIATION

Report on Cancer near Denver Antenna Farm... The cancer rate in the census tract around the Lookout Mountain antenna farm outside of Denver is not significantly higher than in the rest of the metropolitan area, according to a study released on June 15 by the Colorado Department of Public Health and Environment (CDPHE). Between 1985 and 1995 the rate of brain and central nervous system cancers was about 50% higher than expected—but due to the small number of cases, this finding was far from statistically significant. For all other cancers, the risk ratios were lower than expected, sometimes significantly so. The report concluded that if it is possible to collect more precise exposure data, further study might be warranted. The CDPHE inquiry had been requested in April by a citizens group called Canyon Area Residents for the Environment (CARE), which includes 25 neighborhood groups in the Denver suburbs near the antenna farm. In a June 18 press release, CARE stressed that, because of the uneven terrain around the site, residents' exposures may vary widely. "Are these [brain cancers] clustered in areas receiving certain doses of electromagnetic radiation?" CARE asked. "We do not know but would like to find out." Dr. John Reif of Colorado State University in Fort Collins, who helped prepare the report, told *Microwave News* that he would be collecting additional exposure data along with Dr. Frank Barnes of the University of Colorado, Boulder. Reif said he would like to carry out some additional pilot studies, but these would require new funding. CARE called on the CDPHE and county officials to support such research and "fill the funding void left at the national level." Lookout Mountain is home to a dozen high-power radio and TV broadcast towers and to 400-500 other antennas, with another half-dozen large towers planned for the introduction of digital TV. About 10,000 people live in the surrounding area. "From what I know about antenna farms elsewhere in the world, it's a rather unique situation," said Reif. *Cancer Incidence in Residents Adjacent to the Lookout Mountain Antenna Farm* is available from the CDPHE's Executive Director, Dr. Richard Hoffman, in Denver at: (303) 692-2662, Fax: (303) 691-7702.

ELECTRICAL APPLIANCES

U.K. Review of Field Levels... Research on EMFs from home appliances is reviewed in a new report from the British government. *A Review of EMFs Associated with Motorized Appliances* (CRR No.172), prepared by the National Radiological Protection Board for the Health and Safety Executive (HSE), is based mostly on U.S. studies and, to a lesser extent, on European and U.K. research. The report states that, "Lower field levels can generally be expected in European appliances, where the supply current is about half" that in the U.S. Data on the relationship between EMF levels and distance are provided for a range of appliances. Priced at £15 (approximately $25), the report is available from: HSE Books, PO Box 1999, Sudbury, Suffolk CO10 6FS, U.K., (44+1787) 881165, Fax: (44+1787) 313995.

EMI AND RADIO ASTRONOMY

Iridium's Negotiations with Radio Astronomers... Iridium, whose satellite-based mobile phone system is scheduled to be-

gin operation this fall, announced that it is on the verge of agreements to limit its interference with radio astronomy in Europe and India. Iridium reached an "agreement in principle" on July 7 with the European Science Foundation's Committee for Radio Astronomy Frequencies and government regulators from France, Germany, Holland, Norway and the U.K., according to spokesperson Michelle Lyle. The details of agreements with individual European observatories have yet to be worked out, Lyle told *Microwave News,* but she does not expect these negotiations to be difficult. On May 19, a tentative pact was reached with India's National Center for Radio Astrophysics, which operates a radio telescope in Pune, and Iridium expects this to be finalized by early August. At issue is the part of the spectrum between 1610.6 MHz and 1613.8 MHz, the emission frequency of the hydroxyl molecule. Since this is one of the most common interstellar molecules, radio astronomers rely heavily on observations in this band. Iridium satellites do not broadcast below 1621.35 MHz, but their powerful signals are expected to "bleed" into neighboring frequencies, drowning out the faint signals from stars that are light-years away. In March Iridium completed negotiations with the world's largest radio observatory, in Arecibo, Puerto Rico, promising to limit interference with the giant antenna for eight hours a day. Arecibo had held out for a longer quiet period than was granted to other U.S. radio telescopes, and it was the last one in North America to settle with Iridium. But this agreement does not guarantee Arecibo a complete elimination of static—only that it will be reduced by a factor of 30, according to *Science* (March 27). As a result, observations will take longer than in the past. Astronomers in other countries have taken a harder line than their U.S. colleagues (see *MWN,* J/A96), and the wireless trade paper *RCR* reports that some have accused the Americans of "dancing with the devil" (April 13). With more and more satellite-based wireless technologies expected in the future, the stakes are high. Tomas Gergely, in charge of spectrum management issues at the U.S. National Science Foundation, told *Nature* (March 26), "We must be very vigilant, so that radio astronomy as a discipline survives."

The Future of Spectrum Management...*Radio Astronomy Spectrum Planning Options,* a report released in April by the U.S. National Telecommunications and Information Administration (NTIA) in Washington, examines the conflict between science and commerce in spectrum allocation. The report calls for increased sharing of different parts of the radio spectrum, through time-sharing agreements, better filtering of unwanted signals and "geographic and topographic isolation of sensitive receivers." Other options described in the report include increased use of fiber-optic cable and other wireline technologies, shifting existing users to other frequencies and commercial use of the spectrum above 20 GHz. The report can be found on the NTIA's Web site at: <www.ntia.doc.gov>. Printed copies can be requested from the NTIA's Mary Wallach at (202) 482-3999.

ICNIRP

Exposure Limits Updated... The International Commission on Non-Ionizing Radiation Protection's (ICNIRP) exposure guidelines are only designed to protect against "known adverse health

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

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"Digital Cellular Phones Can Disrupt Implanted Pacemakers"

"Cellular Phones May Affect Use of Pacemakers"

Wall Street Journal, April 28, 1995

MWN

Microwave News, November/December 1995

"Higher Leukemia Rates Among Those Living Near Australian TV Towers"

"Living Near TV Towers a Leukemia Risk for Children, Claims Researcher"

Sydney Morning Herald (Australia), December 10, 1996

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impacts," according to Dr. Jürgen Bernhardt, ICNIRP's chairman. Bernhardt reviewed the updated limits, which cover the spectrum from 1 Hz to 300 GHz, in a presentation at the *20th Annual Meeting of the Bioelectromagnetics Society* in St. Pete Beach, FL, on June 10. The limits protect against "short-term, immediate health effects" such as nerve stimulation, contact shocks and thermal insults, according to the guidelines, which appear in the April issue of *Health Physics (74,* pp.494-522, 1998). Despite "suggestive" evidence that power frequency magnetic fields can be carcinogenic, ICNIRP has concluded that this and other nonthermal health effects have not been "established." ICNIRP has long followed this approach to standard-setting (see *MWN,* Mr84, M/A87, J/F88, M/J88, M/J89 and J/F90). In his talk, Bernhardt noted that the guidelines include "no consideration regarding prudent avoidance" for health effects for which evidence is less than conclusive. The exposure limits are expressed in two ways: as basic restrictions and as more readily measured reference levels. For example, ICNIRP's basic restriction for public exposures to 50 Hz magnetic fields is a maximum induced current of 2 mA/m^2 in the head and trunk, and its reference level is 1 G. (At 60 Hz, the level is 833 mG.) "Compliance with the reference level will ensure compliance with the relevant basic restriction," ICNIRP states. For radiation in the 10 MHz-10 GHz range, ICNIRP specifies its basic restriction in terms of specific absorption rates (SARs). For the general public, the maximum allowable whole-body SAR is 0.08 W/Kg. For workers, the maximum SAR is 0.4 W/Kg. The reference level for public exposures is 200 $\propto W/cm^2$ from 10 MHz to 400 MHz. Above 400 MHz, it increases with frequency to a maximum of 1 mW/cm^2 at 2 GHz. To clarify aspects of the guidelines, ICNIRP has prepared a paper in a question-and-answer format, which will appear in the October issue of *Health Physics.*

INTERNATIONAL STANDARDS

Proposed EC Rules Follow ICNIRP... The European Commission (EC) has drafted new guidelines for the general public's exposure to non-ionizing radiation (NIR). The proposal is intended to replace the current patchwork of national and European regulations with a single coherent framework, but must still be voted on by the ministerial council of the European Union (EU). The draft rules "are based on the best scientific advice, notably from the International Commission on Non-Ionizing Radiation Protection (ICNIRP)," according to a June 22 press release from the EC in Brussels, Belgium. The EC noted that the proposed standard does not address "the so-called 'athermal' effects of NIR, such as cancer, for which there is no conclusive scientific evidence." Specific regulations to enforce the guidelines would be left to individual governments. EC Employment and Social Affairs Commissioner Padraig Flynn said that the rules are needed because, "The absence of requirements or guidelines at the EU level in this area is having a negative effect on the attitudes of consumers with regard to equipment emitting NIR." The EU had been urged to develop "a wider international consensus" on public exposure to NIR in a 1996 report from the EC's directorate for employment, industrial relations and social affairs (see *MWN,* S/O97; also S/O96). The new proposal has been endorsed by the EC's Scientific Steering Committee.

That Gallo was giving advice on EMFs was in itself surprising. He is new to the EMF debate, as he often remarked over the ten days of meetings. "I am agnostic" on this issue, he said.

Nor did Gallo learn much about risk during the working sessions—because risk was never discussed in Minneapolis. The panel was told to ignore risk and concentrate on the science. (Translated into jargon, the assigned task was "hazard identification," not "risk characterization." The idea is that you must first identify what risks, if any, exist, before you can judge their size.)

"We don't care what the outcome is," Dr. Kenneth Olden, the director of the NIEHS, instructed the working group on the opening evening of the meeting. "We just want it to be based on good science." Risk analysis would come later.

But, evidently, Gallo and NIEHS' senior managers felt they had to offer their risk assessment without the benefit of the formal risk analysis that Dr. Christopher Portier is preparing for them.

Why was the NIEHS trying to downplay public concern over EMFs? It is puzzling, especially given that the most likely result of the panel's decision would be to prompt more health research, which, after all, is the NIEHS' raison d'être. Why not accept the recommendation of its panel and ask Congress to keep funding EMF studies?

Part of the answer has to do with the current climate for environmental research. The RAPID program is coming to an end, and Congress is not in any rush to renew it. So any future EMF studies would be at the expense of other NIEHS projects.

But there's more than money involved. NIEHS managers long ago decided that EMFs are not worth their attention. In the press release, Gallo did recommend more "hypothesis-driven, focused research," but, in a telling omission, there was no endorsement from the NIEHS. Not from Dr. Gary Boorman, the head of the institute's EMF studies; not from Dr. George Lucier, the director of its Environmental Toxicology Program, who flew in for the concluding sessions of the meeting; nor from institute director Olden himself. The NIEHS does not want to make any commitments to EMFs.

The NIEHS' ambivalence over EMFs is not new. Three years ago, when the institute's long-term animal studies were just getting under way, Boorman said on national public television that, in all probability, it would soon be obvious that "there's really nothing there" (see *MWN,* J/A95).

Boorman's comments were remarkable. Here was a government scientist who had just committed some $10 million of NIEHS (*not* RAPID) funds for a set of animal studies—and he thought there was little evidence of any real risk. For Boorman, it appeared as if their real value was to quell what he perceives to be the public's groundless fears.

As it turned out, the animal studies were not as clearly negative as Boorman had predicted. Earlier this year, the National Toxicology Program found that they showed an "equivocal" cancer risk in male rats (see *MWN,* M/A98).

The $10 million animal data did not play a major role in the NIEHS working group's decision. The epidemiology was the dominant basis for listing EMFs as possible carcinogens. It had to be: There are simply too many high-quality childhood and worker studies to ignore. It makes sense that studies of *human beings* in *real* EMF environments should be given more weight than experiments on animals exposed to idealized magnetic fields.

In the real world, people rarely encounter the type of EMFs to which Boorman's animals were exposed—pure 60 Hz sine waves. In retrospect, it was probably a gross mistake to bet the whole $10 million on one artificial type of EMFs.

Which brings us back to the question of risk. How much of a threat do EMFs really pose? Do they pose only a small health risk, as Gallo and the NIEHS would have us all believe?

When asked to put his quote in context, Gallo explained that he was comparing EMFs to AIDS and TB. But we did not need a multimillion-dollar research project to tell us that EMFs are not the cause of a global plague. No one has ever argued that.

The idea that EMFs pose a small risk (at worst) comes largely from industry propaganda (see p.15). It has been repeated so many times that it is now accepted as dogma.

Even those who should be more skeptical are buying into the low-risk assumption. Jocelyn Kaiser's report on the NIEHS meeting for *Science* (July 3) included this sentence: "Experts are quick to point out that any cancer risk from EMFs is slight." She treated the statement as so self-evident that she did not even bother to name any of the experts.

The risks may indeed turn out to be small, but, at this point, that is still very much an assumption. No one will know the true dimensions of the EMF problem until the active biological agent has been identified. It could be high frequency transients, but that too is a guess.

We are all exposed to EMFs all the time. This means that epidemiological studies give at best a minimal estimate of the real risks, because it is impossible to find a truly unexposed group to serve as controls. EMF studies may be the equivalent of comparing two-pack-a-day smokers with those who smoke three packs a day.

As Dr. Raymond Neutra of the California Department of Health Services pointed out at the BEMS conference this June, "EMF risks could be large compared to lifetime theoretical risks for most regulated chemicals." Neutra argued that, "If you are not willing to do EMF research, you should not be doing any environmental research."

Anyone who has grappled with the inexact science of estimating risk knows that the numbers are easily manipulated to fit a desired objective—especially with agents like EMFs, for which there are large holes in the data. When the NIEHS releases Portier's risk analysis, his assumptions should be examined closely. After all, his superiors have already made clear how it should turn out: not much risk, not much need for research.

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NIEHS Finds "Weak" Evidence That EMFs Pose Health Risks

Prudent Avoidance Endorsed

The National Institute of Environmental Health Sciences (NIEHS) has concluded that the scientific evidence that exposures to power line electromagnetic fields (EMFs) pose a health risk is "weak."

The NIEHS stopped short of saying that EMFs are entirely safe, pointing to a "fairly consistent pattern" of a small increase in leukemia risk with increasing exposure—a pattern observed in epidemiological studies of both children exposed at home and workers exposed on the job. At the same time, the NIEHS noted that animal and mechanistic experiments tend not to support a cancer link.

These findings are contained in NIEHS Director Dr. Kenneth Olden's report to the U.S. Congress on the six-year RAPID research program on power line health effects, which was released on June 15.

Olden recommended a "continued emphasis" on educating the public and reducing EMF exposures because "virtually everyone in the U.S. uses electricity and therefore is routinely exposed." But he advised against "aggressive regulatory actions."

Olden's advice has been widely interpreted as an endorsement of a policy of "prudent avoidance," or taking simple and inexpensive steps to limit exposures. The policy was first put forward ten years ago in a report by the Congressional Office of Technology Assessment (see *MWN,* J/A89). The government of Sweden backed prudent avoidance of power frequency health risks four years ago (see *MWN,* N/D95).

(continued on p.9)

Finding of Scientific Misconduct Against Robert Liburdy

He Stands by EMF–Calcium Results

On June 18, the federal Office of Research Integrity (ORI) declared that Dr. Robert Liburdy had committed scientific misconduct. ORI charged Liburdy with "intentionally falsifying and fabricating data" in two papers about EMF effects on calcium changes in rat blood cells.

In a voluntary settlement with ORI, Liburdy agreed to retract three graphs: two in one paper and one in another. In addition, Liburdy agreed not to receive any federal grant money for the next three years.

"I admit no scientific wrongdoing," Liburdy stated in a letter published in *Science* (July 16), arguing that "the crux of the charges" center on his graphing techniques. "The raw data for my two calcium studies are valid. Thus, these papers are not being retracted, and my scientific conclusions stand as pub-

(continued on p.7)

HIGHLIGHTS

European Union To Adopt ICNIRP-Based Guidelines; Italy Protests That Decision Ignores Long-Term Effects

On June 8, the Council of Ministers of the European Union (EU) agreed on guidelines for public exposure to electromagnetic fields and radiation (EMF–EMR). Italy opposed the measure, arguing that it did not protect against possible long-term effects.

The recommended guidelines, based on those of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), will provide "a high level of protection [against] established health effects," the Council of Ministers declared. The council noted that, "Concerns have been raised about possible health effects, primarily cancer," from low-level, long-term exposure. But it argued that, "There is no convincing scientific evidence of EMFs causing cancer."

German Health Minister Andrea Fischer called the council's action "an important step towards ensuring better protection of the public," according to a June 8 Reuters dispatch. Fischer chaired the meeting of EU health ministers, which was held in Luxembourg.

The council's report noted that Italy had "expressed firm objections against the general approach" of the EC proposal, and had argued unsuccessfully for a policy based on "the precautionary principle." Defeated Italian amendments called for efforts to reduce exposure, especially in "areas intended for children and health facilities."

Italy also complained that the council decision did not take the full range of scientific studies into account. Its amendments would have explicitly stated that, "The induction of cancer from long-term effects cannot be ruled out," and would have deleted both of the recommendation's references to ICNIRP as an authoritative body. Italy did not, however, try to change the proposal's ICNIRP-based numbers.

"The council's recommendation has no legal force—but it does have moral force," Ireland's Dr. Tom McManus said at an IEEE meeting in Long Beach, CA, in June. He predicted that smaller countries such as Denmark and Ireland would translate the guidelines directly into national laws, while larger nations would probably modify them in light of their existing regulations. McManus is the chief technical adviser to Ireland's Department of Public Enterprise, which deals with communications, energy and transportation policy.

The Council of Ministers approved the proposal advanced by the European Commission (EC) in June 1998 without major changes (see *MWN,* J/A98), The council rejected most of the amendments proposed by the European Parliament last March, which would have put more emphasis on a precautionary approach (see *MWN,* J/F99 and M/A99).

The European Parliament's proposed amendments to the EC proposal had little influence on the council's decisions. Though the council's report stated that "nine of the 17 amendments proposed by the European Parliament have, completely or partially, been taken into account," in many cases the council adopted only the weakest elements of a given amendment; the stronger provisions were often ignored.

Italian Who Won Euro Parliament Support for ALARA Loses Seat

In elections on June 13, Gianni Tamino of Italy's Green Party lost his seat in the European Parliament. Tamino led the recent parliamentary effort to press for reductions in EMF–EMR exposure.

Last year the parliament's committee on the environment asked Tamino, a biology professor at the University of Padova, to review public exposure guidelines proposed by the EC (see *MWN,* J/F99). Tamino's report proposed extremely strict numerical limits, but these were rejected by the full parliament in March (see *MWN,* M/A99). But the parliament did support Tamino's call for a precautionary approach, known as ALARA, to possible long-term health effects.

The Italian Green Party saw its support drop by half in the European elections. With only 1.8% of the vote, it was entitled to send only two representatives to the EU's parliament, and Tamino was not ranked high enough within his party to retain his seat.

The member of the European Parliament most likely to take the lead on EMF–EMR issues in the future is Paul Lannoye of the Belgian Greens. Lannoye is the author of a resolution which the European Parliament passed in 1994, *On Combating the Harmful Effects of Non-Ionizing Radiation* (see *MWN,* J/A94).

The council rejected the parliament's support for a precautionary approach based on the "ALARA principle"—the idea that public exposure should be kept "as low as reasonably achievable." It turned down a set of parliamentary amendments, supported by Italy, that would have required the EC to develop a system of regular scrutiny of devices that generate EMFs and EMR, to label such devices with information on field strengths at various distances and to revise the exposure guidelines by 2001 with an eye to possible long-term effects.

The council did, however, instruct the EC to keep the issue "under review," including "possible effects which are currently the object of research," and to prepare a report within five years. The council also supported research on health effects, and specified that this should be part of the EU's "Fifth Framework Program" for scientific research (see p.4 and *MWN,* J/F99).

Though the council accepted ICNIRP's numbers, McManus stressed that it had adopted the ICNIRP standard "in a modified way." The council urged that regulations focus on places "where members of the public spend significant time," and it stressed that limits on EMF–EMR exposure "should consider both the risks and benefits" of the technology concerned. These points responded to concerns raised by industry, which had argued that a strict application of the ICNIRP limits would be too expensive. For example, the U.K.'s electric power industry warned that it could be forced to spend up to $1 billion to reduce short-

term exposures of "a small number of agricultural workers, or ramblers on moorland" from high-tension lines (see *MWN,* J/F 99 and M/A99).

The limits recommended by the council do not apply to workers, or to patient exposure while undergoing medical treatment. They are also not intended to prevent EMI to medical devices.

The June 8 meeting of the council came to political agreement on its EMF–EMR recommendation, but did not formally approve it. That will happen at a future meeting, after the recommendation has been translated into all of the EU's official languages. Once the recommendation is officially approved it will be published in the *Official Journal of the European Communities,* available on the Web at: <europa.eu.int/eur-lex>. The European Parliament's suggested amendments to the EC proposal, approved in March, were published in the June 21 issue of the *Journal*.

French and German Studies on RF/MW Cancer Promotion: Widespread Interest, Inconclusive Results

When the Mobile Manufacturers' Forum (MMF) released a list of planned health studies in January, one topic sparked some curiosity: whether mobile phone radiation promotes the growth of cancer caused by the chemical DMBA.

The MMF said this animal study was needed "to address previous findings"—but most scientists familiar with cellular phone research did not know that such experiments had ever been conducted. What were these "previous findings"? MMF officials would not say.

So in June when results from one of the studies were slated for presentation at the annual meeting of the Bioelectromagnetics Society (BEMS), there was considerable interest. "This paper has attracted a lot of attention before the meeting, and I am expecting a controversial reaction," said Switzerland's Dr. Niels Kuster, the chair of that session, in his introductory remarks.

But results described by Dr. Rachid Anane, on behalf of Dr. Bernard Veyret's group at the University of Bordeaux in France, were ambiguous. In the first of two experiments, rats were exposed to 1.4 W/Kg and above and there appeared to be some increase in cancer. But in a second experiment at lower exposures, the number of malignant tumors went down.

Motorola's Dr. Mays Swicord, based in Plantation, FL, was skeptical about whether these apparent effects were real. "The question is whether these are statistical variations," Swicord said in an interview. "It is difficult for me to believe that these systems are bimodal. I would be more comfortable if the data went one way or the other."

"There is no doubt that the differences between the first and second experiments are statistical fluctuations," commented Dr. Alexander Lerchl of Germany's University of Münster. Lerchl argued that more animals and a lower dose of DMBA would be needed to clarify any possible RF/MW effects. Veyret countered that while the number of animals in his study was small, it should be enough to detect a difference of 40% or more between groups.

Another DMBA study on cellular phone radiation, by Drs. Christian and Hella Bartsch of the University of Tübingen in Germany, has not yet been released. Several scientists at the BEMS meeting told *Microwave News* that the Bartsches had at least some positive findings—but others said the data could be interpreted in various ways.

The German researchers have declined to discuss their experiments until the study is accepted for publication. "We plan to submit our results...in the next month or so," Christian Bartsch told *Microwave News*. "The final statistical analysis has not yet been completed."

Nonetheless, wireless industry representatives agreed that this initial work deserves further attention. Dr. Torsten Gailus of Deutsche Telekom, which funded the Bartsches' research, told *Microwave News* that both of the DMBA studies are "very interesting work." He added that he is "not concerned by their results."

"My personal opinion is that the Veyret study is a good study, and that it looks very important," said Gerd Friedrich of FGF, the German wireless industry research group based in Bonn. In an interview, he noted that Veyret's experiments were small and "still at an early stage." Neither Gailus nor Friedrich would comment specifically on the Bartsches' findings.

The MMF has selected Dr. Robert Hruby of the Austrian Research Center in Seibersdorf to try to replicate the DMBA studies (see p.4). Hruby is expected to use 100 animals per group, and thus achieve a statistically stronger result.

In both of his experiments, Veyret gave the rats one 10 mg dose of DMBA, which induces mammary tumors. Starting ten days later, the rats were exposed to 900 MHz GSM mobile phone radiation for two hours a day, five days a week, for nine weeks.

In the first experiment, three groups of 16 rats were exposed to 1.4 W/Kg, 2.2 W/Kg or 3.5 W/Kg. Another group of 16 was sham-exposed, while eight rats served as cage controls. Overall, exposed groups showed "a slight increase in the number of tumors, but it was not significant," said Anane.

The second experiment was conducted at lower exposures: 0.1 W/Kg, 0.7 W/Kg and 1.4 W/Kg. In this case, the number of tumors per animal decreased as exposure went up, and in two out of three groups the decline was statistically significant. This experiment also used 16 rats per group.

Gailus, who heads Deutsche Telekom's research group on RF/MW bioeffects in Darmstadt, said that Christian and Hella Bartsch used a different exposure system than did Veyret. While both labs used whole-body, far-field exposures, in the German study the cages held several animals each with enough space for them to move about freely. In the French experiments, the rats were confined to individual compartments just large enough for a single animal.

The use of confined spaces in Veyret's exposure system was criticized by Lerchl. He pointed out that in both experiments,

the cage controls had consistently higher body weights than all other groups of animals. "The animals are stressed when they are constrained," Lerchl told *Microwave News*. Since both exposed and sham-exposed animals are stressed, he contended, "You will not see an effect [of RF/MW exposure] unless it is very strong." Lerchl believes that, "This is a guaranteed way not to see any results."

Anane stressed that no firm conclusions could be drawn from his group's study alone. Veyret's lab is also planning further DMBA work, with a larger number of animals. Funded by the French service provider Bouygues Telecom, this study will use 1800 MHz exposures.

Another initiation/promotion study by Veyret's group, this one using benzo(a)pyrene instead of DMBA, found no effects at all from RF/MW radiation. This study, which used much lower level GSM exposures—0.075 W/Kg and 0.27 W/Kg—has been accepted for publication by the *International Journal of Radiation Biology.*

Wireless Industry Picks Studies for European Research Program

The Mobile Manufacturers Forum (MMF) is supporting the proposals listed below for funding from the European Union (EU) under its Fifth Framework Program for Research and Technological Development, known as FP5 (see *MWN,* J/F99). Under FP5 rules, the EU will cover only 50% of the cost of projects done outside of universities. The MMF will pay half the costs of its projects which are chosen by the European Commission (EC).

Research labs submitted applications early this year in response to a request for proposals issued by the MMF that detailed a number of research needs (see *MWN,* J/F99). The applications were evaluated by two panels specially convened by the WHO EMF Project in Zurich, May 8-9. Both panels were chaired by Dr. Chrisopher Portier of the U.S. NIEHS.

A list of labs that were judged capable of doing the research was presented to the MMF, which then matched the labs with specific research projects. Three consortiums, each of which included labs from several different countries, were assembled to do animal, cellular and human research (see below).

Applications for FP5 funding were due on June 8 and are now under review by the EC's Directorate 12, on science, in Brussels. The EC's selections are expected in the fall.

The chair of the MMF is Peter Harrison of Nokia in Camberley, U.K. Its secretary is Matthias Meier of Motorola in Kassel, Germany. Dr. Mays Swicord, Motorola's director of biological research in Plantation, FL, is also playing an active role in this MMF initiative.

***In Vivo* Studies**	**Country**	**Principal Investigator and Affiliation**
Two-year bioassays in rats with 900 MHz & 1800 MHz digital radiation	Switzerland	Dr. Antonio Dotti, RCC Ltd., Itingen
Two-year bioassays in mice with 900 MHz & 1800 MHz digital radiation	Germany	Dr. Clemens Dasenbrock, Fraunhofer Institute, Hannover
Replication of DMBA-initiated breast cancer in rats with 900 MHz digital radiation	Austria	Dr. Robert Hruby, Austrian Research Center, Seibersdorf
Replication of *Pim1* transgenic mouse study	Italy	Dr. Germano Oberto, RBM Bioscience, Colleretto Giacosa
Radial arm and water maze ability in rats and mice	U.K. France	Dr. Rick Saunders, NRPB, Chilton Dr. Jean-Christophe Cassel, Louis Pasteur University, Strasbourg
***In Vitro* Studies**		
Ornithine decarboxylase (ODC) expression using 900 & 1800 MHz digital radiation	France Finland	Drs. Bernard Billaudel & Bernard Veyret, University of Bordeaux Drs. Jonne Naarala & Jukka Juutilainen, University of Kuopio
Genotoxicity and chromosome aberrations using 900 & 1800 MHz digital radiation	Italy U.K.	Dr. Carmela Marino, ENEA, Rome Dr. David Lloyd, NRPB, Chilton
Human Studies		
Hearing and inner ear pathology	Sweden Finland	Dr. Ilmari Pyykkö, Karolinska Institute, Stockholm Dr. Jukka Starck, Institute of Occupational Health, Vantaa
Skin hypersensitivity, headaches and blood pressure	Sweden	Drs. Bengt Arnetz & Lena Hillert, Karolinska Institute, Stockholm
Sleep and EEG recordings	Sweden	Dr. Torbjörn Åkerstedt, Karolinska Institute, Stockholm
Working memory	U.K.	Dr. Adrian Owen, University of Cambridge
Exposure and Dosimetry Support		
Drs. Niels Kuster, Swiss Federal Institute of Technology, Zurich; John Sahalos, University of Thessaloniki, Greece; Philippe Leveque, University of Limoges, France; and Kari Jokela, Center for Radiation and Nuclear Safety, Helsinki, Finland.		

The Talk of Long Beach: Motorola Takes Center Stage as Carlo Makes His Exit

On walking into the BEMS meeting* it seemed as if someone had waved a magic wand and turned all the power line people into cell phone types—and got most of them jobs with Motorola.

Motorola was everywhere. Motorola scientists, engineers, consultants and administrators came to Long Beach from three continents. To keep order, the company sent a lawyer and a PR man. In all, there were about a dozen Motorola staffers at BEMS, not counting those actually doing Motorola-funded research.

Motorola has the largest mobile phone health research program in the world. In fact, it has the *only* research program. In contrast to Wireless Technology Research's (WTR) $25 million effort for the cell phone industry, which never got off the ground, Motorola is actually getting something done.

This was most apparent at WTR's own two-day symposium† held immediately before the BEMS conference. WTR's meeting was designed to showcase WTR results, but it had funded so few studies that Motorola researchers had to be brought in to fill out the program. At WTR's own meeting, there was more science from Motorola than from WTR.

The symposium did feature some WTR research: findings that Dr. George Carlo, WTR's chair, had previously released to the media with much fanfare. Carlo argued strongly that Joshua Muscat's epidemiological study (see *MWN,* M/J99) and Dr. Ray Tice's genetic toxicological experiments (see *MWN,* M/A99) suggested a possible cell phone-cancer link.

Muscat did not say what he thinks about his own findings—perhaps to keep them fresh so that he can publish them somewhere prestigious like the *New England Journal of Medicine*.

Sweden's Dr. Lennart Hardell did not come to Long Beach, but his collaborator Dr. Kjell Hansson Mild presented their recent epidemiological results, which show that users of mobile phones were more likely to develop brain cancer on the side of the head where they held the phone (see p.6 and *MWN,* M/J99).

While many of those in the audience were skeptical that any of these new pieces of the cell phone health puzzle represented a breakthrough, Carlo clearly thought so. He called for an "immediate and comprehensive review" of RF/MW health standards.

"There is something going on that does not involve heating," Carlo told us. Carlo's "deathbed" conversion to the nonthermalist camp may have prompted France's Dr. René de Seze, who does research for Motorola, to reassure the audience at the end of the meeting that there is no health problem. And Norm Sandler, Motorola's spokesman, observed that the reviews of safety standards that Carlo is calling for "are being done all the time."

"It is clear to me that consumers are not being protected," Carlo warned. He predicted that the health controversy is not over: "I am not anticipating an end to this anytime soon," he said.

Carlo now believes that the cell phone industry has a duty to monitor consumer complaints, to do public health studies of phone users and to continue biological research. This is "an ongoing cost of doing business," he said. "Nothing less will protect the consumer." In the past, Carlo has suggested that WTR would be well-suited to run just such a surveillance effort, according to a proposal for a second five-year research plan which Carlo has been circulating.

The Cellular Telecommunications Industry Association (CTIA), which sponsored the WTR program, quickly distributed a press release stating that there are no cell phone health risks.

To no one's surprise, there was visible tension between WTR and the CTIA. Carlo could be seen in heated arguments with CTIA Vice President Jo-Anne Basile in the hall outside the meeting room. "You have caused us a few sleepless nights," Basile said from the floor as the WTR meeting closed.

Carlo told *Microwave News* that the CTIA had informed him last winter that it would no longer support WTR—although it had previously promised him a role in following up the epidemiological and genotoxic findings.

In fact, as far as the CTIA is concerned, Carlo is gone for good. It is a "final goodbye," reported *Wireless Week,* which can be counted on to reflect the industry's position. CTIA's board has made a new commitment to sponsor health research, though it has not been specific as to who will do it and who will run it.

But Motorola is not waiting around. It has taken a central role in coordinating responses to the new European research effort (see p.4). In addition to its ongoing U.S. and European research efforts, Motorola is helping with the exposure system for the replication of a key animal experiment in Australia.

There was a fair amount of discontent among European scientists with Motorola's role in the EC project: "How come some guy from America is telling us how to spend our money?" one commented.

Dr. Mays Swicord, Motorola's director of biological research in Plantation, FL, defended the company's initiative: "If we had not acted, there is a risk the high priority items would not have been addressed." He attributed some of the ill will to hurt feelings because "some people got left out of the process."

Carlo is telling people that Motorola has a nearly unlimited budget when it comes to microwave research. He claimed that the company had given the World Health Organization (WHO) EMF project $10 million. "That's absolutely untrue," countered Dr. Michael Repacholi, the head of the project. He said that the WHO cannot accept direct industry support, but that Motorola has "at times picked up the costs of some meetings." For instance, Motorola paid for NIEHS' Dr. Christopher Portier's trip to Europe to evaluate the proposals for the EC program (see p.4).

Motorola's Sandler said that Motorola has contributed approximately $50,000 a year for the last three years for general support of WHO's RF work, explaining that Motorola gives the money to Australia's Royal Adelaide Hospital, which forwards it to the WHO. Repacholi worked at the hospital before joining the WHO.

Few people seem to be shedding any tears over Carlo's exit from the cell phone scene. "George is having difficulty bowing out gracefully," Repacholi told us as he left Long Beach.

**21st Annual Meeting of the Bioelectromagnetics Society* (BEMS), Long Beach, CA, June 20-24, 1999.

†*2nd State of the Science Colloquium on the Public Health Impact of Wireless Technology,* Long Beach, CA, June 19-20, 1999.

« Wireless Notes »

At the **WTR** symposium in Long Beach (see p.5), Dr. **Maria Feychting** of the Karolinska Institute in Stockholm raised a question about Dr. **Lennart Hardell**'s study of brain cancer and mobile phone use. From a central tumor registry, Hardell identified 270 cases in the study area between 1994 and 1996. Feychting, however, identified 862. While some of the difference is due to the fact that Hardell used only cases who were still alive, she noted that about two-thirds should still be alive a year after diagnosis. "We need to investigate the selection procedure to evaluate possible selection bias," said Feychting, who is working on the International Agency for Research on Cancer's mobile phone study (see *MWN,* S/O98). "It's strange that he does not explain why he identified only 30% of the cases," she told *Microwave News.*

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"**Neil Whitehouse**, stubborn and arrogant airline passenger, was jailed for a year." That was the caption on a photo of Whitehouse in the July 22 *Daily Telegraph* (U.K.), after he was sentenced for repeatedly refusing to switch off his mobile phone on a flight from Madrid to Manchester. While the plane was airborne, flight attendants and the captain warned that the phone could interfere with the aircraft's sensitive navigational systems. "So what?" Whitehouse replied. "Are we going to get lost?" Britain's **Civil Aviation Authority** welcomed the verdict and emphasized that, "Use of mobile phones on any aircraft is a definite safety risk." The sentence was intended "to act as a warning to others," stated **Judge Anthony Ensor**. "Proliferation of ownership of mobile phones and an increasing number of reports from pilots of electromagnetic interference makes this a priority."

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WTR's Dr. **George Carlo** has made peace with Drs. **Henry Lai** and **N.P. Singh** of the University of Washington, Seattle. In May, Carlo wrote to Dr. **Richard McCormick**, the president of the university, charging that they had written a "libelous" letter about WTR which was published in *Microwave News* (see *MWN,* M/A 99 and M/J99). Carlo requested a meeting so that the matter could be resolved "outside the courts." But by mid-June, Carlo had decided not to pursue the matter. "George told me 'Let's forget about it,' in Long Beach," Lai said (see p. 5). Carlo confirmed this to *Microwave News.* Then, on July 9, Dr. **Steven Olswang**, the vice provost of the university, responded to Carlo on behalf of McCormick, stating that, while Carlo's concerns "present legitimate differences of viewpoints about a topic of considerable academic importance," they "do not present investigatable issues of scientific integrity." Olswang added that, "The University of Washington encourages legitimate academic discourse, and as such, we are not prepared to intervene."

Could a Cell Phone Call Spark a Gas Station Explosion?

Is there a small but real danger that a cellular phone could spark a fuel explosion in a gas station? Or is this just "the latest urban legend," as the *Wall Street Journal* suggests?

This question got a burst of attention in the U.S. in June, after Exxon stations posted signs telling customers to turn off mobile phones before filling up. The signs are mandatory in company-owned stations, and "strongly encouraged" at independent Exxon dealers, CNN Financial Network reported on June 28.

BP Amoco has banned cellular phone use in its filling stations in Australia and the U.K., and will extend this policy to the U.S. in the next few months, according to the trade paper *RCR* (June 28). For several months, Japanese gas stations affiliated with Exxon and Shell have prohibited the use of wireless phones.

The wireless industry blames the fuss on an old British government rule requiring manufacturers of all electronic devices to warn customers to switch them off near potentially explosive atmospheres. Motorola's Norm Sandler told the *Wall Street Journal* (July 9) that the regulation was obsolete, and that cellular phone manufacturers may drop the warning from their manuals.

A recent Motorola patent application in the U.K., however, states that wireless phones can pose a danger of explosion in gas stations. It describes a Motorola system that would shut down all mobile phones within a given area. Sandler told *Microwave News* that this text does not reflect company policy, and was written by an individual engineer. He called the wording "unfortunate," and added that Motorola and oil industry experts are currently conferring "to clarify whether these precautions have any technical basis whatsoever."

An unconfirmed report from Indonesia of a gas station fire caused by a mobile phone is currently circulating on the Internet. But it is unclear whether such a fire or explosion has ever occurred, in Indonesia or anywhere else.

Dr. James Stuart, head of Franklin Applied Physics in Oaks, PA, told *Microwave News,* "I don't see any way you could get a spark out of a cell phone. They're designed *not* to cause sparks." Stuart, an expert on accidental discharge of the electro-explosive devices (EEDs) used in construction, noted that, "A two-way radio transmission can cause an EED to explode. But the only way to make an explosive vapor explode is with a spark."

An engineer for a major wireless technology firm, who asked not to be named, concurred. "Even if a wire to the battery breaks, the chances of that producing a spark, in the presence of enough gasoline vapors to matter—well, you'd be more likely to get hit by a meteorite," he said.

"The idea is kind of hard to believe," commented Dr. Motohisa Kanda of the National Institute of Standards and Technology in Boulder, CO. "Now, if you're using one of these pumps where you put in your credit card, the outgoing RF signal could maybe cause some kind of electromagnetic interference with the pump's computer chip and affect the billing," Kanda mused. "That *could* happen. So you might change your bill with a cell phone, but I don't think you can blow yourself up."

Exxon, however, is not taking any chances. In the company's refineries, using a mobile phone is banned in the same areas where using a welding torch would be restricted, spokesperson Crawford Bunkley in Houston told *Microwave News.*

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Carlo is currently in the midst of several suits and countersuits in a bitter divorce case. According to the trade publication *RCR,* his wife and former business partner **Patricia Carlo** has charged that he looted the assets of their consulting firm, **Health and Environmental Sciences Group** Ltd. (HES), by funneling its money to **WTR**. She has accused the head of the WTR audit committee, **Ronald Cavill** of Cavill & Co. of approving "false and fraudulent invoices" that were then submitted to HES, adding that WTR, HES, and Cavill's company all shared the same Washington address. "Patricia Carlo alleges George Carlo improperly spent HES money on close friends and associates for travel, vacations, pleasure boats, country club dues and sporting events," *RCR*'s Jeff Silva reported on July 19. George Carlo denies the charges, characterizing them as pressure tactics designed to get a better deal in the divorce.

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On June 15, **U.K. Members of Parliament** (MPs) heard from critics of tower siting policies and current RF/MW exposure guidelines. "There is widespread support for changing a system which does not protect the interests of the public," said Graeme McAlister of **Friends of the Earth Scotland**, which organized the briefing along with Northern Ireland Families Against Telecommunication Transmitter Siting (**NIFATT**). Margaret Dean of NIFATT called for buffer zones "between masts and homes, schools and hospitals" as a precautionary measure, echoing a proposal of the Swiss environmental agency (see *MWN,* M/A99). U.S. activist **Libby Kelley** described the ongoing legal challenge to the FCC's RF/MW exposure limits (see *MWN,* N/D97, N/D 98 and J/F99). The scientific basis for current RF/MW exposure standards was addressed by Drs. **Gerard Hyland** of the U.K.'s University of Warwick, **Michael Kundi** of Austria's University of Vienna and **Henry Lai** of the University of Washington, Seattle, in the U.S. All three focused on the limits' failure to protect against possible nonthermal effects. To defend its guidelines, the U.K.'s National Radiological Protection Board (**NRPB**) in Chilton sent Sir **Richard Doll** of Oxford University, who chairs NRPB's Advisory Group on Non-Ionizing Radiation, and Dr. **Zenon Sienkiewicz**, who argued that nonthermal effects lack the "established and consistent scientific data" on which exposure limits must be based. The meeting was sponsored by **Phil Willis**, a Liberal Democrat MP from northern England. "There is a lot of cross-party concern and a significant number of MPs are interested" in the tower siting issue, Willis told the BBC. Willis said that MPs from several parties are forming a parliamentary group on tower siting questions and wireless phone safety.

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The **U.K. government** is looking into the placement of mobile telephone base stations on schools. In June, **Education Secretary David Blunkett** announced that he had requested an inquiry into such siting policies and their possible health implications. "This is an issue for the entire country and we need to examine it urgently," said Blunkett, according to the *Daily Mail* (June 28). The *Mail* reported that the inquiry will be directed by the Department of Health. The announcement came as grassroots groups campaigned to ban cell towers on or near schools (see above) and as some local authorities—for example, in Edinburgh, Scotland—adopted precautionary measures restricting tower siting on public property. Dr. **Michael Clark** of the **NRPB** downplayed the risks posed by phone antennas on schools: "Invariably, checks taken in the school playground show that mobile phone transmitters give out far less power than nearby television and FM radio masts," Clark told the *Sunday Telegraph* (June 27). "So if people were being logical, they would want those masts taken down as well." Meanwhile, in another planned U.K. government inquiry, Sir **William Stewart** has been named the chair of an expert panel on mobile phone safety. Previously, Stewart was a chief scientific adviser to the government. **Tessa Jowell**, the minister for public health, promised a "definitive and rigorous assessment" of the health debate last April in response to a University of Bristol study showing faster response times among volunteers exposed to microwave radiation (see *MWN,* M/A99). The other members of the panel have yet to be named.

Finding of Misconduct Against Robert Liburdy *(continued from p.1)*

lished." He explained that he agreed to the settlement because he could not afford "a protracted legal battle with ORI."

The acting director of ORI, Chris Pascal, told *Microwave News,* "There's nothing in the voluntary agreement that says his conclusions were found to be invalid. We think scientists in the field are going to have to decide for themselves if his conclusions still hold up." But, Pascal added, "We did find that there was falsification and fabrication in the three figures, and they were retracted—not corrected, but retracted."

"It is unjustified to attempt to ruin a career over this," Liburdy told *Microwave News.* "ORI could not force me to retract any of the conclusions of my papers, despite being scrutinized for years. How many research findings have been reviewed at that level of hostile scrutiny and found to be accurate?"

By late July the Liburdy story had sparked a minor media frenzy, with prominent coverage in the *New York Times, San Francisco Chronicle,* and many other papers coast-to-coast. Most news stories described the three graphs of calcium data as central to the argument that there is a link between EMFs and cancer (see p.8). But researchers in the bioelectromagnetics community said that Liburdy's disputed data is only tangentially related to the cancer debate, and one small piece of the overall work on EMFs and calcium.

Liburdy and ORI have conflicting views of nearly every issue in the dispute. For example, ORI staff contend that in two of the graphs,* Liburdy's "unreported algebraic manipulations" of his raw data exaggerated calcium responses by a factor of ten and

*Figures 6 and 7 in "Calcium Signaling in Lymphocytes and ELF Fields," *FEBS Letters (301,* pp.53-59, 1992). The third graph is Figure 12 in "Biological Interactions of Cellular Systems with Time-Varying Magnetic Fields," *Annals of the New York Academy of Sciences (649,* pp.74-95, 1992; see box, p.9).

"created an experimental difference...that did not exist in the original data." But Liburdy insists that he simply applied accepted methods of normalization and baseline correction to his data—though he now concedes he should have described these procedures in the text. He plans to republish all three graphs, with a full explanation.

ORI staff accuse Liburdy of "a sustained pattern of deception over a period of several years," while Liburdy maintains that, "All it should have taken to settle this dispute is a revised figure legend giving more details about graphing the data."

ORI's investigation of Liburdy was preceded by a 1995 investigation by Lawrence Berkeley National Laboratory (LBL), where he worked until this March. A complaint was filed against Liburdy by someone whose name has not been released, but who Liburdy characterizes as "a disgruntled employee." An LBL committee accused Liburdy of "disrespect for the integrity of scientific data," and found that he "has published data in a manner which exaggerates their statistical significance and scientific validity."

After LBL completed its investigation in July 1995, internal review and appeals continued for two more years. ORI's investigation began in the fall of 1997, after LBL notified ORI that it had found Liburdy guilty of misconduct.

During LBL's proceedings, Liburdy chose three experts to review different aspects of his data: Drs. Carl Blackman of the Environmental Protection Agency, Richard Nuccitelli of the University of California, Davis, and James Putney of the National Institutes of Health. Liburdy's July 16 letter to *Science* states that while each "constructively criticized" him on various points, all believe "there was no intent to deceive [and] the data supports the conclusions."

ORI staff allege that Liburdy did not supply his own experts with all relevant data, a charge which he denies. Both Liburdy and ORI quote from the experts' letters in support of their positions, but at press time neither had provided *Microwave News* with the complete text of the letters.

ORI declared that, "Liburdy's claims were potentially very important when published in 1992 because they purported to link EMFs and calcium," which plays an key role in many cellular processes. But such a link was in fact first reported fifteen years earlier, and has been the subject of many studies since.

"The critical observations on calcium were made decades ago," Dr. Ross Adey of the University of California, Riverside, said in an interview. Adey noted that in his lab in the late 1960s, Dr. Suzanne Bawin observed that calcium in tissue was sensitive to modulated RF fields. This was a pioneering report of a nonthermal biological effect of non-ionizing radiation. Bawin followed this with work on calcium and extremely low frequency (ELF) EMFs, which was published in the mid-1970s and replicated by Blackman in 1979.

A report from a March 1997 NIEHS symposium on *in vitro* EMF bioeffects research lists 27 papers on EMFs and cellular calcium. Of the two Liburdy studies with data challenged by ORI, only one—the *FEBS Letters* paper—was considered important enough to be part of this list.

Liburdy's best-known research is not his calcium studies, but his experiments on the effects of EMFs on the growth of breast cancer cells. Liburdy has reported that in one line of human breast cancer cells, EMFs can block the anticancer effects of the hormone melatonin. This finding has now been replicated in four other labs, most recently by Drs. Masami Ishido and Michinori Kabuto of Japan's National Institute for Environmental Studies in Ibaraki, who reported their results at this year's BEMS meeting (on the other three labs, see *MWN,* J/A98). Liburdy also found that EMFs can neutralize the anti-breast cancer action of tamoxifen, and he told *Microwave News* that this work has been replicated by three labs in the U.S.

None of Liburdy's cancer studies were at issue in the ORI investigation.

Media Storm Over Liburdy Affair

For over a month after ORI announced its misconduct finding against Dr. Robert Liburdy, the most prominent press coverage was a short piece in the July 2 issue of *Science*. But the story caught fire after an article appeared in the *San Francisco Chronicle* on July 23. In what soon became a theme throughout the media, the *Chronicle* asserted that the two calcium studies "were considered tantalizing evidence that [EMFs] could cause cancer."

The next day a front-page story appeared in the *New York Times,* with the headline, DATA TYING CANCER TO ELECTRIC POWER WERE FAKED, U.S. SAYS. The graphs that ORI forced Liburdy to retract "had been considered crucial evidence of a tie between electric power lines and cancer," wrote reporter William Broad. "If he hadn't gotten these results, nobody would have paid any attention," an anonymous government investigator was quoted as saying. According to the *Times,* Dr. Robert Park, a lobbyist for the American Physical Society, "said Dr. Liburdy's deception was probably typical for the field."

The *Times* article was picked up by many other papers across the country, often appearing on the front page. An Associated Press story ran in the *Wall Street Journal,* the *Washington Post,* and elsewhere.

The next week opinion pieces began to appear. In the *Wall Street Journal* (July 27), Dr. Elizabeth Whelan of the American Council on Science and Health, based in New York City, wrote that in the disputed studies, Liburdy "claimed to have identified a possible mechanism by which EMFs caused cancer" and called this "a new low in the annals of junk science." On July 26, *Times* columnist William Safire complained that Liburdy "avoids prosecution by not contesting these [government] findings, though he admits nothing."

On July 28, Liburdy and Park appeared together on a public radio talk show on New York's WNYC. Responding to the media frenzy, Liburdy noted that his calcium experiments were not cancer studies. "He's absolutely correct on that," commented Park.

In a July 31 letter to the editor of the *Times,* Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, pointed out that concern over EMFs and cancer "is primarily a result of epidemiological studies that show an association between childhood cancer and power lines, not cell biology research."

Opposing Views of a Contested Liburdy Graph

ORI's case against Dr. Robert Liburdy is complex and not easily summarized. Below is a review of key arguments that have raged over one of the three graphs that Liburdy has agreed to retract (Figure 12 of his 1992 paper in *Annals of the New York Academy of Sciences)*. The graph shows changes in calcium within blood cells exposed to EMFs.

An analysis by ORI lawyers, obtained by *Microwave News* under the Freedom of Information Act, contends that in Figure 12: a) Liburdy selected data that supported his hypothesis and discarded the rest; and b) He fabricated parts of the curves. The document claims that this created an EMF–calcium effect not supported by the data. Liburdy vehemently denies these charges.

"Liburdy simply chose data points to express his desired experimental outcome," according to the analysis. It stresses that Liburdy graphed "less than 7.1% of his full data set."

"I could not graph hundreds of calcium data points since I did not have the software to do this in 1991," Liburdy told *Microwave News*. He added that he used more like 15% of the data. While Liburdy said that he sampled "at about 33-second intervals," ORI's analysis contends that he did not sample "systematically, uniformly or even randomly." It states that his selected data were "often clumped in groups of two and three," citing examples separated by 4, 11 and 15 seconds.

"I sampled at shorter intervals where the data were changing rapidly—for example, after the addition of Con A" (which induces cell division), responded Liburdy. This was simply "good experimental design," he said. Liburdy insisted that there was "no overall intent to 'clump' data to distort the findings."

ORI staff further assert that when the full data set is graphed, the variation, or scatter, is larger than any calcium response. They allege that by picking and choosing the data he wanted, Liburdy "manufactured" a calcium response.

Liburdy does not deny that the scatter in his full data set may be larger than any calcium response, or that this is not reflected in the graph. But he rejects the accusation that this was intentional. "The data sampling took place without knowing what the curves would look like, and was done only once," Liburdy said. "ORI analyzed my large data set with 1998-1999 software they knew was not available to me in 1991."

ORI staff also claim that, for one curve, there is physical evidence that Liburdy "rejected and erased data that contradicted the desired results."

"Like any normal person, I made some errors in plotting data points onto a graph with multiple axes," said Liburdy. "Occasionally I erased errors and replotted data. It is appalling to try to attach some other significance to this normal behavior."

Liburdy and the ORI analysis do agree that parts of the curves are not based on actual measurements, but disagree over what this means. The curves show a series of small jagged spikes, with peaks and valleys at intervals of 2-3 seconds—although the data points sampled by Liburdy are on average over 30 seconds apart. This "noise" was hand-drawn by Liburdy.

ORI's analysis says simply that, "Dr. Liburdy falsified the fluctuations in the traces shown in Figure 12," and stresses that the actual "noise" in Liburdy's full data set is much larger.

The 1995 LBL investigation also looked at this issue, concluding, "Liburdy's fabrication of the data noise is not a case of merely processing the results for better readability, but is at the level of tampering with the results in order to mislead the reader."

Liburdy maintains that the size of the fluctuations he drew was based on the observed level of noise. He said that one of the experts whom he had asked to review his data, Dr. Carl Blackman of the EPA, said that while Liburdy should have graphed the individual data points, his "line wiggles" do in fact match the extent of the scatter that Liburdy observed.

Liburdy's overriding defense is that his conclusions are supported not only by Figure 12, but also by a second assay, using calcium-45. "This calcium-45 data has not been challenged and it fully supports my scientific conclusions," he said.

The LBL investigation found that there had been no misconduct after it examined one of the calcium-45 graphs in Liburdy's 1992 paper in *FEBS Letters*. "We generally agree with his average values," LBL concluded. The ORI report does not challenge any of Liburdy's calcium-45 work.

NIEHS EMF RAPID Report to Congress *(continued from p.1)*

The NIEHS report was greeted with widespread approval as an evenhanded summary of the existing state of knowledge. "It's a good report," said Dr. Maria Feychting of the Karolinska Institute in Stockholm, Sweden. Dr. Antonio Sastre of the Midwest Research Institute in Kansas City, MO, called it "fair and balanced." Both Feychting and Sastre were on the 30-member working group assembled by the NIEHS last summer to review the EMF literature, which concluded that extremely low frequency (ELF) EMFs should be classified as "possible human carcinogens" (see *MWN,* J/A98).

The Environmental Protection Agency (EPA) reached a conclusion similar to that of the working group in 1990 (see *MWN,* M/J90). But Dr. Robert McGaughy, who drafted the EPA analysis, said "I would not have used the word 'weak'." He told *Microwave News* that, "I would have emphasized the consistency of the epidemiology, as is pointed out in the report."

On the other hand, the National Electrical Manufacturers Association (NEMA), based in Rosslyn, VA, questioned why EMFs should be regarded as possible carcinogens based only on limited epidemiological evidence.

How To Order the NIEHS Report

A copy of the NIEHS report, *Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields* (Publication No.99-4493), is available on the Internet at: <www.niehs.nih.gov/emfrapid>. Printed copies are available from: EMF RAPID Program, NIEHS, PO Box 12233, Research Triangle Park, NC 27709, (919) 541-7534, Fax: (919) 541-0144, E-mail: <emf-rapid@niehs.nih.gov>.

The NIEHS report comes at the end of the RAPID six-year research program mandated by Congress in 1992 (see *MWN,* S/O 92). The institute received $30 million from the federal government and industry for RAPID health research and public education. The institute also contributed approximately $14 million of its own funds for EMF research. RAPID had originally been designed to be a $65 million program.

Some observers were pleasantly surprised by the report's conclusions. Last December, a group of institute staffers circulated a draft summary of federally funded EMF research, which dismissed the possibility of EMF health risks. This was seen as an indication of what would be in Olden's report to Congress (see *MWN,* J/F99). Shirley Linde, the chair of the National EMF Advisory Committee set up by Congress to monitor the RAPID program, said that she was "pleased, surprised and even amazed" by Olden's report. Linde lives in Los Angeles.

The report that was sent to Congress is seen as a compromise within the NIEHS between those who put the most emphasis on the animal studies, which have been largely negative, and those who argued that the human studies cannot be discounted.

The evidence linking EMFs to childhood leukemia and occupational chronic lymphocytic leukemia "cannot be dismissed as random," said Dr. Christopher Portier, the associate director of NIEHS' Environmental Toxicology Program and the principal author of the NIEHS report. (See also p.11.)

The report's endorsement of a national policy of prudent avoidance also received broad support. "The call for prudent avoidance without excessive regulation is appropriate," Dr. David Carpenter of the State University of New York's School of Public Health in Albany told *Microwave News.* Carpenter was the director of the New York Power Line Project in the 1980s.

"It's good customer relations," commented Robert McCourt, the EMF issue manager at Public Service Electric and Gas Co. in Newark, NJ. McCourt added, however, that prudent avoidance is sometimes "hard to define" and that is why the utility "does not formally embrace it."

"The more sophisticated utilities have been practicing prudent avoidance for many years—since 1989, shortly after the OTA report was released," said Thomas Watson of Watson & Renner, a Washington law firm. Watson represents the Utility Health Sciences Group, which includes over 100 companies in the U.S., Australia, Canada and the U.K.

The NIEHS report specifically encourages "manufacturers of household and office appliances to consider alternatives that reduce magnetic fields at a minimal cost." NEMA's Douglas Bannerman told *Microwave News* that, "We are examining what that means for our products."

With the end of the RAPID program and the shutdown of the Department of Energy's EMF research program, the federal government, including the NIEHS, will no longer set aside any money specifically for EMF research.

The NIEHS stated, however, that it "will continue to support research in this area" through "carefully designed, hypothesis-driven studies." It cited a number of specific areas that warrant attention, including possible EMF links to cardiovascular and neurodegenerative diseases, as well as studies, first performed by Dr. Robert Liburdy (see also p.1), showing that EMFs can offset the beneficial effects of melatonin and tamoxifen.

In addition, the NIEHS concluded that, "More remains to be learned about the physics of magnetic field interactions with biological systems."

EMF researchers were disappointed that directed research will not continue. "Because we do not understand the basic mechanisms of interaction, it is very difficult to make any type of judgment on risk," Dr. Mats-Olof Mattsson of Sweden's Örebro University told *Microwave News*. Mattson, president-elect of BEMS (see p.17), said that he would have liked to have seen "money specifically targeted for hypothesis-driven EMF research."

The only remaining directed research effort is that of the electric utility industry, through EPRI, which is based in Palo Alto, CA. Dr. Leeka Kheifets, the manager of EPRI's EMF program, declined to comment on the NIEHS report.

One more report on the RAPID program is required by Congress. The Interagency Advisory Committee will issue its evaluation of the NIEHS report. Dr. Michael Marron of the Office of Naval Research in Arlington, VA, said that he is planning to have a draft of the committee's report completed by early September and to release the full report by the end of the year.

Last spring, the National Academy of Sciences issued a critical report on the RAPID program which argued that there is no need for a new EMF health effects program (see *MWN,* M/J99).

Excerpts from the Report

"The lack of connection between the human data and the experimental data (animal and mechanistic) severely complicates the interpretation of these results. The human data are in the 'right' species, are tied to 'real life' exposures and show some consistency that is difficult to ignore. This assessment is tempered by the observation that given the weak magnitude of these increased risks, some other factor or common source of error could explain these findings. However, no consistent explanation other than exposure to ELF–EMF has been identified...."

"The NIEHS concludes that ELF–EMF exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF–EMF, passive regulatory action is warranted...."

NIEHS: Recommended Actions

- The power industry should continue the practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards.
- U.S. electric utility companies should continue the practice of measuring EMFs in their customers' homes and of helping them identify sources of high fields.
- Manufacturers of household and office appliances should consider alternatives that reduce magnetic fields at a minimal cost.
- NIOSH and OSHA should evaluate whether EMF exposure standards for workers are adequate.

NIEHS' Dr. Christopher Portier Talks with Microwave News

In July, Microwave News *chatted with NIEHS' Dr. Christopher Portier, the principal author of the RAPID report to Congress.*

MWN: The NIEHS report concludes that there is only weak evidence of an EMF health risk. Can you put EMFs in the context of other environmental health risks?

CP: There is widespread public exposure to ELF EMFs, which is also true of dioxins and fine particulate air pollutants. But the strength of evidence for a hazard from ELF EMFs is much weaker than that for dioxin, where there is both animal and human evidence. It is similar to that for Atrazine, the most widely used herbicide in the U.S. and the world, for which there is only limited evidence for carcinogenicity in humans and an ongoing controversy over the interpretation of the animal data.

MWN: The Mary McBride childhood leukemia epidemiological study, showing no EMF–cancer link, was published on May 1, as the NIEHS was completing its report. Did it influence your final conclusions?

CP: We made some changes after the release of the McBride study. Initially, we were going to weaken our conclusions because of her 48-hour exposure results. But then we asked McBride for the unpublished analysis of her 24-hour data and we saw that her results were not inconsistent with previous findings. The 24-hour data show nonsignificant adjusted odds ratios of 1.18 in the 75th to 90th percentile exposure group and 1.27 in the top 10% exposure group. So we decided to leave our overall conclusions intact.

MWN: And then on the same day that your report was released, Canada's Dr. Lois Green announced that she had found the highest EMF–leukemia risks ever reported. For children who were less than six years old, the odds ratio was 5.7. Were you surprised by her results?

CP: No. Dr. Green had kindly given me a copy of her results a week before the release of our report. They were interesting, but she used a unique way of looking at the data which does not allow direct comparison with previous studies. The analysis of all the children was not remarkably different from what has been reported in the past for 24-hour field measurements, but was very different from what McBride saw with 48-hour measurements. Basically, besides the one analysis for the under six-year-old group, this study was consistent with the associations we have been seeing. I hope this analysis for young children will be repeated by the authors of the other childhood leukemia studies.

MWN: You have said that the association between EMF exposure and childhood and occupational leukemias "cannot be dismissed as random." What kind of data would it take to convince you otherwise?

CP: At the least, it would take a better understanding of the risk factors for these leukemias—especially those which might have misled us into concluding that EMFs can lead to leukemia. In other words, we would need to find specific confounders in the existing studies that could explain away the link to EMFs. But I should add that many people have looked for such missing confounders and have failed. A new study that is similar to existing ones would be unlikely to alter the current view.

MWN: On the other hand, which would do more to convince you that there is definitely an EMF cancer risk: stronger epidemiological evidence or confirmation from animal studies?

CP: Clearly, confirmation from animal studies would carry the greater weight. These studies would be free of many of the problems that have clouded the epidemiological studies. With an animal model, we could plan in-depth, mechanistic studies on the role ELF EMFs may be playing in the development of disease.

MWN: In the cover letter to his report, Dr. Olden makes the point that the human data "are tied to 'real-world' exposures." Is it possible that the reason many of the human and animal studies have been inconsistent is that the electromagnetic environment in the real world is more complex than simple 60 Hz EMFs?

CP: This is always a possibility. The debate over whether to use real-world or simpler laboratory exposures has raged for many years on both chemical and physical environmental agents. The very few studies that have used real-world or mixed-field ELF EMF exposures have had similar contradictory results. If I had to choose a reason for the discrepancy, this would not be my choice.

MWN: What would be your top pick?

CP: There is no single top pick. There are two possibilities. The epidemiology is wrong or, alternatively, the laboratory data are wrong. If I had to choose one reason why the epidemiology data might be wrong, it is that we do not yet understand leukemia very well. As for the animal data, the inconsistencies may be due to genetic variations in strains and/or species. There are of course other possibilities.

MWN: As you know, there is a near infinite variety of EMFs in the real world. Could the epi findings be due to particular types of EMFs, such as high frequency transients "contaminating" power line fields in the real world, but to which experimental animals are not exposed?

CP: I do not have any data to support such a contention. It is true, however, that there are many examples of confounders misleading the epidemiology. For instance, aflatoxin appears to be a powerful liver carcinogen, but when you take into account the action of hepatitis-B virus, the aflatoxin effect gets much weaker. Also, in animal studies the type of species exposed can determine the result you see. Take arsenic for example: We knew for a long time that it is a human carcinogen, but all the animal studies were negative. Then someone tried a transgenic strain of mice and confirmed that arsenic is also an animal carcinogen. Later, another team saw the cancer effects in a second mouse strain.

MWN: Another aspect of high frequency transients is that the amount of EMF delivered varies over time, with some intermittent high levels.

CP: This could conceivably be a problem. One of the major flaws with the way we do toxicological testing is that we usually use continuous, lifetime exposures and seldom study peaks or other types of doses.

MWN: The report points to two potentially important noncancer EMF health areas: Alzheimer's and heart disease. Which of these (or any others) would you most like to see addressed in future studies?

CP: My choice would be Alzheimer's disease. While the theoretical basis for a possible link to heart disease is a bit more solid, a better understanding of Alzheimer's is a priority for the NIH and we could learn a lot by simply adding on to existing studies.

MWN: Most of the attention has been on general public exposures to EMFs. Do you think there should be more concern over occupational exposures, which are usually higher?

CP: The focus of the NIEHS is on general environmental exposures and our concern is for the general public. While occupational exposures were of interest in our analysis since they can provide dose-response data, this question is better answered by the experts at NIOSH.

MWN: The RAPID program is now over and there are no funds set aside for EMF research. The NIEHS states in its report that the institute "will continue to support research in this area" but it is also clear that this field will have to compete with all other environmental agents for a piece of the research pie. Wouldn't it be wise to earmark some money for EMF research so that we do not lose the expertise we have developed over the last six years on an agent to which we are *all* exposed?

CP: Most scientists are in favor of more money for research in every field; this one is no different. The NIEHS has no special program for UV radiation, dioxins, arsenic, fine particulates, low-level ozone and many other environmental agents with similar widespread exposure.

New Canadian Epi Study Points To Risk Among Young Children

Young children's exposures to power frequency EMFs are associated with significantly elevated risks of leukemia in a new study from Canada. The increases are the largest to date for magnetic fields and childhood cancer, using personal measurements. There was no increased risk based on wire codes.

"As exposure assessment is refined, the possible role of magnetic fields in the etiology of childhood leukemia becomes more evident," concludes Dr. Lois Green of the University of Toronto, writing in the June issue of *Cancer Causes and Control (10,* pp. 233-243, 1999). Ontario Hydro funded the study.

Led by Green, a team at the university and at the Hospital for Sick Children in Toronto had 88 children with cancer and 133 controls wear Positron meters for two days to monitor their EMF exposures. The leukemia risk of children in the highest exposure group was 4.5 times higher, after adjusting for possible confounders, than that of children in the least-exposed group—a statistically significant difference.

One of the study's most striking findings was the difference in risk between younger and older children. For children less than six years old at the time of diagnosis and with average exposures over 1.4 mG, the risk was 5.7 times higher than for those with exposures of less than 0.3 mG, a statistically significant difference. The corresponding risk ratio among older children was a nonsignificant 1.6.

Green and coworkers suggest that the greater risk in younger children may reflect a greater susceptibility to EMFs. But they also note that younger children in the study had spent more of their lives in one residence than had older children. As a result, they write, measurements for younger children may be "a better representation of the exposure received during the relevant etiologic time period."

For 201 children with cancer and 406 controls, the team estimated current and past residential EMF levels with spot measurements. In a second paper, which appears in the *International Journal of Cancer (82,* pp.161-170, 1999), they report finding a nonsignificant, 50% risk increase for the most-exposed of these children, compared to the least-exposed.

The team found no increase in risk associated with proximity to high-current wiring as identified by each of three methods: the Wertheimer-Leeper codes, the Savitz-Kaune codes and a modified version of the Wertheimer-Leeper scheme. "We know from our study that wire code is not a good estimator of exposure," Green told *Microwave News.*

The new study follows the release, last spring, of a similar study of EMFs and childhood cancer in other parts of Canada, which found little or no evidence of increased risk (see *MWN,* M/J99). In an interview, Mary McBride of the British Columbia Cancer Agency in Vancouver, the study's leader, said she was "a little surprised" by the new findings.

As a possible explanation for the two studies' divergent results, McBride noted that her group identified cases as they were diagnosed, while the Toronto team drew on cases reported to the children's cancer registry of the Hospital for Sick Children from 1985 through 1993, and was prospective only for the last two years of this period. As a result, the average time between diagnosis and exposure assessment was nearly two years shorter for the 399 children with cancer and 399 controls in the McBride study.

Green and coworkers assigned the cases and controls to four exposure groups, drawing the cutpoints between exposure levels so that the controls were divided into quartiles. The lowest exposure group comprised children with personal readings of less than 0.3 mG, and the highest had exposures of 1.4 mG and above.

Green maintains that the cutpoints used in previous studies result in smaller high exposure groups, which are more prone to error: "The potential for exposure misclassification is greatest at the highest levels," she noted.

Long Delayed, NCRP ELF Report Due at the End of the Year

The National Council on Radiation Protection and Measurements (NCRP) will release a draft of its long-awaited report on the potential health effects of extremely low frequency (ELF) EMFs by the end of the year, according to Dr. Charles Meinhold, the president of the council. The report was submitted for review to the council in June 1995 and the NCRP has had little to say about its status since then.

"We are making rapid progress in resolving the review process," Meinhold said in a talk at the annual meeting of the Bioelectromagnetics Society in Long Beach, CA, on June 22. He explained that the sticking point was "how to handle the recommendations in the report."

The committee that wrote the report endorsed a 2 mG exposure limit, which would take immediate effect for new day care centers, schools and playgrounds, as well as new transmission lines near existing housing (see *MWN,* J/A95). For existing electrical facilities, the committee recommended that restrictions be phased in over time.

The NCRP never released the committee's draft, which was completed in 1995. A copy was obtained by *Microwave News,* which published its conclusions (see *MWN,* J/A95). The committee's recommendations were widely reported by the popular media.

This July, the committee was still working on its revised draft. "We agreed that we would not discuss recommendations until the report is completed," the chair of the committee, Dr. Ross Adey told *Microwave News*. Adey, who is now at the University of California, Riverside, said that his committee would consider the most recent published papers in its latest revision.

Dr. Thomas Tenforde of the Battelle Pacific Northwest Labs in Richland, WA, who is an NCRP scientific vice president on non-ionizing radiation, explained in an interview that an initial review of the draft by 25 experts was completed in 1995. Adey noted that the panel had incorporated the suggestions from these reviewers in subsequent drafts.

The Environmental Protection Agency first requested the ELF report from the council 16 years ago (see *MWN,* N/D83).

U.S. Government Group Identifies 14 Issues To Be Addressed in Revision of ANSI/IEEE RF/MW Exposure Standard

On June 17, 1999, Dr. Gregory Lotz of the National Institute for Occupational Safety and Health (NIOSH) wrote to Richard Tell, the chair of the Institute of Electrical and Electronics Engineers' (IEEE) SCC-28 Subcommittee 4 Risk Assessment Work Group, to identify "certain issues that we believe need to be addressed to provide a strong and credible rationale to support RF exposure guidelines." Lotz, the chief of the Physical Agents Effects Branch at NIOSH in Cincinnati, was writing on behalf of the federal government's Radiofrequency Interagency Work Group (RFIAWG).

SCC-28 is developing a complete revision of the C95.1 exposure standard, which was approved by the IEEE in 1991 and by the American National Standards Institute (ANSI) in 1992 (see MWN, *N/D91 and N/D92). The guidelines were updated earlier this year (see* MWN, *M/J99). Tell's working group has been asked to "assess and characterize the potential risks to human health and safety" from exposure to EMFs of less than 300 GHz. Tell is a consultant based in Las Vegas.*

In addition to Lotz, the other members of the RFIAWG are: Dr. Robert Cleveland, Federal Communications Commission, Washington; Robert Curtis, Occupational Safety and Health Administration, Salt Lake City; Dr. Joseph Elder, Environmental Protection Agency (EPA), Research Triangle Park, NC; Janet Healer, National Telecommunication and Information Administration, Washington; Norbert Hankin, EPA, Washington; Dr. Russell Owen, Food and Drug Administration, Rockville, MD. Lotz noted that, "No particular priority is ascribed to the order in which the issues are listed" and that, "The views expressed...are those of the members of the RFIAWG and do not represent the official policy or position of the respective agencies."

Reprinted below are extended excerpts of the RFIAWG's RF Guidelines Statement.

Biological Basis for Local SAR Limit

The C95.1 partial body (local) exposure limits are based on an assumed ratio of peak to whole body SAR; that is, they are dosimetrically, rather than biologically based. Instead of applying a dosimetric factor to the whole body SAR to obtain the local limits, an effort should be made to base local SAR limits on the differential sensitivity of tissues to electric fields and temperature increases. For example, it seems intuitive that the local limits for the brain and bone marrow should be lower than those for muscle, fat and fascia; this is not the case with the current limits which implicitly assume that all tissues are equally sensitive (except for eye and testicle)....

Selection of an Adverse Effect Level

Should the thermal basis for exposure limits be reconsidered, or can the basis for an unacceptable/adverse effect still be defined in the same manner used for the 1991 IEEE guidelines? Since the adverse effect level for the 1991 guidelines was based on acute exposures, does the same approach apply for effects caused by chronic exposure to RF radiation, including exposures having a range of carrier frequencies, modulation characteristics, peak intensities, exposure duration, etc., that does not elevate tissue temperature on a macroscopic scale?...

Acute and Chronic Exposures

There is a need to discuss and differentiate the criteria for guidelines for acute and chronic exposure conditions. The past approach of basing the exposure limits on acute effects data with an extrapolation to unlimited chronic exposure durations is problematic. There is an extensive data base on acute effects....For lower level ("nonthermal"), chronic exposures, the effects of concern may be very different from those for acute exposure (e.g., epigenetic effects, tumor development, neurologic symptoms)....If the chronic exposure data are not helpful in determining a recommended exposure level, then a separate rationale for extrapolating the results of acute exposure data may be needed....[A] clear rationale needs to be developed to support the exposure guideline for chronic as well as acute exposure.

One-Tier vs. Two-Tier Guidelines

A one-tier guideline must incorporate all exposure conditions and subject possibilities (e.g., acute or chronic exposure, healthy workers, chronically ill members of the general public, etc.). A two-tier guideline, as now exists, has the potential to provide higher limits for a specific, defined population (e.g., healthy workers) and exposure conditions subject to controls, while providing a second limit that addresses greater uncertainties in the data available (about chronic exposure effects, about variations in the health of the subject population, etc.)....

Controlled vs. Uncontrolled (Applicability of 2 IEEE Exposure Tiers)

The current "controlled" and "uncontrolled" definitions are problematic, at least in the civilian sector, particularly since there are no procedures defined in the document to implement the "controlled" condition. The new guidelines should offer direction for the range of controls to be implemented and the training required for those who knowingly will be exposed (e.g., workers), along the lines of the existing ANSI laser safety standards.... [I]f it is determined that certain populations (due to their health status or age) are more susceptible to RF exposures, then a multitiered standard, applicable only to those specific populations, may be considered....

Uncertainty Factors

The uncertainties in the data used to develop the guideline should be addressed. An accepted practice in establishing human exposure levels for agents that produce undesirable effects is the application of factors representing each area of uncertainty inherent in the available data that was used to identify the unacceptable effect level. Standard areas of uncertainty used in deriving acceptable human dose for agents that may produce adverse (but noncancer) effects include: 1) extrapolation of acute effects data to chronic exposure conditions; 2) uncertainty in extrapolating animal data to humans in prolonged exposure situations; 3) variation in the susceptibility (response/sensitivity) among individuals; 4) incomplete data bases; 5) uncertainty in the selection of the effects basis, inability of any single study to adequately address all possible adverse outcomes. If guidelines are intended to address nonthermal chronic exposures to intensity modulated RF radiation, then how could uncertainty factors be used; how would this use differ from the historical use of uncertainty factors in establishing RF radiation guidelines to limit exposure to acute or sub-chronic RF radiation to prevent heat-related effects? There is a need to provide a clear rationale for the use of uncertainty factors.

Pulsed (Intensity) or Frequency-Modulated RF Radiation

Studies continue to be published describing biological responses to nonthermal ELF-modulated and pulse-modulated RF radiation exposures that are not produced by CW (unmodulated) RF radiation. These studies have resulted in concern that exposure guidelines based on thermal effects, and using information and concepts (time-averaged dosimetry, uncertainty factors) that mask any differences between intensity-modulated RF radiation exposure and CW exposure, do not directly address public exposures, and therefore may not adequately protect the public. The parameter used to describe dose/dose rate and used as the basis for exposure limits is time-averaged SAR; time-averaging erases the unique characteristics of an intensity-modulated RF radiation that may be responsible for producing an effect. Are the results of research reporting biological effects caused by intensity-modulated, but not CW exposure to RF radiation sufficient to influence the development of RF exposure guidelines? If so, then how could this information be used in developing those guidelines?...

Time Averaging

Time averaging of exposures is essential in dealing with variable or intermittent exposure, e.g., that arising from being in a fixed location of a rotating antenna, or from moving through a fixed RF field. The 0.1 h approach

historically used should be reassessed, but may serve this purpose adequately. Time averaging for other features of RF exposure is not necessarily desirable, however, and should be reevaluated specifically as it deals with modulation of the signal, contact and induced current limits, and prolonged, or chronic exposure....If prolonged and chronic exposures are considered to be important, then there should be a reconsideration of the time-averaging practices that are incorporated into existing exposure guidelines and used primarily to control exposure and energy deposition rates in acute/subchronic exposure situations.

Lack of Peak (or Ceiling) Limits for Induced and Contact Current

A recent change in the IEEE guidelines allows for 6-minute, rather than 1-second, time-weighted-averaging for induced current limits. This change increases the concern about the lack of a peak limit for induced and contact currents....

Criteria for Preventing Hazards Caused by Transient Discharges

The existing IEEE recommendation states that there were insufficient data to establish measurable criteria to prevent RF hazards caused by transient discharges. If specific quantitative criteria are still not available, can qualitative requirements be included in the standard to control this hazard (e.g., metal objects will be sufficiently insulated and/or grounded, and/or persons will utilize sufficient insulating protection, such as gloves, to prevent undesirable transient discharge)?

Limits for Exposure at Microwave Frequencies

Concerns have been expressed over the relaxation of limits for continuous exposures at microwave frequencies above 1500 MHz. The rationale provided in the current guideline references the fact that penetration depths at frequencies above 30 GHz are similar to those at visible and near infrared wavelengths and that the literature for skin burn thresholds for optical radiation "is expected to be applicable." The rationale then implies that the MPE limits at these high frequencies are consistent with the MPE limits specified in ANSI Z136.1-1986 for 300 GHz exposures. This is apparently the rationale for "ramping up" to the MPE limits for continuous exposure of 10 mW/cm^2 at frequencies above 3 GHz (controlled) or 15 GHz (uncontrolled). The rationale should be given as to why this ramp function has been established at relatively low microwave frequencies (i.e., 1500 MHz and above), rather than being implemented at higher frequencies that are truly quasi-optical....

Replication/Validation

Published peer-reviewed studies that have been independently replicated/validated should be used to establish the adverse effects level from which exposure guidelines are derived. The definition of "replicated/validated" should not be so restrictive to disallow the use of a set of reports that are scientifically valid but are not an exact replication/validation of specific experimental procedures and results. Peer-reviewed, published studies that may not be considered to be replicated/validated, but are well done and show potentially important health impacts provide important information...

Important Health Effects Literature Areas

Documentation should be provided that the literature review process included a comprehensive review of the following three areas: 1) long-term, low-level exposure studies...; 2) neurological/behavioral effects...; 3) micronucleus assay studies (because of their relevance to carcinogenesis).

Compatibility of RFR Guidelines

Compatibility of national and international RFR guidelines remains a concern. It is important for the IEEE Committee to address this issue by identifying and discussing similarities and differences in a revised IEEE guideline and other RFR guidelines....

Hot New Papers

Jolanta Kliukiene, Tore Tynes, Jan Martinsen, Karl Blaasaas and Aage Andersen, "Incidence of Breast Cancer in a Norwegian Cohort of Women with Potential Workplace Exposure to 50 Hz Magnetic Fields," ***American Journal of Industrial Medicine, 36,*** **pp.147-154, July 1999.**

"The main finding in our study is the increased risk shown for breast cancer among women potentially exposed to EMFs at the workplace, and also after adjustment for age at first birth....The present large population-based study, which does not contain selection or information bias, gives some support to the hypothesis that exposure to 50 Hz magnetic fields may increase the risk of breast cancer. However, since we had no direct information on exposures, the results should be interpreted with caution."

Torbjörn Åkerstedt, Bengt Arnetz, Gianluca Ficca, Lars-Erik Paulsson and Anders Kallner, "A 50 Hz Magnetic Field Impairs Sleep," ***Journal of Sleep Research, 8,*** **pp.77-81, March 1999.**

"Clearly, sleep was affected by the low frequency [1 ∝T (10 mG)] EMF. The reductions of [total sleep time] and sleep efficiency suggest a slight disturbance....Considering that the present experiment is the first of its kind and that the issue of EMF effects is sensitive, one needs to carefully consider possible confounders....We feel confident in concluding that the effects must have been caused by the EMF influences on the sleep process. It should be emphasized that, even if significant effects were observed, the absolute levels are still within the range of normal sleep values, and far from clinical significance. Conversely, the present study used healthy subjects, only one night of exposure and rather moderate intensity. However, patient groups might be more sensitive and it is conceivable that increased intensity of the field or of duration of exposure might yield larger effects. This remains to be demonstrated."

Charles Graham and Mary Cook, "Human Sleep in 60 Hz Magnetic Fields," ***Bioelectromagnetics, 20,*** **pp.277-283, 1999.**

"Human volunteers exposed during night sleep to an intermittent, circularly polarized magnetic field (60 Hz, 28.3 ∝T [283 mG]) exhibited statistically significant alterations in traditional EEG sleep parameters (less total sleep time, reduced sleep efficiency, increased time in Stage II sleep and decreased REM sleep). Volunteers in the intermittent exposure group also reported sleeping less well and feeling less rested in the morning. These effects were not found in the group continuously exposed to the same magnetic field or in the sham exposure control group....Little is known about possible biological mechanisms that could provide the necessary link between exposure to ELF fields and sleep regulatory systems in the brain. A biophysically plausible hypothesis is that the electric field induced in the brain by the 60 Hz magnetic field is able to modulate the activity of cortical neurons....In other words, exposure to a 60 Hz magnetic field at the flux density used in the present study could induce a unique electric field 'signal' in the brain, one not easily confused with the endogenous fields....A second possible mechanism can be derived from the 'melatonin hypothesis' developed by [Dr. Richard] Stevens." (See also *MWN,* N/D97.)

Paul Héroux, "The ELF Health Effects Olympics" (invited editorial), ***Annals of Occupational Hygiene, 43,*** **pp.217-219, 1999.**

"I was working in a power utility research facility in 1972 when our managers returned from the CIGRÉ [International Conference on Large High Voltage Electric Systems] in London, where the Soviets had first reported neurological disturbances in workers exposed to high-intensity electric fields. Statements were made that these reports were an attempt by the Soviets to slow the development of Western technol-

EMF Bioassays: No Effects

Gary Boorman, David McCormick et al., "Chronic Toxicity/Oncogenicity Evaluation of 60 Hz (Power Frequency) Magnetic Fields in F344/N Rats," ***Toxicologic Pathology, 27,*** **pp.267-278, May-June 1999.**

"Long-term animal studies are expensive, time-consuming and may be relatively insensitive as a mechanism to identify weak carcinogens. However, when considered together, long-term exposure of rodents to power frequency magnetic fields that are 5,000- to 10,000-fold (the present study), 10,000- to 20,000-fold [Mandeville et al., 1997] and 50,000- to 100,000-fold [Yasui et al., 1997] higher than field levels that are routinely encountered in residential environments has demonstrated no pattern of increased cancer risk. These data, when considered as a whole, provide little or no evidence that exposure to pure 60 Hz linear magnetic fields at up to 10 G field intensities for up to 2 yr can affect neoplastic development in the F344/N rat."

David McCormick, Gary Boorman et al., "Chronic Toxicity/Oncogenicity Evaluation of 60 Hz (Power Frequency) Magnetic Fields in B6C3F$_1$ Mice," ***Toxicologic Pathology, 27,*** **pp.279-285, May-June 1999.**

"The results of this study provide no evidence of increased cancer incidence in male and female B6C3F$_1$ mice exposed (for 2 yr) continuously to pure, linearly polarized 60 Hz magnetic field strengths of 20 mG, 2 G or 10 G, or intermittently to the same 10 G fields. The mouse results are similar to the results of our parallel study in rats [see above], to the results of a Canadian study in which female rats were exposed to 60 Hz magnetic fields at up to 20 G [Mandeville et al., 1997] and to results of a Japanese study in which rats were exposed to 50 Hz magnetic field intensities of up to 50 G [Yasui et al., 1997]. When considered together, these long-term animal studies provide no evidence to support the hypothesis that magnetic field exposure is a significant risk factor for human cancer."

For more on the Mandeville and Yasui studies, see MWN, *J/F98. For more on the two two-year bioassays, see* MWN, *M/A98.*

ogy!...When the Soviet reports appeared, electrical engineers rapidly polarized into two groups: skeptics and believers....It was amazing how early the lines were drawn and how unyielding both sides remained."

Martha Linet et al., "Cancer Surveillance Series: Recent Trends in Childhood Cancer Incidence and Mortality in the United States," ***Journal of the National Cancer Institute, 91,*** **pp.1,051-1,058, June 16, 1999.**

"In summary, there were no consistent large increases or decreases in incidence for the major categories of cancer among children aged 0-14 years during 1975 through 1995, based on data from the nine long-standing registries in the SEER [Surveillance, Epidemiology and End Results] program. The modest increases for childhood CNS cancers, leukemias and infant neuroblastomas were confined to short intervals in the mid-1980s. This pattern suggests that the increase likely reflected reporting or diagnostic changes rather than effects of environmental influences. The short-term jump in CNS tumors in the geographic areas covered by the SEER program registries has been ascribed to preceding developments in diagnostic technology, new neurosurgical procedures and classification changes. However, it is not apparent what specific diagnostic, reporting or classification changes account for the abrupt jump from 1983 to 1984 in leukemia rates or the increase during the mid-1980s for adrenal neuroblastomas."

Werner Irnich and Rolf Tobisch, "Mobile Phones in Hospitals," ***Biomedical Instrumentation and Technology,*** **pp.28-34, January-February 1999.**

"Four devices (two apnea monitors, two respirators) of 224 investigated devices proved to experience interference caused by mobile phones at distances of more than 1 m....Although the walkie-talkie proved to cause the most interference at distances more than 10 m, dangerous situations are normally rare because its use is restricted to short times.... Walkie-talkies in hospitals and in emergency situations should be handled with care, because they are more powerful than hand-held phones. A safety distance from life-saving or life-supporting devices of 1.5 m is sufficient." (See also Irnich and Tobisch's book, *Mobilfunk im Krankenhaus: Einfluß von Mobiltelefonen auf Lebensrettende und Lebenserhaltende Medizintechnik* (Mobile Communications in the Hospital: Influence of Mobile Phones on Life-Saving and Life-Support Medical Technology) Berlin: Schiele und Schön, 1999. Drs. Irnich and Tobisch are with the Institute for Medical Technology at the University of Gießen in Germany.)

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• Researchers at the University of Washington report on a five-year study led by Dr. Bill Guy, in which rats exposed to pulsed 2450 MHz radiation at a maximum specific absorption rate (SAR) of 0.4 W/Kg had significantly more malignant tumors than did controls—primarily in their endocrine systems. An independent assessment of the study for the U.S. Air Force calls the findings "provocative."

• For a "very substantial" sum, Stanley Burgis, a former U.S. Army radar technician, settles his suit against Western Electric, which alleged that radiation from its M-33 military radar ruined his vision.

Years 10 Ago

• A report by the congressional Office of Technology Assessment (OTA) concludes that there are "legitimate reasons for concern" about EMF exposures as a possible health hazard, and proposes that risks could be addressed with a policy of "prudent avoidance."

• In response to the OTA's report, an editorial in *Science* by Philip Abelson, the magazine's deputy editor, calls for increased support of research on health effects of EMFs.

• The Soviet Union says that high frequency radio waves beamed at its embassy in London may have caused the deaths of two Soviet citizens. The U.K. government denies the charge.

Years 5 Ago

• Implanted cardiac pacemakers are vulnerable to electromagnetic interference from mobile phones, researchers in Switzerland and in Italy report at a conference in Copenhagen.

• The EMF exposure standard adopted in 1990 by IRPA (now ICNIRP) is "unethical," says Dr. Indira Nair of Carnegie Mellon University, because it is "the truth, but not the whole truth."

• Dr. Eugene Sobel of the University of Southern California links "medium" and "high" workplace EMF exposures to an increased risk of Alzheimer's disease.

Across the Spectrum

At Motorola's strategic-issues department, director Norm Sandler requests that we all please *relax*. "At the power levels and frequencies of existing cellular phones, there is no established evidence of any biological effects, much less any health effects." [Dr. Ross] Adey [of the University of California, Riverside]: "That is simply not true. Over and over, cell phone fields have produced effects. Industry is lying and lying and lying."

—David Kirkpatrick, "Static? Or Frying Brain Cells?" *Fortune,* p.40, July 5, 1999

#9: Cell phones may be hazardous to your health.

—Michael Kaplan, "Ten Things Your Cell Phone Company Won't Tell You," *Smart Money,* p.138, July 1999

The telecommunications industry poured money into research. Results have been all over the map. Some studies have hinted there might be unhealthful effects. Others are inconclusive. Still others have found no effects....But this is all too familiar. The Beef Industry Council funds research into red meat. "Igor, look! Our experiments! They show T-bone steaks LOWER cholesterol AND make you a hunk, a hunk of burning love! The Nobel is ours!"

—Kevin Maney, "Cell Phones and Cancer: Denial Isn't Just a River in Egypt," *USA Today,* p.3B, July 14, 1999

TEENAGERS AND CELL PHONES: A MATCH MADE IN GAB HEAVEN

—Headline, *New York Times,* p.A1, August 2, 1999

During the past year, several new issues have been raised in the scientific community regarding the link between EMF and health effects. Two results in particular merit closer examination: an epidemiologic study that suggests electrical workers exposed to magnetic fields might have increased risk of acute heart disease and laboratory studies of breast cancer cells that show antagonism to the potential beneficial effects of Tamoxifen and melatonin with exposure to EMF....Plainly, these findings need to be replicated and fully understood. A strongly focused, high-quality research program, similar to EPRI's earlier EMF efforts, should be mounted to address these issues.

—Stephen Peck, vice president, environment division, EPRI, in a letter "To Our Readers" inserted in *EPRI Environment Newsletter,* May 1999

"There is no way to actually protect your children from exposure."

—Dr. Mark Greenberg, Hospital for Sick Children, Toronto, Canada, quoted by Carolyn Abraham in "Scientists Link Magnetic Fields to Leukemia," *Globe and Mail* (Canada), p.A3, June 16, 1999 (see p.12)

"As long as you don't touch the wire, it's okay."

—Ken Hall, Edison Electric Institute, quoted by Bob Pool in "Neighbors Object to Development Below Power Lines," *Los Angeles Times*, p.B5, July 29, 1999

"Get plenty of sleep, use thick blinds to block out stray light and if you need to get up in the middle of the night for any reason, don't turn on a bright light."

—Dr. Russel Reiter, University of Texas Health Science Center, San Antonio, quoted by Kathleen McAuliffe in "Researchers Shine a Night Light on a Possible Link to Cancer," *New York Times,* Special Section on Women's Health, p.22, June 13, 1999

Iridium is looking more like Icarus with each passing day.

—Christian Hill and David Hamilton, "After Lofty Hopes, Iridium Is Falling to Earth," *Wall Street Journal,* p.B1, July 15, 1999

Nancy Wertheimer: You Must Remember This

In studying environmental magnetic field exposures, the exposure assessment problems are formidable. Too often we forget this, and proceed to think of whatever metric a study chooses as if that metric were indeed an accurate reflection of the true historic exposure of interest. That confusion of intent with fact has led some to conclude that risks from magnetic field exposure, "if real, are very small." But this should be understood as a leap of faith.

We need to remember:

- First, that we don't know exactly what to measure;
- Second, that even at best our exposure assessment probably includes considerable random misassignment of exposure, which will null our estimates of any true risk that exists;
- Third, that our hypothetically "unexposed" referent group is, in fact, *always* exposed to a number of unexamined sources of magnetic field, thus further nulling evidence of real risks; and
- Fourth, that magnetic fields may well act only in conjunction with specific cofactors, as some laboratory work has suggested. If so, then only the part of the study population having those cofactors will be at risk from magnetic fields at any given time—still further nulling evidence of any real risk.

Thus in interpreting epidemiologic studies we must stay aware that, while associations based on systematic bias are always possible, and must be guarded against, bias toward a null result is *always* likely in *all* studies. So if the modestly elevated risk ratios that have been repeatedly reported can't be attributed to systematic bias—and so far they haven't been—they are very likely to be *underestimates* of a substantial risk.

—Dr. Nancy Wertheimer, Boulder, CO, in an address on receiving the Bioelectromagnetic Society's d'Arsonval award for "extraordinary accomplishments" at the society's 21st annual meeting, in Long Beach, CA, June 21, 1999 (the full text of her talk will be published in a future issue of *Bioelectromagnetics,* the society's bimonthly journal)

59%: Proportion of Americans who say they would rather visit a dentist than sit next to anyone using a cell phone.

—"Numbers," *Time,* p.19, August 9, 1999

The *New Yorker* can now be counted on to champion the infallibility of U.S. products such as electromagnetic radiation, breast implants and psychoactive drugs.

—Cynthia Cotts, "Press Clips: Spin the Coke Bottle," *Village Voice* (NY), p.40, July 20, 1999

"Don't lean, don't linger, don't worry."

—Dr. Douglas Zipes, Indiana University School of Medicine, Indianapolis, on EMI to implanted defibrillators, quoted by Merritt McKinney, Medical Tribune News Service, in "Anti-Theft Devices No Shock to Heart," posted on *MSNBC* (<www.msnbc.com/news>), July 26, 1999 (see *MWN,* N/D98)

MICROWAVE WEAPONS

Ready, But Still Under Wraps... In the near future, the U.S. will be ready to use high-power microwave (HPM) weapons in the field, military officials say. "There's real stuff happening, both in high-energy lasers and in microwave systems," Earl Good of the U.S. Air Force told *Aviation Week* (July 5). "We're delivering products, and there are lots of demonstrations. It's not just 'viewgraph' technology." Good is the head of the Air Force Research Laboratory's Directed Energy Directorate, which has a yearly budget of about $100 million and is based at Phillips Laboratory in New Mexico. U.S. forces were rumored to have used an electromagnetic pulse (EMP) bomb, one type of HPM weapon, in the NATO air campaign against Serbia earlier this year, according to *Jane's Defence Weekly* (April 7). But Pentagon officials told *Aviation Week* (June 7) that although the U.S. had an EMP weapon ready, it probably would not use it in the Balkan conflict because the military did not want to reveal its capabilities. When detonated, an EMP device emits an intense pulse of electromagnetic energy that can disable sensitive electronics such as computers and communications equipment. Although the weapon is designed to simulate the EMP generated by an atomic bomb, the military claims that this and other HPM devices will not cause the extensive physical damage and loss of life associated with traditional weapons. HPMs are "what this country is looking for to fill the gaps between diplomacy and blowing things up," Good said. (See also *MWN,* J/F97 and M/A98.)

PEOPLE

Dr. **Mats-Olof Mattsson** of Sweden's Örebro University is the new president-elect of the Bioelectromagnetics Society (BEMS). He takes over as president next June. Two other Swedes have also been named to the BEMS board: Dr. **Maria Feychting** of the Karolinska Institute in Stockholm and **Monica Sandström** of the National Institute for Working Life in Umeå....Dr. **William Wisecup** of W/L Associates in Frederick, MD, the executive director of BEMS and organizer of the DOE annual reviews, has announced that he will retire at the end of 2000. He plans to spend more time on photography and will continue to show Border collies and corgis....Dr. **Paul Gailey** is leaving Oak Ridge National Lab to join the physics department at Ohio University in Athens, where he will start a new interdisciplinary program in biology, mathematics and physics....Dr. **Richard Stevens**, long of Battelle Pacific Northwest Labs in Richland, WA, is now on the faculty at the University of Connecticut Health Center in Farmington, where he is teaching and doing cancer research....Dr. **Charles Rafferty** has left EPRI. He is consulting out of Menlo Park, CA....NIEHS' Dr. **Michael Galvin**, who was a member of the RAPID team, has joined NIOSH in Atlanta....Formerly a member of Dr. **Ross Adey's** lab in Loma Linda, CA, Dr. **Christopher Cain** has helped start Phytoanalytics in nearby Riverside. The company offers quality-control testing of vitamins and herbal supplements as well as assays of pesticide residues....**Katja Pokovic** of Dr. **Niels Kuster**'s lab at the ETH in Zurich, Switzerland, won the best student paper award at the BEMS meeting in June. This is two in a row for Kuster: last year (now Dr.) **Michael Burkhardt** of his lab won the prize.

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—Fortune *magazine, July 5, 1999*

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More 1999 Conferences & Courses

August 11: **Avian Mortality at Communications Towers (in conjunction with the 117th Meeting of the American Ornithologists' Union),** Statler Hotel, Ithaca, NY. Contact: Dr. Albert Manville, Office of Migratory Bird Management, U.S. Fish and Wildlife Service, 4401 N. Fairfax Dr., Arlington, VA 22301, E-mail: <Albert_Manville@fws.gov>, Web: <www.fws.gov/r9mbmo/homepg.html>.

September 13-16: **Directed Energy Weapons** (short course), Alexandria, VA. Contact: Association of Old Crows, 1000 N. Payne St., Alexandria, VA 22314, (703) 549-1600, Fax: (703) 549-2589, Web: <www.aochq.org>. (Optional final day is classified.)

September 20-22: **Safety Issues and Requirements for PCS and Wireless Communications Devices** (short course), George Washington University, Washington. Contact: P.J. Mondin, (202) 496-8449, E-mail: <pj@ceep.vpaa.gwu.edu>.

September 28-30: **Power Distribution System Grounding and Transients** (short course), Georgia Institute of Technology, Atlanta. Contact: Georgia Institute of Technology, Continuing Education, PO Box 93686, Atlanta, GA 30377, (404) 894-2400, Fax: (404) 894-8925, E-mail: <register@conted.swann.gatech.edu>, Web: <www.conted.gatech.edu>.

November 15-16: **Potential Therapeutic Applications of Magnetic Fields,** Vanderbilt University Medical Center, Nashville, TN. Contact: PTAMF 99, Symposium Secretariat, PO Box 5940, Buena Park, CA 90622, (714) 562-7530, Fax: (714) 736-7605, E-mail: <PTAMF99@ mindspring.com>.

November 19-21: **4th European Bioelectromagnetics Association Congress,** University of Zagreb, Croatia. Contact: Congress Secretariat, (385+1) 6129 606, Fax: (385+1) 6129 717, E-mail: <4thebea@fer.hr>, Web: <www.ebea.org/EBEA/generalinfo.htm>.

December 5-8: **Society for Risk Analysis (SRA) Annual Meeting,** Marriott Marquis Hotel, Atlanta. Contact: SRA, 1313 Dolley Madison Blvd., McLean, VA 22101, (703) 790-1745, Fax: (703) 790-2672, E-mail: <SRA@BurkInc.com>, Web: <www.sra.org>.

Keeping Current: Follow-Up on the News

◆ Sony announced in July that it is leaving the North American wireless handset market. Last December, Sony recalled 60,000 of its phones that violated radiation standards (see *MWN,* J/F99).

◆ A paper on personal EMF measurements taken in the Mary McBride childhood leukemia study has been delayed and is now slated to appear in the August issue of the *Scandinavian Journal of Work, Environment & Health.* The corrected McBride table we ran in our last issue has been published in the July 15 *American Journal of Epidemiology* (see p.12 and *MWN,* M/J99).

◆ TVB Pearl, a Hong Kong TV station, decided not to air a Canadian documentary on potential cell phone health risks (see *MWN,* J/F99). The *South China Morning Post* (July 7) pointed to a surge in mobile phone advertising. "We are worried the viewers will be misled because the information in the program hasn't been confirmed as accurate," a TVB spokeswoman said.

◆ Rep. George Brown (D-CA) died on July 16 at age 79. As chair of the House science committee, Brown was instrumental in allocating federal funds for research on EMF health effects, including the RAPID program (see *MWN,* J/F92). *Nature* (July 22) called Brown "science's best friend in Congress."

◆ Dr. Lennart Hardell and coworkers' paper on mobile phone use and brain cancer is now in print: *International Journal of Radiation Oncology, 15,* pp.113-116, July 1999 (see *MWN,* M/J99).

◆ The town of Brooklyn, OH, is the first in the U.S. to outlaw using a mobile phone while driving. In 1966, Brooklyn, with a current population of 11,000, was the first in the nation to require the use of seat belts (see also *MWN,* J/F98).

◆ Crossing the Rubicon into the Internet Age: In a June 10 advisory, the CTIA noted that, in an earlier statement, "due to an editorial error, Rubicon was misspelled as Rubicom."

◆ Construction of a digital TV broadcast tower at the antenna farm on Lookout Mountain, outside Denver, was blocked on July 13 by a 3-0 vote of the Jefferson County, CO, commissioners, after months of protest by local residents concerned about RF cancer risks (see *MWN,* J/A98 and M/A99).

◆ New Zealand's health and environment ministers have asked for public comment on a discussion document on RF/MW health effects, *Towards National Guidelines for Managing the Effects of RF Transmitters.* The deadline for submitting comments is September 30. For more information, contact Sally Gilbert at the Ministry of Health in Wellington, (64+4) 496-2000, Fax: (64+4) 496-2340.

Something Is Terribly Wrong

In June 1999, these three events happen in just three days:
• The NIEHS issues its report to Congress, which concludes that the evidence that EMFs pose a cancer risk cannot be dismissed. Though this evidence is weak, the NIEHS says, it is reason enough for prudent avoidance (see p.1).
• EMFs are linked to as much as a sixfold increase in the risk of leukemia among young children, in a new study released by the University of Toronto (see p.12).
• Dr. Robert Liburdy agrees to withdraw three graphs in seven-year-old papers on EMF effects on cellular calcium (see p.1).

Which of these stories makes page-one headlines across the country? The Liburdy affair. And what is the lesson that the *New York Times* draws from the Liburdy business? That "electric power is safe."

Liburdy's calcium experiments were not cancer studies and had only the most speculative relationship to cancer biology. When they were published in 1992, anyone who had said, "This shows that EMFs cause cancer" would have been laughed out of the room. It would have been a ridiculous thing to say, and no one ever did.

Yet now these three Liburdy graphs seem to become more powerful each time they are mentioned in the media. The Associated Press (July 23) claimed that Liburdy's calcium work "was thought to be the first plausible biological explanation" of an EMF–cancer connection. Not one cancer researcher, biologist or biophysicist was quoted in support of this assertion, perhaps because it is not true.

The AP conceded that concerns about EMFs "had been raised well before Liburdy's study," but the *New York Times* (July 24) wasted no space on such qualifications. In the *Times*' hands, Liburdy's graphs became "crucial evidence of a tie between electric power lines and cancer"—which had been "faked." Soon the Cleveland *Plain Dealer* (July 30) was writing that Liburdy "managed to scare the bejabbers out of a lot of people by spinning a yarn about electrical transmission lines causing cancer," and applauded government fraud-busters for exposing this "hoax."

The power of the Liburdy graphs continued to grow. It was in fact "Liburdy's deception" which "sparked a campaign of 'prudent avoidance'," according to Dr. Elizabeth Whelan of the pro-industry American Council on Science and Health, writing in the *Wall Street Journal* (July 27). "We now know" that the EMF issue "is a phony health risk," added Whelan. Ken Hall of the Edison Electric Institute seems to agree: "As long as you don't touch the wire, it's okay," Hall told the *Los Angeles Times* (July 29), in a story about commercial development directly beneath high-voltage power lines. The paper estimated that EMFs in the proposed development would average about 60 mG.

What's ironic is that of the three June events, only two have much to do with EMFs and cancer: the NIEHS report and the Canadian study. Yet those were precisely the two that the media ignored.

There is a serious double standard at work here. The stories on the Liburdy affair are full of false statements—which are repeated so often, without rebuttal, that they are already accepted as fact. Where are the moderating voices of public health, of epidemiologists, of consumer advocates?

We don't believe in conspiracies. But at times the influence of corporate power in both science and the media is so overwhelming that it starts to resemble one. Industries worth hundreds of billions of dollars defend their interests, and they do so in many ways.

Recently, a leading epidemiologist at a world-famous medical institution wrote to us on the Liburdy media blitz. He said, "One reason I left this field was that I saw it was virtually impossible to get decent science funded or done without interference in the face of such massive commercial interest." But we can't tell you who he is. His next sentence was, "Don't quote me."

Memo to Motorola: The Burden of Leadership

The take-home lesson of the recent WTR and BEMS meetings is that Motorola is taking control of worldwide wireless research (see p.5).

On the one hand, we want to give the company credit for developing and funding its own research plan, when it could have simply left it to WTR. Motorola money has produced scientific results.

But we must also note that Motorola can be slow to make information public and does not always tolerate the type of open exchange that normally settles scientific controversies, which are endemic in the wireless world. (Lawyers and nondisclosure agreements, for example, don't mix well with public health.)

Motorola's support of research is of course not totally altruistic. The company has bet its future on wireless technology, and funding safety research is insurance against suffering the fate of the asbestos industry. And it also buys Motorola's PR team a first look at the latest findings.

To those who complain about Motorola's dominant role, the company answers, "If we don't do this work, no one else will." Unfortunately, at this point that is often true. Public health agencies have largely dropped the ball on wireless safety.

But leadership has its responsibilities. To have credibility, the company must be more open—even with its critics.

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Europe Sets the Agenda

Switzerland Adopts Strict Limits for Cell Towers and Power Lines

10 mG Standard for New Sources of EMFs

The Swiss government has adopted stringent new standards for public exposures from power lines and from towers used for mobile communications and radio and TV broadcasting. The new rules, which took effect on February 1, are similar to those in Russia and in China and are among the toughest in the world.

Both new and existing mobile phone towers must meet a 4 $\mu W/cm^2$ standard at 900 MHz. Other sources of electromagnetic fields and radiation (EMF–EMR) are allowed considerable administrative discretion to meet their respective limits as long as specified steps are taken to reduce exposures.

The new limits are "oriented to the future," the Federal Agency for Environment, Forests and Landscape (known as BUWAL) explains in a commentary accompanying the new rules. "Our task is to protect the public not only from agents that are known to be harmful, but also from agents that might prove to be harmful," Dr. Stefan Joss told *Microwave News*. Joss is with BUWAL's non-ionizing radiation unit in Bern.

Joss explained that the rules are an application of the precautionary principle. The Swiss Environmental Protection Law, he said, "gives a clear, prag-

(continued on p.6)

U.K. Childhood Cancer Study: New Controversy Over Power Lines

Role of Pollutants and Electric Fields at Issue

When results from the U.K. Childhood Cancer Study (UKCCS) were released, the headline on the press release read, MAJOR STUDY FINDS NO LINK BETWEEN OVERHEAD POWER CABLES AND CHILDHOOD CANCER. But that soon became a point of controversy.

Scientists at the University of Bristol argue that the UKCCS shows exactly the opposite: While the study found no link between childhood leukemia and time-averaged 50 Hz magnetic fields below 4 mG, they contend that it did find evidence of a greater leukemia risk among children living near high-voltage power lines.

One table in the UKCCS paper on EMFs and childhood leukemia lists 31 cases and 17 controls who lived near power lines for which historical line-load data were available. Children with leukemia were almost twice as likely as controls to live near one of these lines — a statistically significant difference. The study was published in the December 4 issue of *The Lancet*.

(continued on p.10)

NCRP Cuts Scientific Staff: Impact on Non-Ionizing Radiation Reports Uncertain

The National Council on Radiation Protection and Measurements (NCRP) has laid off all three of its full-time staff scientists. One of the three, Dr. Tom Koval, was coordinating the work of two committees preparing reports on radiofrequency and microwave (RF/MW) exposure.

"It's too early to say what the changes might mean for our work," said Dr. Thomas Tenforde, the overall chair of the NCRP's Scientific Committee 89 (SC 89) on non-ionizing radiation (NIR). Tenforde, of Battelle Pacific Northwest Labs in Richland, WA, told *Microwave News* that most of the cuts would be directed "at the infrastructure of the NCRP, at their headquarters in Bethesda, MD."

Dr. William Beckner, the NCRP's executive director, said in an interview that the layoffs became necessary after sharp reductions in the NCRP's funding. "The main cutback was from the Nuclear Regulatory Commission," he explained. "We had a $250,000 annual grant, which has now dwindled to $50,000."

"I don't think this will have that big an effect on any of our programs," Beckner predicted. He said that the NCRP still had five part-time staff scientists, as well as a full-time postdoctoral student and a few consultants. "In essence," he said, "a full-time scientific staff is being replaced, as needed, with a part-time one." In particular, Beckner maintained, "The cutbacks should hardly affect the non-ionizing radiation work at all." Most of the NCRP's work in this area was not being done by its direct staff, he stated.

But it appears that the two RF/MW committees that Koval worked with may be left without staff support. Beckner said that these committees — SC 89-5, which is revising the NCRP's 1986 report on exposure limits for RF/MW radiation (see box), and SC 89-4, on the specific issue of modulation of RF fields — are now "unassigned" in terms of NCRP staff resources.

Koval told *Microwave News* that he has been asked to work as a consultant for two NCRP committees — on ionizing radiation. "I told them I would be willing to do that, and in fact I mentioned I'd be willing to do the same for the two non-ionizing radiation committees." Koval said, however, that there has been no response to this suggestion.

"Obviously, I would prefer to have Tom Koval around, but it was not my decision," said Dr. James Lin of the University of Illinois, Chicago, the chair of SC 89-5. "Bill Beckner and his staff will try to fill in." Lin said his committee would still be able to complete its work, though progress would probably be slower. Funding for meetings is being cut, he said, "and that may be important." Lin said that he still hopes to submit a draft report for review by the full council by the end of 2000, at which point the text would be posted on the Internet.

"I don't think they are a good move," the chair of SC 89-4, Dr. Om Gandhi of the University of Utah, Salt Lake City, said of the layoffs. "I think this is going to impact our work greatly, because Tom Koval has been very helpful in keeping our committee going," ensuring that members complete their assignments.

Gandhi said that his committee, on modulated RF/MW radiation, has done four or five drafts of its analysis, and that "We are in the final stages of what we think is the final draft." He said that the committee hopes to have it ready for NCRP review by April "at the latest." Gandhi's committee is preparing a commentary, not a full report, and Tenforde said that since NCRP commentaries are not reviewed by the full council, the text will not be available until it is final.

The RF/MW modulation report was requested by the Environmental Protection Agency (EPA) and was supposed to be completed by 1997. "Because everything the NCRP does is essentially a volunteer effort," said Norbert Hankin of the EPA in Washington, "there isn't really much a funding agency can do to influence the progress of a report."

The EPA has also provided funding for a report on extremely low frequency (ELF) field health effects. SC 89-3 began work on that report in 1983, and was scheduled to complete it by early 1993 (see *MWN,* D83 and M/J92). The ELF report's draft conclusions have been the subject of controversy (see *MWN,* J/A95) and the report has been delayed repeatedly as it has undergone extensive review. Last year, NCRP President Dr. Charles Meinhold said that it would be issued by the end of 1999 (see *MWN,*

Changes in NCRP RF/MW Panel

As the NCRP's Scientific Committee 89-5 (SC 89-5) on Biological Effects and Exposure Criteria for RF Fields gets closer to completion of a draft report, there have been some changes in its membership. "I recommended restructuring the committee based on the kinds of expertise we need at this point," committee chair Dr. James Lin told *Microwave News*.

On epidemiology, SC 89-5 has recruited Dr. Faith Davis, who, like Lin, is at the University of Illinois, Chicago. On cell biology, Dr. Elizabeth Balcer-Kubiczek, a longtime collaborator of panel member Dr. George Harrison, has agreed to serve as a consultant. Both Balcer-Kubiczek and Harrison are at the University of Maryland, Baltimore.

Leaving the committee are Drs. Robert Liburdy and Jan Stolwijk. Lin said that Liburdy, formerly of Lawrence Berkeley National Lab in California, was required to step down as a result of the agreement he signed with the federal government last May, after investigators concluded that he had falsified research results (see *MWN,* J/A99). Stolwijk, an epidemiologist, recently retired from Yale University in New Haven, CT.

Dr. Patricia Buffler, an epidemiologist at the University of California, Berkeley, will no longer be a member of the committee but will still work with it as a consultant, said Lin.

In addition to Harrison, those continuing as committee members are vice chair Dr. C.K. Chou of Motorola in Plantation, FL, Dr. Eleanor Adair of Brooks Air Force Base, TX, and Dr. Gregory Lotz of the National Institute for Occupational Safety and Health in Cincinnati. SC 89-5 was formed in 1995 (see *MWN,* S/O95).

J/A99), but, in January, Tenforde said, "It's not quite there yet." Committee members, he said, "have been making progress in redrafting chapters and answering reviewers' comments, but they aren't quite where we hoped they'd be."

Alone among the NCRP's committees on NIR, the ELF panel still has specific staff support. Dr. Constantine Maletskos, an NCRP consultant based in Gloucester, MA, said that he hoped a draft would be submitted to the full council "soon." SC 89-3 has made "some significant progress in recent months," said the EPA's Dr. Joe Elder in Research Triangle Park, NC. "I remain optimistic that the report will be completed."

A fourth NCRP report on non-ionizing radiation "has been in limbo for a while," according to Tenforde. SC 89-1, on static (DC) magnetic fields, had been chaired by Dr. Dennis Mahlum of the National Research Council in Washington, but Tenforde noted that Mahlum retired some time ago and that a new committee chair needs to be found. In 1992, the NCRP said that the static field report had been reviewed by the full council and was undergoing final editing (see *MWN,* M/J92) — but it has never been released. "It was put into the hands of Dr. Tenforde," said Beckner, "and he's not been able to get it completed."

The static field report has been "kind of on the back burner," Tenforde conceded. "It's a nice report, and wouldn't have to be updated much," he said.

Asked why so many NCRP reports have run so far behind schedule, Beckner responded, "There's no good answer to that question." He noted that much of the problem stems from the volunteer character of the NCRP's efforts.

« Wireless Notes »

Dr. **Henry Lai** has found that a single one-hour exposure to relatively low levels of microwave radiation can impair **long-term memory** in rats. The rats, exposed to pulsed microwaves with a whole-body specific absorption rate of 1.2 W/Kg, were slower than controls to learn the location of a submerged platform in a water maze. The study appears in the January issue of *Bioelectromagnetics (21,* pp.52-56, 2000). "The results indicate that the rats had trouble forming a map inside their head. In fact, the exposed rats used a different strategy to find the platform," Lai told *Microwave News* from his lab at the University of Washington, Seattle. "This is the first paper on the loss of long-term memory following microwave exposure," Lai said. "It could be a warning sign — we need to look into this further." After the university's news department issued a press release on the forthcoming paper at the end of November, Lai's results gathered a great deal of attention, including coverage by *CBS Evening News with Dan Rather* (December 2), the *New York Times* (December 14), *Scientific American* (February) and <drkoop.com> (December 6). The European press also picked up the story. The U.K.'s *Sunday Mirror* did not wait for the press release and ran an item on October 31, following a presentation by Lai at the NRPB.

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At a conference last summer, Dr. **Maria Feychting** raised questions about the methods used to identify cases and controls in Dr. **Lennart Hardell**'s epidemiological study of cell phones and brain cancer (see *MWN,* J/A99). Feychting and Dr. **Anders Ahlbom**, both of the Karolinska Institute in Stockholm, spell out their concerns in a letter that appears in the November *International Journal of Oncology (15,* p.1,045). On the one hand, Hardell reported an unusually high response rate, they write, but on the other hand, he appears to have missed hundreds of cases. In their reply, Hardell, of Sweden's Örebro Medical Center, and coworkers counter that there is nothing "unusual" about the response rate they had for their subjects. In fact, they point out that they achieved similar response rates in many of their previous case-control studies. No word about the possible missing cases.

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The **Australian Senate** has agreed to open an inquiry into the health risks from mobile phones. The review will address both health research and exposure standards. "This will also be an opportunity for the Senate to scrutinize the expenditure of the Commonwealth's Aus$4.5 million fund for research into and information on electromagnetic emissions," said Sen. Lyn Allison, the telecommunications spokesperson for the Australian Demo-

The Far Field



"Dr. Lai?...I'm supposed to be at the lab? ...Oh, I'm sorry. I completely forgot...."

Kathleen MacInnes

crats, who had pushed for the probe (see *MWN,* J/A98, S/O98 and M/J99). According to the *Sydney Morning Herald* (December 11), the Democrats want manufacturers to inform consumers of the radiation levels emitted by mobile phones.

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Rising public concern over the potential health effects of wireless technology does not seem to have had any impact on Consumers Union, the publisher of ***Consumer Reports***. The February issue of the magazine features an eight-page evaluation of the leading cellular and cordless phones — but not a word about health risks or the radiation output of different phones. Based on criteria that included voice quality, battery life and ease of use, Motorola's StarTac was judged the best analog phone and the Ericsson DF688 the best digital phone; the Sanyo CLT 937A 900 MHz DSS was found to be the best cordless phone.

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It's no secret that the use of mobile phones is exploding. This is forcing service providers to find ways of **increasing capacity** on their networks. The January 15 issue of *Wireless Review* offers the following advice: "**Downtilting antennas** is the easiest and most cost-effective way to increase capacity. A downtilted antenna essentially decreases the size of the cell. Instead of radiating the RF power horizontally, the downward adjustment increases the signal strength close to the site...."

«« »»

Dr. **Eleanor Adair** has accepted the challenge. After reading about a **German** activist group's (**Bürgerwelle**) offer of $10,000 to anyone who would be willing to be exposed to mobile phone radiation below current ICNIRP standards for ten days (see *MWN,* N/D99), Adair contacted *Microwave News* and stated that, "I am willing to [volunteer] without compensation for as long as they wish and at levels well above the ICNIRP guidelines, if they so desire." She added fearlessly that, "I am certain that such irradiation is completely benign." Adair, who is at the Armstrong Lab at Brooks Air Force Base in San Antonio, said that she will be attending this year's BEMS meeting in Munich. The ball is now in Bürgerwelle's court. Stay tuned.

FCC Wins Round on Cell Phone Testing Position

Mobile phone manufacturers yielded to the Federal Communications Commission (FCC) after a disagreement about the positions in which phones should be tested. Manufacturers at first supported a test position that would produce lower exposure readings — but after the FCC held its ground, they gave in.

The Institute of Electrical and Electronics Engineers' (IEEE) Standards Coordinating Committee 34 (SCC-34), Subcommittee 2 (SC-2), has been working to develop a protocol for measuring RF/MW exposures of users of mobile phones. Testing position is one of the subcommittee's last major decisions as it nears the end of its work. A revised draft of the protocol is due to be completed by SC-2's next meeting, in March, and it would then be submitted for IEEE approval.

At its December 7 meeting in Washington, SC-2 decided that all phones should be tested in two positions. (See also p.5.) In the first, known as the "touch position," the phone is held against the ear with the bottom of the phone touching the chin; thus, the antenna is tilted away from the brain. In the second position, the phone is still held against the ear, but the bottom is held away from the chin at a certain angle. (As the angle increases, the antenna gets closer to the skull and exposure is greater.)

Dr. Robert Cleveland of the FCC in Washington proposed that this angle be set at 15 degrees, a motion that was seconded by Dr. Om Gandhi of the University of Utah, Salt Lake City. The motion failed for lack of a quorum because many manufacturers abstained. A rival proposal to set the angle at 10 degrees was put forward by Dr. Niels Kuster of ETH in Zurich and seconded by Dr. C.K. Chou of Motorola in Plantation, FL.

But after industry representatives caucused during a lunch break, their position had changed. The Kuster-Chou motion was withdrawn; Kuster made a new motion backing the 15-degree position, which was seconded by Ron Petersen of Lucent Technologies in Murray Hill, NJ.

This time, the 15-degree position passed decisively. What made the difference? "The FCC made it pretty clear that they considered 10 degrees to be unacceptable," said a participant in the meeting, who asked not to be named, "and industry decided they could live with 15 degrees."

Mobile phone equipment manufacturers represented at the meeting also included Ericsson, Mitsubishi, Nokia, Panasonic and Sony. As in the past, several companies sent more than one representative. (For instance, six of the 36 people on the attendance list were from Motorola.) A December 1 memo advised subcommittee members that under IEEE procedures, each corporation is allowed only one vote.

"This is all resolved now — everyone is in agreement," said Chou. He said that manufacturers at first favored the 10-degree angle because "it was a harmonization issue." The European standards group CENELEC had adopted the "touch plus 10 degrees" policy at its November meeting in Palermo, Italy, Chou said, and many people wanted the two to be consistent.

Speaking to *Microwave News* from the CENELEC meeting in Dublin, Ireland, on January 20, Chou reported that the European group has now decided to follow SCC-34/SC-2 and adopt the same 15-degree test position. (Chou attended the CENELEC meeting as an IEEE observer.)

Four of the seven draft chapters of SCC-34/SC-2's "recommended practice" for exposure testing were submitted by the deadline of January 24, according to Kwok Chan of the FCC lab in Columbia, MD. "Some took a little longer because of this ear issue," said Howard Bassen of the FDA in Rockville, MD, noting that several section editors also serve on the IEEE task force on SARs in the ear.

A conference call of chapter editors to iron out remaining differences was held on February 1. Final changes are scheduled to be made at an editorial meeting February 24-25 in Ft. Lauderdale, FL, before SC-2 next meets, March 13-14.

Cell Phone Signals Do Not Affect Tumor Growth in Brains of Rats

Cellular phone signals did not affect the growth and development of brain tumors in rats, according to a study by Dr. Joseph Roti Roti at Washington University in St. Louis.

Researchers drilled a small hole in the skull of each rat and injected brain cancer cells grown in the lab. Most animals developed brain cancer soon after, but their risk was not affected by exposure to either digital or analog mobile phone signals.

"Tumor cells are constantly formed at a low background rate," Roti Roti and colleagues write in the December issue of *Radiation Research (152,* pp.665-671, 1999). But the ability of these cells to establish tumors "is held in check due to factors such as host surveillance mechanisms." This experiment was designed to see whether mobile phone signals could affect either the establishment of brain tumors or their subsequent growth.

In 1990, Dr. Stephen Cleary of Virginia Commonwealth University in Richmond reported that RF/MW radiation could either promote or retard the proliferation of human brain cancer cells grown in culture, depending on the strength of the signal (see *MWN,* M/A90). Cleary's work has often been pointed to as ground for concern about mobile phones and brain cancer.

The new Washington University study is "directly relevant to Cleary's observations," Roti Roti told *Microwave News*. "In a way, that was why we did it," he said. "Of course, it's not an exact replication. But it could be considered more relevant to humans using cell phones."

In Roti Roti's experiment, rats were exposed to an 836 MHz analog phone signal or an 848 MHz CDMA digital signal, or they were sham-exposed, for four hours a day, five days a week. For both types of radiation, exposure was at a specific absorption rate (SAR) of about 0.75 W/Kg. Each rat was exposed in a small cylinder that kept it at a fixed distance from the antenna. (Cleary's study used frequencies of 27 and 2450 MHz, at SARs of 5 and 25 W/Kg.)

The rats were divided into three groups, based on how many cancer cells were injected, plus a control group injected only with a saline solution.

Exposure of the rats began four weeks before the tumor cells were injected. Roti Roti explained that this was done "in order to see if prior exposure in any way made the brain more susceptible to the establishment of a tumor." After the brain cancer cells were injected, the rats were exposed for another 150 days or until death.

Neither the digital nor the analog signal had any apparent effect on the number of rats with tumors, the average length of survival, the percentage of rats alive at the end of the experiment or the minimum number of cancer cells required to form a tumor. In some experimental groups, exposed rats fared slightly better, in others slightly worse, and in others the response was almost the same. None of these small differences is statistically significant.

There was also no clear difference in tumor size, though here there was one difference of borderline significance. Among rats injected with the most cancer cells, sham-exposed rats had somewhat smaller tumors than CDMA-exposed animals. But Roti Roti expressed doubt that this had much meaning: "It may be a statistically significant result," he said, "but I'm not sure it's biologically significant." He explained that the tumors in these CDMA-exposed animals were still about the same size as the tumors in every other experimental group. "The irregularity occurred in the sham-exposed animals," the paper notes, "not in the CDMA-exposed animals."

The study was funded by Motorola.

SAR Search

• Is it possible to measure SARs in the **outer ear** directly? With current technology, the answer is no, the IEEE's SCC-34/SC-2 decided in a December 7 vote. "Existing probes are too large to measure accurately," the panel concluded. The FDA's **Howard Bassen**, the chair of SCC-34/SC-2, told *Microwave News* that existing probes are 3 mm in diameter, and the outer ear is not much wider than that in many places. "You've got to have a certain amount of simulated tissue around the probe," Bassen explained, "or you'll get huge errors because you're measuring air instead of tissue." But Dr. **Om Gandhi** disagrees, citing data from his group at the University of Utah (see *MWN,* N/D99). Gandhi's model head avoids having an ear that is too thin by filling in the space between the back of the ear and the skull. "We compared measurements for ten phones to computational results, and they agreed to within ±20%," Gandhi, a member of the subcommittee, said in an interview. But Gandhi was on the losing side of the issue, which was decided by a wide margin. The net result: A model head without ears. (See also p.4.)

• SCC-34/SC-2 favors a 6 mm **separation distance** between cell phones to be tested and the tissue-simulating fluid of the model head. The 6 mm total results from the model head's 2 mm shell and a 4 mm plastic spacer used to "simulat[e] a compressed ear." The 4 mm distance represents "the very worst case," according to Dr. **C.K. Chou** of Motorola. This should cover all mobile phone users, including children, he told *Microwave News*.

• Dr. **Niels Kuster** has founded a new institute in **Zurich** — the Foundation for Research on Information Technologies in Society, also known by its acronym, **IT'IS**. Kuster and the new institute will remain closely associated with ETH Zurich, the Swiss Federal Institute of Technology. He will continue his research on dosimetry, and the analysis of interactions in the near field. In addition, IT'IS will focus on new applications of wireless technology, including its use to support the disabled.

• A team from the **University of Singapore** presents a series of calculations on SAR distributions inside "multilayered prolate spheroidal" models of the human head from simulated mobile phone antennas at different distances, operating frequencies and inclination angles. The paper, by X.K. Kang and coauthors, appears in the January/February issue of *Radio Science (35,* pp.247-256, 2000).

matic framework for precautionary measures: Keep exposures as low as is technically feasible and economically sustainable." The need for caution is prompted by "credible indications" that chronic, low-level exposures may be harmful.

The strict EMF and EMR limits apply in all "areas with sensitive uses"—that is, where people are likely to be for extended periods of time, including homes, schools, playgrounds and hospitals. In these locations, the ordinance requires, radiation from each individual source must be kept below a specified level.

In all publicly accessible areas not deemed to be "sensitive," exposure limits are based on the guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP). But the ordinance restricts new construction of buildings in such areas if exposure levels exceed the lower, precautionary limits.

Magnetic fields from new power lines, substations or electric railway lines must not exceed 10 mG in places where people spend time. This is a level that is 100 times lower than that specified in most health standards, including ICNIRP's.

There are no national power line standards in the U.S. But five years ago a committee on EMF health risks set up by the National Council on Radiation Protection and Measurements (NCRP) also recommended a 10 mG exposure guideline in a draft report (see p.2 and *MWN,* J/A95). The committee, chaired by Dr. Ross Adey, then of the Veterans Administration Hospital in Loma Linda, CA, and now at the University of California, Riverside, called for limits ranging from 2 mG to 10 mG for schools, hospitals, homes and offices.

"We felt it was a prudent approach to EMF health risks, especially given that the limits would have been subjected to rigorous periodic review," Adey told *Microwave News*. Adey's report was deemed very controversial and is still under review.

For 900 MHz mobile telephone base stations, the Swiss ordinance limits exposures from each site to 4.0 V/m, or 4.2 μW/cm^2. This level is also 100 times stricter than the 450 μW/cm^2 allowed by ICNIRP and 150 times less than allowed under the exposure guidelines adopted by ANSI/IEEE. Russia's public exposure limit is 3.0 V/m, or 2.4 μW/cm^2, while China's is 5.0 V/m, or 6.6 μW/cm^2.*

The maximum exposures are 3.0 V/m for radio and television transmitters, except for long- and middle-wave transmitters, for which the standard is 8.5 V/m, or 20 μW/cm^2.

Switzerland's wireless industry had a mixed reaction to the new rules. In a December 23 statement, the trade group Protelecom called it "an expensive Christmas gift."

The Zurich-based carrier diAx looked on the positive side, stating that the ordinance "will at long last create legal certainty," adding that it "hopes that applications for building permits for mobile phone transmitters will be processed more rapidly." diAx and another carrier, Swisscom, both warned that the ordinance will make it necessary to build additional transmitters.

BUWAL's Joss said that once the ordinance takes effect, tower opponents "will have little recourse, provided a base station complies with the law. Slight delays may be possible, but that's about all." He noted, however, that comments on a draft of the ordinance indicated that, "The public wants even lower limits" (see *MWN,* M/A99).

Protelecom estimated that it will cost the industry SFr1 billion (approximately US$620 million) to comply with the new rules.

*These limits are for ambient levels, rather than for exposures from individual sources, as in the Swiss ordinance.

The New Swiss Rules: A Vote Against Harmonization

Switzerland's tough new limits are a major setback for the move toward uniform worldwide exposure standards.

There was an intensive lobbying campaign to try to persuade Swiss officials not to adopt the new limits, according to a number of close observers of recent European developments — all of whom asked not to be named. "The fear is that other countries will follow Switzerland's lead," said one source.

At a standards harmonization meeting in Erice, Sicily, a few weeks before the Swiss rules were announced, most attendees were opposed to the adoption of numerical limits stricter than those of ICNIRP, according to Dr. Mirjana Moser of the Swiss Federal Public Health Agency. Many of the participants at the November 27 meeting favored adapting to the precautionary principle, but not to the point of deviating from ICNIRP's numbers.

The Erice meeting was convened by Dr. Michael Repacholi of the World Health Organization (WHO), who heads the WHO's International EMF Project. Repacholi, formerly ICNIRP's chair, has set the globalization of health standards as one of the main goals of the EMF project. He has been sharply critical of the Swiss decision.

"If countries feel that they need further protective measures while the science is gathering information on possible health effects, this should be in the form of *policy*," Repacholi told *Microwave News* in January. As examples of policy changes, he cited public consultation on siting major EMF sources and requests for lower emissions from plants and equipment.

"Unfortunately, it seems as if the Swiss are undermining health-based standards with arbitrary reductions in EMF levels," Repacholi stated.

But Dr. Stefan Joss of BUWAL defended the Swiss rule. "Each country must decide what is technically and economically feasible. That is what we have done," he said in an interview.

Switzerland has now broken ranks with the rest of Europe, North America and Australia. Only Italy has such stringent limits for phone and broadcast towers (see box, p.7).

"It's a step backwards for harmonization," said Dr. Sheila Johnston, a consultant based in London, who attended the Erice meeting.

In most countries—with the exceptions of China and Russia (see *MWN,* S/O99 and N/D99) — the trend so far has been to favor the guidelines set by ICNIRP. For instance, last year, New Zealand moved to discourage local authorities from setting any limits stricter than ICNIRP's (see *MWN,* S/O99).

Joss questioned such predictions. He noted that, by administrative practice, strict limits for wireless base stations have already been in effect for more than a year. "During that time," said Joss, "about 2,000 new sites have been built in Switzerland, and not one site application has been denied because of radiation emissions."

Electric utilities, too, have expressed concern with the new rules, although less vocally than the wireless industry. The ordinance creates "substantial costs not only for utilities, but also for manufacturers, employers and consumers," a spokesperson for the Zurich Electricity Company, known as EKZ, told *Microwave News*.

The new limits are based on a literature review by an expert group that included university scientists as well as officials from BUWAL and the Federal Public Health Agency. "It isn't so much a matter of this or that piece of evidence tipping the balance," said Dr. Mirjana Moser of the health agency's Radiation Protection Office in Bern. "Rather, it is the degree of 'unknowledge.' At this point, we don't know enough to say with confidence that weak non-ionizing radiation is safe," she said in an interview with *Microwave News*.

BUWAL, on the other hand, identified enough evidence to support the strict limits. "Although more scientific evidence is still needed," its commentary states, "the confirmed effects already warrant the consideration of precautionary measures." Among the effects cited are epidemiological studies showing increased cancer risks, as well as studies showing disruption of the immune, melatonin and calcium systems. The commentary also points to the U.S. National Institute of Environmental Health Sciences' Working Group report that classified EMFs as a "possible carcinogen" (see *MWN,* J/A98).

On nonthermal RF/MW effects, the commentary cites the Australian study showing a cancer-promoting effect of GSM mobile phone radiation (see *MWN,* M/J97) and a Swiss study which found that people living near the Schwarzenburg shortwave transmitter had more sleep disturbances (see *MWN,* S/O96).

The ordinance does not apply to occupational exposures or to mobile phones, household appliances or medical devices. In addition, the precautionary limits do not apply to private outdoor spaces, such as the backyards of homes.

The ordinance's reliance on specific numerical limits differs from the approach proposed in a draft that BUWAL released for public comment last spring (see *MWN,* M/A99). In the draft, exposures were to be reduced by requiring that EMF and RF/MW sources be kept at specified minimum distances from locations where people spend time.

According to Joss, BUWAL decided to switch to numerical limits in response to comments on the draft from regional and local officials, environmental groups and the public, as well as from affected industries. Many of those commenting faulted the minimum distances as difficult to interpret, hard to enforce and unclear about the levels to which the public would actually be exposed.

The use of numerical limits is "the best way for Switzerland to fulfill the precautionary principle," the health agency's Moser said, explaining that, "The limits are what is technically and economically feasible, and they are relatively simple to implement."

The 10 mG limit for power frequency sources is "slightly stricter" than the minimum-distance rules in the draft, according to Joss. The same is true for wireless antennas: Under the minimum-distance system, the effective limit for 900 MHz base stations would have been 4.5 $\mu W/cm^2$, compared to 4.2 $\mu W/cm^2$ as per the final ordinance.

Officials can allow some new sources, and many existing ones, to exceed the limits. New power lines, for example, may do so if phase configuration is optimized and if other "technically feasible and economically sustainable" measures, which may include relocation, shielding and underground placement, are taken.

The full text of the *Ordinance on Non-Ionizing Radiation Protection* is available in German and in French at BUWAL's Web site: <www.admin.ch/buwal>. An accompanying commentary and a summary of public comments on the draft ordinance can also be found there. An English translation of the ordinance is being prepared and is scheduled to be posted on the Internet in late March, according to Joss.

Italian Wireless Radiation Limits Enter Second Year

Italy led the way. A year before Switzerland tightened its RF/MW exposure rules, the Italian Ministry of the Environment set a 6 V/m standard (10 $\mu W/cm^2$) for broadcast and mobile phone towers.

The standard, which took effect on January 2, 1999, applies to exposures in homes, schools and hospitals, as well as at other locations where people spend four or more hours. It is designed to protect against possible long-term effects.

The 6 V/m limit covers *all* fixed antennas — old and new — used for wireless communications, as well as radio and TV broadcasters. Emissions from mobile phones are not covered under this rule.

For other RF/MW exposures, the limits are 100 $\mu W/cm^2$ for 3 MHz-3 GHz and 400 $\mu W/cm^2$ for 3-300 GHz, both of which are stricter than the ICNIRP and ANSI/IEEE standards.

The Italian rules, like those in Switzerland, were prompted by public concerns, but they may not be having the desired effect. "The regulations have increased, rather than reduced, public anxiety," said Dr. Paolo Vecchia, the head of the non-ionizing radiation section at the Physics Laboratory of the National Institute of Health in Rome.

"Opposition to base stations for mobile phones seems to be higher than before," Vecchia told *Microwave News*. "Whether this is a temporary effect is difficult to predict." He explained that the 6 V/m limit is interpreted by some members of the public as a threshold for a severe hazard rather than as a safe exposure level.

The full text of Decree No.381, dated September 10, 1998, is available on the Internet at <www.linet.it/sre/foglio2.htm>. A very rough English translation is available by searching for "Decreto 10 settembre 1998 n.381" on AltaVista, <www.altavista.com>, and clicking on "Translate." The decree was originally published in *Gazzetta Ufficiale Della Repubblica Italiana* on November 3, 1998.

New York Suit Blames Landlord for Leukemia Death

In a lawsuit that may soon go to trial, the family of a New York City psychiatrist is claiming that his fatal leukemia was caused by workplace exposure to EMFs. The suit, which accuses the landlord of negligence, is moving forward in court after most other EMF–cancer litigation in the U.S. has ended (see *MWN,* N/D98).

For more than 20 years, Dr. Seymour Grossman saw patients in an office on the ground floor of a 14-story Manhattan apartment building. Power frequency magnetic fields of up to 13 mG were measured in the office last spring.

In July 1990, Grossman was diagnosed with acute lymphoblastic leukemia (ALL). He died a year later. Gloria Weisman, who worked in the office as Grossman's secretary from 1975 until 1990, also developed leukemia: She was diagnosed in 1991 and died the following year.

Representing Grossman's two children and his former wife, Anne-Renée Testa, Lester Tanner of the New York City law firm Tanner Propp filed suit in 1993. "If I can get just this case in front of a jury, I know I can win," Tanner told *Microwave News*. Following Grossman and Testa's divorce, she married Tanner in 1987.

Andrew Sapon of Bivona & Cohen in New York City is the attorney for the estate of Robert Olnick, who was an owner of the building when Grossman worked there. Sapon, who has twice moved to dismiss the case, said that he is "quite confident" the case will not go to trial.

In 1996, after Sapon's first motion for summary judgment, New York state Judge Emily Goodman dismissed several defendants from the case. But she refused to dismiss the case against Olnick, and ruled that a jury trial must take place. The lawsuit is currently on hold, however, pending Goodman's ruling on a second motion, which Sapon filed last spring.

In pretrial briefs, Sapon has contended that EMFs did not cause Grossman's cancer. In an interview, Sapon stressed that the case raises a larger issue: whether landlords can be held responsible for protecting tenants from EMFs. "Are you going to charge every landlord in New York City with a duty to bone up on EMFs and run around with a meter measuring 400 apartments?" At the time that Grossman's exposure would have occurred, he argued, relatively little about EMF health effects was known outside scientific circles.

Besides Sapon, the defense team includes James Orr of Sutherland, Asbill & Brennan in Atlanta. Orr defended Oglethorpe Power Co. in a 1991 suit in which Nancy Jordan alleged that EMFs from the utility's power line near her home caused her non-Hodgkin's lymphoma (see *MWN,* S/O93, M/J94 and J/F 96). Jordan withdrew the suit for health reasons in 1997 (see *MWN,* J/A97).

The intensity of the magnetic fields in Grossman's office is in dispute. In pretrial briefs, Tanner has maintained that the primary source of EMFs in the office was a portable air conditioner, but the unit had been removed after Grossman's death and initially could not be located.

In early 1999, Sapon told Judge Goodman that he had found the air conditioner. Citing measurements by Michael Silva of Enertech Consultants in Campbell, CA — showing that the magnetic field from the air conditioner did not exceed 1 mG at a

Working on the Ground Floor: A Cancer Risk Factor?

Dr. Samuel Milham, an epidemiologist formerly at the Washington State Department of Social and Health Services, has long suspected that working on the ground floor of a large building can mean increased risks of cancer due to elevated EMF exposures.

A multistory building consumes large amounts of electricity, which typically is routed through power lines and transformers in the basement. As a result, offices on the first floor often have high EMF levels.

The possibility of a ground-floor effect suggested an explanation for an anomaly in the Washington state dataset that Milham had used to link work in jobs with elevated EMF exposures to leukemia and other cancers (see *MWN,* J/A82). "I had always been puzzled about the relatively high cancer mortality rates seen in bankers in my Washington state occupational mortality studies," said Milham, who is now retired and living in Olympia, WA.

Banks often occupy street-level — i.e., ground-floor — offices, which in many cities are in high-rise buildings. In Washington state, male bank workers ranked fifth among 219 job categories for total cancer mortality from 1950 through 1989, while female bank workers ranked fifth among 68.

Milham noted that the bankers in his study had elevated mortality from testicular and brain cancer, as well as from melanoma and leukemia. "I think it is no coincidence," he told *Microwave News,* "that many of these same cancer sites have been shown to have elevated mortality in electrical workers."

In 1996, Milham looked into a suspected cancer cluster in an Orange County, CA, high-rise. Eight employees of a real estate brokerage there had developed cancer. All worked on the ground floor, directly above three 12 kV transformers, and they were exposed to EMFs as high as 190 mG (see *MWN,* S/O96).

The New York City psychiatrist and his secretary whose cancers prompted two recent lawsuits (see story at left) also worked in a ground-floor office. Lou Vitale of VitaTech Engineering in Montclair, VA, who measured the fields in the psychiatrist's office, said that this is not an isolated case. "I know of another physician who worked on the ground floor of an office building, with exposures of 10-100 mG, and he also developed leukemia," he told *Microwave News*.

Efforts to reduce EMF levels in ground-floor offices have become increasingly common, often to ensure that computer equipment does not malfunction. These involve shielding electrical switching hardware and transformers, or designing a building so that such equipment is kept distant from occupied office spaces — the approach taken by the World Bank for its headquarters in Washington (see *MWN,* M/A93).

distance of more than three feet — Sapon again moved to dismiss the suit. (Tanner insists that this unit was not the one that had been in Grossman's office.)

Silva's affidavit suggested, however, that the air conditioner had not been the main source of EMFs in Grossman's office. Noting that he made the measurements in an office next to Grossman's, Silva identified a "magnetic field source in [the] floor" that generated increasing EMF levels — up to 6 mG — as he moved toward Grossman's office. Silva declined further comment.

This prompted Tanner to ask Lou Vitale of VitaTech Engineering in Montclair, VA, to measure the EMFs in the office itself. Vitale found that a plumbing pipe in the wall, which acts as a ground conductor for the building, produced EMF levels above 6 mG where Grossman sat, and above 10 mG nearby. A 1996 assessment performed for Sapon by GausScan Corp. in New Canaan, CT, on the other hand, found EMF levels in the office to be generally below 1 mG.

Vitale believes that Grossman's exposure may in fact have been higher than 10 mG. "There could have been a significant ground current in the plumbing pipe from bad wiring or faulty electrical equipment," he said in an interview. If so, Grossman's office "could have had fields of 100 mG or more." Vitale added that he hopes to conduct on-site tests to check this possibility, but that to date he has been blocked from doing so.

If the case goes to trial, expert witnesses for the plaintiffs could include Vitale and Dr. Richard Clapp of Boston University. The defense's experts could include Silva, Dr. Patricia Buffler of the University of California, Berkeley, and Dr. Mark Weiss of Memorial Sloan-Kettering Cancer Center in New York City.

Gloria Weisman's husband, Morey, sued the building's owners in 1995. That suit, which is also being handled by Tanner, is on hold pending the outcome of the Grossman case.

« Power Line Talk »

With the close of the RAPID and DOE EMF programs, the only remaining source of dedicated funds for **EMF research** is **EPRI**. "We do plan to continue our program," Jackie Turner in EPRI's media office in Palo Alto, CA, told *Microwave News*. "It is a reduced program, but we feel it is a strong program." Turner declined to specify EPRI's EMF budget, citing a policy against such disclosures. In the early 1990s, when such information *was* made public, EPRI spent up to about $10 million a year on power line health issues (see *MWN*, M/A89 and S/O91). Turner said that she did not know when the policy had changed. Dr. **Paul Zweiacker**, the acting director of environmental services at TXU, an electric utility in Dallas, and the chair of EPRI's EMF Assessment and Management Business Area Council, advised EPRI last year that the institute "needs to have a viable EMF program."

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In June, **EPRI** will host a workshop in **Brussels**, Belgium, on **EMF Exposure Guidelines**. "It's for those interested in the science that forms the basis of exposure guidelines," said EPRI's Dr. **Robert Kavet**, the meeting organizer. "We plan to review what we know now and what would be useful to do next," he said. The workshop will be held the week following the Bioelectromagnetics Society's conference in Munich, Germany (see the calendar on p.15 for details on both meetings). Kavet cautioned that attendance will be limited: "We have reserved 65 rooms and it may be difficult to find additional space because there will be a popular soccer game in town at the same time." The proceedings will be published in a peer-reviewed journal. The registration fee is $300. For more information, contact Kavet at (650) 855-1061 or E-mail: <rkavet@epri.com>.

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A new **meta-analysis** — this one from **Italy** — of 15 epidemiological studies points to a consistent association between residential exposures and **childhood leukemia** for both direct measurements and for surrogate exposure indices such as wire codes. This finding is in line with the conclusions of several other recent meta- and pooled analyses (see *MWN*, J/F99 and S/O99). Drs. I.F. Angelillo of the University Magna Graecia in Catanzaro and P. Villari of University Federico II in Naples argue that the size of any excess risk is "at present unknown," given the possibility of selection bias, exposure misclassification and confounding variables. Overall, they find, "Enough evidence exists to lead us to conclude that dismissing concerns about EMFs and childhood leukemia is unwarranted." The full text of their paper, which is published in the *Bulletin of the World Health Organization, 77*, pp.906-915, 1999, is available on the Internet at: <www.who.int/bulletin/tableofcontents/vol.77no.11.html>.

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A very different view comes from the Committee on Man and Radiation (**COMAR**) of the Institute of Electrical and Electronics Engineers (IEEE). "There is little cause for concern among most of the population" about power line EMFs and cancer, COMAR concludes in a newly released commentary. The full text of ***Possible Health Hazards from Exposure to Power Frequency EMFs*** appears in the January/February issue of the *IEEE Engineering in Medicine and Biology Magazine*. COMAR also contends that, "The scientific evidence does not support the existence of cancer or other health and safety hazards from exposure to power frequency fields that are encountered in normal residential or most occupational environments," which it defines as 24-hour average magnetic fields below 1 μT [10 mG]. Such levels "characteriz[e] the exposure of more than 99.5% of the U.S. population." The statement was prepared by a subcommittee chaired by Ruth Miller of Kansas State University, Manhattan. The panel members were: Larry Anderson, Jerome Beers, John Bergeron, Janie Blanchard, Linda Erdreich, William Feero, Kenneth Foster, John Male, Charles Polk, Patrick Reilly, Russel Reiter, Carl Sutton and Jan Walleczek. Contributions were made by: Eleanor Adair, Robert Adair, Howard Bassen, C.K. Chou, Kjell Hansson Mild, John Moulder, John Osepchuk, Michael Repacholi and Mays Swicord.

All the extra leukemia cases are in the lowest exposure group, so the UKCCS team concludes that if this does reflect a real difference, it is not related to average magnetic field exposure.

Dr. Denis Henshaw of the University of Bristol thinks that these data support his own hypothesis, which suggests that exposure to aerosol pollutants such as traffic exhaust and radon decay products increases close to high-voltage power lines (see *MWN,* M/A96). If so, Henshaw says, it could explain the conclusions of the 1996 report by the U.S. National Academy of Sciences-National Research Council (NAS–NRC): that there is a consistent association between childhood leukemia and living near power lines, at the same time that there is no clear link to magnetic fields (see *MWN,* N/D96).

"Henshaw's interpretation is wrong," UKCCS study leader Dr. Nicholas Day told *Microwave News*. He explained that the table at issue does not include all children in the study living close to high-voltage power lines — only the 30% for which good line-load data were available. Its purpose, he stressed, is just to show that contemporary field measurements are "a reasonably accurate measure" of past exposure. "This table is...very incomplete and misleading in assessing risk in proximity to power cables," said Day, who is at the University of Cambridge.

Day added that his team is now analyzing proximity data on over 200 cases and controls, and plans to publish the findings.

"The publicity people for *The Lancet,* for Henshaw and for the UKCCS all made a hash of their respective press releases," said Day, "which is why we had a press conference to try to get across the correct message." Journalists in the U.K. tend to equate magnetic fields with overhead power cables, he said — "part of their offensive assumption that the U.K. public doesn't understand science and won't be bothered to make an effort." Day noted that his paper is specifically about "the magnetic component of EMFs." And for the average field strengths found in Britain, he said, it is "as definitive as one is likely to get."

What the UKCCS Found

The UKCCS shows no leukemia risk for average magnetic field exposures below 4 mG (see *MWN,* N/D99). As one part of the largest-ever study on possible causes of childhood cancer, careful efforts were made to assess the magnetic field exposures of 2,226 children with cancer and an equal number of controls. These included field measurements at home and school, questionnaires on proximity to power lines and appliance use in the home, plus data on the historic load on nearby power lines.

"We found no evidence that magnetic fields associated with the electricity supply increase risk of childhood leukemia, malignant brain...tumors or any other childhood cancer," Day and colleagues write in *The Lancet (354,* pp.1,925-1,932, 1999).

Sir Richard Doll, overall chair of the UKCCS and perhaps Britain's most respected epidemiologist, now thinks that there is no need for any further epidemiological studies on this subject in the U.K. "This major study provides firm evidence," said Doll, "that exposure to the levels of magnetic fields found in the U.K. does not augment risk for childhood cancer."

"These results cannot be confidently extrapolated to the United States or Canada," cautioned Ken Campbell of the U.K. Coordinating Committee on Cancer Research (UKCCCR) in London, one of the main sponsors of the study. Only 83 children in the UKCCS (less than 4%) had exposures above 2 mG, compared to more than 11% of children in the U.S. and more than 15% of Canadian children. "Our study contributes little evidence" on exposures of 4 mG and above, the study team notes, given that only 17 children were in this category.

In a commentary in the same issue of *The Lancet,* Drs. Michael Repacholi of the World Health Organization in Geneva and Anders Ahlbom of the Karolinska Institute in Stockholm stress the need to study average exposures above 2 mG, as well as other factors such as high frequency transients (see *MWN,* N/D99).

Henshaw on Power Lines and Cancer

According to Henshaw, "The results of the UKCCS, the review by the NAS–NRC and the recent Bristol papers all point in the same direction, in confirming a link between proximity to power lines and childhood leukemia." His latest research is presented in two papers in the December issue of the *International Journal of Radiation Biology,* published just days before the UKCCS findings appeared *(IJRB, 75,* pp.1,505-1,521 and pp.1,523-1,531, 1999; see *MWN,* N/D99).

Power line electric fields, Henshaw contends, increase both the velocity of airborne pollutants and the number of such particles that are charged, making them more likely to be deposited on the skin and in the lungs of people nearby. "Thereafter," Henshaw told *Microwave News,* "the inhaled particles will pass into the bloodstream and around the body, including the bone marrow." He stated that, "This interaction of airborne pollution with high-voltage power lines is via the electric, not the magnetic, field." (The UKCCS has also collected data on electric field exposures, which will be published in the future.)

The UKCCS table cited by Henshaw is based on both overhead and buried cables, the UKCCCR's Campbell told *Microwave News*. Since the latter produce no appreciable electric field aboveground, they would be irrelevant to Henshaw's hypothesis. Day declined to provide details on the proportion of each type of cable in the disputed table, explaining that this information will not be available until the full set of proximity data is published.

Overall, Day is unconvinced by Henshaw's theory about aerosol pollutants. "Physicists disagree with his theory that the cancer-causing agents can be received within the internal organs," Day told the BBC on December 3.

The U.K. electric industry is also unimpressed. In a December 1 statement from Britain's Electricity Association (EA), EA Scientific Advisor Dr. John Swanson accused Henshaw of engaging in "speculation about health effects of power lines which is not supported by [his] data."

A paper in the same issue of the *IJRB,* by Dr. David Jeffers, a retired engineer for the U.K. electricity provider National Grid Co., concludes, on the basis of theoretical calculations, that electric fields increase the deposit of radon decay products on surfaces within a power line electric field, but that "the effect does not appear to be of epidemiological significance."

The U.K.'s National Radiological Protection Board (NRPB) responded to Henshaw's new papers on December 6. "The NRPB remains extremely skeptical about recent claims that a causal link between power lines and human health can be established,"

the board began. "There must be great doubt about the assertion" by Henshaw's group "that their findings can be extrapolated to real health effects," the NRPB emphasized.

On December 9 the NRPB issued a revised version of this statement. The first sentence was changed to a pledge that, "The NRPB will investigate recent claims" of a power line-cancer link. While "there is doubt" that Henshaw's work is relevant to human health, the NRPB stated, "nevertheless, the NRPB's Advisory Group on Non-Ionizing Radiation will review the work by [Henshaw's group], and the NRPB will take note of their advice." No explanation was given for the change.

When Henshaw first published his hypothesis in 1996, the NRPB called it "implausible" and "purely speculative." A letter to the *IJRB* from Dr. John Stather, a senior NRPB official, and colleagues argued that increased deposit of aerosols such as radon decay products should actually lower their concentration in the surrounding atmosphere. They added that there was no convincing path by which inhaled particles could enter internal organs such as bone marrow in significant concentrations.

Henshaw countered that there is already epidemiological evidence linking traffic pollution to childhood leukemia, presumably from inhalation.

In support of his theory, Henshaw cited a small skin cancer study by Dr. Alan Preece, also of Bristol University, which was presented at the 1996 U.S. Department of Energy contractors review meeting in San Antonio. "Preece found a statistically significant 1.6- to 2.0-fold increase among people living under high-voltage power lines in the counties of Devon and Cornwall, U.K.," Henshaw said. Preece told *Microwave News* that he recently started work on expanding this study, to make the results more statistically robust.

Henshaw's new research used radon decay product aerosols "as markers of general aerosol behavior," and found that they accumulate 1.4 to 3 times faster under power lines than on control samples 100 meters away. Henshaw thinks pollutant aerosols should behave similarly, and that, "In most cases, and certainly for childhood cancer, it is probably pollution that is the key."

Some critics have argued that power line electric fields would be too weak inside the lungs and nasal passages to have much effect. In their latest work, Henshaw and colleagues respond that the electric field around power lines "is often sufficient to ionize the air," creating a stream of charged particles known as corona ions. "Corona ions quickly attach themselves to pollutant aerosols and are then carried away by the wind," Henshaw explained. He contends that these charged particles are twice as likely to be deposited in the lungs.

FROM THE FIELD

Letter to the Editor

Chou Defends Standard-Setting For Cellular Phone Safety

January 19, 2000

To the Editor:

In your recent issue (N/D99), you assert that "industry is in the driver's seat" in revising the RF/MW exposure limit for the ear. I would like to express my opinion on this assertion and clarify the ear safety limit issue.

Standards are developed by committees. In the U.S., two major organizations develop RF/MW safety standards and criteria: IEEE SCC-28/SC-4 and NCRP SC-89. SCC-28/SC-4 is a large subcommittee, with about 100 national and international members representing academia, government and industry. All SCC-28 meetings and records are open to the public and all decisions are made by consensus. All members have equal rights in making decisions. Balanced membership is a key criterion for the committee and the subcommittees.

The ear issue was brought up during deliberations of SCC-34/SC-2 (subcommittee on SAR test procedures). The ICNIRP RF/MW safety guideline published in 1998, which was developed by an international group of experts (without representation from industry), adopted 10 g as the averaging mass for the local SAR limit. When the European CENELEC standardized the SAR measurement protocol, there was no issue with the ear because they accepted the ICNIRP guidelines. Due to the 1 g averaging recommended in the IEEE C95.1-1991 standard and adopted by the FCC, FDTD calculations in 1 g of ear tissue showed values in the pinna which could exceed 1.6 W/Kg. Due to the size of the electric field probe, it is impossible to measure the SAR in the ear. This created a technical issue for the SCC-34/SC-2 to resolve.

Prof. Veli Santomaa of Nokia first raised the ear issue during the SCC-28/SC-4 meeting in Long Beach, CA, in June of 1999. The issue was listed on the SCC-28/SC-4 agenda for the October 17, 1999, Atlanta meeting (cochaired by Dr. John D'Andrea and me). During the meeting, Santomaa made a presentation explaining the reasons for the proposal. It was pointed out that the temperature rise of at least 3°C in the pinna during steady state was mainly due to conduction of heat from the phone and not due to the RF absorption in the ear. The pinna is an important but rugged organ like the hands and feet. The pinna experiences large environmental temperature changes (-40°C to 40°C). The main function of the pinna is to capture sound for hearing. With its efficient vasodilatation, the 4 W/Kg per 10 g SAR will not produce excessive heating in the pinna. After the presentation, Bob Curtis of OSHA made the motion to adopt 4 W/Kg averaged over 10 g of ear tissue, i.e., the same as for other extremities. The motion passed 28-0. I have made the detailed meeting record available to *Microwave News*. A formal ballot by SC-4 is now in process. If the proposal passes, a similar process by SCC-28 will follow. Dr. Om Gandhi, who raised the ear issue, also expressed his support of this proposal at the December 1999 SCC-34/SC-2 meeting.

The assertion that industry is controlling standard setting and keeping the public in the dark is unfounded and does not serve the readers in a positive manner.

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Hot New Papers

G.M.J. Van Leeuwen et al., "Calculation of Change in Brain Temperatures Due to Exposure to a Mobile Phone," *Physics in Medicine and Biology, 44,* pp.2,367-2,379, October 1999.

"We calculated a maximum rise in brain temperature of 0.11°C for an antenna with average emitted power of 0.25 W, the maximum value in common mobile phones. The power distributions causing this were characterized by a maximum averaged SAR over an arbitrarily shaped 10 g volume of approximately 1.6 W/Kg. Although these power distributions are not in compliance with proposed safety standards, absolute temperatures do not rise markedly over 37°C and the temperature rises are far below what is considered dangerous."

Kurtis Andrews and David Savitz, "Accuracy of Industry and Occupation on Death Certificates of Electric Utility Workers: Implications for Epidemiologic Studies of Magnetic Fields and Cancer," *Bioelectromagnetics, 20,* pp.512-518, December 1999.

"The limited quality of occupation and industry information on death certificates argues against relying on such information to evaluate modest associations with mortality."

Ulla Forssén, Maria Feychting, Lars Erik Rutqvist, Birgitta Floderus and Anders Ahlbom, "Occupational and Residential Magnetic Field Exposure and Breast Cancer in Females," *Epidemiology, 11,* pp.24-29, January 2000.

"Although the findings in our study are consistent with our previous results based on residential exposure, which showed an increased risk in the youngest age groups and for ER+ [estrogen-receptor-positive] breast cancer, the results are far from persuasive. The small number of subjects in our study resulted in unstable risk estimates. The elevated relative risks could be the result of chance and should also be viewed in light of the reductions in risk for women more than 50 years of age, which is not consistent with the melatonin hypothesis." (See *MWN,* S/O98.)

Frank Gustrau et al., "Simulation of Induced Current Densities in the Human Body at Industrial Induction Heating Frequencies," *IEEE Transactions on Electromagnetic Compatibility, 41,* pp.480-486, November 1999.

"At industrial workplaces in the vicinity of induction heating and melting devices workers are exposed to strong magnetic fields....This paper provides numerical [FDTD] investigations to clarify the ratio between external homogeneous magnetic fields and induced current densities inside the human body in the frequency range from 250 Hz up to 10 kHz....The magnitude of the external magnetic field equals the reference value for occupational exposure in the current guideline of the International Commission on Non-Ionizing Radiation Protection (ICNIRP). It was found that the calculated maximum current densities inside the body may exceed the basic restrictions of the ICNIRP guideline [by] at least up to a factor of two."

C. Harris et al., "Electromagnetic Field Strength Levels Surrounding Electronic Article Surveillance (EAS) Systems," *Health Physics, 78,* pp.21-27, January 2000.

"Field strength levels were measured around four types of EAS systems: audio frequency magnetic, pulsed magnetic resonant, radiofrequency and microwave. Field strengths from these EAS systems varied with magnetic fields as high as 1073.6 A/m (in close proximity to the audio frequency magnetic EAS system towers), and electric fields up to 23.8 V/m (in close proximity to the microwave EAS system towers). Medical devices are only required to withstand 3 V/m by the International Electrotechnical Commission's current medical device standards. The modulation scheme of the signal transmitted by some types of EAS systems (especially the pulsed magnetic resonant) has been shown to be more likely to cause EMI with electronic medical devices. ...The measurements recorded in this survey of EAS systems show that the types of signals and their associated signal amplitudes are not easy to predict. The field strength levels measured are not only a result of the type of technology employed by the manufacturer, but also a function of the environment where the EAS is being used."

Thurman Wenzl, "Assessment of Magnetic Field Exposures for a Mortality Study at a Uranium Enrichment Plant," *American Industrial Hygiene Association Journal, 60,* pp.818-824, November/December 1999.

"A total of 252 workdays was measured with a personal monitor, and individual average magnetic field exposures ranged from 0.20 to 82.6 mG....Very high consumption of electrical power at this plant does not imply that a large fraction of the workers are highly exposed to magnetic fields. An initial hypothesis had been that since flowing current generates magnetic fields, and this plant uses as much electrical power as a large city (up to 1,750 MW daily), then many workers would have high exposures. More measured workers had average exposures above 3 mG than in the employed population in general (14% vs. 10%), but workers in these jobs represent only about 9% of the work time of the cohort. These high exposures were encountered by switchyard workers, welders and some electricians....Some common assumptions about

EMFs and Childhood Leukemia: "Conservative Interpretations"

Anders Ahlbom and Maria Feychting, "A Bayesian Approach to Hazard Identification: The Case of Electromagnetic Fields and Cancer," in "Uncertainty in the Risk Assessment of Environmental and Occupational Hazards — an International Workshop," *Annals of the New York Academy of Sciences, 895,* pp.27-33, 1999.

"As an example of conservative interpretations, consider the latest [EMF] study from the U.S. [National Cancer Institute]....[T]he study is entirely negative for wire codes and leukemia risk. However, that is not at all the case for 24-hour measurements, and particularly not so for the higher exposure level. Despite this, the paper is accompanied by an editorial that has the following conclusion: 'In this issue of the *Journal,* Linet et al. report the results of a major study showing that the risk of [acute lymphoblastic leukemia] does not increase with increasing electromagnetic field levels in the children's homes.' That is, despite the risk elevations in the commented study and despite the previous literature, the editorial takes this opportunity to dismiss this hypothesis once and for all. The editorial even says: 'It is time to stop wasting our research resources.' As another example of conservative interpretation, we refer to a later publication from the same U.S. study that addresses the use of electrical appliances in relation to leukemia risk. [Some are] linked to increased relative risks. The pattern, however, is not fully consistent: For other electrical appliances there is no risk elevation, and there is some concern about the lack of dose response in some instances. Nevertheless, for the most important exposure source — electric blanket use — the relative risk is high, and there is a clear indication of dose response. The authors' conclusion, however, is careful: 'Although not impossible, we think that a causal relation between magnetic fields from the appliances and acute lymphoblastic leukemia is unlikely.'" (See *MWN,* J/A97, N/D97 and M/J98.)

On the Internet

Think You Have a Brain Tumor?

A new Web site is using concern over mobile phones and cancer to sell cut-rate MRI exams. "Brainscans.com has no position on whether there is a link between cellular telephone usage and brain cancer," it states. "However, an MRI of the brain at $169 will provide peace of mind to those who are concerned about the fact that the 'jury is still out' on this subject." The site features links to television news reports from ABC, the BBC and CNN, as well as the views of the FCC, FDA and the U.K.'s NRPB. Dr. Patrick Kelly, one of the founders of the Web site, said in an interview: "Some of these Wall Street types who're worried about their cell phones — hell, if I were them I'd get it." Kelly is chair of neurosurgery at New York University Medical Center. No medical organization currently supports screening the general public for brain cancer, said Joann Schellenbach of the American Cancer Society in New York City. "They would need a lot more scientific evidence that it would actually reduce mortality," she explained. Brainscans.com states that it is offering the low $169 price "as a public service." Kelly conceded, however, that it is a profit-making enterprise. In a study published in the July 7, 1999, *Journal of the American Medical Association,* 18% of 1,000 healthy adults had "abnormal" results in MRI exams of their brains — but five out of six of these turned out to be "trivial problems such as sinusitis." According to Kelly, "Someone with an abnormality should probably get a diagnostic MRI," which he said normally costs $1,200-$1,500.
<www.brainscans.com>

FDA Seeks Toxicity Testing of RF/MW Radiation

In our last issue, we noted that the Food and Drug Administration (FDA) had nominated RF/MW radiation from wireless communication devices for testing under the national toxicology program (NTP). The full text of FDA's nomination, dated May 19, 1999, appears on the NTP's Web site, run by the National Institute of Environmental Health Sciences.
<ntp-server.niehs.nih.gov/htdocs/Chem_Background/ExecSumm/Cefuroxime.html#Wireless>

Promoting Nonlethal Weapons

In a new report, the Council on Foreign Relations criticizes the Pentagon for the "very slow" development and use of nonlethal weapons and spells out what needs to be done to speed things up. Among the various technologies cited in the report are: RF/MW zappers to "stop vehicles or disable electronics" and acoustic and directed-energy weapons "designed to interfere with local communications, to disorient, to set up buffer zones, to deny access or to repel mobs." One specific criticism is that the military's Joint Nonlethal Weapons Directorate, created in 1997, "has had little or no access to extensive programs in radiofrequency, high-power microwave and other directed-energy technologies that exist in the military services." Full texts of both this report and the council's previous report, issued in 1995, are available on the Web. (See also p.16.)
<www.cfr.org> or <www.foreignrelations.org/public/pubs/Non-ViolentTaskForce.html>

FDA CDRH: Standards Liaison List and Annual Report

The FDA's Center for Devices and Radiological Health has posted a list of its current (as of February 8, 2000) representatives to various standard-setting organizations — such as AAMI, ANSI, IEC, IEEE and ISO.
For U.S. national groups:
<www.fda.gov/cdrh/national.pdf>
For international groups:
<www.fda.gov/cdrh/international.pdf>
And CDRH's 1999 Annual report is at:
<www.fda.gov/cdrh/annual/fy99rpt.pdf>

workplace chemical exposures do not apply to magnetic fields at this site. For example, large groups of professionals and office workers had higher magnetic field exposures than did production and maintenance workers....The weakness of job title alone in predicting exposures has also been suggested in other exposure investigations."

Kathy Ryan, John D'Andrea, James Jauchem and Patrick Mason, "Radiofrequency Radiation of Millimeter Wavelength: Potential Occupational Safety Issues Relating to Surface Heating," *Health Physics, 78,* pp.170-181, February 2000.

"As the use of MMWs [millimeter waves] increases, the possibility exists that personnel might be inadvertently exposed, perhaps leading to injury. Because of the shallow penetration depth of MMWs, thermal injury to the eye and skin are most likely. However, irradiation of both the eyes and the skin are, for the most part, self-limiting in that the exposure will be sensed and avoided before thermal injury is incurred. Low-level exposure of MMWs is not known to be carcinogenic; the majority of animal experiments performed to date have failed to demonstrate carcinogenic potential of microwaves at lower frequencies than MMWs. Finally, in the event of an accidental exposure to MMWs of sufficient power to produce thermal injury, there is an extremely low possibility that scars derived from such [an] exposure might later become cancerous. With proper wound management, this possibility decreases even further...."

C. Graham, M. Cook, A. Sastre et al., "Multi-Night Exposure to 60 Hz Magnetic Fields: Effects on Melatonin and Its Enzymatic Metabolite," *Journal of Pineal Research, 28,* pp.1-8, January 2000.

"Thirty healthy young men were evaluated using a randomized, double-blind test protocol. Statistical analysis indicated that four consecutive nights of exposure to power frequency magnetic fields at occupational intensity (resultant flux density=28.3 μT [283 mG]) had no differential effect on concentrations of melatonin or its major enzymatic metabolite (6-OHMS) in daily morning urine samples, compared to [controls]. The consistency of intra-individual urinary measurements over the four test nights also was quite high ($p<0.01$) in the sham control condition. In contrast, repeated nightly exposure to the magnetic field was associated with reduced consistency. Morning urinary measures obtained after exposure on night 4 differed ($p<0.01$) from similar measures obtained on after the second and third exposure night. Thus, while the overall results of this study do not support the melatonin hypothesis, there is some suggestion of a possible cumulative effect of magnetic field exposure on the stability of individual melatonin measurements over time."

Across the Spectrum

IT'S OFFICIAL. POWER LINES DON'T GIVE CHILDREN LEUKEMIA.

— Headline, editorial on the U.K. Childhood Cancer Study, *New Scientist* (U.K.), p.3, December 11, 1999 (see p.1 and *MWN,* N/D99)

Cultlike purification movements exist to purge our lives of chemicals, power lines or perfume.

— Dr. Peter Huber, Manhattan Institute, New York City, in "Insights: Wealth and Poverty," *Forbes,* p.110, December 27, 1999

"Given the results published up to this point, I personally feel that the implications of cellular telephone effects are not horrendous. But cellular telephones are a recent phenomenon. For the first time in our history, we are putting a microwave source right next to the head of millions and millions of people. So we need to get a consistent and dependable set of answers, and that will take time."

— Dr. James Lin, University of Illinois, Chicago, quoted by Tekla Perry in "Technology 2000: The Environment," *IEEE Spectrum,* p.85, January 2000

"The research keeps rolling in, but we haven't seen anything conclusive to demonstrate that cell phones are a health risk. We agree with the FDA and the scientific community that more research needs to be done. Our position could change with more definitive results."

— Norm Sandler, director, global strategic issues, Motorola Inc., Schaumburg, IL, quoted by Phillip Browne in "Cell Phone Safety Weighed," *Daily News* (Los Angeles), p.20, December 3, 1999

"[It is a] really good study that will answer the question for once and for all."

— Dr. Elisabeth Cardis, International Agency for Research on Cancer, Lyon, France, on its multicountry study of mobile phone use and brain cancer, quoted by Eoin Licken in "Cell Phones: Are Cancer Risks Real?" *International Herald Tribune,* p.6, December 16, 1999 (see *MWN,* J/F98 and S/O98)

"[Go back to your rooms and] dream about the precautionary approach."

— Juan Mayr, chair, conference on genetically modified food, to delegates from 140 countries near the close of a weeklong meeting in Montreal, Canada, quoted by Andrew Pollack in "Talks on Biotech Food Turn on a Safety Principle," *New York Times,* p.A4, January 28, 2000

"[A]s of September, if we find sites out of compliance, we'll use the full measure of the FCC's power to get them in compliance, and if there are penalties to be given out, then that is what will happen."

— Jerry Ulcek, FCC Office of Engineering and Technology, Washington, quoted in "RF Regulations Create Exposure to Liability," *Telecom Land Management Law Report,* p.2, November 1999

"They were not intended to address the situation that the public is most concerned about, and that is chronic exposure. As a result, there's really uncertainty about how protective the current guidelines are."

— Norbert Hankin, EPA Office of Radiation and Indoor Air, Washington, on the FCC's public RF/MW exposure guidelines, quoted by Katie Dean in "Cell Towers Take Root on Farms," *Wired News,* <www.wired.com>, January 10, 2000 (see *MWN,* M/J97 and S/O97)

"There is no demonstrable health risk from using a cell phone that transmits at around a watt. So using a 1 milliwatt Bluetooth transmitter means there is a thousandth of no risk."

— Dr. Michael Clarke, spokesperson, U.K.'s National Radiological Protection Board, on Ericsson's introduction of a wireless headset for a mobile phone, quoted by Barry Fox in "Bluetooth Stops You Getting All Tangled Up," *New Scientist,* p.20, December 18, 1999

"This is the first time that the government is acknowledging that people got cancer from radiation exposures in [nuclear weapons] plants."

— Secretary of Energy Bill Richardson, quoted by Matthew Wald in "U.S. Acknowledges Radiation Killed Weapons Workers: Ends Decades of Denials," *New York Times,* p.A1, January 29, 2000

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

• RF radiation levels from broadcast antennas in Honolulu, HI, are the highest ever measured in an urban area, according to the EPA.

• After determining that power substation workers have an increased risk of chromosomal abnormalities, a team of Swedish researchers finds that electromagnetic pulses (spark discharges) cause breaks in chromosomes *in vitro*.

• The EPA plans to propose several options for limiting public exposure to RF radiation. A federal standard is expected to be in place within a year.

Years 10 Ago

• "Anyone who would believe that EMFs could promote cancer would believe in perpetual motion or cold fusion," says Dr. Robert Adair of Yale University.

• A series of Swedish and Canadian experiments with mouse and chicken embryos indicates greater vulnerability to pulsed magnetic fields in the early stages of pregnancy.

• The U.S. Navy's submarine communications system, Project ELF, with antennas in Michigan and Wisconsin, is fully operational for the first time.

Years 5 Ago

• Drs. David Savitz and Dana Loomis of the University of North Carolina find an elevated mortality rate due to brain cancer among electric utility workers exposed to EMFs. The study does not support a link to leukemia.

• Trees within 50-150 meters of the U.S. Navy's Project ELF transmitters — with exposures of 1-7 mG — are growing up to 74% faster than unexposed trees, according to a Michigan Technological University study.

• Sweden's Ellemtel Telecommunication Systems Laboratories accommodates a group of employees suffering from EMF hypersensitivity, including an electrical engineer who must be confined to a specially shielded office.

2000 Conference Calendar (Part II)

Part I appeared in our last issue.

March 20-21: **Circadian Disruption as Endocrine Disruption in Breast Cancer/National Action Plan on Breast Cancer Workshop,** NIH Campus, Bethesda, MD. Contact: Cheryle Davis, ROW Sciences Inc., (301) 294-5455, E-mail: <cdavis@hq.row.com>. Space is limited.

April 26-28: **Transmission and Distribution World Expo 2000,** Convention Center, Cincinnati, OH. Contact: T&D World 2000, Intertec Exhibitions, 5680 Greenwood Plaza Blvd., Suite 100, Englewood, CO 80111, (800) 288-8606, Fax: (720) 489-3164, Web: <www.tdworldexpo.com>.

May 4-5: **Low Frequency EMFs, Visible Light, Melatonin and Cancer,** University of Cologne, Germany. Contact: Organizing Secretariat, Institute and Policlinic for Occupational and Social Medicine, 50924 Cologne, Germany, (49+221) 478-5819, Fax: (49+221) 478-5119, E-mail: <tim.erren@uni-koeln.de>, Web: <www.uni-koeln.de/symposium2000>.

May 6-7: **COST 244bis Workshop on Bioeffects of Transient EMF Exposure,** Ramón y Cajal Hospital, Madrid, Spain. Contact: Dr. Jocelyne Leal, Dept. of Research, Ramón y Cajal Hospital, Ctra. de Colmenar, Km9, 28034 Madrid, Spain, (34+91) 358-1365, Fax: (34+91) 336-8171, E-mail: <jocelyne.leal@hrc.es>.

June 7-8: **International Conference on Cell Tower Siting,** Salzburg, Austria. Contact: Dr. Michael Kundi, Institute of Environmental Hygiene, University of Vienna, Kinderspitalgasse 15, A-1095 Vienna, Austria, (43+1) 4277-64726, E-mail: <michael.kundi@univie.ac.at>.

June 9-16: **22nd Annual Meeting of the Bioelectromagnetics Society (BEMS),** Technical University, Munich, Germany. Contact: Dr. William Wisecup, 7519 Ridge Rd., Frederick, MD 21702, (301) 663-4252, Fax: (301) 371-8955, E-mail: <75230.1222@compuserve.com>, Web: <www.bioelectromagnetics.org>.

June 15-17: **33rd Annual Meeting of the Society for Epidemiological Research (SER),** Seattle, WA. Contact: SER, 111 Market Pl., Suite 840, Baltimore, MD 21202, Web: <www.jhsph.edu/Publications/jepi>.

June 19-20: **EMF Exposure Guidelines Science Workshop,** Hotel Metropole, Brussels, Belgium. Contact: Gail Banerjee, EPRI, 3412 Hillview Ave., Palo Alto, CA 94304, (650) 855-7956, E-mail: <gbanerje@epri.com>.

June 25-29: **45th Annual Meeting of the Health Physics Society (HPS),** Convention Center, Denver, CO. Contact: Lynne Fairobent, c/o HPS Secretariat, 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101, E-mail: <fairoben@ncrp.com>, Web: <www.webpanache.com/crmchps/hps2000.htm>.

June 27-30: **15th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility,** Wroclaw, Poland. Contact: W. Moron, EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland, (48+71) 348-3051, Fax: (48+71) 372-8878, E-mail: <emc@il.wroc.pl>, Web: <www.emc.wroc.pl>.

July 5-14: **Progress in Electromagnetics Research Symposium (PIERS 2000),** Royal Sonesta Hotel, Cambridge, MA. Contact: Dr. Hsiu Han, 391 Durham Center, Iowa State University, Ames, IA 50011, (515) 294-5320, E-mail: <hsiu@iastate.edu>.

July 16-20: **2000 IEEE PES Summer Meeting,** Seattle, WA. Contact: IEEE PES, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855, (732) 562-3883, Fax: (732) 562-3881, E-mail: <pessm2000@ieee.org>, Web: <www.ieee.org/power>.

July 16-21: **2000 IEEE Antennas and Propagation Society International Symposium** and **USNC/URSI National Radio Science Meeting,** Doubletree Hotel, Salt Lake City, UT. Contact: Michael Jensen, Dept. of Electrical and Computer Engineering, 459 Clyde Building, Brigham Young University, Provo, UT 84602, E-mail: <tpc2000@ee.byu.edu>, Web: <www.caeme.elen.utah.edu/aps2000>.

July 17-19: **35th Annual Microwave Symposium,** Montreal, Canada. Contact: International Microwave Power Institute, 10210 Leatherleaf Ct., Manassas, VA 20111, (703) 257-1415, Fax: (703) 257-0213, E-mail: <info@impi.org>, Web: <www.impi.org>.

Meeting Notes

• A European tour in June: Meetings have now been scheduled for before and after the June 9-16 BEMS annual meeting in Munich. June 7-8, there will be a conference in Salzburg on the siting of cellular phone towers and, June 19-20, a workshop on EMF exposure guidelines will be held in Brussels. See the calendar for details on all three meetings and p.9 for more on the EMF workshop.

• The *1st Australasian Conference on Bioelectromagnetics,* which was to be held in New Zealand at the end of October, has been canceled for financial reasons. According to Dr. William Wisecup, the meeting organizer, there was practically no interest from potential corporate or institutional sponsors.

• On February 7, there will be a panel discussion in Toronto, Canada, on the siting of cell phone towers. Among the participants will be Dr. Henry Lai and Mary McBride. For more information, contact Ronald Macfarlane, (416) 392-1560, ext. 87012 or <rmacfar3@city.toronto.on.ca>.

July 23-28: **World Congress on Medical Physics and Biomedical Engineering,** Navy Pier Convention Center, Chicago, IL. Contact: World Congress Chicago 2000, AAPM Headquarters, 1 Physics Ellipse, College Park, MD 20740, (301) 209-3350, Fax: (301) 209-0862, E-mail: <wc2000@aapm.org>, Web: <www.wc2000.org>. Includes **22nd Annual Conference of the IEEE-EMBS.** Contact: Dr. John Enderle, Dept. of Electrical and Systems Engineering, University of Connecticut, 260 Glenbrook Rd., U-157, Storrs, CT 06269, (860) 486-5521, Fax: (860) 486-2447, E-mail: <jenderle@bme.uconn.edu>, Web: <www.ieee.org/soc/embs>. Note: There will not be a fall EMBS Annual International Conference in 2000.

August 19-23: **12th Conference of the International Society for Environmental Epidemiology (ISEE 2000),** Adam's Mark Hotel and Resort, Buffalo, NY. Contact: Jay Friedman, (716) 645-3705, Fax: (716) 645-3869, E-mail: <sumpter@buffalo.edu>, Web: <www.specialevents.buffalo.edu/ISEE2000>.

August 21-25: **IEEE International Symposium on Electromagnetic Compatibility,** Washington, DC. Contact: IEEE/EMC Washington 2000, 445 Hoes Lane, Piscataway, NJ 08855, Web: <www.dcemc2000.org>.

September 11-15: **4th European Symposium on Electromagnetic Compatibility (EMC Europe 2000),** St. John Hospital, Brugge, Belgium. Contact: EMC 2000, Technologisch Institut, Desguinlei 214, B-2018 Antwerp, Belgium, (32+3) 216-0996, Fax: (32+3) 216-0689, E-mail: <emc2000@conferences.ti.kviv.be>, Web: <www.ti.kviv.be/conf/emc2000.htm>.

September 17-21: **8th International Conference on Dielectric Materials, Measurements and Applications (DMMA 2000),** Heriot Watt University, Edinburgh, U.K. Contact: DMMA 2000 Secretariat, IEE Conference Services, Savoy Pl., London WC2R OBL, U.K., Fax: (44+171) 240-8830, E-mail: <dmma2000@iee.org.uk>.

October 8-12: **3rd International Conference on Bioelectromagnetism and 1st Slovenian-Croatian Meeting on Biomedical Engineering,** Bled, Slovenia. Contact: ICBEM Organizing Committee, Faculty of Electrical Engineering, University of Ljubljana, Trzaska 25, SI-1000 Ljubljana, Slovenia, (386+61) 1768-456, Fax: (386+61) 1264-658, E-mail: <3rdICBEM@svarun.fe.uni-lj.si>, Web: <lbk.fe.uni-lj.si/icbem>.

October 17-20: **Biological Effects of Electromagnetic Fields,** Crete, Greece. Contact: Dr. Panos Kostarakis, NCSR Demokritos, Institute of Informatics and Telecommunications, 15310 Agia Paraskevi, Greece, (30+1) 650-3208, Fax: (30+1) 653-2910, E-mail: <millenium@ariadne-t.gr>, Web: <ikaros.tsinet.gr>.

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UPDATES

ANIMAL MAGNETISM

Butterflies in the Field... The annual migration of monarch butterflies is one of the enduring mysteries of science. These tiny insects travel over 2,000 miles each fall from the northern U.S. and Canada to a specific area in the mountains of central Mexico, and scientists have long wondered how they are able to find their way. Now researchers at the University of Kansas, Lawrence, have demonstrated what many had long suspected: that one of the monarch's navigational tools is an ability to sense Earth's magnetic field directly. Migrating butterflies were put in a plastic column one meter wide, and their direction of flight was observed. Under normal conditions, the monarchs flew to the southwest. Inside a room of nickel-iron alloy, which blocked Earth's magnetic field, they did not fly in any consistent direction. And when coils were used to cancel out this field and create an equal field in the opposite direction, the butterflies flew to the northeast. Interestingly, when the Kansas researchers conducted the same tests with nonmigratory monarchs, the butterflies flew in random directions under all three magnetic field conditions. "The...changes that trigger migration and cause monarchs to respond to magnetic information have not been determined," Dr. Jason Etheredge and colleagues write in the November 23 *Proceedings of the National Academy of Sciences (96,* pp.13,845-13,846, 1999), noting that the butterflies do not navigate by magnetic sense alone. They suggest that, "The site of magnetoreception may be the thorax, which contains 65% of the magnetite" in a monarch's body. Magnetite, they explain, is "a magnetically active, biosynthesized mineral suspected to mediate orientation in organisms that respond to magnetic fields"; magnetite is also found in human brain tissue (see *MWN,* M/J92).

ELECTROMAGNETIC WEAPONS

"Disruption of Voluntary Muscle Control"... Researchers at Oak Ridge National Lab (ORNL), a Department of Energy (DOE) facility in Oak Ridge, TN, are exploring whether EMFs could be used to immobilize enemy personnel. In a funding proposal for FY99, Dr. Clay Easterly had asked for $400,000 for "a proof-of-principle" experiment with mice or rats. Easterly was granted only $100,000, however, and told *Microwave News* in January that, "We're just doing some computer modeling" as a result. "We're starting with a given waveform and seeing how it changes when it goes through the skull," he explained, "and how that might look at the cellular level." The proposal states that, "The active biophysical mechanism in the proposed work is *not heating,* but rather lowering the firing potential of neurons, triggering them to discharge, or inducing currents." Animal studies would try to demonstrate an effect and explore its parameters, laying the basis for "a prototype device for the disruption of voluntary muscle control." Other possible effects include interference with vision and short-term memory. The proposal notes that "high-strength fields have the theoretical potential to *incapacitate personnel"* (original emphasis), and envisions "a weapon system that could be used at close range or 100+ meters." The ORNL's Michael Maston said that if the computer model is successful, animal experiments might follow. "But we're probably two years away from that, even if the model works out," Maston said. Any

animal studies, he added, would likely be carried out with Dr. Karl Pribram of Radford University's Center for Brain Research in Radford, VA. Maston is ORNL's director for work under the DOE's Special Technologies Program (STP), which he defined as "a program that supports the special activities community." And what is that? "The special activities community is the intelligence community, special operations of the FBI, things in that area," Maston answered. "That's about all I can say on that." The STP has two tasks, Maston explained: "real-world operations support" and "limited support for emerging technologies" such as EMF weapons. Developing effective nonlethal weapons "is actually a rather benevolent goal," Maston emphasized (see also p.13). "The current pathway of all weapons is either death or pain, and if we can go beyond that, it would be a good thing." As for weapons based specifically on electromagnetic energy, Maston said, "People have the wrong idea about this — this is not mind control." He said that he had been deluged with Freedom of Information Act (FOIA) requests about research in this area: "You think, my God, we've answered this two or three times already, and the response is, 'Well, yes, but we didn't believe you.'" When the DOE was subpoenaed in a federal lawsuit (see, for example, *MWN,* M/J98), Maston said, he posed this question: "Do you think if I had mind control I would have let you file this FOIA?" He expressed frustration with the amount of time he has had to spend on such matters, and suggested that more might be involved than just frightened citizens: "Some of these FOIA requests may almost be state-sponsored," he asserted. "It would be a great way to gather intelligence."

PEOPLE

Dr. **Elizabeth Jacobson**, the deputy director for science at the FDA's Center for Devices and Radiological Health, has won the Presidential Rank Award, one of the highest awards in the federal civil service....**Ron Petersen** of Lucent Technologies in Murray Hill, NJ, has been elected a fellow of the IEEE "for outstanding contributions and leadership in development of standards for the safe use of electromagnetic energy across the spectrum from DC to light." Petersen plays a key role in two IEEE standard-setting committees: he is chair of SCC-34 and the secretary of SCC-28....Dr. **Jerry Phillips**, formerly a member of Dr. **Ross Adey**'s research group at the VA Medical Center in Loma Linda, CA, has moved to Colorado Springs, CO, where he is now a staff biologist at the Biological Science Curriculum Study, an organization devoted to science education from kindergarten through the first two years of college. He is also opening a martial arts studio — Kung Fu San Soo — in town. Phillips plans to continue to consult on EMF and RF/MW health issues....**Norm Sandler**, Motorola spokesman and director of global strategic issues, is leaving Schaumburg, outside Chicago. He will continue in the same job, but will be based in Washington....**Hedy Lamarr**, the sultry screen star of the 1940s, died on January 19. She shared a patent on the development of spread spectrum techniques (used, for instance, in CDMA)....Dr. **Mary Ellen O'Connor** of the University of Tulsa, in Oklahoma, died on January 14 after a long battle with breast cancer. O'Connor, a former president of BEMS, was last the editor of the society's newsletter. The BEMS board is considering ways to honor her memory.

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VIDEO HISTORY

Antenna Farm Fight...A controversy has been raging for some time over a possible cancer cluster on Lookout Mountain, home to a dozen high-power TV and radio towers — as well as hundreds of other transmitters — serving Denver. Last year, a report from the Colorado Department of Public Health and Environment suggested that there may in fact be an excess incidence of brain cancer among those living close to the antenna farm (see *MWN,* M/A99, also J/A98). This possibility mobilized those living on Lookout Mountain to try and stop the siting of a new 860-foot tower that would broadcast digital TV signals. Len Aitken has produced an hour-long documentary, *$\mu W/cm^2$—Broadcast Blues,* which tells the residents' story. The film ends with the Jefferson County Commissioners voting to reject the application for the new tower and the broadcasters' subsequent attempt to overturn this decision. A number of members of the EMF/RF community appear in the documentary, including: Dr. Robert Cleveland, Jules Cohen, Dr. Philip Cole, Bruce DeBoskey and Dr. Henry Lai. A copy of the video is available for $32.00 (including shipping) from: Len Aitken Productions, 1053 Red Moon Rd., Golden, CO 80401, (303) 526-1896, E-mail: <LAitken@laproductions.com>.

CORRECTION

ICNIRP Standard... In the table comparing the Russian and ICNIRP public RF/MW exposure limits on p.9 of our last issue, we gave the wrong value for the ICNIRP limit in the 400-2,000 MHz frequency band. It should have been f/2 $\mu W/cm^2$, where f is frequency in MHz.

Keeping Current: Follow-Up on the News

◆ In a review of epidemiological studies, New Zealand's Dr. Mark Elwood concluded that there is no "consistent evidence linking RF/MW radiation to cancer" (see *MWN,* M/J99). Australia's Dr. Bruce Hocking now points out that at the time Elwood was preparing his paper, he was a consultant to Telecom NZ in a court case over the placement of a mobile phone tower next to a school. Hocking was a witness for the school. In response, Elwood cites the opinion of the presiding judge, who called his evidence "carefully constructed and balanced." The exchange appears in the December issue of *Environmental Health Perspectives,* in which Elwood's review was originally published.

◆ *Wireless Week* reports in its January 24 issue that there are now some 70,000 mobile phone towers in the U.S., about seven times the number that were in place five years ago, according to Sheldon Moss, director of government relations at the Personal Communications Industry Association in Alexandria, VA.

◆ The International Electrotechnical Commission (IEC) is establishing Technical Committee 106, with the provisional title: *Testing Instrumentation and Methods for Measuring Electric and Magnetic Fields Associated with Human Exposure*. The committee is being set up "amid increasing public and scientific concerns over the effects of electromagnetic radiation on human and animal health," according to the IEC, which is based in Geneva.

◆ On January 27, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) announced the membership of its RF/MW Radiation Working Group, which will develop a new exposure standard (see *MWN,* S/O99). The chair of the group is Dr. Colin Roy, the director of the non-ionizing branch of ARPANSA. The full membership is posted on the Internet at: <www.arpansa.gov.au/arp_news.htm#rf>.

◆ In mid-December, responding to pressure from local activists, the U.S. Air Force announced that it will prepare a detailed environmental impact statement for the PAVE PAWS radar on Cape Cod, MA. The last environmental review was completed in 1979. (See also *MWN,* M/J87, J/A98, N/D98 and N/D99.)

◆ On February 2, as we go to press, the European Commission (EC) has released a "Communication" that details how it plans to apply the precautionary principle in "cases where scientific evidence is insufficient, inconclusive or uncertain and preliminary scientific evaluation indicates that there are reasonable grounds for concern...." The full text of the communication, in the 11 EC languages, is available on the Internet at: <http://europa.eu.int/comm/off/com/index_en.htm>. (See also p.1 and p.19.)

VIEWS ON THE NEWS

Switzerland's Prudent Avoidance of Harmonization

Globalization has become a powerful force in almost every area of modern life. Its effects are felt in business, the environment, entertainment, language and more.

When it comes to non-ionizing radiation, globalization has meant "harmonization": the effort to get all countries around the world to adopt identical safety standards.

There are a lot of arguments in favor of harmonization. It is certainly more convenient for world travelers to be able to use the same mobile phone in different countries. And if a laptop with a wireless Internet link can be sold all over the world, it will generate more profits and presumably more jobs. But let's be clear: harmonization is essentially a commercial imperative.

This was starkly illustrated when the World Health Organization (WHO) led a harmonization delegation to China last year (see *MWN,* S/O99). Besides WHO and ICNIRP officials, it included representatives of Lucent, Motorola, Nokia and the U.S. Air Force. No comparable group of biologists and public health experts went on the trip.

In Switzerland, harmonization has come into conflict with the precautionary principle — the idea that exposures with unknown effects should be kept as low as is practical. Now included in many international agreements, this principle is similar to the policies of ALARA (as low as reasonably achievable) for ionizing radiation and prudent avoidance for EMFs.

The Swiss Environmental Protection Law is based on the precautionary principle, and the government has translated that general idea into what it believes is an appropriate set of numbers for EMF and RF/MW exposure limits. What the Swiss are saying is, "There's reason for concern, there's a lot that we don't know, and if we err it should be on the side of caution." Strictly from the vantage point of public health, we think it is hard to disagree.

Yes, Swiss wireless carriers are complaining that the rules will cost them money, but they also appear to be willing to pay this price to increase public acceptance of their antennas and gain some certainty in the siting process. (In the U.S., Congress tried — and failed — to impose the same certainty by law without making any concessions to public health concerns.)

History shows that exposure standards for radiation and chemicals have been tightened as research has found ill effects at lower and lower levels. The public has learned this lesson and is understandably suspicious when companies hide behind absolutes, and say that there is "no conclusive proof" of a cancer risk or other nonthermal health effects.

Some have argued that numerical limits should only be based on well-defined hazards (see p.6). Prudent avoidance, they say, should be limited to general statements of policy. But there is a simple reason why numbers are needed: Talk is cheap. Vague pledges to reduce exposures may not result in any real change, especially when industry makes all the final decisions. Health standards must be based on sound science — but that does not mean there is no way to take into account research results that are worrisome, if still unclear.

As long as there is uncertainty about health effects, the outlook for harmonization is cloudy at best. Different countries will want different standards, for the simple reason that every country's values are not the same. Such decisions depend heavily on social attitudes about risk, technology, the environment, commerce and public health.

If you want countries to adopt the same standard, there's one sure way to do it: Resolve the scientific uncertainty. Once the data are in, countries will adopt similar safety standards of their own accord. No one will need to force harmonization down their throats.

Unfortunately, funds for research on EMF and RF/MW health effects have dried up in the U.S. European funding, while not quite so miserly, is far short of what is needed.

And the push for harmonization actually undermines the case for more research. The idea that everyone must accept the same numbers exaggerates how much we already know.

There are a host of unanswered questions about non-ionizing radiation — and at the current pace of research, it will be a long time before they are resolved. Until then, harmonization will remain a goal that is driven by commerce, not public health.

Europe Sets the Agenda

At this time last year, we noted that the action had moved to Europe. That is even more true today.

Interesting meetings are being held all across the European continent. Policy debates on health standards are taking place in numerous European capitals. Whatever research will be done in the next few years is mostly being planned by the EU or by individual countries.

Meanwhile, the U.S. has its head firmly planted in the sand. Congress is apathetic about funding research. The Bioelectromagnetics Society is wondering how it will survive the money drought. And some members of the IEEE standards group on RF/MW radiation want to do away with its two-tier exposure standard, basically returning to the 1,000 $\mu W/cm^2$ limit of the 1980s. It does not inspire confidence.

But Europe has often led the way on environmental questions, while the U.S. played catch-up. We predict that before long the call for tougher, precautionary standards will get louder on this side of the Atlantic.

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Consumers Betrayed and Abandoned

Revision of RF/MW Standard Stalls As IEEE Panel Is Split on Key Issues

Disagreements within the IEEE's International Committee on Electromagnetic Safety (ICES) have stalled progress on updating its standard for human exposures to radiofrequency and microwave (RF/MW) radiation.

On one side, representatives of federal agencies have made it clear that they will not support a proposal to substantially relax key sections of the existing standard. On the other side, many members of the committee — especially those working for, or allied with, the Department of Defense — still favor looser limits.

"Everything is open," Dr. Eleanor Adair, the chair of ICES, better known as SCC-28, told *Microwave News*. Adair recently returned to New Haven, CT, after serving as a senior scientist at Brooks Air Force Base in San Antonio.

Last September, the Revision Working Group, a panel within subcommittee 4 (SC-4) of SCC-28, circulated a draft proposal for a more lenient exposure standard (see *MWN,* S/O01). But when the revision group met in Fort Lauderdale, FL, January 10-11, it repudiated many of the central elements of the draft. Then, a week later, SC-4 met in San Antonio and it, in turn, rejected some of the decisions made by its working group.

"It's pretty divided," said Richard Tell, a consultant based in Las Vegas who led the effort to draft the September proposal.

For instance, Tell's September draft stipulates that a single set of standards should cover workers and the general public. In Fort Lauderdale, there was a

(continued on p.7)

Epidemiologists at Odds Over Meaning Of New EMF Exposure Index

Do you have to be exposed to a magnetic field above some threshold level before it can cause a miscarriage? And if so, for how long?

Some leading epidemiologists are asking these questions in one of the liveliest debates on electromagnetic field (EMF) health effects in years.

International standards for power-frequency EMFs allow a pregnant woman to be exposed to as much as 1,000 mG, but in a paper published in the January issue of *Epidemiology,* a team led by Dr. De-Kun Li of Kaiser Permanente in Oakland, CA, shows that exposures to 16 mG or higher can result in significantly elevated rates of miscarriage (see *MWN,* M/J01).

"We don't know the mechanism, but there could be a switch that is activated above a certain threshold," Li told *Microwave News*. "If that is the case, I think that it makes more sense to look at the maximum rather than the average field exposures."

(continued on p.3)

« Power Line Talk »

In 1994, researchers on both sides of the Atlantic found strong power-frequency magnetic fields in hospital **incubators** used to nurture premature babies. **Gert Anger** of the Swedish Radiation Protection Authority in Stockholm reported levels as high as 48 mG, while in the U.S. the late Dr. **Charles Polk** of the University of Rhode Island, Kingston, found a peak reading of 289 mG using a different measurement protocol (see *MWN,* M/A94). These relatively brief and intense exposures do not appear to increase the risk of **childhood leukemia**, according to a new epidemiological study led by Dr. **Maria Feychting** of the Karolinska Institute in Stockholm, which appears in the January issue of ***Epidemiology*** *(13,* pp.45-49, 2002). Feychting's team, which includes Anger and Karin Söderberg, a doctoral candidate at the Karolinska, used hospital records of 619 Swedish children with leukemia and an equal number of controls, together with measurement data, to estimate EMF exposures. There were 53 children with leukemia and 57 controls who had been in incubators (some hospital records for other children were missing). The time spent in an incubator was "often less than 24 hours," according to the paper, but some stays were much longer — up to 28 days, Feychting told *Microwave News*. Measured fields were consistent with those Anger had found in 1994: The highest was 44 mG, with an average of 11 mG. Factoring in the time in an incubator, the Swedish researchers estimated that the maximum cumulative exposure was 6,136 mG-hours. Not only was leukemia risk no higher among the children who had been in incubators, there was also no increased risk for the high-exposure groups — that is, above either 6 mG or 10 mG — or those with cumulative exposures above 100 mG-hours. The new study did find elevated risks for acute lymphoblastic leukemia among those diagnosed between the ages of five and nine and for acute myeloid leukemia, the less common type, in all children, but these two estimates are based on small numbers of cases and are not statistically significant. Feychting believes that they are probably chance findings. She cautions, however, that there is no contradiction between these new results and previous studies (including her own) pointing to a link between childhood leukemia and residential EMF exposures. "Incubator exposures are profoundly different from those in the home," she said.

«« »»

ICNIRP has concluded that EMFs may be a risk factor for childhood leukemia. This is not too surprising since the chair of ICNIRP's epidemiology subcommittee is Dr. **Anders Ahlbom** of the Karolinska Institute in Stockholm, who also led the meta-analysis which persuaded the IARC EMF panel to designate EMFs as possible human carcinogens last summer (see *MWN,* S/O00 and J/A01). A doubling of the risk among children with average exposures above 4 mG is "unlikely to be due to chance," Ahlbom's subcommittee writes in a detailed review of the entire body of the EMF epidemiological literature — it appears in ***Environmental Health Perspectives*** *(109,* Supplement 6, pp.911-933, December 2001). Evidence linking EMF exposures to cancer in adults — specifically, brain tumors or leukemia — is "weak" according to the subcommittee, which also includes Drs. **Elisabeth Cardis** of IARC, **Martha Linet** of the U.S. NCI, **David Savitz** (see p.3) and **Anthony Swerdlow** (see p.10). For ALS, however, they write that the data are "intriguing and point toward a possible risk increase," especially among workers in electrical occupations, while noting that the association could also be due to electric shocks (see p.12, also *MWN,* N/D01).

Utility Industry Speaks Loudly On California Risk Analysis

The California EMF Program received 75 sets of comments on the draft assessment of EMF health risks, released last July. Those offering assessments — a veritable *Who's Who* of the EMF world — include many whose comments were solicited by the electric utility industry.

In their draft, Drs. Raymond Neutra, Vincent DelPizzo and Geraldine Lee of the EMF program concluded that EMFs are more likely than not to cause childhood leukemia, adult brain cancer, ALS and miscarriages (see *MWN,* J/A01).

The industry-sponsored submissions are for the most part quite critical. "Most scientists today would probably not agree" with the report's conclusions, wrote Dr. Abdelmonem Afifi of the University of California, Los Angeles (UCLA). Afifi, a long-time consultant to EPRI, was hired by Southern California Edison, Pacific Gas & Electric and four other utilities. These same utilities also paid for comments by Drs. Sander Greenland of UCLA and consultants Drs. Jack Sahl and Peter Valberg. They also sponsored a review by Dr. Lisa Croen of Kaiser Permanente — she agreed with the report's conclusion on miscarriages.

Attorney Tom Watson of Watson & Renner in Washington, DC, who represents the Utility Health Sciences Group, assembled a team featuring Drs. John Boice of the International Epidemiology Institute, Mark Israel of Dartmouth Medical School and Robert Tarone of the National Cancer Institute, each of whom filed separate critical comments.

The Edison Electric Institute in Washington turned to the Exponent Health Group, which points to the "strong possibility that there is no risk at all" (see also p.8). EPRI's Dr. Rob Kavet wrote his own comments.

Many others, however, filed positive comments. Dr. Herbert Needleman of the University of Pittsburgh called the report an "extremely valuable and sound analysis." Dr. Anders Ahlbom (see below) congratulated the authors for their "most comprehensive and ambitious risk evaluation." Among the others who supported the report are: EPA's Dr. Carl Blackman, NIOSH's Joseph Bowman, Dr. David Savitz (see p.3) and Dr. Gilles Thériault of McGill University.

All the comments, along with the EMF program's responses, will be posted on the Internet in late February. Print copies are also available from the City Copy Center in Oakland; call (510) 763-0193 for price information.

Health Canada Review: Transport EMFs Present Little Hazard

The prospect of a significant health threat from the EMFs generated by electrical transportation systems is "rather speculative and remote," according to a new report prepared for Health Canada by Dr. Tony Muc of Radiation Health and Safety Consulting in Toronto. He notes, however, that exposures over 1G are common and that "relatively little scientific investigation of transportation system EMFs has been carried out to date."

Muc analyzed EMF exposures of the public and workers associated with a number of currently used or projected technologies, including high-speed rail, Maglev, electrified railways, subways, trolleys and electric cars. In his view, the complexity and variability of transportation EMF exposures "far exceed the complexity addressed by present standards and guidelines."

Dr. Aviva Brecher of the U.S. Department of Transportation in Cambridge, MA, told *Microwave News* that the report "reinforces our conclusion that transportation EMF exposures are unique in their high degree of variability." Much of the data on EMF exposures presented by Muc is adapted from measurement surveys initiated by Brecher some years ago (see *MWN*, J/A93 and M/J99).

Muc also includes information from ongoing projects and yet-to-be-published research. For instance, measurements inside Washington Metro subway cars found fields ranging from 100 G to 1,000 G at floor level, generated by currents of up to 600 A.

Muc closes on a quirky note. He quotes, with approval, the view, written in Italian, of two obscure researchers that there are no demonstrable health risks. Their paper, presented at the 1996 annual meeting of the Automobile Club of Italy, "can hardly be claimed" to have been peer reviewed, Muc acknowledges.

The report was submitted to Health Canada last May. Muc only recently posted it on his Web site, <www.rhsc.ca>. Print copies can be purchased from RHSC for C$60 (US$40) each by writing to TransEMF, 64 Donlea Dr., Toronto, ON M4G 2M4, Canada, or faxing (416) 425-4233.

Debate Over Miscarriages and Exposure Index *(continued from p.1)*

Dr. Raymond Neutra of the California Department of Health Services in Oakland, whose EMF Program helped sponsor Li's study, uses an analogy to noise pollution to explain the significance of what Li calls maximum magnetic field (MMF) exposure. "One is not really interested in the cumulative amount of noise," he said in an interview, "but rather in the loud noise that wakes you up at night."

Dr. David Savitz is skeptical that Li's new exposure index has much meaning. In an editorial accompanying Li's paper, Savitz argues that the MMF index is probably little more than a random indicator.

In his prospective study, Li found no increased risk of miscarriage for time-weighted average (TWA) magnetic field exposures, but the risk of a spontaneous abortion almost doubled for those women who were exposed to a magnetic field of 16 mG or more for at least ten seconds. For those women exposed to 16 mG or more who said that the 24-hour magnetic field measurements were taken on a "typical day," the risk was three times that expected and close to six times higher for those women who had a miscarriage less than ten weeks into their pregnancies (see table at right for Li's results). "Our results are very coherent and provide strong evidence of a miscarriage risk," Li said.

"It's very comforting to me that, after our study found the association with MMFs, Raymond Neutra and Gerri Lee went back and looked at their own data and found a similar link," Li said. The Lee and Neutra miscarriage study appears in the same issue of *Epidemiology*.

"We are not saying that a single short exposure during the whole pregnancy is enough to lead to miscarriage," Li said. "We are saying that, if the measurement was taken on a typical day, then a woman was probably exposed to 16 mG almost every day. Our study could not answer how long or how often a woman had to be exposed to affect the pregnancy."

Nor did Li's study shed much light on the sources of the women's magnetic field exposures, though he notes that fields above 16 mG are routinely found near electrical appliances in the home and electrical equipment in the workplace, on electrically powered transit systems (see story above) and under some power lines.

Savitz, who is at the University of North Carolina, Chapel Hill, ascribes the different MMF exposures to behavioral differences between those who are and those who are not pregnant. He writes that Li's results really show that pregnant women limit their mobility due to bouts of nausea or to their increased girth. "Women who have lost or will soon lose their pregnancies are less likely to be nauseated and more likely to be mobile and thus will tend to have higher peaks and more variability in exposure," according to Savitz.

Not so, respond Li and Neutra in a letter that will appear in the March issue of *Epidemiology*. "We tested 30 different poten-

MMF and Risk of Miscarriage

Women Exposed ≥16 mG	Risk Ratio*	95% CI
All miscarriage	1.8	1.2-2.7
Early miscarriage†	2.2	1.2-4.0
Susceptible women‡	3.1	1.3-7.7
Measurement on typical day	2.9	1.6-5.3
Typical day/susceptible women‡	4.0	1.4-11.5
Typical day/early miscarriage†	5.7	2.1-15.7

* MMF≥16 mG vs. MMF<16 mG.
† Less than ten weeks of gestation.
‡ With multiple prior fetal losses or subfertility.

De-Kun Li et al., "A Population-Based Prospective Cohort Study of Personal Exposure to Magnetic Fields During Pregnancy and the Risk of Miscarriage," *Epidemiology, 13,* pp.9-20, January 2002.

tial confounders, including nausea, and none of them made the EMF association go away," Li said.

"I am not totally convinced," Savitz told *Microwave News*. He has written a second response to the journal, which prompted a further reply from Li and Neutra. (See box below for excerpts from their exchange.)

Other epidemiologists who are watching from the sidelines approve of the public debate, which spans three issues of the journal.

"The dialogue is healthy," said Dr. Kenneth Rothman of Boston University. "I am sure Li's findings will make a lot of people uncomfortable." He added: "By delving into other methodological explanations, Savitz is making a very important contribution." Rothman is the former editor of *Epidemiology*.

Similarly, Dr. Anders Ahlbom of the Karolinska Institute in Stockholm said that Savitz's commentary is an "excellent demonstration on how to write a good editorial."

Dr. Nancy Wertheimer in Boulder, CO, commented that she was pleased that Li had looked beyond TWAs, but, she noted, "I would like to know more about what these exposures above 16 mG indicate. The question is whether going over 16 mG points to some other aspect of electromagnetic exposures which could be responsible for the miscarriages."

Savitz said that Li's study is much better than the past EMF–miscarriage studies. He stressed that, putting aside the question of the MMF index, "The lack of an association with TWAs in Li's study is striking and that should not be ignored."

Despite all his skepticism, Savitz concludes his first commentary by stating that the new exposure index "deserves further scrutiny and is likely to get it." But, like Wertheimer, Savitz believes money would be best spent understanding the sources of 16 mG exposures.

What Does Maximum Magnetic Field (MMF) Mean? Li & Neutra and Savitz on Nausea, Mobility and Random Motion

"...Perhaps the investigators have pinpointed biologically important indices, as they suggest. But it seems even more plausible that the results are based on behavioral differences between women with healthy pregnancies and women who either experienced a miscarriage or were destined to have one....All other things being equal, a woman experiencing nausea will be less likely to move around her home or workplace or community, and therefore less likely to experience the diverse magnetic field sources in those places. As a result, she is less likely to encounter high magnetic field peaks and less likely to have substantial magnetic field variability over time. At its extreme, nausea can keep a woman in bed or at least in her home for much of the day. Thus, nausea (a marker of low risk of miscarriage) will be associated with lower peaks and variability in magnetic fields. Women who have lost or will soon lose their pregnancies are less likely to be nauseated and more likely to be mobile and thus will tend to have higher peaks and more variability in exposure. Thus, nausea may explain the association between magnetic field peaks and miscarriage...."

David Savitz, "Magnetic Fields and Miscarriage" (Commentary), *Epidemiology, 13,* pp.1-3, January 2002.

"...[Li] evaluate[d] this hypothesis directly, [with] information [collected in the in-person interviews] on nausea and related symptoms such as vomiting...As expected, nausea and vomiting themselves were associated with a reduced risk of spontaneous abortion (hazard ratio (HR)=0.3, 95% confidence interval (CI)=0.2-0.4 and HR=0.3, 95%CI=0.2-0.4, respectively). However, the frequency of nausea or vomiting was very similar for women exposed to maximum MF>16 mG (exposed) and to maximum MF<16 mG (unexposed)...After adding the nausea and vomiting variables to [our] model, the hazard ratio for the association of MMF with risk of spontaneous abortion remained essentially the same, if not strengthened...These results do not support the suggestion by Savitz that nausea or vomiting could influence MMF exposure or that adjusting for them might modify the measure of association between MMF exposure and the risk of spontaneous abortion...."

De-Kun Li and Raymond Neutra, Reply to Savitz, *Epidemiology,* March 2002 (in press).

"...[My original] rationale is that we are surrounded by magnetic field sources, ranging from pencil sharpeners to sewing machines to photocopiers, and that the only difference between someone who encounters such an exposure and someone who does not is the extent of random movement through their otherwise similar environments. If, indeed, moving around were the issue, then there are reasons to believe that nausea of early pregnancy or advanced size of later pregnancy would inhibit such Brownian motion....[T]he virtual lack of correlation between early and late pregnancy for MMF (r=0.09) and rate-of-change metric (r=0.19), far lower than for the time-weighted average [TWA] (r=0.64), would be consistent with a nearly random phenomenon. However, a random event would not be expected to be associated with risk of miscarriage...Putting aside the biological plausibility of an effect of MMF of 16 mG or higher...we are left with the question of what these measures capture about a woman's environment and behavior. Before taking on the extremely challenging goal of replicating the association with magnetic fields, the more modest and readily attainable goal should be to determine what is driving these indices...."

Savitz, Response to Li and Neutra, *Epidemiology,* March 2002 (in press).

"In his latest response...Savitz considered the measure of MMF untrustworthy because he speculates that measuring MMF is like measuring 'a random event.' An implicit assumption in his speculation is that MMF is highly associated with daily activities and daily activities are essentially random events. While we would agree that MMF is probably more likely than TWA to be related to daily activities, daily activities are by no means 'random events.'...[Our] study also showed that no association was found if the study was restricted to women who were measured on a nontypical day. This suggests that peak exposures need to occur on a daily basis in early pregnancy to have an effect. Of course the ultimate resolution to the reliability of MMF measurement will come from studies that measure MMF on multiple days...[S]tudies are [also] needed to identify the mix of sources that produce these peaks...."

Li and Neutra, Further Response to Savitz, *Epidemiology,* May 2002 (in press).

Tenforde To Lead NCRP; RF/MW Panel May Be Revived

Dr. Thomas Tenforde is set to become the next president of the National Council on Radiation Protection and Measurements (NCRP) in Bethesda, MD. Currently the senior chief scientist at the Battelle Pacific Northwest Labs in Richland, WA, Tenforde will move to the Washington, DC, area as soon as he is formally elected.

The directors of the NCRP recommended that Tenforde become president at their December 17 board meeting. The next step is for the council's nominating committee to endorse the board's decision. The entire NCRP membership will vote on the nomination at the council's annual meeting on April 11. This process is "usually perfunctory," William Beckner, NCRP's executive director, told *Microwave News*.

The NCRP has always placed the most emphasis on ionizing radiation and this will no doubt continue. Nevertheless, Tenforde will have to address two pieces of unfinished business on non-ionizing radiation: whether to reinstate Dr. James Lin's committee on RF/MW radiation and whether — and in what form — to issue a report on extremely-low-frequency (ELF) EMFs drafted by a committee chaired by Dr. Ross Adey.

Last summer, on the recommendation of Ron Petersen, NCRP vice president for non-ionizing radiation and a member of its board, Lin's committee was disbanded because it was moving too slowly (see *MWN,* S/O01). At their December meeting, the directors of the NCRP asked Tenforde to consult with Lin and Petersen on whether the committee should be revived. Lin's work on updating NCRP's 1986 RF/MW exposure limits began in 1995 (see *MWN,* S/O95). Tenforde is scheduled to report back to the board by the end of February, according to Beckner.

"I hope we can move forward," Tenforde told *Microwave News*. "I am open to a variety of actions to resolve the differences of opinion. It might require adding or replacing some members of the committee. We have a lot of flexibility."

In an interview, Petersen said a key element in reviving Lin's panel is fund-raising, given the council's budget shortfall.

Lin, who is at the University of Illinois, Chicago, is encouraged by the news that his committee might soon be back in business. But at the end of January, as we go to press, Lin said that he had not yet heard anything from Tenforde or the NCRP.

The NCRP began work on the ELF EMF report under a contract from the Environmental Protection Agency in 1983 (see *MWN,* D83). In an 800-page draft completed in 1995, Adey's panel urged that strong action be taken to control EMF exposures (see *MWN,* J/A95). The report has been under review and revision ever since.

In the summer of 1999, NCRP President Charles Meinhold said that the NCRP would post a draft of the report for public comment on its Web site by the end of the year (see *MWN,* J/A99). It was not clear whether the NCRP would include Adey's recommendations. Then last fall, Meinhold reiterated that the report would be released — but, he said, the recommendations would be omitted (see *MWN,* S/O01). Nothing has yet appeared, however. Adey, now semiretired, is based in Redlands, CA.

"I don't have a plan," Tenforde said about the ELF EMF report. "I'm thinking about the options." He called the document a "remarkable resource that contains a wealth of information." But he also wondered whether there was sufficient interest in EMFs to warrant its publication by the NCRP.

Part of Tenforde's hesitation over the EMF report is due to his long-held skepticism that magnetic fields are responsible for the association between childhood leukemia and power lines. "The bulk of the data, especially the laboratory data, do not support the link," he said. "There may be something else we do not understand that can explain the association." (For more on Tenforde's interest in other explanations, see *MWN,* N/D88).

Meinhold, who is with the Brookhaven National Lab in Upton, NY, has led the NCRP since 1990. He has wanted to step down for some time, but the board has had a hard time finding a replacement.

The presidency will continue to be a part-time position. But Tenforde made it clear that he will be devoting a lot of energy to his new job and would place special emphasis on fund-raising. "I plan to spend much of my time working on the NCRP. A lot of things need attention."

Tenforde has had a long association with the NCRP. He was first elected to the council in 1988 and was appointed the scientific vice president for non-ionizing radiation in 1995. He served until 2000, when he was replaced by Ron Petersen, then of Lucent Technologies and now a consultant (see *MWN,* M/J00).

Tenforde has been a member of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) since 1992. He will complete his third and final term in 2004.

Beckner has agreed to continue as executive director for at least a year, but not longer than two. He said that he will soon be 70 and that it is time to move on.

Russia Offers RF Weapons

Russia's arms export agency, Rosoboronexport, is offering two powerful RF electronic warfare weapons — but only qualified buyers with deep pockets need apply.

The weapons, called Ranets-E and Rosa-E, were presented at Malaysia's International Maritime and Aerospace Exhibition (LIMA 2001) in October, and on October 25, Rosoboronexport issued a press release over the *PR Newswire*.

The Ranets-E, a ground-based "cannon," uses 10-20 nanosecond pulses at around 30 GHz with an output power of more than 500 MW, and, according to the release, "is capable of incapacitating an enemy's high-precision weapons in a radius of 10 km." Rosoboronexport claims that it can disable a missile's guidance system. Rosa-E, operating in the same frequency range with an output power of 5-10 kW, can zap radar systems at a distance of 500 km.

Rosoboronexport makes the following qualification:

> Clients may not purchase a finished product or the technical documentation of either model. Potential customers need to clearly define their tactical and technical preferences as well as finance the Russian researchers' and producers' work. After this, their request will be accepted or denied. If accepted, they can receive a model after concluding a special agreement. The model can be tested at a military range.

Standards Watch: German, Spanish and U.S. Developments

The **German** government is sticking with **ICNIRP** and shelving a proposal to adopt a stricter standard for mobile phone antennas. Last July, the Federal Environment Ministry announced that it was weighing the adoption of precautionary limits for RF/MW radiation, citing Switzerland's 4 V/m (4 μW/cm^2) standard as a possible model (see *MWN,* J/A01). But such strict standards are "not scientifically justified at present," the prime minster's office stated on December 7. Instead, the government is calling for voluntary measures — that is, prudent avoidance. Germany's **Radiation Protection Commission**, a panel that advises the government, supported a mix of the ICNIRP limits and prudent avoidance in a report released in September (see *MWN,* S/O01). The commission, whose resident expert on non-ionizing radiation is Dr. **Jürgen Bernhardt**, the vice chair of ICNIRP, called for "minimizing" exposures to both EMFs and RF/MW radiation, especially in places where people spend a significant amount of time. The mobile phone operators oppose precautionary limits and it is widely believed that they made a deal to sponsor health research in order to avoid them (see p.8 and *MWN,* M/J01).

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Spain has also decided to follow **ICNIRP**, with an added helping of precaution. On September 29, the Spanish parliament approved a new law, a Royal Decree, which requires that exposures from all **RF/MW** sources meet ICNIRP's limits for the general population. The Ministry of Health and the Ministry of Science and Technology had drafted the law, based on the advice of an expert panel. The panel's report, issued in August, concluded that the existing scientific evidence supports the ICNIRP guidelines and noted that the EU Council of Ministers had recommended that all member states adopt the ICNIRP limits (see *MWN,* J/A99). The panel, however, also pointed to biological effects that occurred at lower levels and advocated a "precautionary" approach. As a result, the new law requires that SARs be provided with all mobile phones and that base stations be sited to minimize exposures in schools, hospitals and other "sensitive areas." The expert panel also endorsed the ICNIRP limits for **ELF EMFs** with a recommendation that power lines be located to avoid unnecessary exposures. The parliament did adopt the ELF guidelines, but without establishing a mechanism to enforce them and without including any of the precautionary language. Dr. **Alejandro Úbeda**, a research scientist at the Ramón y Cajal Hospital in Madrid who coordinated the panel's work with Dr. Francisco Vargas of the Ministry of Health, told *Microwave News* he is disappointed that his report did not mention IARC's designation of ELF EMFs as possible human carcinogens (see *MWN,* J/A01). He explained that the nine-member panel had already completed its work by the time the IARC committee met for its EMF review last June. The report, *Electromagnetic Fields and Public Health,* is available at <www.msc.es/salud/ambiental/ondas/camposelectromag.htm>. The Ministry of Science and Technology has posted the text of the ordinance, *Real Decreto 1066/2001,* at <www.mcyt.es/notas_prensa/gabinete_mcyt/oct2001/rdemisiones.htm>, along with a summary of its main provisions. These documents are all in Spanish, but an English translation of the expert panel's report will be available soon, according to Úbeda.

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Dr. **Ralf Bodemann**, who is responsible for EMF issues at **Siemens**, has been appointed vice chair of the IEEE International Committee on Electromagnetic Safety (**SCC-28**). Bodemann, an active member of the EMF Working Group of the Trans Atlantic Business Dialog, is based in Munich, Germany....Lt. Col. **Bruce Ruscio** of the U.S. **Air Force** has taken over as chair of the panel reviewing the epidemiological literature for the ongoing revision of SCC-28's RF/MW exposure standard (see p.1). Ruscio is much involved in the continuing controversy over the USAF's PAVE PAWS radar on Cape Cod.

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IEEE SCC-28 has threatened to take legal action against the **EMR Network** for posting the September draft revision of the IEEE RF/MW exposure standard on the Internet (see *MWN,* S/O01). The draft is "an internal document" and the property of the IEEE, Dr. **Eleanor Adair**, the chair of SCC-28, wrote in a December 8 e-mail demanding its immediate removal. "If this is not done," Adair warned, IEEE's lawyers "can take appropriate action." Deb Carney, an attorney in Golden, CO, said that the network has no plans to comply with Adair's demand. The issue may now be moot: The SCC-28 subcommittee revising the standard has decided to take a fresh look at key provisions of the proposal (see p.1). At press time, the draft was still in the "news" section of the network's site, <www.emrnetwork.org>.

SAR Measurement Protocol Almost Completed (Really)

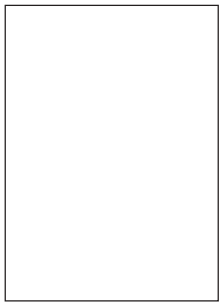
After five years of work, the IEEE's standard for measuring SARs from mobile phones will soon be completed.

"All the issues have been resolved," Ron Petersen, the chair of the IEEE's Committee on Product Safety with Respect to Electromagnetic Energy (SCC-34), told *Microwave News*. A vote by the full committee will take place in April, and the standard could then be forwarded to the IEEE Standards Board for a final okay in September.

"It was much more work than I ever expected," said Howard Bassen of the FDA's Center for Devices and Radiological Health in Rockville, MD, who chaired the SCC-34 subcommittee that wrote the standard. "The manufacturers need a very detailed protocol, which gives very accurate SARs, in order to meet the needs of the regulatory agencies." The standard was originally requested by the FCC in 1997 (see *MWN,* M/A97 and J/F01). The next meeting of Bassen's subcommittee will be in Ottawa, May 2-3.

consensus to return to a two-tier standard, the same way the existing standard is now structured. But in San Antonio, the subcommittee decided to "reconsider the two-tier approach." (A consensus statement of the Fort Lauderdale group, and how it was modified by those in San Antonio, appears below.)

The division within ICES has prompted some members to back away from a full-scale revision of the current standard in favor of making small, incremental changes. "There was a sense in San Antonio that the old standard isn't too bad and that some parts need tuning up," said Ron Petersen, the executive secretary of SCC-28. "I don't see much wrong with what we have now," added Petersen, a consultant based in Bedminster, NJ, who used to work for Lucent Technologies.



"Everything is open."
— Dr. Eleanor Adair

Part of the reason for the different outcomes at the two meetings is that those representing the federal health agencies were present only in Fort Lauderdale, not in San Antonio. "There is a different perspective in the group when the health agencies are present," commented Dr. Gregory Lotz of the National Institute for Occupational Safety and Health (NIOSH) in Cincinnati.

While many members of ICES still want a one-tier standard, the health agencies are unified against it. "A standard that does not recognize the need for safety factors for different members of the population would have little value," said Robert Curtis, the director of the Occupational Safety and Health Administration's (OSHA) Health Response Team in Salt Lake City.

A number of those in Fort Lauderdale were pleased with the progress made at the meeting. "I think we are moving in the right direction toward a scientifically supportable standard," said Dr. Robert Cleveland of the Federal Communications Commission in Washington.

"The earlier draft was based on faulty concepts and we are back to a more acceptable proposal," said Dr. Niels Kuster of IT'IS in Zurich. Neither Kuster nor Cleveland attended the San Antonio meeting.

But not all those at the Florida meeting agreed with the proposed changes, as later became clear in Texas. Some resent the pressure from the federal health agencies. "There were some remarks in Fort Lauderdale that 'if you don't do it our way, we aren't going to play' and people did not like it," said Dr. John Leonowich, a staff scientist at the Battelle Pacific Northwest Labs in Richland, WA. Leonowich did not go to San Antonio.

Some see the split as the health agencies against everyone else. But, in fact, the four Motorola staff members who were at the Fort Lauderdale meeting did not appear to be backing a full-scale relaxation of the existing standard. "Motorola's participation was definitely helpful in revising the proposal drafted by the Revision Working Group," said NIOSH's Lotz.

One of the many unresolved issues is whether the new limit for partial-body exposures should be changed. (The draft had proposed raising it to 10 W/Kg.) Also undecided are the size and shape of the averaging volume.

SCC-28 Working Group: Consensus Statement

At a January 10-11 meeting held at Motorola's offices in Ft. Lauderdale, FL, the Revision Working Group of IEEE's SCC-28 agreed on a consensus statement for revising the IEEE's standard for RF/MW radiation exposures. This statement, reprinted below, was then modified by SCC-28's subcommittee 4 at its meeting in San Antonio, January 19. Text that is struck through below was deleted in San Antonio, and the text that was added is in italics.

Based on our current understanding and pending the conclusion of the review and white paper process, the consensus of the Revision Working Group is as follows:

1. The RF safety standard should be based on science.

2. RF safety standard revision should be derived from peer-reviewed publications and documents that are reviewed by the SC-4.

3. The adverse effect level remains at 4 W/Kg subject to revision following completion of the literature evaluation and white papers.

4. The maximum exposure limits should be based on established adverse effects after inclusion of an appropriate safety factor(s).

5. Safety factor(s) should consider uncertainties in the biological database (e.g., ~~unknown health consequences~~, measurements, environmental conditions, exposure duration, individual variability, and other factors).

6. Nonthermal RF biological effects have not been established and none of the reported nonthermal effects are proven adverse to health (does not apply to electro-stimulation). Thermal effect is the only established adverse effect.

7. The microwave hearing effect is not adverse and should not be used for setting the peak power limit.

8. The shape and size of the averaging volume and the peak SAR limit ~~will be determined after the WHO temperature workshop in March~~ *are still to be determined*. The important end point is the temperature change.

9. RF standard should be harmonized with other international standards to the extent where scientifically defensible.

10. Rationales must be documented for all changes relative to the current standard.

11. *The editorial committee w*~~W~~ill add *in the informative section a paragraph* dealing with potentially sensitive subpopulations, such as children.

12. *Reconsider* ~~Keep~~ the two-tier approach (whole-body average SAR 0.4 and 0.08 W/Kg), ~~and leave~~ the peak SAR value and averaging volume. ~~blank, which are to be decided after the WHO temperature workshop results become available.~~

The partial-body limits are crucial to Motorola and the rest of the telecom industry because they determine the allowable specific absorption rate (SAR) for mobile phones. Essentially all parties agree that this part of the current standard was set arbitrarily. "We recognize as a group that the partial-body exposure limit is less-than-well-founded on science," said OSHA's Curtis.

Further debate on the partial-body limit has been delayed until after the March thermoregulation workshop being organized by the WHO's EMF project (see p.13). Most of those who will attend — with the exception of Adair and Motorola's Dr. Joe Elder — will be from outside the RF/MW community. WHO's Dr. Leeka Kheifets declined to disclose the invitation list.

At the San Antonio meeting, SC-4 asked members to submit a one-page statement on key elements of the standard — for instance, whether the standard should be one-tier or two-tier and whether the SAR averaging volume should be 1g or 10g. Tell said that these viewpoints are due by March 1 and will be assembled for the next meeting of the Revision Working Group, in Washington, April 8-9.

Dr. C.K. Chou, cochair of SC-4, told *Microwave News* that the subcommittee is not planning to respond directly to the 14 questions raised by the federal health agencies but that they would be addressed in the revised standard (see *MWN,* J/A99).

The goal is to have a first draft of a new standard for the next SC-4 meeting, which will be held in conjunction with the Bioelectromagnetics Society's annual conference in Quebec City, Canada, during the last week of June — and a completed draft for a vote by the full SC-4 at the end of the year.

« Eye on Europe »

Germany's six service providers have agreed to sponsor a four-year health **research program**, with a total budget of €8.5 million ($7.6 million) in exchange for the government's pledge not to tighten exposure limits for mobile phone towers (see p.6). In addition, the companies promised to give local officials and the public a greater role in decisions on siting base station antennas, to avoid the placement of antennas near schools or kindergartens and to install a network of measurement stations to monitor RF/MW radiation from their systems. Government officials welcomed these measures as "an important contribution" and said that they will monitor their implementation by the carriers. The new industry-backed research program would supplement a government-funded effort announced last summer (see box on p.9). According to the environment ministry, an "independent body" will direct the industry program, but a spokesperson for T-Mobil in Darmstadt told *Microwave News* that no decision has yet been reached as to who will run it.

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The fallout continues from the letter by five **Swedish professors** attacking Drs. **Lennart Hardell** and **Olle Johansson** for "talking nonsense" about mobile phones, dioxin and other health risks (see *MWN,* S/O01). The letter was translated into English and republished in the *Bioelectromagnetics Society Newsletter,* which is edited by Dr. **Mays Swicord** of Motorola. In a letter that appeared in the next issue of the newsletter (November/December), Dr. **Kjell Hansson Mild** of the National Institute for Working Life in Umeå, Sweden, wrote that he is "astonished" that he, a past president of BEMS and a collaborator of Hardell's, was not given the opportunity to respond. In an accompanying letter, Dr. **Michael Kundi** of the University of Vienna writes that instead of "muzzling" scientists who don't agree with the majority, a strategy should be devised to convince the public that its concerns are being taken seriously. Then on December 17, the Swedish tabloid *Aftonbladet* ran an exposé on one of the five professors, Dr. **Hans-Olov Adami**, an epidemiologist at the Karolinska Institute in Stockholm. NOBEL PROFESSOR HIRED BY CHEMICAL GIANT ran the headline. (Adami is a member of the selection committee for the Nobel Prize.) At issue is Adami's work for **Exponent** Inc., which does a lot of consulting work for the chemical industry — and specifically on dioxin. Dr. **Jack Mandel**, who runs Exponent's health and envionmental group, did not respond to a request for confirmation of his relationship to Adami. (Mandel has criticized EPA's and IARC's designation of dioxin as a known human carcinogen.) Exponent's Dr. **Michael Kelsh**, based in Menlo Park, CA, told *Microwave News* that Adami had not worked on his study of Motorola workers (see *MWN,* M/A00). Adami told *Aftonbladet* that industry could never make him say anything that he could not defend scientifically.

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Telecommunications antennas and toxic chemicals are being blamed for a **cancer cluster** in the provincial capital city of Valladolid, north of Madrid. The story has drawn widespread attention not only in **Spain** but across Europe. Beginning in December 2000, three children at an elementary school with approximately 450 students have been diagnosed with leukemia — a rate many times greater than the national annual incidence of 4.3 cases per 100,000. In addition, a fourth child at the school was diagnosed with Hodgkin's disease. In October, parents petitioned the courts for an order to turn off the transmitters — operating at 3.5 GHz and 26 GHz — on the roof of a building near the school. A report on a preliminary investigation of the cluster, issued in November, eliminated the antennas as a cause, primarily because they had been operating only a month before the first case was diagnosed. Unconvinced, a municipal judge on December 21 ordered the antennas be turned off. Media coverage of the incident has been so extensive that the **WHO** EMF project was moved to issue a statement to the press on January 23 correcting what it calls a "distortion" of its position on the possible health effects of radiation from mobile phones and base stations. The project managers, Drs. Leeka Kheifets and Michael Repacholi, asked journalists to distinguish between ELF EMFs and microwaves. It is the former, not the latter, that was designated a possible hu-

man carcinogen by IARC last summer, they explained (see *MWN,* J/A01). A full-scale investigation of the Valladolid cluster is now under way, focusing on the children's exposures to toxic chemicals and both ionizing and non-ionizing radiation, according to the January 12 issue of the *Lancet*.

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COST281, **EBEA** and **ICNIRP** have taken their case against precautionary-based exposure limits to the president of the European Parliament — and have posted the letter on the COST281 Web site. In a November 27 letter to Nicole Fontaine, Drs. **Norbert Leitgeb**, **Paolo Vecchia** and **Jürgen Bernhardt**, representing the three organizations, respectively, argued that standards should not be "based on fragmentary scientific evidence or the scientifically unrepresentative opinions of a few individuals." Just in case there is any doubt as to whom they are referring, their letter is posted right above COST281's critique of Dr. **Gerard Hyland**'s report on low-level health effects (see *MWN,* N/D01). Hyland's paper is now available at the COST281 Web site. All three documents are at: <www.cost281.org/activities.php>. The COST281 review of the Hyland report was originally requested by Dr. **Tom McManus**, the chief technical advisor at **Ireland**'s Department of Public Enterprise in Dublin. In mid-January, Pat Cox of Ireland became the new president of the European Parliament.

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Gert Anger of the **Swedish Radiation Protection Authority** (SSI) has issued a new report on **SARs** and **emitted power** from 21 different mobile phones operating at 900 MHz and 1800 MHz. Most of the SAR measurements, carried out by IMST in Kamp-Lintfort, Germany, according to the 1998 CENELEC protocol, were released last year (see *MWN,* M/A01). Emitted power is an indicator of the amount of power used for communication (see *MWN,* J/F01). Anger found that the average phone used only 16% of its available power. The report (2002:01, released January 17), which is in Swedish with an English abstract, is available on the SSI's Web site, <www.ssi.se>. (See also p.2.)

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In a new report, the **Health Council of the Netherlands** has found that radiation from mobile phones "does not constitute a health hazard, according to the present state of scientific knowledge." In contrast to the advice of expert panels in England, France and Germany, the Dutch council "feels there is no need for recommending restrictions on the use of mobile phones by children." The council allows that some biological effects have been documented in experimental studies, but that these are "minimal" and "reversible" and "cannot be considered hazardous to health." The report, released on January 28, was drafted by the council's EMF committee, chaired by Dr. **Eric Roubos**, a professor of zoology at the Catholic University of Nijmegen. A copy of the full 96-page report is available in English on the council's Web site, <www.gr.nl>. A copy may also be ordered from the council by fax: (31+70) 340-7523 or by e-mail: <order@gr.nl>. The council has previously issued reports on GSM radiation and on EMFs (see *MWN,* N/D00 and M/J00, respectively; also J/A01).

Germany Plans Broad Research Program on Mobile Phones

The Federal Radiation Protection Office in Salzgitter, Germany, is considering proposals on 15 different projects in its new research program on mobile phone safety (see *MWN,* J/A01). The four-year effort, which is being administered with the assistance of the Federal Environment Ministry, has a total budget of €8.5 million ($7.6 million).

Among the proposals requested by the radiation office are:

- A repeat of the Australian mouse lymphoma experiment known as the Repacholi study, but with a different type of transgenic mouse: the *AKR/J* strain instead of the *Pim1* strain. In addition, the mice would be exposed to SARs "substantially below," as well as close to, the ICNIRP limits.
- *In vivo* experiments investigating effects of GSM and UMTS (3G) signals on the ears and eyes and looking for genetic and other effects in rats over several generations of exposures.
- Research on effects in isolated pineal glands under various exposure conditions.
- Studies of protein expression, signaling and other functions in various cell types exposed to both pulsed and CW radiation.
- An assessment of the feasibility of a study of health risks among people in occupations with high RF/MW exposures.
- An epidemiological analysis, beginning with a pilot study, of health complaints and radiation from mobile phone base stations, with a study population of approximately 2,000.

The list of proposed projects, posted at <www.bfs.de/forsch/index.html>, also includes a study of lymphoma in mice exposed to 50 Hz EMFs. The deadline for submitting applications was January 5.

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The **U.K.**'s National Radiological Protection Board (**NRPB**) has been folded into a new government agency, whose main mission will be to control infectious diseases. Sir **Liam Donaldson**, the chief medical officer at the Department of Health, announced the reorganization on January 10. The National Infection Control and Health Protection Agency is designed to "provide an integrated approach to protecting the health of the public against infectious diseases as well as chemical and radiological hazards," the department stated. The threat of a terrorist attack was only part of the reason for the shuffle: epidemics of BSE and foot-and-mouth disease have caused huge economic losses across Britain. "We have been assured that the NRPB will remain a distinct entity within the agency," NRPB's Dr. **Michael Clark** told *Microwave News*. Clark said that the NRPB staff — like many observers — were surprised by the changes.

U.K. Mobile Phone Research Under Way; Fifteen Projects Receive $6.4 Million

On January 25, the U.K. Mobile Telecommunications and Health Research Program announced its first 15 projects, with total funding of approximately £4.5 million ($6.4 million). The program, which has a total projected budget of £7.4 million ($10.5 million) and is supported equally by industry and government, was recommended by Sir William Stewart in his May 2000 report (see *MWN*, M/J00).

The big winners are epidemiologist Dr. Anthony Swerdlow, who will receive close to a quarter of all the money awarded, and MCL, formerly called Microwave Consultants Ltd., which also got two grants (and is consulting on a third). Swerdlow is a member of the National Radiological Protection Board's (NRPB) Advisory Group on Non-Ionizing Radiation (AGNIR), as well as of ICNIRP. Dr. Edward Grant, a director of MCL, was a long-time member of the AGNIR who very recently stepped down. NRPB researchers received a total of £731,000 (more than $1 million).

Dr. David de Pomerai, a relative newcomer to RF/MW research, was thrilled at winning a grant. "It will be a change not to run my microwave research on a shoe-string budget," he told *Microwave News*.

Details of each project listed in the table below are available at <www.mthr.org.uk>. The table also lists two additional mobile phone grants which were funded by the U.K. Department of Trade and Industry. A second call for proposals was issued at the end of last year (see *Nature*, December 6).

Name/Institution	Title	Cost/Years	Comments
Dr. Martin Bootman Babraham Institute	Effect of Pulsed RF EMFs on Redox Signaling & Calcium Homeostasis	£500,000 (≈3yr)	Use of new screening technology to monitor changes in cellular calcium and in nitric oxide
Dr. Peter Burns Transport Research Lab	Conversations in Cars: Relative Hazards of Mobile Phones	£75,000 (1 yr)	Compare the distraction of use of hands-free phone with other common driver activities
Dr. Ray Cartwright University of Leeds	U.K. Case Control (CC) Study of Adult Brain Tumors	£265,000 (≈2 yr)	Supports an extension to U.K. component of IARC Interphone study (see *MWN*, M/A00)
Dr. Philip Chadwick MCL	International EMF Dosimetry Project	£220,000 (3 yr)	Coordinating international effort to provide free on-line resource for EMF and RF dosimetry
Dr. Robert Clarke National Physical Lab	"Traceability" for Mobile Telecom and Health Research	≤£97,000 (3 yr)	Calibration services for those labs involved in the MTHR projects
Dr. David de Pomerai University of Nottingham	Cellular & Subcellular Effects of MWs in the Nematode	£323,000 (3 yr)	Follow-up on stress response and changes in gene expression in roundworms (see p.14)
Dr. Peter Dimbylow NRPB	Assessment of SARs in the Head from TETRA Handsets	£75,000 (1 yr)	Computer modeling and experimental measurements of the TETRA helical antenna
Dr. Paul Elliott Imperial College, London	Cohort Study of Mobile Phone Users (Pilot Study)	£202,500 (1 yr)	Feasibility study for a long-term effort; Karolinska's Ahlbom is a member of the team
Dr. Camelia Gabriel MCL	Measurement of the Dielectric Properties of Biological Tissue at MW Frequencies	£350,000 (3 yr)	Dosimetry for both pig and human tissues, and how dielectric properties change with age
Dr. Linda Luxon National Hospital for Neurology and Neurosurgery	Evaluation of the Effects of Mobile Phone Use on Labyrinthine Function	£180,000 (2 yr)	Does RF cause imbalances in the ear, leading to headaches and nausea? (see *MWN*, J/A00); team includes Robin Cox and MCL's Chadwick
Dr. Simon Mann NRPB	Measurement of RF Power Densities near Microcell & Picocell Base Stations	£66,000 (1.5 yr)	Further surveys at 20 sites (see *MWN*, J/A00); will work with EC/JRC project (see p.13)
Dr. Riccardo Russo University of Essex	Mobile Phone Radiation and Cognitive Function	£200,000 (2.5 yr)	Double-blind studies on effects of GSM and analog signals on memory and attention
Dr. Zenon Sienkiewicz NRPB	Effects of RF Radiation on Brain Physiology and Function	£590,000 (3 yr)	Looks for changes in specific areas of the brain, and in learning and memory performance
Dr. Anthony Swerdlow Institute of Cancer Research	CC Study of Leukemia in Relation to Use of Mobile Phones	£880,000 (4 yr)	Will enroll 900 cases and 900 controls; ICR's Mel Greaves is on the team
Dr. Anthony Swerdlow Institute of Cancer Research	CC Study of Brain Tumors & Acoustic Neuroma Mobile Phones: SE England	£280,000 (2.5 yr)	Will enroll 1,000 cases and 1,000 controls; part of the IARC Interphone study
Dr. Anthony Barker† Royal Hallamshire Hospital	Effects of Mobile Phone Radiation on Blood Pressure	£330,000 (2 yr)	Five different signals, including TETRA, will be tested on 120 normal volunteers
Dr. Stuart Porter† University of York	Interactions of Emerging Mobile Telecom Systems with the Human Body	£454,000	Exposure and absorption from phones, hands-free kits, laptops, wearable PCs & base stations

*£1≈$1.42

†Sponsored by the Department of Trade and Industry

« Wireless Notes »

The long-awaited paper by Drs. **Ray Tice** and **Graham Hook** describing their work for Dr. **George Carlo**'s **WTR** on the genotoxic effects of mobile phone radiation appears in the February issue of *Bioelectromagnetics (23*, pp.113-126, 2002). Their experiments at ILS in Research Triangle Park, NC, are the centerpiece of Carlo's passionate claims that cell phone radiation can no longer be considered benign and that follow-up studies are needed (see *MWN,* M/A99 and J/A99). While Tice and Hook did not find any increases in DNA breaks, they did see more micronuclei in cultured human blood cells exposed to four different types of cell phone signals (both analog and digital) at SARs of 5 W/Kg and higher. ILS is repeating these *in vitro* studies under a **CTIA** contract, as is Dr. **Maria Scarfi** of the University of Naples (see *MWN,* M/J01). Carlo has also finally released the March 1999 report written for WTR by Drs. **Henry Lai** and **N.P. Singh** on their 1988 *in vivo* study of DNA breaks following exposure to analog 837 MHz radiation. This study has been the subject of a great deal of controversy (see *MWN,* M/A99 and M/J99). Attorneys at **Kirkland & Ellis**, which is representing Motorola in the ***Newman*** brain tumor lawsuit (see *MWN*, S/O00), have been demanding a copy of the Lai-Singh report for months. Carlo said that he did not want to release the report until it had been peer reviewed. Last fall, Carlo asked Dr. **Jerry Phillips** in Colorado Springs, CO, to do the peer review and the report was made available in December.

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Dr. **Russell Owen** is leaving the **FDA** to join the **EPA**'s National Health and Environmental Effects Research Lab in Research Triangle Park, NC. "I'm very excited about it," he told *Microwave News*. Since 1995, Owen has headed the radiation biology branch at the FDA's Center for Devices and Radiological Health in Rockville, MD, with responsibility for cell phones. At the EPA, Owen will be the chief of the molecular toxicology branch within the environmental carcinogenesis division. He said that he will be setting up his own lab but will not be doing research on the health effects of electromagnetic radiation. Nevertheless, he added, "I plan to stay active as a member of ICNIRP." He was elected to the commission in 1998. Owen is no stranger to the Durham-Chapel Hill area, having completed his undergraduate and graduate studies at Duke University. No word yet as to who will lead the FDA's effort on cell phones after Owen leaves in late February or March.

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Motorola has asked Dr. **Larry Anderson**'s group at the **Battelle** Pacific Northwest Labs in Richland, WA, to follow up on the experimental findings of Dr. **Pierre Aubineau** at the University of Bordeaux. Aubineau's work could explain why some users of cell phones develop headaches (see *MWN,* N/D01). The Battelle group will estimate the SARs in the dura mater, one of the membranes that surround the brain, according to Dr. **Mays Swicord**, Motorola's director of EME programs in Plantation, FL. "It's a small dosimetry contract," he told *Microwave News*.

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The **FCC** has denied the **EMR Network**'s petition that the agency take a fresh look at its RF/MW exposure guidelines — but the network is not giving up. On December 11, the FCC's Office of Engineering and Technology (OET) stated that it would not open an "inquiry," as the network had requested in the fall (see *MWN,* S/O01). Since it is "well established" that the FCC is not an expert health agency, it should not decide whether its RF/MW standard protects the public, OET's **Bruce Franca** told the network of grassroots groups fighting telecommunications towers. Instead, Franca referred the network to the EPA or the FDA, on whose advice the FCC "relied heavily" in developing its guidelines. On January 10, the EMR Network filed a formal appeal asking FCC Chair Michael Powell and the other commissioners to overrule the OET. Franca's argument is "astonishing," wrote **James Hobson** of Miller & Van Eaton in Washington, who is representing the network. The FCC "cannot lawfully avoid" its responsibility to stand behind its rules, he argued. **Janet Newton** of Marshfield, VT, the director of the EMR Network, pointed to the inconsistency in the agency's position. "When we asked the court to overturn the FCC's rules, the commission convinced the court that it *is* competent to decide which standard is appropriate," she told *Microwave News* (see *MWN,* M/A00 and J/F01). If the FCC denies the latest appeal, the network may go back to court. The FCC faces no formal deadline for responding to the appeal, but if it waits too long a judge could be asked to intervene.

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The **Friends of the Earth** (FOE) and the **Forest Conservation Council** have not fared any better than the EMR Network. On January 4, the **FCC**'s Wireless Telecommunications Bureau (**WTB**) dismissed petitions filed by the two groups seeking a single environmental impact statement (**EIS**) for *all* the antenna **towers** it licenses (see *MWN,* J/A01). The FOE and the council contend that the towers kill migratory birds, encroach on wildlife habitat and give off radiation that may be a human health hazard — and that the WTB okays thousands of towers with virtually no environmental review. The WTB ruling clears the way for the approval of more than 30 proposed towers that had been challenged by the environmental groups. The FCC argued that the FOE and the council are not legally qualified to challenge those tower applications — that is, they lack standing — and advised them to raise their concerns through the FCC's rulemaking process. "There may be legitimate issues here, but this is not the right way to raise them," WTB spokesperson Meribeth McCarrick told *Microwave News*. The forest council's John Talberth countered that his group had resorted to blocking the towers because the FCC had ignored earlier requests to open a rulemaking proceeding. "They know that these are important concerns," he said in an interview. "They just don't want to deal with them yet." Both Talberth and FOE's Brian Dunkiel said that they will appeal WTB's decision to FCC Chair Michael Powell and the other commissioners by the February 6 deadline.

FROM THE FIELD

Across the Spectrum

"It's sort of a no-brainer."

—Alex Story, 27, Alexandria, VA, on his decision to save $30 a month by terminating his landline phone service and relying exclusively on his mobile phone, quoted by Yuki Noguchi, "More Cell Phone Users Cut Ties to Traditional Service," *Washington Post,* p.E5, December 28, 2001

[S]hould we be making public health decisions for more than 100 million users of handheld cell phones on the basis of data from 106 patients, particularly when the latency for cancer to appear is typically longer than the latency experienced by these few patients?

— Dr. Allan Frey, Randomline Inc., Potomac, MD, "Hold the (Cell) Phone..." (letter), *Science,* pp.440-441, January 18, 2002. The 106 patients are those with brain tumors included in the Inskip and Muscat epidemiological studies, who had used cell phones for more than a short period of time (see *MWN,* J/F01). Both study teams concluded that they did not find a brain tumor risk. Frey's letter is in response to a November 16 article by Mark Parascandola on the upcoming *Daubert* hearing in the Christopher Newman cell phone–brain tumor lawsuit. Frey is a consultant to Peter Angelos's law firm in Baltimore, which is representing Newman (see also *MWN,* N/D01).

Letter to the Editor

ALS and Electroshock Therapy

December 26, 2001

To the Editor,

In amyotrophic lateral sclerosis [ALS] studies, it has been difficult to separate the relative etiologic contributions of EMFs and electric shocks. Patients receiving electroconvulsive shock therapy receive numerous electric shocks producing unconsciousness without chronic EMF exposures.

If electric shocks cause ALS, they should be a high-risk population.

Samuel Milham, MD
2318 Gravelly Beach Loop, NW
Olympia, WA 98502
E-mail: <smilham2@attbi.com>

In a report released last November 8, the Advisory Group on Non-Ionizing Radiation of the U.K.'s National Radiological Protection Board concluded that work in electrical occupations is associated with an increased risk of ALS (see MWN, *N/D01). The group, which is chaired by Sir Richard Doll, suggested that a large case-control study taking account of employment history, electroshock treatments and transcranial magnetic stimulation, among other factors, could help clarify the possible roles of EMF exposures and electric shock in causing ALS.*

On the Internet

MCL Calculator

Need to know the ICNIRP occupational exposure limit for electric fields at 400 kHz or the ANSI/IEEE "controlled" power density standard at 2.4 GHz? Now the math-challenged have quick, reliable access to such numbers, thanks to MCL in London. The company's Web site, **<www.mcluk.org>**, has a calculator that provides the ICNIRP, IEEE or NRPB limits for any specified frequency. Time-averaged and peak values are included as well as contact currents. If you make a mistake, like asking for a power-density limit below 10 MHz, the computer explains what you did wrong. Especially useful is its ability to compare the limits for the various standards. MCL makes it all very easy. Elsewhere on the site are details of the consulting and research support services offered by MCL's team of experts, which is led by Drs. Philip Chadwick, Camelia Gabriel and Edward Grant (see also p.10). The firm was formerly called Microwave Consultants Ltd.

Germans Talk About EMFs

The Jülich Research Center in Jülich, Germany, has established a site, **<www.emf-risiko.de>**, to address "scientific and social controversies over EMFs," with special emphasis on mobile phones. The center's Group on Humans, Environment and Technology, has posted audio files of an EMF forum featuring former ICNIRP Chair Dr. Jürgen Bernhardt, Dr. Lebrecht von Klitzing of the University of Lübeck and Dr. Roland Glaser of Humboldt University in Berlin. The center's analysis of the four reports on health research commissioned by the wireless carrier T-Mobil (see *MWN,* M/J01 and J/A01) is also on the site, as is *Guidelines for Addressing Problems of Electromagnetic Fields in Communities*, a book written at the request of the German Federal Environment Ministry. General descriptions of the work are available in both German and English, but most of everything else is only in German.

NRPB Revamps Web Site

The U.K.'s National Radiological Protection Board (NRPB) has completely redesigned its Web site, **<www.nrpb.org>**. The home page has a special button for information on electromagnetic radiation and fields. The NRPB's *Radiological Protection Bulletin* can be downloaded from this site — the *Bulletin* is no longer published in print form.

The Frequency Fence

In 2004, extraterrestrials will use the electric power grid, radiation from mobile phone towers and television broadcasts to impose an "electromagnetic-induced form of mind control" on humanity—the "frequency fence." So say Terry and Isha Robinson of the International Sovereignty Alliance (ISA) in a report posted at **<www.abovetopsecret.com>**, a site that covers topics such as the NSA's Echelon surveillance system and that perennial favorite, Area 51, with the aim of "exposing the secrecy that exists within the government and military organizations of the world." "Actually," Terry Robinson told *Microwave News* from ISA's headquarters in Kapaa, HI, "it will probably happen in 2003." For those who wish to protect themselves, the ISA recommends its course on "DNA strand activation," available on six audio cassettes for $99.00 plus shipping and handling. For details, go to ISA's Web site, **<www.dimensionalshift.20m.com>**.

2002 Conference Calendar (Part II)

Part I appeared in our last issue.

March 1: **JRC Collaborative Action: Human Exposure to Radiation from GSM and GPRS/UMTS Base Stations Across Europe,** Joint Research Center (JRC), Ispra, Italy. On March 2, the JRC will host two roundtable discussions: **R&D Issues on Human Exposure EMF Measurements and Protocols** and **EMF Risk Perception & Communication**. Contact: Dr. Demosthenes Papameletiou, EC/JRC, Institute for the Environment and Sustainability, I-21020 Ispra, Italy, (39+0332) 785282, Fax: (39+0332) 786272, E-mail: <demosthenes.papameletiou@jrc.it>.

March 21-22: **Adverse Temperature Levels in the Human Body Workshop,** World Health Organization (WHO), Geneva, Switzerland. Contact: Dr. Leeka Kheifets, Radiation Program, WHO, CH-1211 Geneva 27, Switzerland, (41+22) 791-4976, Fax: (41+22) 791-4976, E-mail: <kheifetsl@who.int>.

May 16-17: **International Conference on Electromagnetic Environments and Health in Buildings,** Royal College of Physicians, London, U.K. Contact: Jill Skinner, Abacus Communications, The Pool House, South Hill, Chislehurst, Kent BR7 5EF, U.K., (44+20) 82952951, Fax: (44+20) 84670145, E-mail: <jill@abacuscom.co.uk>, Web: <www.emr-environments.com>.

June 14-19: **12th Annual Conference of the International Society for the Study of Subtle Energies and Energy Medicine (ISSSEEM),** Boulder, CO. Contact: Penny Hiernu, ISSSEEM, 11005 Ralston Rd., Ste.100D, Arvada, CO 80004, E-mail: <issseem@compuserve.com>, Web: <www.issseem.org>.

June 26-28: **Mediterranean Microwave Symposium,** Cáceres, Spain. Contact: MMS, Secretariat, Escuela Politécnica de Cáceres, Universidad de Extremadura, 10071 Cáceres, Spain, (34+927) 257-443, Fax: (34+927) 257-202, E-mail: <mms2002@tsc.unex.es> or <llandesa@unex.es>, Web: <http://tsc.unex.es/mms2002>.

July 21-25: **2002 IEEE Power Engineering Society (PES) Summer Meeting,** Palmer House Hilton, Chicago, IL. Contact: IEEE PES Executive Office, 445 Hoes Ln., Piscataway, NJ 08855, Web: <www.ieee.org/power>.

August 11-15: **12th Conference of the International Society of Exposure Analysis (ISEA)** and **14th Conference of the International Society for Environmental Epidemiology (ISEE),** University of British Columbia, Vancouver, Canada. Contact: Dr. Michael Brauer, UBC Conference Center, 5961 Student Union Blvd., Vancouver, BC V6T 2C9, Canada, (604) 822-1050, Fax: (604) 822-1069, E-mail: <brauer@interchange.ubc.ca>, Web: <www.conferences.ubc.ca/iseaisee2002>.

August 17-24: **27th General Assembly of the International Union of Radio Science (URSI),** Exhibition and Congress Center, Maastricht, The Netherlands. Contact: Dr. Leon Kamp, Dept. of Applied Physics, Eindhoven University of Technology, PO Box 513, NL-5600 MB Eindhoven, The Netherlands, (31+40) 247-4292, Fax: (31+40) 244-5253, E-mail: <URSI2002@tue.nl>, Web: <www.ursi-ga2002.nl>.

August 18-21: **3rd International Conference on Microwave and Millimeter Wave Technology,** Beijing, China. Contact: Ms. Fang Min, Chinese Institute of Electronics, PO Box 165, Beijing 100036, China, (86+10) 6828 3463, Fax: (86+10) 6828 3458, E-mail: <shaz@sun.ihep.ac.cn>, Web: <www.cie-china.org/icmmt2002>.

August 18-22: **16th International Epidemiological Association World Congress of Epidemiology,** Montreal, Canada. Contact: Congress Secretariat, c/o Events International Meeting Planners, 759 Victoria Sq., Ste. 300, Montreal, PQ H2Y 2J7, Canada, (514) 286-0855, Fax: (514) 286-6066, E-mail: <iea2002@eventsintl.com>, Web: <www.iea2002.com>.

August 19-23: **IEEE International Symposium on Electromagnetic Compatibility,** Minneapolis, MN. Contact: Duane Bagdons, International Certification Services, E-mail: <drbicsi@hutchtel.net>, Web: <www.2002-ieee-emc.org>.

August 25-30: **39th CIGRÉ General Session,** Paris, France. Contact: Liliane Ney, CIGRÉ, 21 rue d'Artois, Paris 75008, France, (33+1) 5389-1290, Fax: (33+1) 5389-1299, E-mail: <secretary-general@cigre.org>, Web: <www.cigre.org/GB/2002/fr2002session.htm>.

September 9-13: **International Symposium on Electromagnetic Compatibility,** Sorrento, Italy. Contact: AEI Central Office, Massimo Iandolo, Piazzale R. Morandi 2, Milan 20121, Italy, (39+02) 7779-0218, Fax: (39+02) 798-817, E-mail: <emceurope2002@aei.it>, Web: <www.aei.it/emceurope2002.html>.

September 11-14: **16th EPICOH Congress on Epidemiology in Occupational Health,** Barcelona, Spain. Contact: EPICOH Technical Secretariat Suport Serveis, Calvet 30, Barcelona 08021, Spain, (34+93) 201-7571, Fax: (34+93) 201-9789, E-mail: <suport@suportserveis.com>, Web: <www.suportserveis.es>.

September 19-22: **19th Annual Meeting of the European Society for Magnetic Resonance in Medicine and Biology (ESMRMB),** Florence, Italy. Contact: ESMRMB, Neutorgasse 9/2A, Vienna A-1010, Austria, (43+1) 535-1306, Fax: (43+1) 535-7041, E-mail: <office@esmrmb.org>, Web: <www.esmrmb.org>.

September 23-24: **3rd International Conference on Electromagnetic Fields and Human Health: Fundamental and Applied Research,** Moscow, Russia. Andrey Vasin, Institute of Biochemical Physics, Russian Academy of Science, Kosigina 4, Moscow 117334, Russia (7+95) 190-5421, E-mail: <yurgrigor@cityline.ru>, Web: <www.pole.com.ru/conf2002>. Following this meeting, on September 25-27, there will be a conference on **Harmonization of EMF Standards in Connection with the Science for East European Countries**. This is the latest in a series organized by the World Health Organization (WHO).

October 6-10: **24th Annual Electrical Overstress/Electrostatic Discharge Symposium,** Convention Center, Charlotte, NC. Contact: Steve Voldman, IBM Microelectronics, MS 972F, 1000 River St., Essex Junction, VT 05452, (802) 769-8368, E-mail: <a108501@us.ibm.com>, Web: <www.esda.org/symposia.html>.

October 7-11: **2nd International Workshop on Biological Effect of EMFs,** Aldemar Paradise Royal Mare Hotel, Rhodes, Greece. Contact: Prof. Panos

Meeting Notes

• The objective of the March 1 **EC/JRC** workshop is to begin drafting a protocol for measuring RF/MW radiation levels associated with mobile phone base stations. The meeting is by invitation only.

• The WHO EMF Project has scheduled three by-invitation-only meetings. On March 21-22, it will host a **Temperature Workshop** in Geneva, which is being organized by Dr. Joe Elder of Motorola and WHO's Dr. Leeka Kheifets. The project's international advisory committee will meet in Geneva, June 6-7. And from October 28 to November 1, the ***WHO Workshop on Finalizing the Framework for Harmonized EMF Standards*** will be held in Guilin, which is in Guangxi Province, China. For more information, contact Kheifets — see March 21-22 listing at left.

• The ***WHO–USAF Asia-Pacific EMF Conference***, scheduled for October 21-27 at the five-star Arcadia Beach Resort on Phuket Island, Thailand, has been postponed. Dr. Jon Klauenberg, of the USAF's RFR branch at Brooks AFB, explained that this was due to limits on overseas travel following the September 11 attacks. Klauenberg said that it may be held next year. He can be reached at (210) 536-4837, Fax: (210) 536-3977, E-mail: <b.jon.klauenberg@brooks.af.mil>.

Kostarakis, (30+1) 650-3129, Fax: (30+1) 653-2910, E-mail: <conf2002@imm.demokritos.gr>, Web: <www.uoi.gr/conf_sem/bioeffects>.

October 15-17: **IEE Radar Conference,** Edinburgh, Scotland, U.K. Contact: IEE Conference and Exhibition Services, Savoy Pl., London WC2R 0BL, U.K., (44+207) 344-5477, Fax: (44+207) 240-8830, E-mail: <radar2002@iee.org.uk>, Web: <www.iee.org.uk/Conf/Radar>.

October 20-24: **1st Asian and Oceanic Congress for Radiation Protection (AOCRP),** Seoul, Korea. Contact: Dr. Myung-Jae Song, R&D Office, Nuclear Environment Technology Institute, KHNP, PO Box 149, Yusung, Daejon 305-600, Korea, (82+42) 870-0202, Fax: (82+42) 870-0269, E-mail: <mjsong@khnp.co.kr>, Web: <www.aocrp-1.com>.

October 24-27: **24th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS)** and **2002 Annual Fall Meeting of the Biomedical Engineering Society (BMES),** Westin Galleria Hotel, Houston, TX. Contact: EMB Executive Office, (732) 981-3433, Fax: (732) 465-6435, E-mail: <emb-exec@ieee.org>, Web: <embs-bmes2002.org>.

November 10-14: **Engineering and Physical Sciences in Medicine,** Convention Center, Rotorua, New Zealand. Contact: Dr. David Black, Enviromedix, Private Bag 24 904, Royal Oak, Auckland, New Zealand, (64+9) 625-0407, Fax: (64+9) 625-2292, E-mail: <david@enviromedix.co.nz>, Web: <www.epsm2002.com>.

November 12-14: **12th International Symposium on Antennas,** Acropolis Convention Center, Nice, France. Contact: Secrétariat JINA 2002, France Télécom R&D, Fort de la Tête de Chien, 06230 La Turbie, France, Fax: (33+492) 106519, E-mail: <jina.cnet@wanadoo.fr>, Web: <www. jina2002.com>.

Hot New Papers

Wolfgang Löscher, "Do Cocarcinogenic Effects of ELF Electromagnetic Fields Require Repeated Long-Term Interaction with Carcinogens? Characteristics of Positive Studies Using the DMBA Breast Cancer Model in Rats," *Bioelectromagnetics, 22,* pp.603-614, December 2001.

"By reviewing the Hannover series of experimental studies on MF effects in the DMBA model, we have identified a number of factors that seem to be critical for the outcome of such laboratory studies: (1) The rat substrain used is possibly the most important factor in determining the results from EMF exposure. We have started to directly compare MF bioeffects in different SD [Sprague-Dawley] substrains in our laboratory...(2) The dose of DMBA is critical because the cocarcinogenic effect of MF increases with decreasing background tumor incidence.... (3) The duration of MF exposure is important, because our data strongly indicate that MF exposure affects tumor growth rather than tumor incidence....(4) The flux density used for MF exposure is important, because the cocarcinogenic effect of MF seems to be lost at high (mT) flux densities, indicating a flux-density window in the μT range. (5) The location of tumors across the mammary gland complexes of the female rat is important, with the cranial thoracic complexes being most sensitive to EMF exposure....Even though the effects of MF exposure seen in our experiments were small, MF effects of similar magnitude in human populations would represent a critical adverse health effect because of the high incidence of female breast cancer. A critical question is whether these results are real or are due to chance or methodological biases. That in our six experiments group tumor incidence in MF-exposed groups was never below sham controls, but above controls in five experiments, argues against chance as an explanation for the findings."

David de Pomerai et al., "Growth and Maturation of the Nematode *Caenorhabditis Elegans* Following Exposure to Weak Microwave [MW] Fields," *Enzyme and Microbial Technology, 30,* pp.73-79, January 2002.

"Prolonged exposure to weak MW fields...at 25˚C induces a heat-shock response in transgenic *C. elegans* strains carrying *hsp16* reporter genes. A comparable response to heat alone requires a substantially higher temperature of 28˚C...Here we investigate two further biological consequences of prolonged MW exposure [750-1000 MHz, SAR 0.001 W/Kg] at 25˚C in synchronized cultures of wild-type worm larvae, namely alterations in (i) growth rate (GR) and (ii) the proportion of worms later maturing into egg-bearing adults (MP). Both of these parameters are significantly increased following MW exposure (GR by 8-11% and MP by 28-40%), whereas both are significantly decreased (GR by 10% and MP almost abolished) after mild heat treatment at 28˚C for the same period. It follows that the biological consequences of MW exposure are opposite to, and therefore incompatible with, those attributable to mild heating. This evidence does not in itself necessitate a non-thermal mechanism, but does eliminate explanations that invoke the bulk heating of tissues by MWs." (See also *MWN,* M/J00.)

New Research Projects

• Dr. **Peter French** of St. Vincent's Hospital in Sydney, **Australia**, is investigating whether long-term, intermittent exposures to mobile phone radiation can modulate the genetic activity of human brain cells. The experiment will test French's hypothesis that phone use can stimulate the expression of **heat shock proteins**, leading to the development of cancer (see *MWN,* J/A01). Telstra, the Australian telecommunications giant, is providing the TEM exposure system. French told *Microwave News* that he expects to announce results by the end of the year.

• An **epidemiological** study of people living near the Lookout Mountain antenna farm outside Denver is under way. Drs. **John Reif** and **James Burch** of Colorado State University in Ft. Collins, the coprincipal investigators, will determine whether broadcast RF/MW radiation affects the production of melatonin and ornithine decarboxylase (ODC), among other biological markers. Past studies suggesting that higher-than-expected rates of brain cancer on Lookout Mountain and a proposal to build new DTV transmitters have added fuel to the long-running controversy over possible health impacts (see *MWN,* M/A99 and J/F00). The new study, which is being sponsored by the National Institute of Environmental Health Sciences (**NIEHS**), is the first epidemiological study of broadcast radiation ever funded by a U.S. government agency. Both Reif and Burch declined to discuss the project with *Microwave News*.

C. Cranfield, A. Wood, V. Anderson and K. Menezes, "Effects of Mobile Phone Type Signals on Calcium Levels Within Human Leukemic T-Cells (Jurkat Cells)," *International Journal of Radiation Biology, 77,* pp.1207-1217, December 2001.

"In an experiment in which SARs in individual human leukemic cells have been accurately determined [915 MHz GSM, 1.5 W/Kg (95% CI: 1.0-2.2W/Kg)], no changes in average calcium level have been de-

tected. In addition, no significant alteration has been shown in either the percentage of cells showing 'spiking' or the height and number of these spikes. The significant change in average frequency derived from the PSD [power spectral density] of the variations in fluorescent intensity was for one combination of experimental conditions only and is difficult to assess in terms of biological sequelae and could be a statistical anomaly."

Päivi Heikkinen et al. (including Sakari Lang and Jukka Juutilainen), "Effects of Mobile Phone Radiation on X-Ray-Induced Tumorigenesis in Mice," *Radiation Research, 156,* pp.775-785, December 2001.

"Two hundred female CBA/S mice were randomized into four equal groups at the age of 3 to 5 weeks. The mice in all groups except the cage-control group were exposed to ionizing radiation at the beginning of the study and then to RF radiation for 1.5 h per day, 5 days a week for 78 weeks. One group was exposed to continuous NMT (Nordic Mobile Telephone)-type frequency-modulated RF radiation at a frequency of 902.5 MHz and a nominal average specific absorption rate (SAR) of 1.5 W/Kg. Another group was exposed to pulsed GSM (Global System for Mobile)-type RF radiation (carrier-wave frequency 902.4 MHz, pulse frequency 217 Hz) at a nominal average SAR of 0.35 W/Kg....The RF radiation exposures did not increase the incidence of any primary neoplasm in the tissues examined significantly. The incidence of glandular polyps in the uterus ($p=0.011$) was decreased in the group exposed to continuous RF radiation, and the incidence of benign pheochromocytomas in the adrenal glands was lower in both RF radiation–exposed groups ($p=0.041$ and $p=0.039$ for the continuous RF and pulsed RF group, respectively). However, the incidence of hyperplasias in the adrenal medulla was not significantly different in those groups... The results of the current study suggest that long-term exposure of mice to low-level RF radiation (902 MHz) at these exposure levels and modulation characteristics does not affect the development of malignant lymphomas induced by ionizing radiation....Chou et al. [1992, known as the Guy study] reported a significant increase in the overall incidence of primary malignancies in rats exposed to 2.45 GHz microwaves at an SAR of 0.15-0.4 W/Kg. There were no differences, however, for any specific type of tumor. In our study, the proportions of animals with primary malignant neoplasms were slightly higher in the two groups exposed to RF radiation (56% and 50%) than in the sham RF radiation–exposed animals (40%), but this difference was not statistically significant, and survival was not changed. Furthermore, the exposures to RF radiation did not significantly increase the incidence of any primary neoplasm considered separately. There was a statistically significant decrease in the incidence of benign pheochromocytomas in RF radiation–exposed groups. It remains to be determined whether this statistically significant difference is a real effect of the exposure to RF radiation or is a consequence of chance....The exposure to RF radiation did not cause any nonneoplastic changes that could be interpreted as promotion of tumor development....The RF radiation exposures apparently did not cause any other harmful effects in the animals."

Paolo Bernardi et al., "Power Absorption and Temperature Elevations Induced in the Human Head by a Dual-Band Monopole-Helix Antenna Phone," *IEEE Transactions on Microwave Theory and Techniques, 49,* pp.2539-2546, December 2001.

"A numerically efficient way to evaluate specific absorption rate (SAR) deposition and temperature elevation inside the head of a user of a cellular phone equipped with a dual-band monopole-helix antenna is proposed. The considered antenna operates at both frequencies (900 and 1800 MHz) [GSM]. The results obtained show that, for a given radiated power, although the maximum SAR value as averaged over 1 g in the brain is higher at 900 MHz than at 1800 MHz, the maximum temperature increase in the brain is higher at 1800 MHz. However, taking into account that the average power levels radiated at the two operating frequencies are different (250 mW at 900 MHz and 125 mW at 1800 MHz), higher temperature elevations are obtained at 900 MHz. In this last case, the temperature increases are on the order of 0.2°C in the ear, and less than 0.1°C in the external brain region close to the phone. When the heating effect due to the contact of the ear and cheek with the phone is also taken into account, it is found that the predominant heating effect in the ear, able to cause temperature increases as high as 1.5°C, is the one due to the phone contact, while SAR deposition plays a significant role only in the heating of the external brain region."

"MICROWAVE NEWS" FLASHBACK

Years 20 Ago

• Two U.S. government advisory panels, ERMAC and FMAC, weigh issuing a statement assuring the public that, "No health hazard can result from total incident radiation lower than 50 $\mu W/cm^2$."

• Exposures at 17 out of 21 workplaces with RF heaters and sealers exceed OSHA's 10 mW/cm^2 limit, a NIOSH survey finds.

• Multnomah County, OR, extends its moratorium on new broadcast transmitters and considers adopting its own RF/MW standard. These actions follow a study by Dr. William Morton linking RF/MW radiation to uterine cancer in parts of Portland.

Years 10 Ago

• The Wisconsin Public Service Commission orders state utilities to use the "best available control technology" to reduce EMFs from new and upgraded transmission lines.

• Over 150 researchers gather in Brussels for the inaugural conference of the European Bioelectromagnetics Association.

• Florida health officials identify a cluster of Hodgkin's disease cases near Patrick Air Force Base. Seven of the eight cases lived within 400 yards of the radar, used by both the USAF and the FAA.

Years 5 Ago

• A memo written by Motorola spokesman Norman Sandler to Burson-Marsteller reveals that they have been "war-gaming" their response to the impending release of a study by Drs. Henry Lai and N.P. Singh showing that microwaves can cause breaks in DNA.

• Living near a broadcast tower carries increased risks of adult leukemia, according to Dr. Helen Dolk in the U.K., and of childhood leukemia, according to Dr. Bruce Hocking in Australia.

• U.S. and Swedish researchers find statistically significant links between EMF exposures at work and Alzheimer's disease.

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UPDATES

AT THE MOVIES

Turning Off the Lights... Say you want to rob some casinos and need to cut off the power to the alarms and closed-circuit video cameras. How would you do it? In the 1960 production of *Ocean's Eleven,* Frank Sinatra and the members of his "rat pack" used explosives to topple one of the transmission line towers feeding electricity to Las Vegas. That is too low-tech for Steven Soderbergh's 2001 remake with the same title. Soderbergh must have heard that street lights in Hawaii's Waikiki beach mysteriously went out after a 1962 nuclear test in the Pacific. So, this time around, the gang, led by George Clooney, steals a portable EMP generator from a research lab. When the zapper is activated, Vegas goes dark. Another striking difference between the two movies is that most of the stolen cash goes up in smoke at the end of the 1960 film. But in the remake, Clooney escapes with the loot, as well as the pretty girl (Julia Roberts). Hollywood screen writers are no strangers to the marvels of EMP. In the 1995 James Bond movie, *GoldenEye,* agent 007 battles Russian hoods who harness a satellite that uses EMP to disable electronics. And in *Eraser,* which appeared the following year, Arnold Schwarzenegger contends with corporate and government thugs armed with EMP guns. Also in 1996, EMP weapons were featured in *Broken Arrow* and *Escape from L.A.* (see *MWN,* S/O96).

MILITARY RADAR

Health Concerns in Azerbaijan... Agence France-Presse (AFP) reports that citizens living in the shadow of the Russian missile defense radar in Qabala, in northern Azerbaijan, are complaining of too many birth defects and too many sick children as well as the sudden deaths of apparently healthy adults (January 23). "It's like living next door to Chernobyl," said one local teacher. On its Web site, GlobalSecurity.org states that the radar, completed in 1984, has a projected output power of 350 MW. A joint Russian-Azeri study commission exonerated the radar from any blame for the health complaints, according to the AFP. This is not the first time a Russian radar has been the target of local concern. In the mid-1990s, a number of studies pointed to health and ecological effects in the vicinity of the military radar station in Skrunda, Latvia (see *MWN,* S/O94 and S/O96).

PEOPLE

Dr. **Anders Ahlbom** of the Karolinska Institute in Stockholm has been awarded the International Prize for Tumor Prevention by the Italian Association Against Cancer. Ahlbom is being honored for his epidemiological studies on the cancer risks associated with EMFs. The award, which includes a check for 10 million lire (over €5,000 or $4,600), is presented every four years. Past winners include Dr. **Irving Selikoff** and **Cesare Maltoni** for their work on asbestos and vinyl chloride, respectively. Ahlbom will be feted at a ceremony in Latina, an hour's drive south of Rome, on February 22....On December 31, Dr. **Neil Cherry** was named an Officer of the New Zealand Order of Merit. Cherry, of Lincoln University in Canterbury, was honored for "services to science, education and the community" by Queen Elizabeth II, who also enjoys the title of Queen of New Zealand. "My com-

munity work includes appearing without payment on behalf of over 25 communities in New Zealand and Australia trying to keep cell sites away from their homes and workplaces," Cherry told *Microwave News*. Cherry has long voiced concern that RF/MW radiation exposure standards are too lenient and has been especially critical of ICNIRP's limits (see *MWN,* M/A97 and M/A 00). The award comes as Cherry has been diagnosed with motor neuron disease, a condition in which muscles progressively and irreversibly degenerate over a three-to-five-year period. He plans to continue working: "I will be able to use a computer to write and communicate for a long time in this period," he said....**Mike Silva** of Enertech Consultants in Campbell, CA, has joined EPRI as a half-time consultant to help manage its new RF safety and wireless technology program. Silva declined to discuss his move up from the ELF part of the spectrum, referring calls to EPRI's PR office. He can be reached at <msilva@epri.com>....**Mark Douglas** has left the antenna development group at Sony Ericsson Mobile Communications in Research Triangle Park, NC, to become the engineering manager at Dr. **C.K. Chou**'s EME lab at Motorola in Plantation, FL....Dr. **Marvin Ziskin** of Temple University in Philadelphia is the new chair of IEEE's Committee on Man and Radiation (COMAR). He replaces **Howard Bassen** of FDA's Center for Devices and Radiological Health, who served a two-year term. Ziskin is on the board of directors of the NCRP.

PRECAUTIONARY PRINCIPLE

Assorted Notes... The European Environment Agency (EEA) has published a report (No.22) that examines how the precautionary principle has been applied — or not — over the last hundred years. Based on 14 contributed case studies, *Late Lessons from Early Warnings: The Precautionary Principle 1896-2000* presents 12 lessons for policy makers. These include acknowledging ignorance, uncertainty and risk, identifying gaps in scientific knowledge and following up early warnings. Among the agents studied are ionizing radiation, asbestos, benzene, DES and MTBE, as well as mad cow disease. The 200-page report, released on January 10, is available free on the Internet at: <http://reports.eea.eu.int>. Earthscan Publications Ltd. in London will issue the report in the spring. Tel: (44+207) 278-0433, Fax: (44+207) 278-1142, E-mail: <earthinfo@earthscan.co.uk>, Web: <www.earthscan.co.uk>....More than 75 scientists from 17 countries issued a statement following the *International Summit on Science and the Precautionary Principle,* held in Lowell, MA, September 20-22. They urged governments to "adopt the precautionary principle in environmental and health decision-making under uncertainty when there are potential risks." Among the signers were Drs. Marco Martuzzi of the WHO in Rome and David Ozonoff of Boston University. The full statement and a list of signers are at: <www.uml.edu/centers/lcsp/precaution>....Drs. Ken Foster of the University of Pennsylvania in Philadelphia and Paolo Vecchia of Italy's National Institute of Health in Rome are seeking papers on the precautionary principle for publication in the winter issue of *IEEE Technology and Society Magazine*. Papers are due on April 1. This special issue of the magazine will appear in December. For more information, contact Foster at (215) 898-8534, or <kfoster@seas.upenn.edu>.

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As We Go to Press

NAS–NRC Committee on Potential Health Effects of PAVE PAWS Radar

On February 5, the National Academy of Sciences–National Research Council (NAS–NRC) announced the members of its committee to assess the potential health effects of PAVE PAWS radiation (see *MWN,* N/D01).

The provisional members of the committee are:

- Dr. Frank Barnes, University of Colorado, Boulder, chair
- Dr. Robert Hansen, RC Hansen Inc. (consulting engineers), Tarzana, CA, vice chair
- Dr. Larry Anderson, Battelle Pacific Northwest Labs, Richland, WA
- Dr. Graham Colditz, Harvard Medical School and School of Public Health, Boston, MA
- Dr. Francesca Dominici, Johns Hopkins University School of Public Health
- Dr. Kenneth McLeod, State University of New York, Stony Brook
- Dr. Keith Paulsen, Dartmouth Medical Center, Hanover, NH
- Dr. Leslie Robison, University of Minnesota, Minneapolis
- Dr. Susan Santos, University of Medicine & Dentistry of New Jersey, Piscataway
- Dr. Jan Stolwijk, emeritus, Yale University School of Medicine, New Haven, CT

Both Anderson and Hansen have security clearances, according to Dr. Rick Jostes of the NAS–NRC.

The NAS–NRC is inviting comments on these provisional choices for 20 calendar days from February 5. Go to: <http://nationalacademies.org> and search for "PAVE PAWS."

Keeping Current: Follow-Up on the News

◆ Baltimore attorney Peter Angelos, who is heavily involved in cell phone lawsuits, is set to collect $250 million for representing the state of Maryland in tobacco litigation. The state had originally promised to pay him 25% of any award. But when the state won $4 billion, many balked at giving him a ten-figure payday. Angelos has offered to take a 75% cut in return for being paid over six years instead of 20 and avoiding future litigation.

◆ Israel's Ministry of Defense has evaluated dozens of nonlethal weapons, Major General Isaac Ben-Israel, the outgoing chief of military R&D, told *Defense News* (December 17-23). Among these are: EMP and high-powered microwaves. It is not clear whether they have ever been deployed. Ben-Israel also said that his directorate has explored mind-control technologies, but decided that they were not effective.

◆ Narda Safety Test Solutions will hold a three-day seminar on measuring and managing sources of electromagnetic radiation at Narda's headquarters in Hauppauge, NY, April 9-11. Cell phone and radio transmitters as well as radar will be covered. For more information, contact Richard Strickland at (631) 231-1700, ext. 322 or <richard.strickland@narddasts.com>.

◆ U.S. soldiers who served in the 1990-1991 Gulf War are "nearly twice as likely" to develop ALS, according to a study of more than 2.4 million men and women by the VA and the defense department. Forty Gulf veterans with ALS are now eligible for compensation and other benefits, the VA announced in December. (See also p.12.)

◆ The U.K. Electricity Association has posted a revised edition of its 10-page pamphlet, *Electric and Magnetic Fields [The Facts],* on its Web site, <www.electricity.org.uk>. Also posted is a one-page briefing, *Recent Developments,* dated May 2001.

◆ The Science and Technology Committee of the Knesset, Israel's parliament, has adopted a recommendation that the use of cell phones by children should be kept to a minimum, according to the January 2 *Jerusalem Post*.

◆ The long-delayed DMBA–RF/MW rat studies by Germany's Drs. Hella and Christian Bartsch will appear in the February issue of *Radiation Research (see MWN,* J/A99 and N/D00).

Consumers Betrayed and Abandoned

When shopping for the most reliable washing machine or the best shampoo for the dollar, many Americans depend on *Consumer Reports,* published by the Consumers Union (CU). On the other side of the Atlantic, the British consult *Which?,* the magazine of the U.K. Consumers' Association (CA).

But this strategy is a loser when it comes to learning about the possible risks associated with electromagnetic radiation.

February is cell phone month at *Consumer Reports*. This year, the magazine features 13 pages on how to buy the best phone, find the best service plan and weigh the hazards of driving while on the phone — one full page is on hands-free headsets.

Yet there is not a single word about possible radiation health risks.

Perhaps the CU only addresses phone radiation in odd numbered years. It did devote a single paragraph in its 8-page cover story last February — 2000 was another fallow year — but even so, it used wording usually favored by industry. "To date no *conclusive* evidence has demonstrated [a brain tumor] risk," the CU editors wrote [emphasis added].

Of course we agree with that. Everybody does. But it obscures the many uncertainties about what might happen if you put a radio transmitter next to your brain day after day, year after year.

Expert panels in England, France, Germany and Spain have all advised that children should limit their use of mobile phones. The British Medical Association and the German Academy of Pediatrics have made similar recommendations.

Sir William Stewart, the former science advisor to the British prime minister, has been particularly vocal in trying to stop the marketing of phones to children — a message he repeated at the end of January on announcing the 15 new grants for mobile phone research (see p.10).

The CU appears to be apathetic about any long-term risks to children. Or maybe it is simply unaware of what is going on in other parts of the world. We tried to ask the new editor of *Consumer Reports* for the CU's point of view, but she did not respond to our messages.

In 1997 and again in 2001, the CU suggested that concerned readers use a hands-free set. But over in England, the CA has discouraged their use, arguing that these sets can actually increase radiation exposure (see *MWN,* M/J00 and S/O00).

With the exception of ERA Technology, which made the measurements for the CA, none of the many test labs we contacted on three continents thinks that there is any substance to ERA's and CA's claims. But in the ensuing media storm, the CA has made no effort to respond to its naysayers.

Microwave News has learned that one of CA's own technical experts advised the staff not to publish the article on hands-free sets. "I told them there must be something seriously wrong with their tests," said Dr. Alan Preece of the University of Bristol.

When a U.K. government agency scheduled a meeting to bring all the parties together to settle the confusion, the ERA engineers did not show up (see *MWN,* N/D00).

The CA dug in its heels and refused to back down. Given the CA's stature, the U.K. Department of Health decided not to endorse hands-free kits to cut radiation exposure. In its consumer brochure on *Mobile Phones and Health,* issued in 2000, the department waffled and told consumers that "the level of effectiveness of hands-free kits to reduce SAR is still uncertain."

Today, close to two years after the CA sounded the alarm, the issue remains in limbo — though the government has now funded a project to settle the question (see p.10).

The CA deserves credit for having raised a potentially serious problem. But having done so, it has the responsibility to finish what it started. By casting doubt on the only generally recognized way of limiting radiation exposure from mobile phones and then doing nothing to clear up the confusion, the CA has abandoned its public.

The one benefit of CA's botched cell phone crusade is that it has generated a lot of media attention. The U.K. press, unlike its U.S. counterpart, has actively covered every twist and turn in the mobile phone health controversy — some would say it has been *hyper*active. Nevertheless, the media are a reflection of public anxieties, and together they have prompted the new broad-based English research program.

By ignoring the uncertainties about safety and hiding behind mealymouthed truisms, the Consumers Union has done nothing to educate the American consumer about cell phone health risks. It has also encouraged continued government complacency.

Once Again, the TCO Shows the Way

In Sweden, the TCO, the Swedish union of white-collar workers, is showing what can be done. Unwilling to wait until the uncertainties are resolved years from now, it is proposing a sensible technical solution.

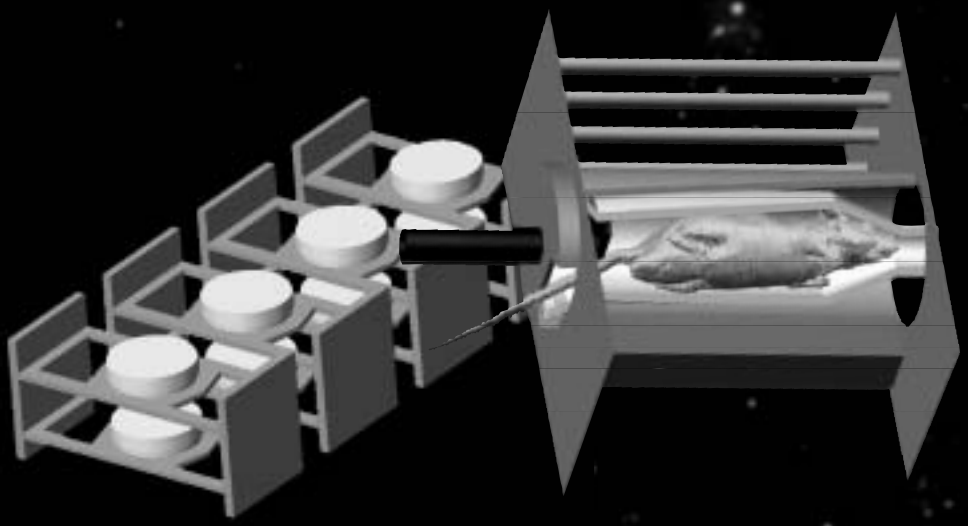
The TCO is pushing for a stricter SAR standard and is promoting a new index of performance, the communication efficiency of a mobile phone (see *MWN,* J/F01; also p.9). Consumers and workers all over the world already owe a huge debt to the union for pushing the computer industry into making safer computer monitors — and to Per Erik Boivie, who masterminded TCO's campaign. TCO95 and TCO99 stickers are known the world over as signs of safe computing. The union is now applying the lessons learned with VDTs to mobile phones.

The CU and CA should wake up and catch up. Consumers on both sides of the Atlantic deserve better.

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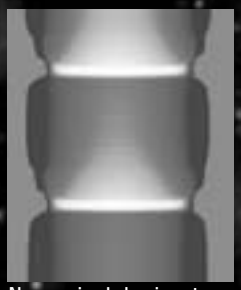
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Swedish Study Must Be Followed Up

Swedes Find GSM Radiation Causes Nerve Damage at Very Low Doses

Leakage Through the Blood-Brain Barrier

In a new paper that is sure to reignite concerns over the safety of mobile phones, Drs. Leif Salford and Bertil Persson have shown that extremely low doses of GSM radiation can cause brain damage in rats.

Salford, a neurosurgeon, and Persson, a biophysicist, both at Sweden's University of Lund, report that they see nerve damage following a single two-hour exposure at a specific absorption rate (SAR) of 0.002 W/Kg. The effect becomes statistically significant at 0.02 W/Kg. These nonthermal levels are a hundred to a thousand times lower than the 2 W/Kg exposure standard recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

Salford and Persson first showed that low-level microwave radiation can cause leakage through the blood-brain barrier (BBB) over ten years ago (see *MWN*, J/F92 and J/A92). In this latest work, they again show that microwave

(continued on p.19)

1993 FDA Memo

Data "Strongly Suggest" Microwaves Can Promote Cancer

In the spring of 1993 at the height of public concern over cell phone–brain tumor risks, Food and Drug Administration (FDA) biologists concluded that the available data "strongly suggest" that microwaves can "accelerate the development of cancer." This assessment is in an internal agency memo recently obtained by *Microwave News* under the Freedom of Information Act.

"Of approximately eight chronic animal experiments known to us, five resulted in increased numbers of malignancies, accelerated progression of tumors, or both," wrote Drs. Mays Swicord and Larry Cress of FDA's Center for Devices and Radiological Health (CDRH) in Rockville, MD. They also pointed to other evidence from laboratory (*in vitro*) studies that supported a cancer risk.

Yet, in its public statements at that time, the agency played down these findings. For instance, in a Talk Paper issued in early February, the FDA stated that there was "limited evidence that suggests that lower levels [of microwaves] might cause adverse health effects."

"A few studies suggest that [microwave] levels [from cellular phones] can accelerate the development of cancer in laboratory animals," the FDA added, "but there is much uncertainty among scientists about whether these results apply to the use of cellular phones."

(continued on p.5)

Brillouin Precursors Round 2: Attacks on Albanese Intensify; Editors at "Radiation Research" Join Forces with Robert Adair

Dr. Richard Albanese, a U.S. Air Force (USAF) medical doctor and a voice of concern about the safety of PAVE PAWS radar radiation, has once again been sharply criticized by Dr. Robert Adair — and this time the editor-in-chief of *Radiation Research,* Dr. Sara Rockwell, has joined the fray.

In an editorial* appearing in the January issue of *Radiation Research,* Rockwell and Dr. John Moulder of the Medical College of Wisconsin, Milwaukee, denounce Albanese's arguments as an "unpublished, non-standard" theory that is stirring up public controversy and delaying the modernization of the radar system. Moulder is a senior editor of the journal.

The editorial accompanies a commentary† by Adair, a Yale University physicist, who writes that Albanese suffers from "the mistaken belief that the PAVE PAWS radiation is quite different from the radiation from other scanning radar systems." Adair insists that, "Real pulses used in radar technology seldom, if ever, generate significant Brillouin precursors. PAVE PAWS does not."

Even if PAVE PAWS radiation could induce Brillouin precursors, Adair adds, such effects "are far too small to have any conceivable effect on physiology." (See also *MWN,* M/J02.)

"The first reaction of most radiation scientists is to ignore such [non-standard] theories," Moulder and Rockwell write. But it is "appropriate and necessary for the public good," for "rigorously peer-reviewed journals such as *Radiation Research"* to step in when a theory influences public policy.

Albanese declined to comment.

"They are not playing fair," objected Dr. Kurt Oughstun, who has long collaborated with Albanese. "Albanese hasn't published anything about all this because the Air Force won't let him," Oughstun told *Microwave News*. "This is all politics."

Oughstun pointed out that he and others have published numerous papers on Brillouin precursors in the peer-reviewed literature, so it is "extremely misleading" to suggest that Albanese's theories are based on unpublished data.

Albanese "does not appear to be acting as if there are any restrictions," Moulder told *Microwave News*. "I've never heard that Albanese has made that claim."

Oughstun is skeptical. "It's common knowledge that Albanese is required to clear his papers with his superiors. If the editors didn't know that, they should have," he said.

At the opening meeting of the NAS–NRC inquiry on PAVE PAWS, held last March 15 in Washington, Albanese was clearly concerned about disclosing secret information. He interrupted his own presentation to say that any further discussion of biological effects of phased-array radiation would have to take place in "another setting." After the meeting, he told *Microwave News* that the USAF can block the release of any paper that does not conform to official policy (see *MWN,* M/A02).

Rockwell, a physicist who is a professor of therapeutic radiation at Yale University's medical school in New Haven, CT, said that she and Moulder "sought no information on the classified papers or any other aspect of Dr. Albanese's classified research." Rather, she said, they relied on Albanese's unclassified papers and presentations — "most of which were not readily available." These documents were collected by Adair and made available to the editors and reviewers during the peer review of his commentary. (In the interview, Rockwell noted that, earlier in her career, she had worked on classified projects for the military.)

Lt. Col. Bruce Ruscio, a public health advisor at the Cape Cod Air Force Station, did not respond to requests for comment.

Non-Standard Theories Defined

According to Moulder and Rockwell, theories such as Albanese's "tend to have certain elements in common":

- No "formal statement...that contains enough information on the details...to allow rigorous analysis"
- They are based on data that are "not in the peer-reviewed literature" or not otherwise available to the public
- They "often include *ad hominem* attacks on the proponents of 'standard' theories"
- The authors' training has "little or no relevance to the theory or even to the general area"
- The authors have "few or no relevant peer-reviewed publications."

USAF Researcher at Center of Storm

Dr. Richard Albanese has worked at Brooks Air Force Base in San Antonio since 1971 and has done research on Brillouin precursors for over 15 years. Albanese studied chemistry and mathematics as an undergraduate at Princeton University and received a degree in medicine from Columbia University. He has a top secret security clearance.

Albanese believes that the radiation from PAVE PAWS is qualitatively different from other types of radar and could cause harmful biological effects by inducing Brillouin precursors on entering the human body (see *MWN,* M/A02). In a May 2000 letter to the Massachusetts Department of Health, he warned that the potential effects of PAVE PAWS phased-array radiation are "completely unexplored" (see *MWN,* S/O00).

Albanese has also been an outspoken critic of an Air Force study that tried to downplay the health effects of Agent Orange, a herbicide used during the Vietnam War.

An abbreviated listing of Albanese's publications is posted on the Web at: <www.pavepaws.org>.

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* J. Moulder and S. Rockwell, "Critiquing Unpublished Theories," *Radiation Research, 159,* pp.1-2, January 2003.

† R. Adair, "Environmental Objections to the PAVE PAWS Radar System: A Scientific Review," *Radiation Research, 159,* pp.128-134, January 2003.

They cite a number of other examples of non-standard theories, including the epidemiological studies of Poland's Dr. Stanislaw Szmigielski, which point to increased cancer risks among Polish military personnel exposed to RF/MW radiation, and the work of Dr. Denis Henshaw of the U.K.'s University of Bristol suggesting that electric fields play a role in the power line–cancer equation (see *MWN,* J/F98 and M/A96, respectively). They also question the work of Dr. Neil Cherry of New Zealand's Lincoln University.

Henshaw is puzzled by the label. "I'm afraid I do not recognize our 1996 paper as in any way being a 'non-standard' theory," he said in an interview. The Advisory Group on Non-Ionizing Radiation of the U.K.'s National Radiological Protection Board is investigating Henshaw's hypothesis (see *MWN,* N/D01).

NAS–NRC Panel Says PAVE PAWS Data Inadequate To Judge Safety, But No Decision on Need for Epidemiological Study

Midway through its planned two-year investigation, a panel of the National Academy of Sciences–National Research Council (NAS–NRC) finds that it does not have enough information to determine whether the USAF's PAVE PAWS missile defense radar on Cape Cod, MA, poses a health risk to those living nearby.

Currently available data "are not adequate for determining the biologic and potential health effects" of PAVE PAWS radiation, the panel's chair, Dr. Frank Barnes of the University of Colorado, Boulder, wrote in an interim report* dated November 15.

The NAS–NRC panel is calling for more precise information on the type of signal — the waveform — to which nearby communities are exposed, as well as their levels of exposure.

The USAF is sponsoring the NAS–NRC inquiry at the urging of Sen. Edward Kennedy (D-MA) (see *MWN,* J/F01). Cape Cod residents have voiced concerns that radiation from the system — which has been operating since 1980 at 420-450 MHz with a peak power of 582 kW — is responsible for elevated cancer rates on the Cape (see *MWN,* J/F98).

While the new report states that "epidemiologic methods" are "important to the determination of possible health effects," it stops short of recommending an epidemiological study of those living near the radar. Dr. Susan Santos, a panel member, cautioned that it remains to be seen whether a study is warranted.

If the NAS–NRC panel were to recommend such a study, it would probably meet with resistance from the Armed Forces Epidemiological Board (AFEB). "There is no immediate indication to support either initiation of new, or further analysis of existing, epidemiologic investigations," the board stated in a December 10 memorandum† prepared at the request of the USAF Surgeon General.

According to the new report, waveform data would be used to determine "the comparability of the PAVE PAWS phased-array radiation with radiation emitted by non-phased-array systems," and, in turn, the "adequacy of the existing RF energy literature" for assessing potential effects.

The panel cites "issues related to the rise and fall portions" of the waveform. Barnes explained that this is a reference to Brillouin precursors, which could cause harmful biological effects, according to Dr. Richard Albanese of the USAF in San Antonio (see p.2).

Dr. Kurt Oughstun of the University of Vermont, Burlington, who briefed the panel last September, said in an interview that he is "very pleased" by the request for more waveform data. "Until we find out what the pulses actually look like," he said, "no one can really say that it is impossible for PAVE PAWS to generate Brillouin precursors."

Dr. Robert Adair of Yale University has dismissed Albanese's concerns as unfounded (see p.2).

Additional power-density measurements are needed, the November 15 report states, because previous surveys by the USAF "were not designed to cover a wide range of census tracts for epidemiologic purposes" (see *MWN,* M/J87),

"You need to see some data on exposures in order to assess any health impacts," Santos, a consultant on risk analysis based in Medford, MA, told *Microwave News*. She explained that the panel would then try to combine that information with data on the incidence of various health problems — for example, from the Massachusetts cancer registry.

According to the report, the panel is eager to see the results of a measurement survey initiated by the PAVE PAWS Public Health Steering Group (PPPHSG), a committee of local health officials which receives financial and administrative support from the USAF. But this survey is not expected to be finished before September, when the panel's work is due to be completed. NRC's Dr. Rick Jostes told *Microwave News* that the panel may ask the USAF for an extension so that it can include the measurements in its final report.

Calculated exposure estimates have been prepared for the USAF by MITRE, an engineering firm with headquarters in Bedford, MA, that works closely with the U.S. military. But Barnes said that it is not clear whether the panel will be able to use these estimates — because of technical problems, not because of military secrecy. "They have been very cooperative in giving us everything we've asked for," Barnes said in an interview.

In a press release dated November 19, the USAF said that it was "very pleased" by the interim report, which "has validated the approach" it has taken in addressing health questions about PAVE PAWS. Requests for clarification were left unanswered.

* The November 15 NAS–NRC report is available at <www.nap.edu/books/NI000483/html/>.

† AFEB's recommendations are at <www.ha.osd.mil/afeb/2003/2003-03.html>.

Status of Research on Microwaves and Cancer — FDA's View in 1993

Reprinted below are excerpts from an April 7, 1993, memo prepared by Drs. Mays Swicord and Larry Cress of FDA's CDRH.

The literature contains reports of probably thousands of experiments relating to microwave [MW] bioeffects. Very few of these are relevant to the question of whether MWs can in some way accelerate the development of cancer in humans. This is because endpoints other than cancer were examined in most of the studies; many examined behavioral effects, cataract development or thermoregulation. In addition, many of these studies involved acute exposures to relatively high levels of MWs. For the types of exposures involved with devices such as cellular phones and police radar, long-term exposures to much lower power levels are of interest. The majority of the reported experiments also involved exposures at 2450 MHz, the "oven" frequency; higher and lower frequencies are employed in police radar and cellular phones, respectively. In spite of these caveats, there are a few reported experiments which bear directly on the question of cancer progression and chronic, low-level exposures. This small and incomplete database strongly suggests that under at least some circumstances these exposures do indeed accelerate the development of cancer by some unknown mechanism.

In Vivo Experiments

Of approximately eight chronic animal experiments known to us, five resulted in increased numbers of malignancies, accelerated progression of tumors, or both. One of the experiments, conducted 30 years ago, involved relatively high-level exposures and suffered from a number of problems...

A much more disturbing study is that of Guy and Chou. Financed by the Air Force, this well-planned and executed study was intended to examine a number of biological, behavioral and biochemical endpoints. Two groups of 100 rats each were used; the exposed group was treated with pulsed-modulated waveform for 22 hours each day over a period of two years. Although no one type or anatomic site of tumor predominated, 18 of the exposed animals developed a malignancy of some type versus only 5 of the control animals, statistically significant at the p= 0.001 level. In addition, 7 of the exposed animals developed "benign" pheochromocytomas versus only one of the control animals, also highly significant (p=0.02). Although this study has been discounted by some critics because no one tumor site or target organ predominated, this is precisely what one would expect for an agent which accelerates the progression of naturally occurring malignant cells. That is, any transformed neoplastic group of cells occurring in an organ will be promoted without reference as to site or type of tumor. These results are particularly disturbing because the rate of MW energy deposition in the rats' bodies is comparable to that of users of cellular phones and other portable communications equipment. The study's applicability to these devices may be questioned, however, on the grounds that the frequency is 3 times that used in cellular phones and the modulation is also different.

Szmigielski published reports of experiments using three different models of tumor progression. One group used a strain of mice with a high rate of spontaneous mammary tumors, a second group had the chemical carcinogen 3,4-benzopyrene applied to their skin and a third group was injected with sarcoma cells which resulted in pulmonary tumors. Animals were exposed to 2450 MHz unmodulated MW radiation two hours a day for several months....All groups showed earlier appearance and accelerated growth of tumors, suggesting a tumor-promoting activity. In addition, the mice exposed to higher levels developed tumors at a faster rate than the group receiving less radiation.

The only study reported in the peer-reviewed literature that did not show accelerated tumor progression used mice with melanomas subcutaneously implanted under their skin. Exposure to 2450 MHz MWs (both unmodulated and pulsed) for 2.5 hours a day did not affect tumor progression or survival times. One reason that this study may have given a negative result is that the mice only lived about 6 weeks after implantation of the highly malignant melanoma cells. The Szmigielski data show that about 4 months of exposure is necessary before tumor progression is accelerated by MWs. The melanoma-implanted mice thus did not survive long enough for their disease to be accelerated by the MW exposure.

In Vitro Experiments

Although the animal experiments described above offer the strongest evidence implicating the ability of MWs to promote cancer, other evidence exists in the form of *in vitro* data. A standard method for screening chemical agents for the ability to promote neoplastic transformation employs cells in culture. This technique has been applied to MW radiation by Balcer-Kubiczek and Harrison who found that although 2450 MHz MWs alone did not cause malignant transformation in their system, low-level MW irradiation did increase the amount of transformation caused by TPA, a phorbol ester tumor promoter. Furthermore, the magnitude of this effect increased with increasing MW power level, strongly suggesting that it is not an artifact. It must be noted that the MWs used in this study were modulated at 120 Hz, raising the question of whether the observed effect could actually be due to the lower frequency component.

A number of other *in vitro* experiments also suggest that low-level MW irradiation can interact with the cell's growth-control mechanisms in ways that could be harmful. Byus has demonstrated the ability of modulated MWs to increase cellular ornithine decarboxylase (ODC), an enzyme that is also induced by chemicals known to be cancer promoters. Czerska and colleagues have similarly found that MW exposure can induce the transformation of human lymphocytes, but pulsed MWs are more effective than unmodulated MWs. Dutta has found that very low-level irradiation can induce oncogene expression in cultured neuroblastoma cells, but this work has been published only in abstract form. Cleary has demonstrated that irradiation can induce the proliferation of cultured glioma cells, and that the effect persists for several days after irradiation, but the published experiments involved power levels greater than those likely to be encountered with cellular phones and similar devices. A number of other experiments have demonstrated genetic abnormalities, such as chromosome despiralization, but many of these studies used crude exposure systems and dosimetry, and some of the reported effects may have been due to heating and not MW exposure per se.

Summary of Research Situation

Most of the published MW bioeffects literature describes experiments that are not relevant to the question of whether MWs can accelerate cancer progression. In particular, very few chronic, low-level animal exposure experiments have been done. It should be noted that most of the experiments described above have not been replicated, and most were conducted with frequencies and modulation different from cellular phones. The fact remains, however, that the data which exist strongly suggest that MWs can, under at least some conditions, accelerate the development of malignant tumors. These *in vivo* data are also supported by *in vitro* data which have demonstrated not only malignant transformation but other effects on the cell's growth-control mechanisms. Taken together, these two lines of evidence make a compelling case for further research to either confirm or refute previous work.

1993 FDA Memo: Microwave Data "Strongly Suggest" a Cancer Risk *(continued from p.1)*

The cell phone scare became front-page news in early 1993 after CNN reported that David Reynard of St. Petersburg, FL, had filed a lawsuit charging that his wife had developed brain cancer after using a cell phone. The suit was originally filed in April 1992 (see *MWN,* M/J92).

The Talk Paper also stated that, "If there is a risk from these devices — and at this point we don't know if there is — it is probably small." This view was widely quoted in the press. In contrast, Swicord and Cress were silent on the magnitude of any possible risk in their memo.



IN 1993, MOTOROLA'S MAYS SWICORD WAS AT THE FDA

In 1993, Swicord was the chief of the radiation biology branch at FDA's CDRH. He is now the director of electromagnetic energy programs at Motorola's Florida Research Labs in Plantation. Cress is still at the CDRH today.

"My view at the time was that the database certainly did not support very strongly that there is nothing there," Swicord told *Microwave News* this January.

And Cress said that, "It was our honest scientific evaluation of the existing, albeit inadequate, database."

At the time the Swicord-Cress memo was being prepared, the Cellular Telecommunications Industry Association (CTIA) was under great pressure to calm public fears and a jittery market in cell phone stocks. Its initial strategy, later abandoned, was to ask the FDA to supervise a research program on the possible health effects of microwave radiation.

Swicord and Cress wrote that there is "a compelling case for further research to either confirm or refute the previous work." (Extended excerpts of the Swicord-Cress memo are reprinted on p.4.)

At a February 2, 1993, Congressional briefing convened by Rep. Edward Markey (D-MA), Swicord, together with representatives of the Environmental Protection Agency (EPA) and the Federal Communications Commission — as well as Markey himself — all called for more research (see *MWN,* J/F93).

A number of former and current FDA staff members suggested that Swicord and Cress used strong language in their memo to help secure funding for their particular sphere of interest at the CDRH. Cress, however, rejected this explanation. "It was not a funding document," he said.

The FDA documents also reveal that:

• A document prepared to brief then CDRH Director Dr. Bruce Burlington stated that, "Evidence exists of nonthermal and cytotoxic effects at power levels produced by cellular phones." The briefing document was prepared by Dr. Elizabeth Jacobson, then CDRH's deputy director for science, and was largely based on the Swicord-Cress memo. Both Burlington and Jacobson have since left the agency.

• Dr. Richard Adamson of the National Cancer Institute (NCI) "adamantly opposed" a proposal to use industry funds to pay for a government-run research program, according to the Jacobson document. An interagency coordinating committee cochaired by Adamson reacted negatively to the proposal "because of the appearance of conflict of interest," Jacobson wrote.

• Jacobson told Burlington that, in her view, the NCI brain tumor study — which included questions on cell phones — was "flawed" because "it ignores the fact that widespread use of phones is a very recent phenomenon, and if there is any 'latent period' for development of tumors, a negative result will be hard to interpret." Adamson later left the NCI to run the Washington office of the National Soft Drink Association. The NCI study, which was released in December 2000, did not find a link between cell phones and brain cancer (see *MWN,* J/F01). An editorial in the *New England Journal of Medicine* by Drs. Dimitrios Trichopoulos of Harvard School of Public Health in Boston and Hans-Olov Adami of the Karolinksa Institute in Stockholm that accompanied the NCI paper concluded that it is "highly unlikely" that cell phones increase the risk of brain tumors.

• Jacobson also advised Burlington that, "With a burgeoning wireless...industry, it is imperative to establish a clear scientific understanding of health effects from low-level microwave exposure."

• Swicord and Cress were disturbed by the results of the long-term microwave exposure study by Drs. Bill Guy and C.K. Chou at the University of Washington, Seattle (see *MWN,* J/A84). They wrote: "Although this study has been discounted by some critics because no one tumor site or target organ predominated, this is precisely what one would expect for an agent which accelerates the progression of naturally occurring malignant cells....These results are particularly disturbing because the rate of microwave energy deposition in the rats' bodies is comparable to that of users of cellular phones..." Guy later helped oversee the research program set up by Dr. George Carlo and paid for by the CTIA. Chou, who later received $1.5 million from Carlo for a dosimetry study, now works with Swicord at Motorola's Florida labs.

• At about the same time that the cell phone industry was telling the American public that thousands of scientific studies proved the safety of hand-held phones, Swicord and Cress advised that, "Very few of these are relevant to the question of whether microwaves can in some way accelerate the development of cancer in humans."

Three years before the cell phone–brain tumor scare took center stage, the EPA drafted a report which concluded that microwave radiation should be classified as a possible human carcinogen (see *MWN,* M/J90). Like Swicord and Cress, the EPA analysts based their finding on the results of the Guy-Chou long-term exposure study and the experiments of Poland's Dr. Stanislaw Szmigielski (see *MWN,* My81).

This January, on the tenth anniversary of the cell phone flare-up, Jacobson told *Microwave News* that parts of the briefing document were a "little zingy." They "were designed to get the director's attention."

Both Swicord and Cress have had a major change in their outlook. "More than 300 studies have been done since then, including a number of animal studies, and there is no indication of a problem," Swicord said.

Cress agrees. "My evaluation has gone from being concerned to believing that there is a very small chance of health effects."

Australians Concede Error in Cell Phone Cancer Paper; Explanation Baffles Skeptics

Drs. Tammy Utteridge and Tim Kuchel have admitted that they mistakenly published conflicting and confusing data in a widely cited paper that discounts cancer risks from mobile phones.

Their correction resolves many of the contradictions in the original paper. But critics say they cannot understand how the error could have been made and they continue to view the Australian paper with deep skepticism.

Writing in the February issue of *Radiation Research* in response to letters that challenge their work, the Australian researchers explain that they had presented data on the survival of their mice in terms of "days of exposure" — instead of absolute age. Because the mice were not exposed on weekends and national holidays, they appeared to die earlier than they actually did. This error muddled the interpretation of their results.

For instance, the original paper, published in *Radiation Research* last September, showed that all the transgenic mice had died at about 19 months of age, but were still being handled and weighed at the age of 28 months (see *MWN,* S/O02).

Many are not satisfied with the explanation offered by Utteridge and Kuchel. "This is the most ridiculous thing I have ever read," said Dr. Alexander Lerchl of Germany's International University Bremen. "If that happened in my lab, I would fire those responsible immediately." Lerchl had pointed to the anomaly in the ages of the mice in one of three letters published in *Radiation Research*.

"A time axis that is computed by leaving out weekends and public holidays is not easily produced," commented Dr. Michael Kundi of the University of Vienna. "The whole story about the mislabeled figures is incredible," he told *Microwave News*. Kundi is the author of another of the published letters. Omitting the days without exposure is an unheard-of way of describing the survival age of the mice, he said.

Dr. Ron Melnick of the National Institute of Environmental Health Sciences (NIEHS) in Research Triangle Park, NC, said that he had never heard of anyone reporting survival data in terms of days of exposure instead of absolute age.

"I have not seen it before," agreed Dr. Mays Swicord. "It's a strange thing." Swicord is the director of Motorola's electromagnetic energy programs in Plantation, FL. (See also p.1.)

"This is a major correction to their paper," said Melnick, who is leading the effort to design a set of animal experiments to test the carcinogenicity of wireless signals under the U.S. National Toxicology Program. "They should have published a formal correction in the journal."

Lerchl also believes that the Australians' indirect acknowledgment is insufficient: "If I was in the situation of Utteridge and coauthors, I would at least write an erratum."

Neither Utteridge nor Kuchel responded to questions from *Microwave News* on why they counted exposure days instead of actual age. Kuchel, of the Institute of Medical and Veterinary Science in Gilles Plains, has consistently refused to be interviewed since the paper was published last summer.

Utteridge, who has now left the institute, exchanged numerous e-mails with *Microwave News* last year. But at the time, despite repeated questions about the apparent inconsistencies in the published data, she never revealed that the axes had been mislabeled.

The third letter is from the World Health Organization's EMF project in Geneva, headed by Dr. Michael Repacholi. Repacholi was the lead author on the original transgenic mouse study, which points to a cancer risk following exposure to GSM radiation (see *MWN,* M/J97). The new study sought to confirm or refute the Repacholi finding.

Repacholi and colleagues spell out a number of concerns they have with the Utteridge-Kuchel paper and suggest that the transgenic mice used in the follow-up study are different from the ones Repacholi had originally used because, among other reasons, they have a much higher rate of spontaneous cancer.

That concern has now been resolved with the corrected survival curves. "If what Utteridge and Kuchel say is correct, their study makes a lot more sense and one is left with the conclusion that the two studies — Repacholi's and Utteridge's — show different effects of RF radiation," NIEHS' Melnick said. "Some other factor may be involved. I am not sure how to reconcile the two sets of results."

Questions About Dosimetry Left Unanswered

One of the objectives of the Utteridge-Kuchel experiment was to correct what they called a "shortcoming" of the original Repacholi study: the wide variation in the mice's radiation exposures. The specific absorption rates (SARs) varied considerably because the animals were allowed to roam unrestrained in their cages.

The Australian team opted to use a setup in which the mice were exposed in a confined space in order to better regulate the dose. The system was designed, supplied and paid for by Motorola. In their paper, Utteridge and Kuchel report the SARs as single values (for instance, 0.25, 1, 2 or 4 W/Kg) — without allowing for variations in dose, as Lerchl points out in his letter.

In their published reply, the Australians note that, to their surprise, there was a large variation in the weight of the mice: Some were 26 g and others weighed 62 g "for most of the study." But they do not go the next step and discuss the implications for the published SAR values. (As the weight of the animals goes up, the SARs go down.)

In fact, Utteridge and Kuchel are again totally silent on the question of SAR variability in their February response.

Motorola's Swicord said that his group has completed a detailed analysis of the dosimetry in the Australian study. It has not yet been submitted for publication.

Another contentious issue is whether the control mice — the comparison group — developed cancer at an abnormally high rate, which would make it difficult, if not impossible, to see any cancer increase due to radiation exposure. In their letters, both Kundi and Lerchl speculate that the mice may have experienced stress while being restrained during the exposures.

In their original paper, Utteridge and Kuchel did not present the cancer incidence among the mice not placed in the exposure apparatus. (These are called the cage controls; the shams were also not exposed but were placed in the restraining chambers.) These data, presented in their February letter, show that the sham and cage controls had similar cancer rates at the end of the experiment, which would argue against any problem caused by restraint stress.

The Australians do not, however, present data on the mortality of the cage controls over the life of the experiment. Such data are presented for the other exposed animals, including the shams.

"It's perplexing that they do not give the time course for either the free-roaming controls or the positive (ENU) controls," Dr. Lawrence Goldstein of WHO's EMF project said in an interview. "Incidence data alone provide limited information."

Kundi, Lerchl and Melnick would all like to see information on the survival of the cage controls over time.

Swicord said that Utteridge told Motorola that they had not included the time course data for the cage controls because they fell on top of the other curves and would only have cluttered up the figures.

As to whether the Utteridge-Kuchel study could be considered a replication of the Repacholi study, Goldstein said that, "The two studies are different experiments." For his part, Repacholi told *Microwave News* that he "would not go so far as to say that the experiments are totally different because they use the same animal model and similar methodology."

In general, the Australian researchers discount their critics. In their published reply, they state, "We are particularly puzzled by the criticism of our study, the results of which are consistent with the remaining body of evidence worldwide, while the study of Repacholi *et al*. remains the anomaly."

« Eye on Europe »

COST281's advisory against carrying out an epidemiological study of health impacts of mobile phone base stations has itself become a target of criticism (see *MWN,* N/D02). The European cell phone health research committee believes that there is "insufficient basis" for such an effort and, even if a study were done, it could neither show small risks nor demonstrate the absence of risks. After COST issued its "scientific comment" on December 9, a Swiss official, who asked not to be identified, said that the COST position has not been well received throughout the government. This is significant because the COST commentary was originally requested by the Swiss Office of Public Health. Then, in a widely circulated e-mail to COST281 Chair Dr. **Norbert Leitgeb** of Austria's University of Graz, Dr. **Elisabeth Cardis** disputed COST's overly negative view of the limits of epidemiological analysis. Cardis of IARC in Lyon, France, is leading the international study of mobile phone use and cancer (see *MWN,* M/A00). These arguments and counterarguments will no doubt come up again at ***Mobile Communication Base Stations and Health,*** a COST281 workshop to be held in Dublin, May 15-16. For more information, contact Gerd Friedrich of FGF, the German mobile phone industry research group, at <info@fgf.de>; Friedrich serves as the secretary of COST281.

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In response to what it calls "controversial" laboratory studies, **COST281** has set up a new task force to organize an international project on possible **genotoxic** effects of mobile phone radiation. This new effort grew out of discussions held at a workshop on ***Genetic and Cytogenetic Aspects of RF Field Interactions,*** held in Löwenstein, Germany, in late November. That meeting was organized by **FGF** and COST281, as well as a German state environmental agency. Those participating in this project plan to meet at the May workshop in Dublin and devise ways to secure funding to set up simultaneous experiments in multiple laboratories. Abstracts of the papers — as well as some of the slide presentations — from the Löwenstein meeting are available at the COST Web site, <www.cost281.org>. Earlier, the COST panel launched a "short-term mission" on mobile phones and children after its workshop in Rome last May (see *MWN,* M/J02).

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On December 9, as expected, health and labor officials of the **European Union**'s **Council of Ministers** received draft **occupational limits** for exposures to EMFs and RF/MW radiation based on **ICNIRP**'s guidelines (see *MWN,* N/D02). Discussions among the 15 member states will now probably continue "throughout 2003" before a final agreement is reached, a spokesperson for the council told *Microwave News*. An updated version of the draft is available in English at: <register.consilium.eu.int/pdf/en/02/st15/15400-r1en2.pdf>.

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Officials of **Germany**'s Federal Office for Radiation Protection (known as the BfS) have spelled out why they favor a **precautionary approach** to radiation from mobile telecommunications. In a new paper, Drs. **Anne Dehos** and **Wolfgang Weiss** argue that "indications of biological effects...at intensities below the currently applied limit values" require a policy response, because if an actual hazard were to emerge it "might affect a large number of people." The two members of BfS' Institute for Radiation Hygiene, outside Munich, advise that public exposures be kept "as low as possible." For instance, they suggest keeping calls short and using a land-line phone when available. They do not cite BfS' previous recommendation to limit use of mobile phones by children (see *MWN,* J/A01 and N/D01). Their paper, which is in German with an abstract in English, is in the December 2002 issue of *Gesundheitswesen — Public Health — (64,* pp.651-656). It is available free at: <www.thieme.de/gesu>.

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The five mobile phone companies in the **U.K.** have set up the **Mobile Operators Association** (MOA). Previously, they were represented by a group within the Federation of the Electronic Industry (**FEI**), but decided to go off on their own after FEI merged with a computer association and changed its name to "Intellect." **Mike Dolan,** who ran the FEI group, is the executive director of the MOA and continues to be based in London. For more information, go to <www.mobilemastinfo.com>.

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Vodafone Portugal has signed an agreement with the Institute of Telecommunications to tell the public more about radiation from mobile phone base stations. Under the new initiative, known as **ITEM** — Technical Information on Exposure to Electromagnetic Radiation in Mobile Communications — the institute will measure radiation levels around 400 Vodafone antenna sites, set up a network of remote monitoring stations in a medium-sized city and maintain an Internet site so that all these data are easily accessible.

«« »»

German-speaking **high school students** can learn about the possible health effects of electromagnetic radiation with **interactive software** from Austria's Technical University of Graz. Lectures, pictures and calculations show, for example, how magnetic fields around a power line or microwaves from a mobile phone base station decrease with distance. The university's Andreas Abart, who led the CD development team, formerly wrote public information brochures for an electric utility and a wireless operator. The new software may be offered next year in English, French and Italian. *Electromagnetic Fields and Waves... Electrosmog?* is available for €45 ($48) from DBV Verlag, (43+316) 383033, Fax: (43+316) 383043, E-mail: <office@dbv.at>, Web: <www.dbv.at>.

EMF NEWS

EMFs and Chemicals Together Increase Brain Cancer Risk

Combined exposures to extremely-low-frequency electromagnetic fields (ELF EMFs) and certain types of toxic chemicals can act synergistically to increase brain cancer risks, according to a new study of Swedish workers led by Dr. Marina Pollán of Spain's National Center for Epidemiology in Madrid.

But, interestingly, this finding holds only for gliomas — tumors that develop in the glial cells, or supportive tissue, of the brain — and not for meningiomas, which grow in the membrane that surrounds the brain. While gliomas are malignant, meningiomas are usually benign,

"Our study is the first to try to assess a possible interactive effect — that is, whether the effects of ELF EMFs vary when workers are also exposed to chemicals," Pollán told *Microwave News*.

Pollán's team, which includes Dr. Birgitta Floderus of the Karolinska Institute in Stockholm, analyzed cancer incidence among Swedish men who had held jobs between 1970 and 1989 — a cohort of more than 1.5 million. Their results appear in the December 2002 issue of *Cancer Epidemiology, Biomarkers & Prevention (11,* pp.1678-1683).

In jobs likely to entail exposure to solvents, the glioma risk was more than 50% higher among those also exposed to EMFs above 2 mG. For men exposed to pesticides or herbicides, the risk was approximately doubled when combined with similar ELF EMF exposures, and for lead the combined risk was nearly four times greater.

All three associations are statistically significant. There was a trend of increasing risk with higher EMF exposure for both pesticides/herbicides and lead. The association for lead is based on only a handful of cases.

No increase in the risk of glioma or meningioma was seen for EMF exposures in the absence of chemical agents.

Although very few epidemiological studies have looked for synergies between EMFs and other agents linked to cancer, Pollán points out that such a combined analysis makes sense because "there is consensus" that if EMFs do play a role in cancer, they act as a promoter, requiring the presence of initiators such as chemical carcinogens.

Others — for instance, Dr. Susan Preston-Martin of the University of Southern California — have previously reported higher risks for gliomas than for meningiomas among those exposed to EMFs (see *MWN,* M/A90). And in a 1996 meta-analysis of brain tumors among EMF-exposed workers, Dr. Leeka Kheifets, then at EPRI and now at the WHO in Geneva, found that the risk increased about 25% when the analysis was narrowed from all brain tumors to only gliomas (see *MWN,* J/F96).

"You see a clearer picture when you exclude the non-gliomas," said Dr. Samuel Milham, an epidemiologist and consultant based in Olympia, WA. "It's basic epidemiology that you're better off not lumping different types of tumors together if there are differences in etiology."

Dr. David Savitz of the University of North Carolina, Chapel Hill, who in recent years has expressed a great deal of skepticism over the value for continuing to do EMF epidemiological studies (see p.14 and *MWN,* M/J01 and S/O01), agreed that distinguishing among cancer types "is a very logical thing to do when you have the data to do it." But he noted that the link between brain cancer and chemicals "is just as murky" as the link with EMFs. "How promising is it to put together two murky areas of research?" he wondered in an interview.

In his own study of workers at five electric utilities, Savitz was unable to look at specific types of brain cancer because he used death certificates that lacked such information (see *MWN,* J/F95).

IEEE Rebuffs Appeals On ELF Standard

The IEEE has rejected challenges to its new ELF standard on procedural grounds, without addressing the substantive issues. Bob Ashley and David Fichtenberg filed formal appeals last October, shortly after the standard was approved by the IEEE Standards Board (see *MWN,* N/D02).

The standard, designated C95.6, "shall proceed without change through the publishing process," a three-member panel convened by the board recommended on January 8. The panel noted that IEEE rules require that it only consider procedural issues and that it therefore could not consider technical matters.

Fichtenberg, a resident of Seattle, contended that ICES (formerly SCC-28) Subcommittee 3 (SC-3) violated IEEE ethics guidelines in developing the standard by ignoring possible long-term health effects, such as cancer, and that the 5 kV/m limit for electric fields specified by the standard would allow members of the public to receive painful shocks.

The panel responded that it does not have the authority to address ethics violations, and found Fichtenberg's other objections to the standard to be invalid because he raised them after SC-3's members had voted on it.

Ashley, who is at St. Cloud State University in St. Cloud, MN, disputed the validity of the standard's separate limits for "controlled" and "uncontrolled" environments. He also claims that SC-3 ignored his input. The appeals panel concluded that the SC-3 working group that drafted the standard, chaired by Kent Jaffa of PacifiCorp in Salt Lake City, UT, had given Ashley "an opportunity to express opinions" and "discussed [his] comments openly and at length."

Neither Ashley nor Fichtenberg responded to repeated requests for comment.

Industry Lobby Glosses Over EMF Leukemia Risk

The National Electrical Manufacturers Association (NEMA), an industry lobby group based in Washington, is discounting possible cancer risks from exposure to power-frequency EMFs.

The "available scientific evidence" indicates that EMF exposure "is not a cause" of long-term chronic health effects, including cancer, according to a statement adopted by NEMA's board of governors on November 10 (see box at right).

NEMA does not mention childhood leukemia—in contrast to a number of scientific review panels that have cited epidemiological evidence showing a doubling of risk with average exposures above 3-4 mG (see, for example, *MWN,* J/A01).

According to NEMA, its conclusions are based on reports from the NIEHS' RAPID program, the NAS–NRC and the U.K.'s NRPB, as well as the American Physical Society.

The statement does not cite the designation of EMFs as a "possible human carcinogen" by the RAPID working group or by IARC (see *MWN,* J/A98 and J/A01, respectively).

Dr. Steinar Dale, chair of NEMA's EMF task force, which wrote the statement, told *Microwave News* that it does not mention epidemiological evidence pointing to leukemia risks because "we did not want to go into that level of detail." He said that he sees "no inconsistency" between the statement and others that do note childhood cancer risks.

According to Dale, of ABB Power Systems in Raleigh, NC, NEMA decided that its previous statement on EMFs and health, adopted in 1996, should be updated to reflect the findings of the RAPID program. In 1996, NEMA found "no credible basis" for EMF health risks.

Douglas Bannerman, who has long monitored EMF health developments for NEMA, declined to comment.

NEMA represents more than 400 companies with total revenues exceeding $100 billion.

At the end of January, Dale left ABB and resigned as chair of the NEMA EMF task force. No replacement has yet been named.

NEMA Statement on EMFs & Cancer

The board of the National Electrical Manufacturers Association (NEMA) adopted the following statement on November 10. It is available at: <www.nema.org>.

It is generally recognized that extra-low-frequency (50-60 Hz) electromagnetic fields (ELF EMF) are present in the environment as a result of the generation, transmission, distribution and use of electricity in modern society.

The available scientific evidence indicates that public exposure to ELF EMF is not a cause of long-term chronic adverse health effects, based on the multimillion dollar, 6-year National Institute of Environmental Health Sciences (NIEHS) RAPID research program. The RAPID program's findings, reported to the U.S. Congress in 1999, are supported by several highly respected and independent organizations including the National Research Council of the National Academy of Sciences (1996), the American Physical Society (1995), the World Health Organization (ongoing) and the British National Radiological Protection Board (2001).

NEMA believes that standards for human exposure to ELF EMF are only warranted if a credible scientific basis can be established for adverse effects. Such a basis has not been established for long-term chronic health effects, e.g., cancer, brain tumors, etc. At the same time, NEMA recognizes that exposure to low-frequency magnetic field strengths at levels much greater than typically encountered may cause short-term reactions. Standards that seek to minimize exposure to such field strengths may be warranted.

NEMA recognizes that there are global and political pressures to adopt ELF EMF regulations and standards. Where standards for exposure to ELF EMF are warranted, ELF EMF regulations and standards must comply with rules established by the World Trade Organization for international trade and should be harmonized globally so as to allow the free flow of goods and services across state and national borders.

Catholic School Seeks To Silence Opponent in Power Line Fight

Catholic school officials in Edmonton, Canada, have threatened to sue EMF activist Lisa Amyotte for making "defamatory" statements about health risks at a school currently under construction 108 m from a 240 kV power line.

As a result, Amyotte told *Microwave News* that she will refrain from speaking out against the school—"for the moment." She will instead press for more protective policies on the general issue of EMFs from power lines.

Last November 8, a local planning board rejected the school site because the EMFs — estimated to be 1-2 mG — could increase childhood cancer risks. But a month later, the city council overruled the board; the school is now expected to open in the fall.

In a December 31 letter, Teresa Haykowsky, an attorney for Edmonton Catholic Schools (ECS), warned Amyotte that she faced legal action "in the event that you do not cease and desist in your defamatory conduct."

Haykowsky declined to be interviewed, referring questions to ECS spokesperson Lori Nagy. Nagy told *Microwave News* that Amyotte had made "inaccurate and misleading" statements that "go beyond freedom of expression."

The letter cites a large number of Amyotte's remarks to the press that ECS deems to be defamatory. These include:

> "We believe a safe Catholic school for all children now and in the future is worth fighting for."
>
> "If we can prevent one child from going to that school that might have gotten leukemia it will have been worth it."

At Amyotte's request, several prominent public health scientists have written to the city advocating a policy of prudent avoidance and warning that building a school near a power line would entail health risks (see *MWN,* N/D02).

Officials of the city's public health system, Capital Health, paved the way for the city council's approval of the new school. In a December 4 memorandum, Capital Health concluded that the planning board's decision "appears to be [an] improper application of the principle of prudent avoidance."

Former Head of IARC Backs the Precautionary Principle

Reprinted below are excerpts from a paper, "Primary Prevention Protects Public Health," presented by Dr. Lorenzo Tomatis at Carcinogenesis Bioassays and Protecting Public Health, *a conference organized in memory of Dr. Cesare Maltoni of the Ramazzini Foundation in Bologna, Italy (see* MWN, *M/J02). The proceedings have been published as* Vol.982 *of the* Annals of the New York Academy of Sciences. *Tomatis was the director of the International Agency for Research on Cancer (IARC) from 1982 to 1993. He now lives in Trieste, Italy. His e-mail address is: <ltomatis@hotmail.com>.*

Originally, Group 2B [of IARC's classification of carcinogens] was conceived as a temporary grouping of agents for which further investigation was urgently needed. It has now become a huge parking lot, with over 200 agents or mixtures of agents, in which the available data are of variable quality and quantity. The possibility that new data will become available on these agents in the near future now appears remote....

EMFs provide another example of controversy. There is apparent consensus on the epidemiological evidence for an increased risk of childhood leukemia, with a far from negligible relative risk of 2.0 for postnatal exposure to 0.4 ∝T [4 mG]. Although it has been stated authoritatively that the energy [of] EMFs is insufficient to damage DNA directly and that EMFs cannot therefore have tumor initiation activity, at the same time the need to identify possible mechanisms of action has been emphasized. A severe limitation of the experimental approach for studying the possible carcinogenic effect of EMFs is use of the same criteria traditionally applied to study the carcinogenicity of chemical agents. In the sequence of events that lead to malignant transformation, mechanisms other than direct interaction with or damage to DNA may be involved. Thus, experimental approaches should be used that can support or refute alternative mechanisms that could modify the risk of cancer. In the absence of a mechanism that can satisfactorily justify the increased risk, EMFs have joined the hundreds of agents in IARC Group 2B. However, in contrast to its companions in this large parking lot, EMF has actually stimulated the interest of epidemiologists and, importantly, the release of funds for additional research.

Another relevant example of uncertainty...is non-Hodgkin's lymphoma (NHL), whose incidence has continued to increase throughout the past quarter of a century....Several risk factors have been incriminated, including nitrites in drinking water, EMFs, hair colorants, dietary habits and (above all) occupational exposure to organic solvents, pesticides and herbicides. Whatever the role of each of these factors, none alone can clearly explain the continuous, widespread increase in the incidence of NHL....

We may find ourselves facing a choice between an active attitude, expressed as the adoption of measures of primary prevention in the absence of certainties, and a passive attitude that finds in the etiological uncertainties justification to disregard prudent primary prevention. In the case of NHL, the first attitude would involve drastic measures to reduce the use of pesticides, herbicides and organic solvents; evacuation, at least temporarily, of residences with high levels of EMFs; and orientation towards a utopic, but essential, reduction in consumption. Clearly, this first choice reflects the widely discussed precautionary principle, which indicates that urgent intervention is justified in the face of a potentially serious risk even in the absence of incontestable scientific evidence of a cause-effect relationship.

A cautious, prudent attitude is sometimes interpreted as antitechnological and antiscientific. In fact, those who champion an attitude of caution are simply recognizing that predictive knowledge in most instances is of lesser quality and remains at a lower level than technological knowledge. Recognition of our limited capacity to predict the long-term consequences of our knowledge can only lead to learning more, and thus it represents a stimulus, and certainly not an impediment, to research.

By adopting an attitude of responsible caution, we also accept that we have a duty to provide accurate information on possible or potential risks and to prevent relevant data from being ignored or concealed. Only with such an attitude can we avoid the entire human species being exposed to everything that technological progress can invent.

Hot New Papers

S. Hadjiloucas, M.S. Chahal and J.W. Bowen, "Preliminary Results on the Nonthermal Effects of 200-350 GHz Radiation on the Growth Rate of *S. cerevisiae* Cells in Microcolonies," *Physics in Medicine and Biology, 47,* pp.3831-3839, November 7, 2002.

"Exponentially growing *Saccharomyces cerevisiae* yeast cells grown on dry media were exposed to EMFs in the 200-350 GHz frequency range at low power density to observe possible nonthermal effects on the microcolony growth. Exposure to the EMF was conducted over 2.5 h. ...A statistically significant difference (using a paired t-test at $p<0.01$) between control and exposed groups (enhanced growth) was observed for several small microcolonies which were exposed to 341 GHz radiation. For all other frequencies enhanced or stunted growth was not observed to a statistically significant level. The enhanced growth observed for the exposed microcolonies at 341 GHz suggests a 'window effect' at the earlier stages of growth....Based on these observations, a more detailed study was performed where the effects of exposure duration on the growth of microcolonies were investigated at 341 GHz. A much larger number of microcolonies was observed after sequentially exposing the same microcolonies to radiation over a period of 30, 60, 90, 120 and 150 min....A statistically significant difference (using a t-test) between control and exposed groups is apparent for all of the exposure times except for that at 150 min, but it is clear that the greatest difference occurs within the first 30 min of exposure....These results suggest that exposure to radiation has the greatest effect when the cells are at an early growth stage."

Reprints: Dr. Sillas Hadjiloucas, School of Systems Engineering, Reading University, Reading, U.K., E-mail: <cybsh@cyber.reading.ac.uk>.

Fung Hin Tat, Kam Chak Wah and Yau Hon Hung, "A Follow-Up Study of Electromagnetic Interference [EMI] of Cellular Phones on Electronic Medical Equipment in the Emergency Department [ED]," *Emergency Medicine, 14,* pp.315-319, September 2002.

"Compared with our study of GSM cellular phones in 1997, the current PCS cellular phones impose less EMI on electronic medical equipment found in the ED....Malfunction of electronic medical equipment is determined primarily by the EM shielding of the medical device, the distance between the cellular phone and that device and the EMI characteristics of the cellular phone. The phone's frequency is of greater importance than its power. A frequency of 900 MHz is more likely to cause EMI than 1800 MHz....Of interest is the fact that the hemoglucostix meter was still affected by cellular phone EMI despite being labelled with several EMI standard certificates (CE, GS & UL). This labelling reflects the current lack of a widely adopted specific standard for cellular phone EMI on electronic medical equipment....As a result of this study it is suggested that a separation distance of 1 m between a cellular phone and any electronic medical device provides adequate safety from EMI and should form the basis of policy which seeks to control the usage of cellular phones within a hospital. This policy would also take into account the situation in which two mobile phones ring simultaneously within a small confined area containing electronic medical equipment."

Reprints: Dr. Kam, Tuen Mun Hospital, Hong Kong, China, E-mail: <kamcw@ha.org.hk>.

Justin Bekelman, Yan Li and Cary Gross, "Scope and Impact of Financial Conflicts of Interest in Biomedical Research: A Systematic Review," *Journal of the American Medical Association, 289,* pp.454-465, January 22/29, 2003.

"This comprehensive review of the literature confirms that financial relationships among industry, scientific investigators and academic institutions are pervasive. About one fourth of biomedical investigators at academic institutions receive research funding from industry....Despite the prevalence of these relationships and the broad concerns they have generated, a relative paucity of data has been published describing the impact of financial ties on biomedical research. Although only 37 articles met inclusion criteria, evidence suggests that the financial ties that intertwine industry, investigators and academic institutions can influence the research process. Strong and consistent evidence shows that industry-sponsored research tends to draw pro-industry conclusions. By combining data from articles examining 1,140 studies, we found

Nonthermal Cell Phone Radiation Leads to "Gross" Mutagenic Activity

Maya Mashevich et al. (including Rafi Korenstein), "Exposure of Human Peripheral Blood Lymphocytes to Electromagnetic Fields Associated with Cellular Phones Leads to Chromosomal Instability," *Bioelectromagnetics, 24,* pp.82-90, February 2003.

"We have examined whether *in vitro* exposure of human peripheral blood lymphocytes (PBL) to continuous 830 MHz EMFs causes losses and gains of chromosomes (aneuploidy), a major 'somatic mutation' leading to genomic instability and thereby to cancer. PBL were irradiated at different average absorption rates (SAR) in the range of 1.6-8.8 W/Kg for 72 hr in an exposure system based on a parallel plate resonator at temperatures ranging from 34.5-37.5°C....A linear increase in chromosome 17 aneuploidy was observed as a function of the SAR value, demonstrating that this radiation has a genotoxic effect. The SAR-dependent aneuploidy was accompanied by an abnormal mode of replication of the chromosome 17 region engaged in segregation...suggesting that epigenetic alterations are involved in the SAR-dependent genetic toxicity. Control experiments (i.e., without any RF radiation) carried out in the temperature range of 34.5-38.5°C showed that elevated temperature is not associated with either the genetic or epigenetic alterations observed following RF radiation...These findings indicate that the genotoxic effect of the EM radiation is elicited via a nonthermal pathway. Moreover, the fact that aneuploidy is a phenomenon known to increase the risk for cancer should be taken into consideration in future evaluation of exposure guidelines. ...These findings support the view that exposure to RF radiation of average SAR values of 2.6-8.8 W/Kg may lead, through a nonthermal pathway, to a carcinogenic activity. Our study does not elucidate the specific primary mechanism by which radiation interacts with the cell and alters its genetic material. However, it does demonstrate that exposure to RF radiation results in a gross somatic mutation leading to a major modulation in gene expression which may be amplified by epigenetic mechanism of gene expression..."

Reprints: Prof. Rafi Korenstein, Sackler School of Medicine, Tel-Aviv University, Israel, E-mail: <korens@post.tau.ac.il>.

Korenstein has also studied the genotoxic effects of ELF EMFs, see *MWN*, J/A00. (See also p.1.)

that industry-sponsored studies were significantly more likely to reach conclusions that were favorable to the sponsor than were nonindustry studies....Several studies found that industry-sponsored research appears to be of similar quality to other research....Consistent evidence also demonstrated that industry ties are associated with both publication delays and data withholding. These restrictions...serve to compound bias in biomedical research. Anecdotal reports suggest that industry may alter, obstruct or even stop publication of negative studies."

Reprints: Dr. Gross, Yale University School of Medicine, New Haven, CT, E-mail: <cary.gross@yale.edu>.

Edwin van Wijngaarden, "An Exploratory Investigation of Suicide and Occupational Exposure," *Journal of Occupational and Environmental Medicine, 45,* pp.96-101, January 2003.

"This exploratory study evaluated the association between suicide and occupational exposure to EMFs, pesticides and hydrocarbon solvents. The study population comprised 11,707 suicide deaths...from U.S. death certificate files for the years 1991 and 1992. Exposure assignment was based on job title reported on the death certificates. Exposure to EMFs and pesticides was weakly associated with suicide risk, while little evidence for an increased risk was seen for hydrocarbon solvents. The association for EMF exposure was highest for suicide between ages 20 and 35 (odds ratio: 1.5)....Interestingly, a pattern across age groups similar to the one reported here has been reported previously [Van Wijngaarden, 2000]. A difference in the nature of depression and suicide between age groups may account for the possibly increased vulnerability of younger people to the effects of EMFs."

Reprints: Dr. Wijngaarden, Applied Epidemiology Inc., Amherst, MA, E-mail: <evanwijngaarden@appliedepidemiology.com>.

See *MWN,* M/A00 for a discussion of the 2000 suicide paper.

Chung-Yi Li and Fung-Chang Sung, "Association Between Occupational Exposure to Power-Frequency Electromagnetic Fields and Amyotrophic Lateral Sclerosis [ALS]: A Review," *American Journal of Industrial Medicine, 43,* pp.212-220, February 2003.

"Although there is some consistency in the findings, a causal link between occupational exposure to EMF and ALS cannot be substantiated based on the existing data because of certain methodological limitations and the small number of publications. Our review shows that confounding is of greater concern than the potential exposure misclassification due to inadequate exposure assessment or selection bias in interpreting the results from the selected studies. Most studies did not consider work-related factors potentially associated with ALS in the analysis. Of particular interest was the role of electrical trauma in the possible link between EMF exposure and ALS. Trauma due to electric shock was frequently observed as a risk factor of ALS. As people employed in electric utilities are more likely than others to experience electric shock or trauma, the excess number of patients with ALS or deaths from it among electricity-related occupations may be due to repeated electric contusions rather than to exposure to high levels of EMF. The study by Gunnarsson et al. attempted to assess the separate effect of EMF exposure and electrical shocks on the risk for ALS. The results showed a substantially elevated risk for ALS for those that work with electricity (OR: 6.7), but reported null effects from either EMF exposure (OR: 0.6). Further studies should consider investigating the separate effect of EMF exposure and electrical shocks to make more specific causal interpretations. An alternative way of separating EMF exposure from electrical shocks is to conduct a residential study since there is no indication that people living near high-voltage power lines are prone to electrical shocks."

Reprints: Dr. Chung-Yi Li, College of Medicine, Fu Jen Catholic University, Hsinchuang, Taiwan, E-mail: <chungyi@mails.fju.edu.tw>.

Letter to the Editor

Unambiguous Confirmation of a Nonthermal Effect in the Inorganic World

January 15, 2003

To the Editor:

In your last issue (*MWN,* N/D02), some argued that nonthermal microwave effects do not exist. With respect to the processing of inorganic materials we have conclusively demonstrated that nonthermal microwave radiation can influence the microstructures, phase transformations and sintering of materials.

We see startling differences when various materials are exposed separately to E- and H-fields in a microwave single-mode cavity. While the controversy over biological and human health effects — whether good or bad — goes on, our most extraordinary discovery merits everyone's attention because it shows that microwave magnetic fields can cause major phase changes in inorganic solids.

Working at Penn State's Materials Research Institute, we have found striking differences between the effects of magnetic and electric fields at 2.45 GHz on common high-tech, high-melting-point, inorganic materials. In a series of papers and patents (see below), we have shown that magnetic materials can be turned into glasses and that they lose their permanent power to stick to iron! And this occurs in 5-15 seconds!!

Confirmation that this is a field effect is simply stated: We have repeated the experiment in our laboratory hundreds of times and each time the magnetic field transformed the material into an amorphous phase within a few seconds. But when we exposed the identical sample in the very same cavity to only an electric field, we saw the opposite effect: The material became even more crystalline.

While these exposures were at GHz frequencies, the fields involved were less than a gauss, and the temperatures measured at the surface were far below the melting point of the exposed material. Initial work on cell cultures confirmed that differences between E- and H-fields were also manifest in the biological world.

For more details on Penn State's Microwave Processing Center, please visit: <www.mri.psu.edu/centers/mpec>.

Prof. Rustum Roy, E-mail: <rroy@psu.edu>
Prof. Dinesh Agrawal, E-mail: <dxa4@psu.edu>
Microwave Processing and Engineering Center
Materials Research Institute, Pennsylvania State University
University Park, PA 16802

R. Roy, R. Peelamedu, L. Hurtt, J. Cheng and D. Agrawal, "Definitive Experimental Evidence for Microwave Effects: Radically New Effects of Separated E- and H-Fields, such as Decrystallization of Oxides in Seconds," *Materials Research Innovations, 6,* pp.128-140, September 2002.

R. Roy, R. Peelamedu, C. Grimes, J. Cheng and D. Agrawal, "Major Phase Transformations and Magnetic Property Changes Caused by Electromagnetic Fields at Microwave Frequencies," *Journal of Materials Research 17,* pp.3008-3011, December 2002.

R. Roy, J. Cheng and D. Agrawal, "Microwave Processing in Pure H-Fields and Pure E-Fields," U.S. Patent No.6,365,885, April 2, 2002.

2003 Conference Calendar (Part II)

Part I appeared in our last issue.

January 24-25: **Non-Ionizing Electromagnetic Fields and Radiations and the Impacts of New Technologies on Health and Environment,** Porto Alegre, RS, Brazil. Contact: Brazilian Association for Defense of Concerned Dwellers and Users of Cellular Telecommunications Equipment, Tel & Fax: (55+11) 3666-8081, E-mail: <abradecel@hotmail.com>, Web: <www.abradecel.org.br>.

February 21: **National Toxicology Program (NTP) Workshop on Genetically Modified Rodent Models for Cancer Hazard Identification,** Hamilton Crowne Plaza Hotel, Washington, DC. Contact: Diane Spencer, Liaison & Scientific Review Office, NTP, (919) 541-2759, E-mail: <spencer2@niehs.nih.gov>.

March 11-14: **Mobile Health and the Environment,** Melia White House Hotel, London, U.K. Contact: Tamara James, IBC Conferences, 30-32 Mortimer St., London W1W 7RE, U.K., (44+1932) 893-853, Fax: (44+1932) 893-893, E-mail: <cust.serv@informa.com>, Web: <www.ibctelecoms.com>.

March 24-25: **ICNIRP/WHO International Workshop on Weak ELF Electric Field Effects in the Body** (attendance by invitation only), NRPB , Chilton, U.K. Contact: Rüdiger Matthes, ICNIRP, Germany, (49+89) 3160-3288, Fax: (49+89) 3160-3289, E-mail: <rmatthes@bfs.de>.

April 18-22: **3rd International EMF Seminar in China: EMFs and Biological Effects,** Guilin, China. Contact: Zeng Qunli, Bioelectromagnetics Lab, Zhejiang University School of Medicine, 353 Yan-an Rd., Hangzhou 310031, China, (86+571) 8721-7094, Fax: (86+571) 8721-7410, E-mail: <zengql@cmm.zju.edu.cn>.

June 8-11: **22nd Annual Scientific Conference of the Society for Physical Regulation in Biology and Medicine (SPRBM),** San Antonio, TX. Contact: Gloria Parsley, 2412 Cobblestone Way, Frederick, MD 21702, (301) 663-4556, Fax: (301) 694-4948, E-mail: <gloriaparsley@aol.com>, Web: <www.sprbm.org>.

June 8-15: **IEEE Microwave Theory and Techniques Society (MTT-S) International Symposium,** Convention Center, Philadelphia, PA. Contact: Richard Snyder, (973) 492-1207, Fax: (973) 492-2471, E-mail: <r.snyder@ieee.org>, Web: <www.ims2003.org>.

June 11-13: **3rd International Symposium on Nonthermal Medical/Biological Treatments Using EMFs and Ionized Gas (ElectroMed 2003),** San Antonio, TX. Contact: Dr. Michael Murphy, RFR Branch, 8315 Hawks Rd., Bldg.1162, Brooks AFB, TX 78235, (210) 536-4833, Fax: (210) 536-3977, E-mail: <Michael.Murphy@brooks.af.mil>, Web: <www.electromed2003.com>.

June 12-14: **36th Annual Meeting of the Society for Epidemiologic Research (SER),** Marriott Marquis Hotel, Atlanta, GA. Contact: SER, PO Box 990, Clearfield, UT 84098, (801) 525-0231, Fax: (801) 774-9211, E-mail: <membership@epiresearch.org>, Web: <www.epiresearch.org/meeting/index.html>.

June 19-24: **17th International Symposium on Bioelectrochemistry and Bioenergetics (BEB 2003),** Florence, Italy. Contact: Prof. Maria Rosa Moncelli, Dept. of Chemistry, Universita di Firenze, via della Lastruccia 3, 50019 Sesto Fiorentino (Firenze), Italy, (39+55) 457-3100, Fax: (39+55) 457-3098, E-mail: <moncelli@beb2003.org>, Web: <www.beb2003.org>.

June 19-25: **13th Annual Conference of the International Society for the Study of Subtle Energies and Energy Medicine (ISSSEEM),** Boulder, CO. Contact: ISSSEEM, 11005 Ralston Rd., Ste.100-D, Arvada, CO 80004, (303) 425-4625, Fax: (303) 425-4685, E-mail: <issseem@cs.com>, Web: <www.issseem.org>.

June 22-26: **25th Annual Meeting of the Bioelectromagnetics Society (BEMS),** Outrigger Wailea Resort, Maui, HI. Contact: Gloria Parsley, see June 8-11 above, Web: <www.bioelectromagnetics.org>.

June 22-27: **IEEE International Symposium on Antennas and Propagation** and **North American Radio Science Meeting,** Hyatt Regency Hotel, Columbus, OH. Contact: Ron Marhefka, ElectroScience Lab, Ohio State University, 1320 Kinnear Rd., Columbus, OH 43212, (614) 292-5752, Fax: (614) 292-7297, E-mail: <Marhefka.1@osu.edu>, Web: <aps2003.eng.ohio-state.edu>.

Meeting Notes

• The **precautionary principle** (PP) is a hot topic on the conference circuit this winter. The **WHO** EMF project, the NIEHS and the EC are organizing a three-day meeting, February 24-26, at the EC in Luxembourg. Only the first day is open to the public — the other two are by invitation only. We asked **NIEHS**' Dr. **Chris Portier**, who will be there, if he would let us come. "Sorry," he replied, it's up to WHO's Dr. **Leeka Kheifets**, who is organizing the meeting. She also said no, pointing out that those invited to serve on the working groups would take up all the available space. Others, including all members of the press, had also been refused, she told us, closing with, "Of course, we will be happy to share with you materials as they become available." In late January, a seminar on the PP and EMFs was on the agenda at the **World Social Forum** in Porto Alegre, **Brazil**. The forum was held at the same time as the World Economic Forum was being held in Davos, Switzerland — the two meetings attracted very different attendees. And March 20-22, the **European Policy Center** in Brussels is organizing a conference on ***The US, the EU and Precaution: Comparing Risk Management in a Complex World***. One of the case studies on the provisional agenda will be moderated by Dr. **Granger Morgan** of Carnegie Mellon University (CMU) in Pittsburgh; Dr. **Peter Wiedemann** of Germany's Jülich Research Center will give a presentation. Last January, the policy center worked with the EC to host a conference on risk management at which Dr. John Graham of the U.S. Office of Management and Budget spoke on the PP (see *MWN,* M/A02). Graham received his doctorate from CMU in 1983; Morgan was his advisor.

• Prof. **Zhaojin Cao** of the Chinese Center for Disease Control and Prevention in Beijing will present a paper on epidemiological studies in **China** at the April EMF seminar in **Guilin**.

July 13-18: **Power Engineering Society (PES) Summer Meeting,** Toronto, Canada. Contact: Joe Bailey, Toronto Hydro, (416) 542-2874, Fax: (416) 542-2833, E-mail: <jbailey@torontohydro.com>, Web: <www.ieee.org>.

July 20-24: **48th Annual Meeting of the Health Physics Society (HPS),** Town & Country Hotel and Convention Center, San Diego, CA. Contact: HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101, Web: <www.hps.org>.

July 27-August 1: **International Conference on Magnetism,** Palazzo dei Congressi, Rome, Italy. Contact: Mrs. G. Ianni, ISM-CNR, Area della Ricerca di Roma, PO Box 10, 00016 Monterotondo Scalo (RM), Italy, (39+06) 9067-2285, Fax: (39+06) 9067-2470, E-mail: <icm2003@mlib.cnr.it>,Web: <www.icm2003.mlib.cnr.it>.

August 17-21: **6th International Symposium on Antennas, Propagation and EM Theory (ISAPE),** Beijing, China. Contact: Dayong Liu, ISAPE 2003, PO Box 165, Beijing 100036, China, (86+10) 6828-3463, Fax: (86+10) 6828-3458, E-mail: <davidwd@btamail.net.cn>, Web: <www.cie-china.org/isape2003>.

August 18-22: **IEEE Symposium on Electromagnetic Compatibility,** Hynes Convention Center, Boston, MA. Contact: Vita Feuerstein, IEEE Conference Services, 445 Hoes Ln., Piscataway, NJ 08855, (732) 562-6826, Fax: (732) 981-1203, E-mail: <emc2003info@ieee.org>, Web: <www.emc2003.org>.

September 7-12: **IEEE/PES Transmission & Distribution Conference & Exposition,** Convention Center, Dallas, TX. Contact: Al Dirnberger, TXU Electric, (817) 215-6363, E-mail: <al_dirnberger@txu.com>, Web: <www.ieeetd.org>.

September 17-21: **25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society,** Cancun, Mexico. Contact: Universidad Autónoma Metropolitana-Iztapalapa, Dept. of Electrical Engineering, Av. San Rafael Atlixco 186, Col. Vicentina, Iztapalapa 09340, Mexico, (525) 804-4905, ext.204, Fax: (525) 804-4631, E-mail: <j.stock@ieee.org>, Web: <www.itzamna.uam.mx/cancun>.

September 18-21: **20th Annual Meeting of the European Society for Magnetic Resonance in Medicine and Biology (ESMRMB),** Rotterdam, The Netherlands. Contact: ESMRMB, Neutorgasse 9/2A, Vienna A-1010, Austria, (43+1) 535-1306, Fax: (43+1) 535-7041, E-mail: <office@esmrmb.org>, Web: <www.esmrmb.org>.

September 21-25: **13th Annual Conference of the International Society of Exposure Analysis (ISEA),** Palazzo dei Congressi, Stresa, Italy. Contact: ISEA Secretariat, International Center for Pesticide Safety, via Magenta 25, 20020 Busto Garolfo (MI), Italy, Fax: (39+33) 156-8023, E-mail: <mail@icps.it>, Web: <www.ktl.fi/isea2003>.

September 24-26: **15th Annual Conference of the International Society for Environmental Epidemiology (ISEE),** Perth, Australia. Contact: Andrea Hinwood, PO Box 749, Wembley, WA 6913, Australia, E-mail: <andrea.hinwood@environ.wa.gov.au>, Web: <eventedge.com.au/isee/index.html>.

November 6-12: **WHO/U.S. Air Force Asia Pacific EMF Conference,** Bangkok, Thailand. Contact: Dr. Michael Murphy, see June 11-13 above; Web: <www.who.int/peh-emf/meetings/thailand2002/en>.

November 13-15: **6th International Congress of the European Bioelectromagnetics Association (EBEA),** Budapest, Hungary. Contact: Diamond Congress Ltd.-EBEA 2003, PO Box 48, H-1255 Budapest, Hungary, (36+1) 214-7701, Fax: (36+1) 201-2680, E-mail: <diamond@diamond-congress.hu>, Web: <www.diamond-congress.hu/ebea2003/entry.htm>. The meeting will be followed by a COST 281 workshop.

Across the Spectrum

"There's some snake oil out there."

— David Heim, deputy editor, *Consumer Reports,* Yonkers, NY, referring to devices to reduce radiation exposures from mobile phones, quoted by Ellen Sheng, "Cell Phone Radiation Is Team's Focus," *Wall Street Journal,* p.B3A, December 18, 2002

It only needs the perception, let alone the reality, of financial conflicts and commercial pressures to destroy the credibility of important organizations such as IARC and its parent, WHO.

— Editorial, "Transparency at IARC," *The Lancet, 361,* p.189, January 18, 2003

If it is not worth doing, it is not worth doing well.

— Dr. David Savitz, University of North Carolina School of Public Health, Chapel Hill, in a commentary, "Health Effects of Electric and Magnetic Fields: Are We Done Yet?" *Epidemiology, 14,* p.16, January 2003

"It's preventive medicine. And it's less expensive than medications and antidepressants."

— Dr. Damien Léger, neurophysiologist, Paris, France, on using light to treat patients with seasonal affective disorder (SAD), quoted by Elaine Sciolino, "Paris Journal: Call It the City of Darkness, and Give It Vitamin D," *New York Times,* p.A4, January 6, 2003

"The real world intervenes from time to time. And you reach in there and take something out that is still in a developmental stage, and you might use it."

— Donald Rumsfeld, U.S. secretary of defense, on using high-power microwave weapons (HPM) in a war with Iraq, quoted by Mark Thompson, "Electrical Storm: America's Ultra-Secret Weapon," *Time,* p.27, January 27, 2003

"MICROWAVE NEWS" FLASHBACK

Years 20 Ago

• Budget cuts force the EPA to close its program on RF/MW radiation at its Health Effects Research Lab.

• Citing evidence of a possible risk to pregnant women who work with VDTs, the Canadian Center for Occupational Health and Safety recommends that radiation exposure standards be extended to include the VLF frequencies emitted by computer terminals.

• After a 25-year run, the U.S. government's Electromagnetic Radiation Management Advisory Council (ERMAC) disbands when the NTIA decides against renewing the council's charter.

Years 10 Ago

• Responding to public concerns over a lawsuit linking cell phone use to brain cancer, the wireless industry promises to sponsor research on possible health risks.

• The Centers for Disease Control and Prevention find that ELF EMFs have no known role in inducing or promoting cancer in women living on Long Island, NY. Nevertheless, NIH Director Bernadine Healy favors more research on the question.

Years 5 Ago

• A four-year-old, unpublished EPA draft obtained by *Microwave News* states that power-frequency EMFs "must be considered as one risk factor" for cancer.

• The FDA tells Rep. Edward Markey (D-MA) that more research is needed on cell phone safety. It points, with approval, to the congressionally mandated EMF RAPID program.

• The International Agency for Reseach on Cancer unveils plans for a multi-country, multimillion-dollar study of cancer among mobile phone users.

UPDATES

CIRCADIAN RHYTHMS

Cancer: A Matter of Timing... Genes that regulate circadian cycles also play a role in preventing cancer. A team led by Dr. Cheng Chi Lee of Baylor College of Medicine in Houston reports that 71% of transgenic mice lacking one of the eight core circadian genes developed lymphoma within 16 months following a single dose of ionizing radiation, compared to 5% of wild-type mice — a highly significant difference ($p<0.00001$). In another experiment, all transgenic mice, even without initiation with radiation, were found to have abnormal cell growths (hyperplasias) in their salivary glands at 18 months, and all of the male mice developed teratomas or other types of tumors. No hyperplasias or teratomas were seen in any of the wild-type controls. These results were also highly significant. Lee found that, when exposed to gamma radiation, the mutant mice had a much smaller increase in cell death — cell death serves as a cancer-suppressing response — than wild-type controls. The absent gene "can be regarded as a tumor suppressor," Lee concludes in a paper published in the October 4 issue of *Cell (111,* pp.41-50, 2002). He adds that "other circadian regulators may play a similar role in tumor suppression as well." In a commentary on these new results appearing in *Nature (420,* pp.373-374, November 28, 2002), Drs. Michael Rosbash of Brandeis University in Waltham, MA, and Joseph Takahashi of Northwestern University in Evanston, IL, point out that health problems among shift workers have already been linked to "disruption of physiological systems that are under circadian control" — such as melatonin production. The new results, they write, suggest that "there might also be a direct connection" between interference with circadian mechanisms at the genetic level and illnesses linked to shift work.

CONSUMER REPORTS

Advice on Mobile Phones..."Research hasn't proved any hazards, but there may be cause for concern." That is the view offered by *Consumer Reports* in this year's survey of wireless phones and service providers. The influential publication, published by the Consumers Union in Yonkers, NY, devotes a full page to phone safety in its February issue. It notes "provocative findings," including those of Sweden's Dr. Lennart Hardell on brain tumor risks and Finland's Dr. Dariusz Leszczynski on changes in gene expression (see *MWN,* S/O02 and J/A02, respectively). The article also advises readers that expert panels in France, Germany and the U.K. have discouraged the use of phones by children. Closer to home, it cites the FDA's research agreement — or CRADA — with the CTIA, the wireless industry lobby group, and the agency's "carefully worded but equivocal" position on the health issue: that although available evidence does not point to any health problems, there is "no proof" that phones are "absolutely safe." Previously, *Consumer Reports* largely ignored health concerns in its coverage of mobile phones (see *MWN,* J/F00 and J/F02), though it suggested the use of hands-free sets for those wanting to reduce their radiation exposure. This year, it adds that those who are concerned should limit the use of phones by children and teenagers: "Encourage them to wear a headset or to send text messages."

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DOSIMETRY

Hot Pockets... Using a hands-free set can result in higher radiation exposures if the phone is placed in a pocket: The 1g and 10g SARs are two-to-seven-times greater than those obtained for a model head (with a plastic ear), according to calculations and measurements by Drs. Om Gandhi and Gang Kang of the University of Utah, Salt Lake City. A phone could therefore meet U.S. and European SAR limits but still be "severely out of compliance if it were placed in the shirt pocket," they warn in a paper published in the December issue of *Physics in Medicine and Biology (47,* pp.4301-4313, 2002). This is because when placed in the pocket, there is no separation between the phone and the human body — under the most widely used testing protocols, there is a stipulated separation of 6 mm between the skull and the phone. (The Australian Consumers' Association issued a similar warning a few years ago based on a report by Chris Zombolas of EMC Technologies in Melbourne; see *MWN,* S/O00). Gandhi presented these results at the URSI meeting held in Maastricht, The Netherlands, last August. His paper prompted Dr. C.K. Chou, the director of Motorola's RF dosimetry lab in Plantation, FL, to comment that, "You have to have a separation distance. We don't recommend putting a phone in your pocket." Chou, who plays a key role in the IEEE committees writing standards for radiation exposures and for devising test methods, said that holders are provided with Motorola phones and that, "If you carry the phone on the body, put it in the holder."

DRIVING & PHONING

Inattention Blindness... Tests by psychologists at the University of Utah in Salt Lake City show that using a cell phone disrupts a driver's ability to process visual information. In the February/March issue of *Injury Insights,* published by the National Safety Council in Chicago, Dr. David Strayer and coworkers write that, "Legislative initiatives that restrict handheld devices but permit hands-free devices are not likely to eliminate the problems associated with using cell phones while driving. These problems are attributed in large part to the distracting effects of the phone conversations themselves."

PEOPLE

Dr. Boris Pasche has been appointed a contributing editor of the *Journal of the American Medical Association* with responsibilities for oncology, genetics and molecular medicine. Pasche, the director of the cancer genetics program at Northwestern University's medical school in Chicago, has played a leading role in the development of low-energy-emission therapy (LEET) to treat chronic insomnia. LEET uses nonthermal RF radiation with very specific ELF-modulations to induce sleep (see *MWN,* M/J96).... Dr. **Brian Beard** of the FDA's electrophysics branch in Rockville, MD, has taken over as the chair of IEEE SCC-34 Subcommittee 2's working group on computational dosimetry for mobile phones. He replaces **Kwok Chan** of the FCC lab in Columbia, MD (see *MWN,* M/A97). Beard works with **Howard Bassen**, the branch chief, who chairs both Subcommittee 2 and the other

working group — on experimental dosimetry....Dr. **Edwin van Wijngaarden** has completed his doctoral studies at the University of North Carolina, Chapel Hill, and has joined Applied Epidemiology Inc. in Amherst, MA, a research and consulting firm specializing in environmental and occupational health. (See p.12 for his latest paper on the possible link between EMFs and suicides.)...The NCRP is moving to assure a smooth succession when **William Beckner**, its executive director, retires. The council has invited applications for the position of deputy executive director, who is expected to take over from Beckner when he steps down in about a year....Dr. **Tom Rozzell** has retired as the director of fellowship programs at the National Academy of Sciences in Washington. Rozzell, who was previously at the Office of Naval Research, was one of the founders of the Bioelectromagnetics Society and the first editor of its newsletter.

PRECAUTIONARY PRINCIPLE

Common Sense or Environmental Extremism?... Dr. Ken Foster poses this question in a paper on the precautionary principle (PP) — part of a collection of nine short papers on the PP and RF radiation that makes up the winter 2002/2003 issue of the *IEEE Technology and Society Magazine*. Foster of the University of Pennsylvania in Philadelphia and Dr. Paolo Vecchia of the National Institute of Health in Rome served as the guest editors of the special issue. In another paper, they offer a commentary on the continuing controversy over the Vatican's RF transmitters in Cesano, outside Rome. (This is not their first collaboration on the PP; see *MWN,* M/J00.) "The case of the Vatican radio shows that a misuse of the PP not only may cause mistrust in science by the public but lead to a misuse of data and methodology by scientists themselves." On the other hand, writing with his colleague Dr. Carlo Petrini in another paper in the same collection, Vecchia takes a softer approach, arguing that the PP "may be the most effective way to force society to address uncertainties about such problems and to avoid letting decision makers evade their responsibilities." (For another recent paper on the PP and RFR, see *MWN,* N/D02).

SAILING

Room for Health Concerns... Umpires will officiate aboard the competing sailboats during the final stage of this year's America's Cup off the coast of New Zealand, race officials announced January 9 — even though the umpires will be close to the antennas that transmit telemetry and communication signals. Bryan Willis, chair of the international jury and chief umpire, told the *New Zealand Herald* (January 10) that referees are simply better able to call penalties when they are close to the action. A plan to put umpires on board was proposed during the last cup regatta, in 2000, but was rejected by the jury because referees would be one-and-a-half meters away from the antennas, and the panel was unwilling to take the health and insurance liability risks. Nevertheless, this year, umpires will be positioned only a half-meter away. Willis noted that insurance liability remains a significant concern for the jury. "[It] could kill the plan, but we're doing what we can to resolve the issue."

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SECONDHAND RADIATION

Phones in Railway Cars... Japan's Dr. Tsuyoshi Hondou caused quite a stir last year when he predicted that a railroad car full of mobile phone users could result in unhealthy exposures to RF/MW radiation (see *MWN,* M/J02 and J/A02). A number of observers immediately issued statements denouncing his model. Now, two research groups with ties to the wireless industry have published their criticisms. "It seems highly improbable that ICNIRP basic restrictions or even reference levels could be exceeded" in an enclosed space, Nokia's Dr. Anssi Toropainen concludes in the January 2003 issue of *Bioelectromagnetics (24,* pp.63-65). Toropainen contends that every passenger in a commuter rail car would need to have four or five 900 MHz GSM phones operating at full power (250 mW) to exceed the ICNIRP ambient limit of 450 ∝W/cm^2, while each passenger would have to be using 16 phones in order to exceed the SAR limit of 0.08 W/Kg. Hondou's arguments are also the subject of an exchange in the December issue of the *Journal of the Physical Society of Japan, (71,* p.3100-3102, 2002), where he originally published his concerns. Drs. Axel Kramer, Jürg Fröhlich and Niels Kuster of IT'IS in Zurich contend that even in a worst-case scenario — with many people using phones at full power — "exposure can never reach 25% of the...SAR safety limits for environmental exposure." Closed spaces "do not impose safety issues other than those in any other location." Hondou, who is at Tohoku University in Sendai, responds that the IT'IS calculations are wrong because they assume that radiation will be absorbed equally by each passenger. The criticisms are "based on naïve implicit assumptions which are neither relevant nor valid," he writes.

Keeping Current: Follow-Up on the News

◆ Half of all 14- to 20-year-olds in the U.S. will own a cellular phone by the end of the year, according to the Zelos Group, a research and consulting firm based in San Francisco. And Student Monitor, another data group, estimates that 70% of the 5.6 million full-time college students in the U.S. now own cell phones, the *New York Times* reports (January 20).

◆ As expected, the Australian Communications Authority (ACA) has released draft standards to regulate radiation emissions to protect the public and workers. The objective is to ensure that exposures are below the ICNIRP limits (see *MWN,* N/D02). The deadline for comments is February 20. The proposals are available at: <www.aca.gov.au/standards/emr/draftemrstd.htm>.

◆ Coming soon from ICNIRP: The report on health risks posed by radiation from anti-theft devices, funded by the EC's Fifth Framework research program (see *MWN,* M/A00), is now in press. And guidance on judging compliance of pulsed and complex non-sinusoidal waveforms below 100 kHz with ICNIRP's limits will appear in the March 2003 issue of *Health Physics* and soon afterwards at <www.icnirp.org>.

◆ The appeal in the Newman cell phone–brain tumor case was filed by the Peter Angelos law firm on January 21 in the U.S. Court of Appeals for the Fourth Circuit in Richmond, VA (see *MWN,* S/O02 and N/D02). The reply from the defense team is due February 24.

◆ The first issue of *EHP Toxicogenomics,* dated January 2003, is out. The journal is a quarterly supplement to *Environmental Health Perspectives,* which is published by NIEHS. The print edition is free for the first year for qualified subscribers. For more information, go to: <ehp.niehs.nih.gov/txg>. And the IEEE Power Engineering Society has inaugurated a new bimonthly magazine, *IEEE Power & Energy.*

◆ Two years ago, U.K. researchers argued that teenagers were substituting mobile phone use for smoking (see *MWN,* N/D00). Now, a group in Finland has found contrary evidence among 10,000 Finnish teenagers. In a letter to the *British Medical Journal* (January 18), the Finns allow that their results may not apply to other countries "where parents do not help pay for their children's mobile phone costs as much as they do in Finland."

radiation can impair the BBB, but they now add that the chemicals that leak through the BBB probably damage neurons in the cortex, the hippocampus and the basal ganglia of the brain. The cortex is close to the surface of the skull, while the basal ganglia are much deeper.

Salford and Persson write that the damaged neurons they observed may in fact be dead brain cells.

Perhaps their most surprising observation is that leakage through the BBB was still evident eight weeks after a single two-hour exposure — even at these low doses.

Salford and Persson close their paper with this warning:

> [N]euronal damage of the kind here described may not have immediately demonstrable consequences, even if repeated. It may, however, in the long run, result in reduced brain reserve capacity that might be unveiled by other later neuronal disease or even the wear and tear of aging. We cannot exclude that after some decades of (often) daily use, a whole generation of users may suffer negative effects maybe already in their middle age.

Neither Salford nor Persson could be reached for comment.

The paper will appear in a future issue of *Environmental Health Perspectives,* a peer-reviewed journal published by the National Institute of Environmental Health Sciences (NIEHS). The editors posted a typescript copy of the paper on the journal's Web site* on January 29.

Salford and Persson exposed three groups of eight rats to digital 915 MHz microwaves at 0.002, 0.02 and 0.2 W/Kg, and another eight served as controls. They note that, "We realize that our study comprises few animals, but the combined results are highly significant and exhibit a clear dose-response relationship."

"They used enough animals that it would be hard to say that what they saw is an artifact," said Dr. Henry Lai of the University of Washington, Seattle. Lai has previously reported that microwaves can cause DNA breaks in the brains of rats (see *MWN,* N/D94). "DNA breaks could lead to cell death, and this would look like what Salford is reporting," Lai said. (See also p.11.)

Salford and Persson exposed rats that were 12 to 26 weeks old in order to simulate the level of development of "human mobile-phone-addicted teenagers." The rats were allowed to live on for about 50 days after their exposures before they were sacrificed and their brains examined.

Dr. Yngve Hamnerius of Chalmers University of Technology in Göteborg, Sweden, had suggested this delay before examining the rats' brains. Some 20 years ago, he and other researchers at Chalmers found damage in the brains of rabbits that had been exposed to pulsed microwaves similar to those from radar for one hour a day for three days. The Chalmers team told the 1984 annual meeting of the Bioelectromagnetics Society that no acute effects were seen, but that morphological and biochemical changes became apparent three to four months later.

The implications of this observation were never pursued until now. "People very rarely wait before looking for an effect," Hamnerius told *Microwave News*. He believes that Salford and Persson's new work "should be taken seriously."

*The paper is posted at: <www.ehponline.org>; its tracking number is: doi:10.1289/ehp.6039.

VIEWS ON THE NEWS

The Blood-Brain Barrier Work Must Be Followed Up — Now

Salford and Persson's new results were announced as this issue was going to press. Because we have often run editorials on the need to address the long-festering issue of leakage through the BBB (see, for example, *MWN,* N/D99), we are devoting this page to their study and offering only a few brief comments.

First, we must admit that we are surprised by the low levels of radiation implicated by their experiment — a finding that only makes the need for a follow-up even more urgent.

Second, the over one billion users of mobile phones deserve to know — and without further delay — whether, as Salford and Persson speculate, long-term exposure to microwaves contributes to premature aging, and possibly worse.

The U.S. health agencies have given the cell phone industry a free ride for far too long. It's about time they began serving those who use the phones — and pay their salaries.

In the summer of 2001, Drs. Pierre Aubineau and Fatma Töre of the University of Bordeaux reported leakage from blood vessels in the brains of rats, including the BBB, exposed to non-thermal levels of microwaves (see *MWN,* N/D01).

The ability of microwaves to cause leakage through the BBB was first demonstrated by U.S. scientists in the mid-1970s, but research was later cut off by the U.S. military funding agencies. Over the years, sporadic reports have briefly rekindled interest in the area.

Salford and Persson's own reports of BBB leakage have not been followed up. For instance, not a single study was undertaken by the U.S. mobile phone industry's six-year research effort directed by Dr. George Carlo and its lobbying arm, the CTIA.

"This is yet another instance in which a long-standing observation has been ignored for too long," said Dr. Ross Adey, who has been doing brain research for more than 50 years. Adey is based in Redlands, CA.

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Microwave News *invites letters from its readers. We ask writers to be brief, and we reserve the right to edit contributions for length.*

ERMAC-FMAC To Issue Statement on RF/MW Safety

Briefings on Regulations and Standards

The Electromagnetic Radiation Management Advisory Council (ERMAC) and the Frequency Management Advisory Council (FMAC) intend to issue a statement to assure the public that low levels of non-ionizing radiation are not hazardous. The councils decided to release a statement at a joint meeting in Washington, DC, on December 18. ERMAC chairman Donald Jansky of the National Telecommunications and Information Administration (NTIA) hopes the document will be ready by late March.

Council members, responding to growing public apprehension over non-ionizing radiation, agreed that some type of formal assurance is needed before the Environmental Protection Agency (EPA) proposes a federal guideline in 1983. They were split, however, over whether or not to cite a number for safe population exposure in the statement—and if so, what number.

Jansky asked everyone on the councils to submit a proposal for a statement by mid-January. Dr. Samuel Koslov of the Johns Hopkins University Applied Physics Laboratory and FMAC's Sidney Metzger of the Communications Satellite Corp. were charged with editing these drafts.

As of the end of January, Koslov had received six drafts representing a wide range of views.

Federal Agency Actions

EPA's David Janes told the meeting that his agency's schedule cannot be speeded up; it will need until at least September 1983 to propose a population exposure guidance. When asked what the guideline might be, he would only say that EPA is considering numbers bounded on the low side by the Soviet standard (0.005 mW/cm^2) and on the high side by levels slightly lower than the new American National Standards Institute (ANSI) standard (1.0–5.0

(continued p. 2)

A Proposed ERMAC-FMAC Statement

by Professor Charles Susskind

Whereas no regulatory arm of the US government is likely to adopt a maximum permissible level of non-ionizing radiation exposure for the general public in the next two years;
Whereas several existing and proposed US standards have been set at this level variously between 100 uW/cm^2 and 10 mW/cm^2;
Whereas further research is needed to determine where this level should be set;
Whereas no health hazards have been demonstrated below 100 uW/cm^2;
Therefore, the ERMAC and the FMAC declare that the state of the art enables them to say that no health hazard can result from total incident radiation lower than 50 uW/cm^2.
This statement is issued without prejudice toward any level that may be adopted, and in the knowledge that this level is likely to be well above 50 uW/cm^2.

ERMAC-FMAC MEETING

(continued from p. 1)

mW/cm^2). Janes estimated the guidance will require one million dollars to complete. The agency's Environmental Biology Division in Research Triangle Park, NC, is now circulating its criteria document for the guidance.

Briefings at the meeting from other federal agencies provided the following updates on standards actions:

• Paul Strudler of the National Institute for Occupational Safety and Health (NIOSH) would not say what standard the institute will propose in its long-awaited criteria document. But he did note that thinking at NIOSH is "not that different" from that at EPA, ANSI and the American Conference on Governmental Industrial Hygienists (ACGIH).

• The Federal Communications Commission's (FCC) Robert Cleveland announced that the agency's response to a 1979 notice of inquiry (NOI) on potential radiation hazards was imminent. At a January 28 meeting, the commission did act on the staff recommendation; it intends to apply its environmental rules to radiofrequency/microwave (RF/MW) transmitters. The details are in the FCC's advanced notice of proposed rule making, which had not yet been released. Observing that times have changed since the commission issued its NOI, Cleveland reported that the National Association of Broadcasters (NAB) has reversed its initial position and now supports radiation guidelines —possibly because inquiries from the general public on radiation hazards have risen sharply. (For other NAB news, see updates on communications, p. 6.)

• Two staffers at the Occupational Safety and Health Administration (OSHA) are still working on an advanced notice of proposed rule making for a new RF/MW standard, but the agency has no schedule for issuing it.

• A spokesman for the Bureau of Radiological Health (BRH) said the bureau intends to abandon proposed plans for a performance standard for diathermy products. (See p. 4.)

• A settlement has been reached between BRH and the American Home Appliance Manufacturers on amending BRH's microwave oven standard. (See updates on ovens, p. 7.)

Other News

Summaries of non-governmental standards activities, state and local rule making, international actions, litigation and siting problems filled the rest of the busy morning agenda. Items from these briefings included:

• A scientific committee of the National Council on Radiation Protection and Measurement (NCRP) hopes to complete its report on the bioeffects of RF/MW radiation at a March meeting. Disagreement over the general population standard continues, however, with proposals ranging from 0.1 mW/cm^2 to 1 mW/cm^2.

• The BRH's Dr. Zory Glazer said the ACGIH would discuss its proposed standard in January; at that meeting in Cincinnati, final consideration of the RF/MW threshold limit value (TLV) was postponed until an April 21–23 meeting in San Antonio, TX. The ACGIH's rationale has been published in *Supplemental Documentation 1981* to the ACGIH TLV book.

• Filmways, Inc. of Syracuse, NY, has taken the town of Onondaga, NY, to court over its moratorium on construction of broadcast stations. The company wants the building ban lifted and is seeking more than five million dollars in damages for the delay of its proposed station on channel 43.

• The new ANSI standard is in galleys and will be published soon.

• The military does enforce national RF/MW exposure standards in Poland, according to Dr. Przemyslaw Czerski, a visiting scientist at BRH. Enforcement is separate, though, for security reasons. Czerski believes that the same holds true for the Soviet Union.

• Koslov reported that preliminary results of work at the Johns Hopkins University Applied Physics Laboratory suggest tissue damage occurs at about 10 mW/cm^2 at high frequencies. (See p. 5.)

ERMAC-FMAC Statement

Much of the debate on the proposed ERMAC-FMAC statement on public safety focused on citing a safe level of RF/MW exposure. Many members feared a number could become a de facto standard and urged that no specific levels be set. Metzger suggested avoiding a number by issuing a general assurance that population exposures from current RF/MW equipment are safe. A general statement on the state of the art in bioeffects research was also proposed.

Other members favored citing a low number that would cover normal population exposures. ERMAC's Professor Charles Susskind of the University of California at Berkeley offered a proposal which assured that exposures below 50 uW/cm^2 are safe (see p. 1 for complete text). According to electronics engineering consultant Jules Cohen, AM transmitters might exceed the 50 uW/cm^2 level; he suggested adding some type of frequency dependency.

ERMAC's Dr. Ross Adey of the Veterans Hospital in Loma Linda, CA, argued that ERMAC and FMAC "should not get involved with contingencies" and should produce a simple document with one number. Adey also asked that the statement acknowledge the need for more study before a final standard is set. He urged that "we must not sweep under the rug the low-level effects that are now understood...if we wish to enjoy credibility in the eyes of the public."

Both EPA's Janes and Dr. Nicholas Steneck from the University of Michigan told the councils that guidelines require public participation. Janes, defending EPA's lengthy rule-making process, said that given the public's concerns, "I don't see how any group can issue a guidance without a chance for public review and comment." Steneck asserted that the public will question the ERMAC-FMAC statement. "You end up nowhere, official statements from above are not effective," he said. Jansky quickly replied that "it would be irresponsible not to do anything."

Whatever the final form of the statement, FMAC's Judge Ann Aldrich of the US District Court in Cleveland stressed that it could provide long-term benefits to industry. Comparing non-ionizing radiation to asbestos, Aldrich advised industry to weigh the costs of enforcing a standard against the potential costs of future litigation.

ERMAC and FMAC considered several courses of action in addition to issuing a statement. ERMAC's Professor A.W. Guy from the University of Washington, Seattle, suggested using the ANSI standard as an interim guideline, but council members rejected endorsing this or any current or proposed standard. When model state regulations came up for review, Aldrich warned that they present "thorny jurisdictional issues." Cleveland said the FCC has not addressed the issue of local preemption. Facilitating an interim federal guideline was also on the list of possible actions, but representatives from EPA, NIOSH, OSHA and the FCC ruled out any chance of such a policy statement coming from government.

NTIA is waiting for the proposals for a statement to come in before scheduling another meeting. In a speech before a meeting at the Bell Labs in Whippany, NJ, Bill Mumford of ERMAC came out in support of the Susskind proposal.

The minutes for the December 18 meeting will be ready soon and will go out to all attendees. Others can request a copy from Janet Healer, Office of the Chief Scientist, NTIA, 1325 G Street, Washington, DC 20005.

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OCCUPATIONAL HEALTH: RF SEALERS

The table below summarizes 19 of 21 field surveys of worker exposure to radiofrequency (RF) heaters and sealers made by the National Institute for Occupational Safety and Health (NIOSH) between 1978 and 1981.

The machines operate in the ISM (industrial, scientific and medical) bands at frequencies between 10 and 50 MHz, with power outputs ranging from 0.8 to 75 kilowatts. All measurements are corrected for the duty cycle (the on/off schedule) of the units.

Most of the surveyed units sealed plastic on products such as binders, luggage and handbags, though the devices are used in a broad range of applications.

In 17 work places at least one tested machine exposed workers to radiation exceeding the equivalent of the Occupational Safety and Health Administration (OSHA) 10 mW/cm^2 standard. Because exposure occurs in the near field of the power source, the standard should be cited in terms of the electric field and magnetic field intensities: for 10 mW/cm^2, these are 200 V/m and 0.5 A/m respectively.

Occupational Exposure to RF Radiation from Heat Sealers: Summary of NIOSH Work Place Surveys

Work Place	Survey Date	# Units At Site	# Units Tested	# Units Emitting ≥200 V/m	# Units Emitting ≥0.50 A/m	Highest Reading/Location‡
Hazel, Inc., Washington, MO	11-20-78	~33*	6	3	1	>1461 V/m N >0.53 A/m K
Standard Plastic Products, Inc., South Plainfield, NJ	11-29-78	~10	3	3	1	>1259 V/m N,W,K 0.60 A/m K
Henry Richards Company, Inc., Hamden, CT	12-6-78	~64*	11	10	3	>823 V/m C 1.03 A/m C
Tag-A-Long Handbags & Accessories, Inc., East Haven, CT	12-6-78	9	4	4	1	445.1 V/m C 0.58 A/m C
Jaclyn, Inc., West New York, NJ	12-7-78	~33*	6	4	1	1493 V/m K, 1363 V/m E 1.40 A/m E
Celebrity Inc., New York, NY	12-8-78	~41*	5	5	3	595 V/m C, 566 V/m E 0.60 A/m E
Chrysler Trim Plant, Lyons, MI	2-14-79	13	5	2	1	2700 V/m E,C 1.21 A/m E
General Motors Fisher Body Trim Plant, Grand Rapids, MI	2-15-79	33	11	0	0	ND
Ford Motor Utica Trim Plant, Utica, MI	2-15-79	28	5	1	0	867 V/m W 0.184 A/m W
Dielectrics, Inc., Chicopee Falls, MA	3-14-79	~49*	4	2	0	222 V/m W 0.06 A/m E
Blair Industries, Chicago, IL	4-5-79	28	5	1	2	400 V/m E 0.54 A/m E
Fabrico Manufacturing Corp., Chicago, IL	4-6-79	64*	8	4	4	563 V/m E 6.52 A/m C
Holum and Sons, Inc., Westmont, IL	6-25-79	14	6	2	•••	247 V/m W
Wilson Jones Company, Chicago, IL	6-26-79	7	5	2	•••	391 V/m K
S.I. Jacobson Manufacturing Company, Chicago, IL	6-27-79	22	9	5	•••	390 V/m K
Georgia-Pacific Corp., Ste. Genevieve, MO	8-29-79	20*	7	1	0	263 V/m E 0.12 A/m C,K
Georgia-Pacific Corp., St. Louis, MO	8-30-79	~29	7	0	0	191 V/m W 0.46 A/m K
National Blank Book Company, Inc., Holyoke, MA	2-11-80	22*	9	8	7	506.5 V/m W 2.01 A/m A 0.005
Beaverite Products, Inc., Beaver Falls, NY	2-14-80	8*	8	6	4	896.2 V/m W,G 2.40 A/m A 0.005

ND—Not detected.

*Some or all machines located in wire mesh enclosed room to eliminate RF interference with other devices to comply with FCC regulations.

•••Magnetic field measurements not taken.

‡E-Eye, C-Chest, W-Waist, G-Gonad, K-Knee, A-Ankles

HIGHLIGHTS

Microwave Charge Dismissed in Watson Case

A federal judge in US District Court in Los Angeles has dismissed the charge that microwave radiation played a role in causing birth defects to the child of a marine who served at the US embassy in Moscow, according to Peter Danelo of the Seattle firm, Carmody, Syrdal, Danelo & Klein. A second charge of medical malpractice by navy doctors is still pending.

Marine Sergeant George Watson's son was born with a hydrocephalic condition soon after Watson returned from a tour of duty in Moscow. He sued the government for not taking fast enough action to limit the injury to his son and for his exposure to microwaves while at the embassy—the exposure, he claimed, was responsible for his son's condition. (No. CV-80-5737)

District Court Judge Cynthia Hall, who has recently taken over the case, based her dismissal on a decision in the Ninth Circuit Court of Appeals. In that case, *Monaco* v *U.S.* (No. 79-4787, decided November 9), the court affirmed an earlier decision that the government had immunity from claims by those serving in the armed forces under the *Feres* doctrine.

Another VDT-Related Cluster Reported

A new cluster of problem pregnancies among VDT workers has been reported by a Communications Workers of America (CWA) local in Renton, WA. In the last 18 months, three out of three pregnancies of women working at Pacific Northwest Bell have had adverse outcomes. A 23-year-old woman gave birth to a mongoloid child a year ago last July. Since then, one woman's child was born with an open spine and another was stillborn—both women are in their 20's. No other pregnancies have come to term during this period, but one woman is two months pregnant and another is five months pregnant. Both are still among the 100 women working on 38 VDTs at the company.

According to Carl Rude of CWA Local 9103, the union is negotiating with Pacific Northwest Bell and Washington's Department of Labor and Industries for a joint epidemiological study at Renton. If no agreement is reached, the union will ask the state to do a compulsory on-site inspection for ionizing and non-ionizing radiation. Rude admitted that the chances for a thorough epidemiology are "very slim."

Rude has contacted other locals around the state and advised them of the potential problem.

A number of miscarriage and birth defect clusters among clerical workers have been reported; in each case, however, no cause for the adverse outcomes has been identified (see *MWN*, November 1981).

DoD Budget: PAVE PAWS Loses, ELF Wins

The final $199.7 billion FY82 defense budget cleared Congress in December. Funds to begin building the new SE and SW PAVE PAWS radars did not make it through the conference committee, though it did allocate $3.8 million for continued R&D on the warning system. The conferees agreed to consider a supplemental request for the $71 million in procurement funds, but a DoD spokesperson said the Air Force will probably ask for the money in the FY83 budget. The $3.8 million will allow the environmental assessments for the two radars to proceed and, as the Senate Appropriations Committee suggested, the improvement of the "overall system detection and performance."

The conferees sided with the Senate on Project ELF; the submarine communications program will receive the full $34.8 million; Senator William Proxmire (D-WI) registered his disapproval in the conference report. In arguing against the project, the House Appropriations Committee noted: "The Committee concludes that ELF is an outmoded concept in search of a mission and should be discontinued."

Other budget decisions include: $79.6 million to buy AN/TPQ-37 artillery locating radars developed by Hughes Aircraft Co.; $82.1 million for the AF's EHF satcom system; and $30.2 million for DARPA's blue-green communications system. There was also a special $200,000 allocation for hardening White House communications to EMP.

Medical Devices: Rules & Research

The Bureau of Radiological Health (BRH) has decided to withdraw its proposed rules for performance standards for diathermy products. The decision is now under review at the Food and Drug Administration (FDA) and will probably be approved. The rationale for abandoning the regulation, proposed in July 1980 (45 *FR* 50359), is that no equipment is now being manufactured in the US and that the standards would not cover existing equipment. Hyperthermia researchers had told BRH that they were worried the rules would interfere with their work. (See *MWN*, February 1981.)

The Bureau of Medical Devices (BMD) is circulating a draft policy for Class II devices. The new policy statement was the subject of a meeting in Washington, DC, on January 26. Hyperthermia units and NMR imagers are in Class III and are therefore not affected. Diathermy devices used for heat treatment are Class II, but it is not yet clear how the policy will apply to them. The policy statement will now be published in the *Federal Register* to solicit further public comment.

BMD and BRH are in the process of working out new arrangements to handle applications for radiation-emitting equipment. The new agreement promises more autonomy for BRH. It is on the FDA's commissioner's desk and is almost sure to be signed.

Research on hyperthermia is receiving more funds. The National Cancer Institute (NCI) is soliciting proposals for another five-year project, a hyperthermia quality assurance program (*Commerce Business Daily*, December 16). According to the institute's Dr. David Pistenmaa, this new effort will complement the study, already underway at five teaching hospitals, that is assessing the performance of microwave, RF and ultrasound systems (see *MWN*, November 1981).

Oregon County Plans RF/MW Standard...

Multnomah County, outside Portland, OR, has extended its moratorium on new building applications for broadcast facilities to May 25, and will consider adopting a radiofrequency/microwave (RF/MW) standard after a study on the possible biological effects of this radiation is completed. The Board of County Commissioners imposed the freeze on December 3 after station KLRK's proposal for a radio transmitter raised questions about potential radiation hazards at a public hearing last year. The moratorium was originally slated to end March 30, but was extended at a January 26 board meeting.

This January, the county hired Nero and Associates of Portland to evaluate the RF/MW bioeffects literature and to recommend an appropriate safety standard for the county. The

county has contracted another firm, Cogan and Associates, to evaluate land use and develop a siting standard. A total of $11,500 has been allocated for the two studies.

Independent of the studies, County Health Officer Dr. Charles Schade has formed a blue ribbon committee to review the work of Dr. William Morton of the University of Oregon's Health Sciences Center in Portland. Several years ago, a study by Morton revealed a significantly higher incidence of uterine cancer in Portland's West Hills section, which has the highest RF/MW radiation levels in the city. Neighborhood opposition to adding a transmitter to an antenna farm in this area eventually led to the city's adoption of an Interim Radiofrequency Emission Standard in 1980.

...Unexpected Results Found in Portland Cancer Study

A study on the incidence of certain cancers among Portland, OR, residents has found a significant correlation between three types of cancer and radiofrequency/microwave (RF/MW) radiation levels, according to Dr. William Morton of the University of Oregon's Health Sciences Center in Portland. Morton recently submitted a preliminary report on the study, which began in 1978, to the Environmental Protection Agency's (EPA) Experimental Biology Division.

Acting Division Director Dr. Joe Elder has just taken over and said he had not had a chance to study the report.

Morton indicated that RF power density levels positively correlated to the number of reported cases of lymphatic leukemia, adenocarcinoma of the uterus and breast cancer. No correlation was found for non-lymphatic leukemia and cancer of the pancreas.

Morton said that he had not anticipated these results. He was particularly surprised that for the three frequency bands examined, the correlations occurred with the low and high VHF TV bands (54-88 MHz and 176-216 MHz respectively), and not with the FM radio band (88-108 MHz) where power density levels are relatively much higher. Calculated radiation levels ranged from under 0.004 to under 0.018 uW/cm^2 for low and high VHF TV and from under 0.013 to under 0.44 uW/cm^2 for FM radio. These averages were extrapolated from EPA measurements taken in 1977.

Now that the preliminary report is complete, Morton will seek EPA funding for another year of work. His last EPA grant ran out at the end of 1980.

US-USSR Tentatively Agree on Measurement Work Plan

Members of the US-USSR Working Group for Metrology have agreed on a provisional work plan for cooperation during a visit by three Soviet scientists last December, according to Dr. Arthur McCoubrey, associate director for measurement services at the National Bureau of Standards (NBS). The plan, which is still subject to formal approval, would result in the exchange of technical information—including the measurement of non-ionizing radiation fields. Later, there would be an exchange of visits by research scientists.

Dr. Donald McRee of the National Institute of Environmental Health Scientists participated in the talks and said that he was pleased with their outcome. "This could give us the opportunity to learn about the Soviets' capability to measure fields in bioeffects research," he said.

Ric Tell of the Environmental Protection Agency's radiation lab in Las Vegas, NV, one of the labs on the Soviets' tour, said that he felt the trip was more of a fact-finding mission and that he hoped there would be an opportunity for technical discussions at later meetings. Tell was particularly interested in comparing radiation hazard instruments and field survey data with the Soviets.

The microwave expert on the Soviet delegation was A.I. Mekhanikov, who is the deputy director of VNIIFTRI—the All Union Scientific Institute for Physico-Technical and Radio-Technical Measurement—north of Moscow. The institute is akin to the NBS labs in Boulder. The head of the delegation was L.K. Isayev, who is the chief of metrology administration at Gosstandart.

New Findings at Hopkins Lab

Preliminary research indicates a new type of tissue damage from exposure to 2.45 GHz radiation at 10 mW/cm^2, according to Dr. Samuel Koslov of the Johns Hopkins University's Applied Physics Lab. Koslov announced the new findings at last December's ERMAC meeting (see page 1). While 1 mW/cm^2 may be a safe level at GHz frequencies, he said, 5 mW/cm^2 may not be safe for prolonged exposures.

The Hopkins researchers are not ready to publish the results, nor was Koslov willing to be more specific about the type of effect or susceptible organ. Koslov did express his concern that, if this effect is confirmed, it would mean that the new ANSI standard, which allows exposures of 5 mW/cm^2 above 1.5 GHz, would not provide enough protection for the public. "I would have violent objections to the application of the ANSI standard in the upper frequency range if applied to the general population," he warned.

Workshop on Behavioral Effects

An interdisciplinary workshop on *Behavioral Effects of Microwave Radiation Absorption* is *tentatively* scheduled for March 16-19 at the Homestead Lodge near Salt Lake City, UT. The first day of the meeting will be devoted to a literature review; the second to contemporary topics, including drug-microwave synergy, chronic exposure studies, dosimetry and extrapolation among target systems; and the third to future directions for research.

The workshop is open to all; there will be a $50 registration fee. For more information contact Professor John D'Andrea at the Department of Electrical Engineering, University of Utah, Salt Lake City, UT 84112, (802) 581-8590 or 851-6943.

Changes at EPA

Dr. Daniel Cahill has left the Environmental Protection Agency (EPA) to go work for Carolina Light and Power (CP&L). Dr. Joe Elder is filling in as acting director of the agency's Experimental Biology Division in the Office of Research Development in Research Triangle Park, NC. In an interview, Cahill said that the change was a "career move: I just ran out of room."

Meanwhile back at the agency's headquarters in Washington, Dr. Gordon Burley is still the acting director of the Office of Radiation Programs. Burley replaced Dr. David Rosenbaum, who left EPA to start his own consulting firm: Technical Analysis Corp. of Arlington, VA. Rosenbaum said that he had decided to leave as a result of the budget cuts and lay offs. "I could see it was only going to get worse," he said. Burley had been chief of the environmental standards branch and moved up when Rosenbaum and three division directors all left.

UPDATES

Biological Effects....NASA has issued a new literature review, *Electromagnetic Field Interactions with the Human Body: Observed Effects and Theories.* The report, prepared for NASA by Dr. Jeremy Raines of Techovators of Rockville, MD, is available from the National Technical Information Service, Department of Commerce, Springfield, VA 22161. It can be ordered by its NASA document number: N81 25668; $12 for a paper copy and $4 for microfiche....Professor Edward Grant of Queen Elizabeth College, London, has published a short article on the "Biological Effects of Microwaves and Radio Waves," in the *Proceedings of IEE* (UK), *128,* Pt A, 602, December 1981. Grant sums up with "the 10 mW/cm^2 standard, although adequate at frequencies in excess of 1 GHz, is too high in respect of lower frequencies, and needs revision."...Dr. Ewa Manikowska-Czerska, a visiting scientist at BRH, is scheduled to present a seminar on "Meiotic Chromosome Aberrations and their Biological Significance Following Microwave Exposure" on February 2 in Bethesda....BRH's Dr. Whit Athey has raised some objections to a model devised by EPA's Drs. William Joines and Carl Blackman which allows them to scale the internal electric fields that induce calcium efflux from chick brain tissue. Athey thinks that the uncertainties are too large to allow conclusions to be drawn from the model. Joines and Blackman reply with a new and more detailed version of the model; this too is consistent with the data. In an interview, Blackman said that, while he agrees that the model is not thoroughly validated, he thinks it has less uncertainty than Athey indicates in his paper. For both points of view, see *Bioelectromagnetics, 2,* 407-413, 1981....Drs. Ernest Albert and James Kerns of George Washington University describe their recent experiments on the effects of microwaves on the blood brain barrier (BBB) in *Brain Research, 230,* 153, 1981. Two-hour exposure with 2.45 GHz CW at 10 mW/cm^2 resulted in reversible permeability of the BBB to horseradish peroxidase. ...EPA's Claude Weil proposes a terminology system for dosimetry in the December issue of the *Bioelectromagnetics Newsletter*....A group headed by Albert Friend, Jr. of the Naval Electronic Systems Command in Washington has published a paper in the *IEEE Transactions on Microwave Theory and Techniques, MTT-29,* 1271, December 1981, which indicates "no hemolysis in red blood cells exposed *in vitro* to large microwave pulse with peak SAR's of more than 1 kW/g."...The NY Overhead Power Lines Project is still scheduling a meeting for February 19–21 in New York City. For more information contact: Dr. Maria Reichmanis at (518) 474-3215....Some have speculated that Russian radar is responsible for the increased incidence of heart disease among Finns living in North Karelia. Beginning in 1972 a program was initiated to try and control the risk of disease. A five-year report of the North Karelia Project is described in the *American Journal of Public Health, 72,* 43, January 1982. While the data show some encouraging results, they are far from conclusive. Microwaves were not included in the discussion....Linda Garmon reviews research on the effects of ions in the December 5 *Science News.*

Communications....The National Association of Broadcasters' (NAB) Advisory Committee on Radiation and Regulation has informed the EPA that it supports a national population exposure standard for non-ionizing radiation. In a December 14 letter to Kathleen Bennett, assistant administrator for air, noise and radiation, the NAB urged sufficient funding be provided to complete a guidance and stated "there are sound economic, scientific and policy reasons for our position." Citing increasing state and local rule making, a December NAB memo to its state officers carried the same message....A public forum for users of the Private Operational-Fixed Microwave Service, sponsored by the Private Radio Bureau, will be held in Washington, DC, on March 31. Topics on the agenda include interference analysis and public access to microwave applications and data base information. Contact: John Small, FCC, Room 8202, Washington, DC 20554, (202) 632-7197....The FCC affirmed its earlier ruling giving AT&T half of each new cellular communications market on December 17. (See *MWN,* May 1981.) Twenty-five potential competitors to AT&T had petitioned the commission to reconsider its April ruling....Now the commission has begun an inquiry on the future needs of private land mobile radio users, a group including police, doctors, utility crews and taxi drivers (NOI No. 82-8). Contact: FCC's Joseph Levin, (202) 254-3301....In another inquiry, the FCC is asking for comments on the allocation of the 40.5–400 GHz spectrum to comply with the 1979 WARC actions (46 *Federal Register* 60221, December 9)....Air-to-ground telephones will enable American Airlines passengers to make calls while airborne. Airfone, Inc. is installing the one-way system on some planes this year....Arthur D. Little, Inc., of Cambridge, MA, is developing a search scenario for detecting and locating trapped miners using radio transmitters under a $108,000 contract from the US Bureau of Mines. According to ADL's Robert Lagace, the system's ability to transmit detectable rescue signals to the surface in the 500–3,000 Hz frequency range has been recently tested in some 94 mines in US coal fields. The bureau has sponsored the development of both seismic and electromagnetic trapped miner location systems since 1970....RCA plans to build nationwide communications networks among 50 cities. RCA Network Services, Inc. has joined 11 other applicants seeking FCC permission to start microwave digital termination systems.

Compatibility & Interference....The FCC has issued a rule that will allow the commission to shut down any source of electromagnetic interference which could peril human safety or damage property (47 *Federal Register* 1392, January 13, 1982). The regulation is a result of EMI from TV news equipment, which affected the space shuttle's tracking and communications equipment during last April's flight. Now the FCC's Chief of Field Operations can order broadcasters or cable operators to shut down interfering equipment....Comsearch, Inc., of Falls Church, VA, and Chomerics, Inc., of Woburn, MA, have set up measurement laboratories for EMI and EMC tests. ...The Navy has awarded BE&C Engineers, Inc., of Tukuila, WA, a subsidiary of Boeing, more than $4 million to deliver an electronic warfare and EM environmental effects test facility....And the Naval Surface Weapons Center in Dahlgren, VA, has issued a $902,000 contract to Eldyne of San Diego, CA, for engineering design support for EMC....The Naval Sea System Command intends to ask for EMI services next month (*Commerce Business Daily,* January 25)....The Rome Air Development Center is looking for a contractor to assess EMC in C^3 systems which use microelectronics....The National Association of Broadcasters' Radio Board is trying to secure government help to stop interference to AM stations from Cuba.

Government....Everyone is waiting for the president to unveil his FY83 budget. Among the leaked items are OMB proposals to phase out the Public Health Service Commissioned Corps, to further cut the EPA budget, to close down some FDA labs and to kill the NASA 30/20 GHz program (see satcom updates)....Barry White, a former OSHA regional administrator, has been named to head OSHA's directorate of Safety Standards Programs....After the *New York Times* ran a story about the antennas on the Soviet embassy in Washington, DC being used for surveillance (December 11), the embassy issued a denial. In a follow-up piece on December 21, a spokesman for the FBI reaffirmed the accusation....About a hundred people attended the Technical Electronic Product Radiation Safety Standards (TEPRSSC) meeting in Rockville, MD, December 9–10. RCA's Howard Johnson, a member of TEPRSSC, proposed that BRH consider a generic regulatory approach to reducing leakage from all electronic products which emit non-ionizing radiation. BRH Director John Villforth replied that he did not agree with such an approach.... BRH has issued a new subject index for its publications, dated October 1981 (No. FDA 82-8070)....The FAA has issued final rules prescribing minimum standards for microwave landing systems (MLS) not operated by the federal government (46 *FR* 61560, December 17)....And at the end of January, the FAA unveiled a 20-year, $9-billion plan to modernize the air traffic control system....The Department of Commerce is looking for someone to review NTIA's Spectrum Management Program (*Commerce Business Daily,* December 18).

IEEE....The responses to the IEEE's Committee on Social Implications of Technology's (CSIT) editorial on the Committee on Man and Radiation's (COMAR) draft position paper on human exposure to RF/MW appear in the December issue of *Technology and Society*, the CSIT newsletter. (See *MWN*, October 1981.)

Litigation....A defense motion to dismiss Nettie Yannon's suit against RCA in the New York State Supreme Court, Richmond County, was denied this January.

Measurement....The Department of Commerce has approved a request to develop a voluntary laboratory program (LAP) for electromagnetic calibration services. The request was made some six years ago by Dr. Bruno Weinschel of Weinschel Engineering in Gaithersburg, MD, who said that while he was pleased with the decision, he felt it had been a long time coming. The next step is to set up a workshop, probably in Washington, DC, to consider criteria for evaluating labs....Meanwhile NBS's MAP is growing. The measurement assurance program recently approved five labs on the West Coast, those at Boeing, Hewlett-Packard, Hughes, Rockwell and TRW. NBS is now looking at five labs back East and will be making a final selection in the spring.

Medical Applications....A team from Harvard reports hyperthermia can inhibit the activity of natural killer cells *in vitro* in the January 2 *Lancet*. The authors speculate that "fever may act as an immunoregulatory mechanism by decreasing NK activity."...A group from UCLA compares ways of heating deep-seated tumors, including with the Magnetrode unit, which failed to win FDA premarket approval last year (see *MWN*, May 1981), in the *IEEE Transactions on Biomedical Engineering*, January 1982. They express a preference for sources which produce an electric field parallel to skin/fat/muscle interfaces....BRH's Christian Hochuli and Dr. Gideon Kantor describe temperature measurements with a minimally disturbing probe in microwave diathermy in the December issue of the *IEEE Transactions on Microwave Theory and Techniques*....Dr. Robert Balaban of the National Heart, Lung and Blood Institute in Bethesda, MD, arranged the session on the application of NMR in biology and medicine at this year's AAAS meeting. Many of the papers described work using P-31 NMR....The January 23 *Science News* reports from the AAAS meeting that scientists from the University of Hawaii and the California Institute of Technology have found that a rotating magnetic field appears to significantly retard the growth of a mouse tumor that contains magnetite. Human cancer cells are not known to contain such particles....Electro-Biology, Inc., is planning to offer one million shares of common stock to the public....A team from Finland describes the use of magnetic measurements—magnetic susceptibility plethysmography—to measure changes in total cardiac volume in the January *IEEE Transactions on Biomedical Engineering*.

Military Systems & Radar....The Navy Electronic Systems Command has awarded two $3.5 million contracts for studies on the design of submarine laser communications, one to Lockheed Missiles and Space Co. in Palo Alto, CA, and one to TRW in Redondo Beach, CA....And the Office of Naval Research is negotiating with Sanders Associates of Nashua, NH, for research on blue-green noise measurements....*Discover* ran a piece on Project ELF in the January issue....In December, DoD won one of Senator Proxmire's Golden Fleece awards for the Navy's handling of a research program on the health effects of ELF radiation. A bull was kept at the Wisconsin Clam Lake facility as part of a program that even Vice Admiral G.R. Nadler acknowledged was useless from a scientific point of view. Cost: $13,000....In other contract news, the Navy awarded $1.6 million to GE in Syracuse, NY, and $920,000 to Calculon of Philadelphia, PA, for work on the AN/TPS-59—a D-band, long-range, 3-D air surveillance phased array radar....The Office of Naval Research is negotiating with Comsearch of Falls Church, VA, for below deck electromagnetic surveys and has awarded Ohio State University $350,000 for research on electromagnetic radiation and scatter and $1 million to SRI in Menlo Park, CA, for work on the over-the-horizon backscatter radar....The armament division at Eglin AFB wants to upgrade and modernize the DoD radar scatter facility at the White Sands Missile Range, NM....And the AF wants to build an RF anechoic chamber at Wright-Patterson AFB, OH.

Ovens....The Association of Home Appliance Manufacturers (AHAM) has withdrawn its objection to BRH's proposed amendments to the microwave oven performance standard (see *MWN*, May 1981). In a November 24, 1981 letter to BRH, AHAM said it was satisfied by a FDA Advisory Opinion on the amendments released November 20. BRH will now republish the amendments in the *Federal Register*, where they appeared on November 28, 1980 (45 *FR* 79028)....Microwave oven manufacturers had a good year in 1981, and AHAM forecasts an even better one for 1982. Shipments grew by 20% last year; a total of 4.3 million units were produced or imported. As of last November, AHAM expected factory shipments to increase to more than 4.7 million units in 1982, up almost 10%—the largest projected growth for any appliance....The *Washington Post* reports that DOE is in the process of canceling proposed rules that would have set minimum efficiency standards for major appliances including ovens. According to the December 21 item, OMB must still approve the DOE analysis....Raytheon's John Osepchuk writes that "there is almost vanishing probability of interference of today's pacemakers by today's microwave ovens," in an article in the November/December 1981 issue of *Microwave World*: "Debunking a Mythical Hazard."...The Cooking Appliance Section of the International Microwave Power Institute (IMPI) has assembled a ten-year bibliography on microwave cooking. The cost of the report has still to be set. Contact: Ms. Diane Ellison, IMPI, 301 Maple Avenue West, Tower Suite 520, Vienna, VA 22180, (703) 281-1515....Cober Electronics, Inc., of Stamford, CT, has introduced a new, 6 kW microwave batch pre-heater (Model BPH-6000)....And Cober has released a new brochure to describe its continuous microwave dewaxers for the precision casting industry. For a free copy, contact: Casting Industry Brochure, Cober Electronics, Inc., 102 Hamilton Avenue, Stamford, CT 06902.

Power Lines....Most of the recent issue of *Bioelectromagnetics* (Volume 2, Number 4) is devoted to studies of the biological effects of 60-Hz power lines....The third symposium on *Environmental Concerns in Rights-of-Way Management* is scheduled for February 15–18 at the Hyatt Islandia Hotel in San Diego, CA. Among the sessions is one on the health and safety of high power transmission lines and the siting of new energy facilities. Dr. Gus Tillman of the Cary Arboretum of the New York Botanical Gardens is chairing the session, which will feature speakers from Western Electric, Bonneville Power and Georgia Power. Contact: Lisa Lava-Kellar, 215½ S. Main Street, Ann Arbor, MI 48104, (313) 996-2696.

Satellite Communications....Alascom, Inc.'s request to build a satcom station on Vashon Island, WA, was denied by the King County zoning adjuster on December 31. (See *MWN*, December 1981.) The company has appealed the ruling and a public hearing is scheduled for March 2 to review the decision....National Satellite Service, Inc., a Hughes Aircraft Company subsidiary, wants to build a satcom station in the Spring Creek area of Brooklyn, NY. A draft environmental impact statement for the proposed facility is being reviewed by the city before proceedings on a land use variance can begin....NASA is contracting Arthur D. Little, Inc. of Cambridge, MA, for a profile of the domestic satellite communications industry....OMB wants to cut NASA's 30/20 GHz program from the FY83 budget, according to the December 21 *Aviation Week and Space Technology*. NASA is reportedly appealing the cancellation. The funding picture may be looking better with the recent appointment of Dr. Burt Edelson, formerly of COMSAT, as NASA's head of science applications....Meanwhile, NASA has recently awarded close to one million dollars in contracts to ITT, General Electric and Western Union Telegraph for 30/20 GHz studies....During a review of its satellite services policies this January, the FCC invalidated RCA's November auction for transponder leases. (See *MWN*, December 1981.) At the same meeting, the commission decided to solicit public comment on whether satellite owners should be allowed to negotiate private sales of transponders. Under current FCC rules, use is allocated at fixed rates on a first-come, first-serve basis....*Compendium of Communication and Broadcast Satellites: 1958–1980*, edited by Martin P. Brown Jr., has been published by the IEEE Press. Cost: $34.95, $26.20 for IEEE

members. Order prepaid from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854.

Technology.... Research on electromagnetic launcher technology, or railgun, continues. The Defense Advanced Research Projects Agency has awarded the Rand Corp. in Santa Monica, CA, nearly $300,000 to continue their work on it. The Air Force has its own program and is looking for a contractor to design and produce a railgun which can launch a projectile weighing ten grams with a muzzle velocity of 3 km/sec. For more information contact: AF's Bill Lucas, (904) 882-8240. Both projects are classified Secret. Nevertheless, *Science News* ran a progress report on the railgun in its December 12 issue.... Companies making anti-shoplifting devices are jockeying for new markets, especially supermarkets, according to a January 28 article in the *New York Times*. The industry is dominated by a few companies, including Sensormatic Electronics Corp. of Deerfield Beach, FL, Knogo Corp., of Hicksville, NY, and Checkpoint Systems, Inc., of Thorofare, NJ.... Raytheon's William Brown details the status of the microwave power transmission component for solar power satellites in the December *IEEE Transactions on Microwave Theory and Techniques*.... DOE's Laramie Energy Technology Center has awarded the University of Wyoming a $75,655 contract to study the basic principles involved in RF retorting of oil shale.... In other contract news the Air Force has awarded the Polytechnic Institute of New York in Brooklyn $277,000 for research on "Microwaves, Electromagnetic Theory and Information Processes," and NASA is negotiating with Ball Aerospace of Boulder, CO, for a "Shuttle Active Microwave Experiment."

VDTs.... *Health and Ergonomic Considerations of Visual Display Units*, a two-day seminar sponsored by the Ergonomics and Non-Ionizing Radiation Committees of the American Industrial Hygiene Association (AIHA) will be held March 1-2 in Denver, CO. Contact: J.R. Conti, AIHA, 475 Wolf Ledges Parkway, Akron, OH, 44311, (216) 762-7294.... The Ontario Ministry of Labor's advisory task force on video display terminals (VDTs) has finished its review of potential non-ionizing radiation health effects and is moving on to ionizing radiation. (See *MWN*, December 1981.) According to task force chairman Dr. Gordon Stopps of the University of Toronto's Occupational and Environmental Health Unit, no recommendations will be made before late spring or early summer.... The Newspaper Guild (TNG) and the International Typographical Union have published *Humanizing the VDT Workplace*, a 48-page health manual for local officers and shop stewards. The booklet is designed to help identify and eliminate VDT-related health and safety problems.... TNG has published its constitution, adopted at last year's guild convention, which includes its collective bargaining program and bargaining recommendations for VDT health issues. Copies are available from TNG, 1125 15th Street, NW, Washington, DC 20005.

LETTERS

To the Editor: I would like to draw your attention to an incorrect piece of news reported at the bottom of page 5 in your October issue. The London *Times* article did indeed imply that the National Radiological Protection Board (NRPB) had the only on-going microwave bioeffects research program in the UK, and that I had failed to obtain grants to carry out research in this area. You were quite entitled to draw these conclusions but in fact both are untrue.

I have a research team of eleven people and am supported financially in the UK by the NRPB itself, as well as by the Cancer Research Campaign. Generous support has also been provided by all three of the United States Armed Services and in addition I receive money from the NATO Scientific Affairs Division. I certainly would not like the impression to be given that my research team is short of funds and personnel; it would also be unfair to those organizations which support the research.

Professor E.H. Grant

Physics Department, Queen Elizabeth College, Campden Hill Road, London W8 7AH, United Kingdom.

CONFERENCE CALENDAR

• March 15-18: *International Workshop on Physics and Engineering in Medical Imaging*, Asilomar Conference Grounds, Pacific Grove, CA. Contact: University Extension, University of California, PO Box AZ, Irvine, CA 92716.

• March 29-April 2: 3rd *International Congress of Thermology*, Bath, England. Contact: Congress Secretariat, Martlet Conference Services, 24 Preston Street, Brighton, Sussex BN1 2HN, England.

• April 21-23: *Biomedical Engineering Society Annual Meeting*, New Orleans, LA. Contact: Dr. Yoram Ruby, Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH 44106.

• April 26-28: 1982 *Microwave Power Tube Conference*, Naval Postgraduate School, Monterey, CA. By invitation only, DoD Secret clearance required. Contact: Bill Lin, Litton Industries, 960 Industrial Road, San Carlos, CA 94070.

• May 24-28: *International IEEE/APS Symposium, National Radio Science Meeting and Nuclear Electromagnetic Pulse Meeting*, University of New Mexico, Albuquerque, NM. Contact: Dr. Kendall F. Casey, Dikewood Corp., 1613 University Blvd., NE, Albuquerque, NM 87102.

• June 7-8: 1st *Southern Biomedical Engineering Conference*, Louisiana State University Medical Center, Shreveport, LA. Contact: Dr. S. Saha, Department of Orthopaedic Surgery, Louisiana State University Medical Center, PO Box 33932, Shreveport, LA 71130.

• June 15-17: IEEE MTT-S *International Microwave Symposium*, Hyatt Regency Hotel, Dallas, TX. Contact: J.R. Griffin, Texas Instruments, Mail Stop 3432, PO Box 405, Lewisville, TX 75067. On June 18 immediately after the conference, there will be a one-day workshop on *Medical Applications of Electromagnetic Energy*. Contact: Dr. Gordon Short, BSD Medical Corp., 420 Chipeta Way, Salt Lake City, UT 84108.

• June 28-July 2: 4th Annual *Bioelectromagnetics Society Meeting*, Beverly Wilshire Hotel, Beverly Hills, CA. Contact: BEMS, 1 Bank Street, Suite 307, Gaithersburg, MD 20878.

• July 20-22: IEEE Annual Conference on *Nuclear and Space Radiation Effects*, Caesars Palace, Las Vegas, NV. Contact: A. Ochoa, Jr., Div. 2144, Center for Radiation-Hardened Microelectronics, Sandia National Laboratory, Albuquerque, NM 87185. This meeting will be followed on July 23 by the *Hardened Electronics and Radiation Technology Conference* hosted by the Defense Nuclear Agency. A Secret security classification is required to attend. Contact: Director, DNA, Attn: ISSO/Barbara Perkins, Washington DC 20305.

• July 25-30: 17th Annual Symposium of the *International Microwave Power Institute*, Town and Country Hotel, San Diego, CA. Contact: IMPI, 301 Maple Ave. W., Tower Suite 520, Vienna VA 22180.

• August 11-13: 4th Annual *Satellite Communications Users Conference*, Regency Inn, Denver, CO. Contact: Satellite Communications Magazine, 3900 S. Wadsworth Blvd., Denver, CO 80235.

• September 5-11: *World Congress on Medical Physics and Biomedical Engineering*, including the 13th *International Conference on Medical and Biological Engineering* and the 6th *International Conference on Medical Physics*, Congress Center, Hamburg, Germany. Contact: MPBE 82, Congress Organization, PO Box 302360, D-2000 Hamburg 36, Federal Republic of Germany.

• September 6-10: 7th *Colloquium on Microwave Communication*, Budapest, Hungary. Contact: Secretariat of the 7th Microcoll, H-1525, Budapest 114, POB 15, Hungary.

• September 8-10: *International Symposium on Electromagnetic Compatibility*, Marriott Hotel, Santa Clara, CA. Contact: Dr. Andrew Nalbandian, 20617 Debbie Lane, Saratoga, CA 95070.

• September 20-21: 4th Annual *Conference of the IEEE Engineering in Medicine and Biology Society*, Marriott Hotel, Philadelphia, PA. Contact: Dr. Alfred R. Potvin, Department of Biomedical Engineering, PO Box 19138, University of Texas, Arlington, TX 76019.

• September 20-22: 2nd Annual *Meeting of the Bioelectric Repair and Growth Society*, Oxford, England. Contact: Dr. B.F. Sisken, Wenner Gren Research Laboratory, University of Kentucky, Lexington, KY 40506.

• September 22-24: 35th Annual *Conference on Engineering in Medicine and Biology*, Marriott Hotel, Philadelphia, PA. Contact: ACEMB, 4405 East-West Highway, Suite 210, Bethesda, MD 20814.

MICRO WAVE NEWS

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Microwave News *invites letters from readers. We ask writers to be brief, and we reserve the right to edit contributions for length.*

EPA Set to Close RF/MW Research Lab

The Environmental Protection Agency (EPA) is planning to close down the radiofrequency and microwave (RF/MW) radiation program at the agency's Health Effects Research Laboratory. EPA Administrator Anne Gorsuch did not request any funds for the program in her fiscal year (FY) 1984 budget, and unless Congress forces a change, all EPA research on RF/MW radiation will stop on September 30.

As this issue goes to press, the official budget has yet to be released by the President; nevertheless, most researchers contacted by *Microwave News* had already heard about the decision and expressed their dismay and disappointment. EPA staff refused to comment until the budget was made public.

The cut back comes at an inopportune time. EPA's Office of Radiation Programs (ORP) has just officially announced its intention to set a safety level, or "guidance," for public exposures to RF/MW radiation (see p. 3). The lab, which is part of EPA's Office of Research and Development (ORD) in Research Triangle Park, NC, was to have supported that effort. In addition, cuts in this year's (FY83) budget have already forced a reduction in many research programs at EPA and other federal agencies.

EPA is not the only federal agency whose non-ionizing radiation program is in trouble: NIOSH has lost much of its staff as it closed its Rockville offices, and NTIA has let ERMAC's charter expire and has ended its role in coordinating federal RF/MW bioeffects research. See p. 2.

The RF/MW research group's FY83 budget is $1.5 million, compared with $2.12 million in FY82. ORP's budget, which includes both ionizing and non-ionizing radiation activities is slated to stay at its FY83 level, approximately $10 million.

The EPA R&D effort represents about 15 percent of the federal budget for non-ionizing radiation research, of which more than 60 percent is controlled by the military, primarily by the air force and the navy.

EPA's research budget will be the subject of congressional hearings tentatively scheduled for March 2, 9 and 16 by the subcommittee on natural resources, agriculture research and environment of the House Committee on Science and Technology. Tony Clark, a consultant to the subcommittee, said "you can be assured that the budget cuts will be addressed at the hearing." Representative James Scheuer (D-NY) is the chairman of the subcommittee.

Last summer, Kathleen Bennett, EPA's assistant administrator for air, noise

(continued on p. 2)

Computer RFI

Many computer users are experiencing problems caused by radiofrequency interference (RFI). In the course of checking out these complaints, we have contacted a number of computer manufacturers; they respond that computer susceptibility to RFI is rare and not a general problem. We invite our readers to send us reports about specific incidents and solutions so that we can sort this situation out.

EPA to Close Lab *(continued from p. 1)*

and radiation, made a strong case for the continued funding of the RF/MW research group. In a memo to Courtney Riordan, the acting assistant administrator for R&D, Bennett argued that her staff at ORP would need the help of the health effects research team in the development of the public health guidance through FY89. Even once a public limit is issued in FY85, Bennett wrote, EPA will still have to address a number of important issues such as mechanisms, modulation, chronic exposures and frequency specific effects. (The full text of Bennett's memo appears below.)

Paradoxically, the announcement that the RF/MW lab is scheduled to be disbanded comes only a few weeks after a peer review committee issued a glowing assessment of its work. In its report, the committee wrote: EPA RF/MW research is "of high quality and is highly regarded by peers in the scientific and engineering community. The breadth of expertness in the division is impressive." They cite "the excellent leadership and scientific competence" of the acting head of the lab's division, Dr. Joe Elder. The committee's members were Professor Carl Durney of the University of Utah (chairman), Dr. Elliot Postow of the Naval Medical R&D Command and Dr. Don Justesen of the VA Medical Center in Kansas City, MO.

One of the projects to be terminated when the lab closes is Dr. Carl Blackman's experiments on the effects of ELF modulated fields on calcium efflux in the brain. The review committee singled out this work as being "of immense potential significance in the determination of safety standards and in establishing a sound scientific basis for such standards."

In a telephone interview with the members of the peer review panel, all three expressed their disappointment with EPA's decision. "We need that kind of research and I will be sorry to see it go," said Durney. "The whole area is headed for extinction unless something is done... I am alarmed," said Justesen. ●

Memorandum from Kathleen M. Bennett, Assistant Administrator for Air, Noise, and Radiation, to Courtney Riordan, Acting Assistant Administrator for Research and Development, on Non-ionizing Radiation Research Needs.

I am writing to document the research activities we will need from the Office of Research and Development (ORD) to support our regulatory program for non-ionizing radiation.

Over the next few years (FY84-85) we will be developing guidance to control the radiofrequency exposure of the public. We will need the continued support of the health effects research staff to evaluate new research results through the public comment period. More importantly, the guidance we are developing will not address such important areas as mechanisms, inhomogeneous absorption, modulation, population sensitivity, chronic low-level exposure and frequency specific effects. Research in these areas needs to begin now so that you can address these issues in a major revision of the health effects document in support of our reevaluation of the radiofrequency guidance in FY89.

We also need your assistance in reaching decisions on the need for regulation at frequencies not covered by the guidance we are now developing, i.e., for frequencies above 100 gigahertz (GHz) and frequencies below 10 kilohertz (kHz), especially at 60 hertz (Hz), the frequency used for high voltage power transmission. This is a critical area, since the trend is to higher transmission voltages and effects are now seen in animals at levels very near those produced by present transmission voltages. We need an evaluation of effects, definition of uncertainties, and research to resolve these uncertainties.

The technological advances in the use of the electromagnetic spectrum are rapid and to a great extent unpredictable. As the spectrum becomes crowded, pressures mount to move to higher and higher frequencies and different applications. We do not perceive that the issuance of guidance for radiofrequencies in FY85 will reduce the support we need from ORD to make regulatory decisions at higher and lower frequencies or to reevaluate guidance for issuance in FY89. The health effects research staff is the only source of support we have tracking and evaluating research results and for conducting an integrated (intramural and extramural) research program to resolve important issues.

ERMAC Fades Away

The charter of the Electromagnetic Radiation Management Advisory Council (ERMAC) expired on January 9 and the National Telecommunications and Information Administration (NTIA), its parent agency, has made no move to renew it. NTIA head Bernard Wunder said that he has not yet decided ERMAC's future.

The agency did not request any money in its fiscal year 1983 budget for the coordination of federal research on the biological effects of non-ionizing radiation, bringing this work to a stop last October 1. Because no other agency has stepped forward to take over ERMAC from NTIA, the council may cease to exist.

Janet Healer, NTIA's program manager for non-ionizing radiation activities and an ERMAC member since its creation in 1968, has been temporarily assigned to other duties at NTIA.

ERMAC's sister committee, the Frequency Management Advisory Council (FMAC) will be renewed. Donald Jansky, associate administrator of NTIA and FMAC chairman has resigned to open up his own consulting firm. Jansky served as ERMAC's chairman at its last two meetings and had tried to find funds to allow its continued operation. ●

NIOSH in Disarray

The Rockville staff of the National Institute for Occupational Safety and Health (NIOSH) has dispersed. Just before Christmas, a congressional ban on moving NIOSH personnel out of the Washington, DC, area was revoked: employees were given 30 days to report to their new offices in Atlanta, GA, or Cincinnati, OH. Most refused to be reassigned. The resulting upheaval promises to further delay the completion of the institute's criteria document on radiofrequency and microwave (RF/MW) radiation.

NIOSH's criteria document development division was slated to go to the institute's laboratories in Cincinnati, OH. Of the three experts on non-ionizing radiation in Rockville, MD, Dave West has left to join the National Center for Devices and Radiological Health and Drs. Momtaz Wassef and Paul Strudler are believed to be resisting the move to Ohio. Neither could be reached for comment. Wassef had been the principal writer of the document; now that responsibility has been transferred to the Physical Agents Effects Branch, which has always been in Cincinnati.

When the move was first proposed two summers ago (see *MWN*, July/August 1981), there were some 152 employees in Rockville; by last Christmas only 60 remained—most of these will stay in Washington, DC. For example, only one of 24 members of the criteria development division has decided to go to Cincinnati. Many NIOSH staffers have found new jobs at the center or other parts of the Food and Drug Administration and the Department of Health and Human Services.

Senior NIOSH officials in Cincinnati are reevaluating plans for the RF/MW criteria document. They are weighing the possibility of changing course and releasing a much shorter report which could serve as rationale for a future RF/MW occupational exposure standard. A trimmed down document could be completed by this summer, reliable sources said, whereas there was practically no chance a complete criteria document could be finished this year with the present staff. ●

HIGHLIGHTS

EPA Moves Forward on RF/MW Exposure Guidance

The Environmental Protection Agency (EPA) has formally announced its plan to propose a "guidance" for general population exposure to radiofrequency/microwave (RF/MW) radiation in September. EPA officials already have a working number for the limit, though they do not plan to reveal it for some time.

Observers are confident that the number will be somewhere between the 50 uW/cm² standard proposed in New York City and the new American National Standards Institute's 1,000 uW/cm² recommended guideline. Specifically, many are betting on 200 uW/cm², which Massachusetts has proposed.

When final, the "guidance", unlike a standard, will only apply to federal agencies and their facilities. As the first national limit for public RF/MW exposure, however, its importance will far exceed its legal reach. Last year, the Federal Communications Commission (FCC) announced it will use EPA's number in determining whether proposed broadcast sources seeking licenses pose health hazards. (See *MWN*, March and September 1982.) The guideline will not cover occupational exposures or emissions from consumer products which, according to EPA, can be "more easily controlled" through performance standards.

The group at the Office of Radiation Programs (ORP) has finished a working draft of the guidance and plans to circulate it for inter-agency review this month. The office sent out letters in January requesting that interested federal agencies each appoint a staffer to participate in this preliminary evaluation.

The agency's Office of Research and Development (ORD) has prepared a draft criteria document on RF/MW bioeffects, which will serve as the basis for the guidance. The report is scheduled for public release in March when it goes to the Scientific Advisory Board (SAB) for review. The agency is now setting up a special panel to advise the SAB. Reliable sources say Professor Charles Susskind of the University of California, Berkeley, will be asked to chair the group. (By law, EPA must also consult the National Council on Radiation Protection and Measurement and the National Academy of Sciences on the guidance.) The publication of the criteria document is tentatively scheduled to coincide with release of the agency's notice of proposed recommendation in September.

Another support document, an economic impact study by the Environmental Sciences Division at the Department of Energy's Lawrence Livermore National Laboratory in Livermore, CA, should be completed by early summer.

The communications industry has been anxiously awaiting a national guideline on RF/MW radiation as proposed broadcast sources have met increasing opposition from community groups. Comments submitted last year on FCC's proposed RF/MW rules reflect industry fears over restrictive state and local standards.

EPA field measurements indicate most ambient radiation levels fall below even the strictest possible guideline. Based on readings from 15 cities, EPA estimates that over 99 percent of the population is exposed to RF/MW fields of less than 1 uW/cm². The median residential exposure is 0.005 uW/cm² at FM radio and TV frequencies (up to 806 MHz) and 0.019 uW/cm² at AM radio frequencies. These bands are "the principal contributors to the general radiofrequency environment." Above 806 MHz, exposures are estimated to be "much less than 1 uW/cm² for most of the population." (The agency has asked for comments on what frequencies the guidance should cover.)

For people living near high power transmitters, exposures can be "considerably higher"—as high as 5,000 uW/cm² in localized areas—according to EPA. Measured levels near FM broadcast antennas reported in the notice go as high as 350 uW/cm² in a residential neighborhood and 97 uW/cm² in a tall office building. Exposures "in the range of 10 to 100 uW/cm² can occur at distances up to 0.5 miles from some radar systems and satellite communication earth terminals."

The agency lists five key areas it will consider in establishing limits, including: 1) mechanisms of interaction, 2) possible thresholds of effects, 3) reversibility of effects, 4) dependence of effects on duration of exposure and 5) whether biological effects adversely affect human health. It provides few clues, however, as to what types of exposure may be unsafe. The agency does cite Eastern European reports of behavioral and nervous system effects at levels below 1 mW/cm², but then qualifies that this "limited clinical data suggest that these effects are reversible."

As for the key question regarding public safety, the agency only states, "It is not known whether the long-term, low-level exposures received by the general population can lead to irreversible adverse health effects, overt clinical disease, or whether adaptation can occur."

EPA is now awaiting comments on the scope and approach the guidance should take. The specific questions it wants addressed are listed below. Comments on the advanced notice (47 *FR* 57338, December 23, 1982) are due by February 22 but ORP's Norbert Hankin admits that he expects to receive some late replies. The agency will hold public hearings after the release of the proposed guidance.

Questions Posed by EPA

We specifically request comment on the following:

1. What conceptual approach should be used to develop limits for exposure? Examples of some possible approaches for establishing exposure limits include:
   (a) Threshold for biological effects.
   (b) As low as reasonably achievable.
   (c) Limit risk to a level comparable with that for other environmental pollutants.
   (d) Use of best available or best achievable technology.
2. What range of frequencies should be included in the guidance?
3. Should different guidance be developed for partial-body and whole-body exposure?
4. Should the exposure limits take into account the fact that the rate of energy absorption varies with frequency?
5. Should limits be placed on maximum as well as average exposure?
6. Should limits be placed on instantaneous as well as time-averaged specific absorption rates?

We would appreciate comments on these questions and identification of other issues that should be considered in the development of this guidance. ●

Canadian Group Recommends Limits for VLF Radiation from VDTs

A Canadian advisory group has recommended extending radiation standards to include the very low frequencies (VLF) emitted by some video display terminals (VDTs). In a statement issued in January, scientists at the Canadian Center for Occupational Health and Safety (CCOHS) say that although there is no known link between VDT exposure and reported reproductive problems, a cautious approach demands reducing emissions through shielding or terminal redesign until present uncertainty is resolved.

The center recommends that, on an interim basis, exposures to non-ionizing radiation from VDTs be limited to 60 V/m, as measured 30 cm from the set, for frequencies above 10 kHz. In Canada, a 60 V/m limit is already recommended by the province of Ontario for frequencies down to 300 kHz and by the federal government for frequencies down to 10 MHz. No standard in either the US or Canada now covers the 10–300 kHz band, though the

American Conference of Governmental Industrial Hygienists (ACGIH) has proposed limiting exposures to 614 V/m between 10 kHz and 3 MHz. The new American National Standards Institute (ANSI) standard does not recommend safety levels for frequencies below 300 kHz.

In considering possible causes for eight clusters of miscarriages and birth defects reported among VDT Operators (see *MWN*, July/August 1982), CCOHS scientists contend that "the weight of the scientific evidence is against ionizing radiation" because most VDT surveys show "negligible" X-ray emissions. Instead, they are looking to the pulse-modulated VLF fields produced by VDT flyback transformers.

Although the presence of VLF fields is widely acknowledged, most experts do not believe they are biologically active. CCOHS is focusing attention on the pulsed nature of these emissions because "pulse-modulated fields could be biologically more harmful than [unmodulated] fields." This is the first explanation, other than chance, for the clusters.

The center's Dr. Karel Marha cautions that research on the specific fields associated with VDTs must still be done. Nevertheless, he says the results of experiments with related pulsed fields provide a basis for concern. Czech researcher Dr. Hana Pafkova, for example, exposed pregnant mice for 17 days to a pulsed 300 Hz field with a peak value of 28,500 V/m and a pulse width of 10 microseconds and found "an unfavorable effect" on embryonic development. (Published in *Pracovni Lekarstvi, (Occupational Medicine) 32*, 334, 1980, written in Czech with an English abstract.)

In a telephone interview with *Microwave News*, Marha pointed out that the time-averaged field used by Pafkova was actually about 85.5 V/m, a level he called "not very high." He stressed that no one knows whether there is a radiation problem, but added, "*if* something is going on, these fields could be responsible."

The center's recommendation to limit these exposures drew sharp criticism from the Canadian Business Equipment Manufacturers Association in Toronto. In a telex sent January 10, the association's general manager Jim Flood warned the center that its statement would only create needless concern among VDT users and asked that it be withheld. According to Flood, "the center has proposed solutions to problems that don't exist: there is no evidence indicating VLF radiation is a hazard."

CCOHS scientists say only research, ranging from mathematical modeling to animal testing, will resolve the radiation issue and urge that this work be started. Noting that epidemiological studies are either underway or planned, they warn that there are too many confounding factors in this type of research to provide any clear-cut answers.

Marha has prepared a short paper, *The State of Knowledge Concerning Radiations From Video Display Terminals*, which reviews the types of emissions from VDTs. CCOHS is located at 250 Main Street East, Hamilton, Ontario, L8N 1H6, Canada.

NBS Designs New Meter to Measure E- and H-Fields Simultaneously in Near Field

Researchers at the National Bureau of Standards (NBS) have shown the theoretical feasibility of building a meter that can measure electric and magnetic fields *simultaneously* in the near field. Preliminary experiments, run at 100 MHz, indicate that the theory is correct. NBS' Dr. Moto Kanda said that a fully designed meter should be available within two years.

A sensor capable of measuring both electric and magnetic fields at a given point would represent a significant breakthrough—with widespread applications in the biological effects and radiofrequency interference communities. At present, there is no quick and reliable way of characterizing the components of low frequency (below 300 MHz) electromagnetic fields, which have extensive near fields.

Speaking from their laboratory at NBS' Electromagnetic Fields Division in Boulder, CO, Moto Kanda and Frank Ries said that, in the months ahead, they plan to design an isotropic antenna, to establish a flat frequency response for broadband measurements and to develop a fiber optic link so that the new sensor would not perturb the field.

Once the research and development is completed, NBS will disclose the meter's design to encourage the private sector to manufacture and market it. Kanda and Ries said that a number of companies have already expressed interest in the new meter.

Kanda is scheduled to describe the theoretical basis for the sensor in a paper to be presented at the *Electromagnetic Compatibility Symposium* to be held in Zurich, Switzerland, in early March.

Wertheimer Extends Cancer Study to Adults

Dr. Nancy Wertheimer and Ed Leeper have extended their 1979 work on childhood cancer and 60 Hz fields to adults: they have identified a "highly significant" association between the incidence of adult cancer and alternating magnetic fields (AMFs), though it was "considerably weaker" than the association observed for children. They contend that prolonged exposure to AMFs may promote the development of cancer.

While admitting that epidemiologically derived results can always turn out to be artifactual, the Colorado researchers argue that the association between cancer and the presence of high current electrical distribution lines may be a causal link because: "(1) a dose-relationship was observed; (2) two different control procedures yielded essentially similar results; (3) the strength of the associations observed in different age, urbanicity and socioeconomic groups was consistent with a causal interpretation; (4) a distinct pattern of latency between first exposure to the [high current configurations] and cancer diagnosis was seen, which is consistent with a hypothesis of cancer promotion produced by [exposure to AMFs]."

Wertheimer and Leeper maintain that the stronger association with children relative to adults may not indicate that children are more susceptible to the effects of AMFs—rather that any increase in cancer rates would show up more clearly in a population with a low incidence of cancer such as children.

In recent months, there have been three other reports connecting extremely low frequency (ELF) radiation to cancer. Studies from Washington state and California have found indications that workers exposed to electromagnetic fields have a greater risk of developing leukemia (see *MWN*, July/August and December 1982). And a Swedish team found support for Wertheimer and Leeper's 1979 results among Stockholm residents exposed to 50 Hz fields (see *MWN*, November 1982).

"Adult Cancer Related to Electrical Wires Near the Home" appears in the *International Journal of Epidemiology, 11*, 345, 1982. Wertheimer is with the Department of Preventative Medicine and Community Health at the University of Colorado Medical Center in Denver.

ITT Settles Engell Suit

Attorneys for ITT and Robert Engell agreed to an out of court settlement on December 23. Engell had filed a $4.5 million claim alleging that he had developed pancreatic cancer due to radiation exposure from tactical air navigation (TACAN) equipment manufactured by ITT. None of the attorneys involved would divulge the amount of the settlement, though one source did remark that more than nuisance money is involved.

Marc Moller and Michael Young, two of Engell's attorneys at the New York City law firm of Kreindler & Kreindler, said that they

were pleased with the outcome in the light of the present state of knowledge on radiation injuries. They said that Engell is satisfied. Matthew Shafner of O'Brien, Shafner, Garvey, Bartinik & Stuart of Groton, CT, was co-counsel on the case.

ITT was represented by John FitzGerald of the Hartford, CT, firm of Howard, Kohn, Sprague & FitzGerald; he refused to discuss the settlement.

A jury had been selected and the trial was scheduled to begin on January 5 in US District Court in Hartford. Engell's original suit, filed in 1977, named General Dynamics, Raytheon, Rockwell International and Varian Associates as co-defendants along with ITT. All four companies settled out of court in November; those agreements also stipulated that the settlements be kept confidential.

Engell worked at the Naval Air Rework Station on Quonset Point, RI, from 1965 until it was closed in 1973. He and one of his coworkers, Donald Cadieux both developed pancreatic cancer. More specifically, Engell had nonbeta islet cell cancer of the pancreas while Cadieux had adenocarcinoma of the pancreas. Cadieux died in October 1974; his widow's claim of wrongful death was barred under the Rhode Island statute of limitations.

One medical opinion, solicited by Engell's attorneys and placed in the court's records, states that "to find two men under 40 to have contracted pancreatic cancers in the same place is so highly unusual as to invite the inference that the disease states in each of them was occupation related." The expert was Dr. Leonard Dauber, an assistant clinical professor of medicine at Albert Einstein College of Medicine in New York City.

ITT never acknowledged that TACAN radiation caused the cancer; but, according to Young, the company filed papers with the court admitting there were no warnings of potential radiation dangers on the equipment when Engell worked on it. Among those listed as experts for ITT were: Drs. Don Justesen, Sol Michaelson, John Osepchuk, and Paul Tyler.

TACAN operates at frequencies of 1.025–1.213 GHz. In addition, the men were probably exposed to X-ray radiation from the rectifier tubes in the high voltage power supply.

UPDATES

Biological Effects... Dr. Carl Blackman and his colleagues at EPA published their latest findings on ELF-induced calcium efflux from brain tissue in the December *Radiation Research*. As Blackman reported at last summer's BEMS conference (see *MWN*, July/August 1982), the EPA group used 16 Hz sinusoidal fields *without* a carrier wave and found two power windows of enhanced efflux at 5–7.5 V/m and 35–50 V/m. These results are similar to those obtained with 50 and 147 MHz carrier waves modulated at 16 Hz, leading them to the conclusion that the RF carrier is not the responsible agent. They write that the experiment provides: "strong evidence against any potential mechanism of action that invokes generalized heating as the underlying cause." Blackman's findings disagree with those of a similar experiment run some years ago by Drs. Suzanne Bawin and Ross Adey. While both groups identified the same frequency specificity, Bawin and Adey found a reduction in calcium efflux while the EPA researchers found an enhancement—a difference that remains unexplained. At the 1982 BEMS meeting, Blackman said that he planned to see if higher ELF frequencies affected calcium mobility. In a telephone interview, Blackman said that he is in the process of running experiments at frequencies of up to 120 Hz. He predicted that he would have some results for the 1983 BEMS meeting, which will be held in Boulder, CO, in mid-June.... Professor Bill Guy will also be in Boulder to present the near-final results of his multi-million dollar, long-term study. Guy's research team at the University of Washington, Seattle, turned off the power last September after exposing 98 rats to 2450 MHz, 8 Hz pulsed microwaves for 36 months. The statisticians are still at work, Guy told *Microwave News*, but the preliminary indications are that there were no significant differences between the exposed and control animals. At last year's BEMS meeting, there was a paper out of Guy's lab indicating there might be some changes in T and B cells among the rats exposed to microwaves, but these were not confirmed by later tests. Guy said that he would like to do some more work on the effects of radiation on the immune system as well as the metabolic changes that follow irradiation. Now that the experiment is over, Guy intends to design improved applicators for hyperthermia treatment.... Another, though less ambitious, chronic study is reported by two Canadian researchers in the second issue of *Journal of Bioelectricity*, published by Marcel Dekker. Dr. J.A. Tanner of the National Research Council of Canada in Ottawa and Dr. C. Romero-Sierra of Queen's University in Kingston, exposed a colony of leghorn chickens to 7.06 GHz CW from a four-foot parabolic dish for more than 200 days: field intensities ranged from 0.19 uW/cm² to 360 uW/cm² depending on the location of the cage with respect to the dish. Microwaves increased egg production by 13 percent over the controls but was accompanied by double the mortality rate—mostly from avian leukosis and tumors in the central nervous system. In addition, the birds that survived showed a pronounced deterioration in health. The authors explain these adverse effects at such low levels with the hypothesis that "high intensity fields trigger thermal effects that block the non-thermal effects identified with low intensity fields."... Meanwhile scientists at the Battelle Northwest Laboratories have been investigating the effects of magnetic fields on trout. Battelle's Dr. John Strand reports that "fertilization was enhanced when ova and sperm of rainbow trout were exposed to a 1-tesla magnetic field before fertilization." A number of other magnetic field studies are also underway at the lab; to date, no adverse impacts have been detected.... As anticipated, ONR has picked up the abstracting of the bioeffects literature from NTIA. The BENER (Biological Effects of Non-Ionizing Electromagnetic Radiation) digests will continue to be prepared by Bruce Kleinstein under a newly created company, Information Ventures. Kleinstein, who is based in Philadelphia, PA, has received a one-year $72,000 contract, renewable for two more years, to prepare a quarterly review of the world's bioeffects research. The digest will pick up where NTIA left off; the first issue will begin with January 1982. If renewed, the total contract will be worth $212,000.... The research group at the University of Utah continues to turn out a large number of papers. Two recent additions were published in the November *IEEE Transactions on Microwave Theory and Techniques:* Professor Om Gandhi presents a review of the bioeffects and medical applications of RF/MW fields and, with two of his colleagues, some results on radiation absorption in the near field.... The most recent contribution to the debate on the potential hazards of fluorescent lights appeared in the November 27 *Lancet*. Dr. Robert Stern of Harvard Medical School contends that the increased risk of melanoma associated with fluorescent light in a recent study (see *MWN*, September and December 1982) is likely to reflect a bias in the selection of controls rather than a true risk .... Professor Albert Krueger died in December at the age of 80. Krueger, who spent much of his career at the University of California, Berkeley, was a leading researcher on the biological effects of air ions.

Communications... MCI Communications Corp. is bullish on fiber optics. Since November the company has purchased rights-of-way for over 4,000 miles of cables, including the Washington, DC, to New York City corridor. MCI chairman William McGowan says the east coast link will boost transmission capacity at a cost that is "far more economical" than expanding the company's existing point-to-point microwave network. The new technology, which is digital, can also improve transmission quality because it is immune to interference.... Meanwhile, ITT continues its efforts to site a point-to-point tower in northern New Jersey, one link in a planned network between Newark and Boston. A permit application was rejected by South Nyack, NY, last year and the company is now seeking approval in Ringwood, NJ, for the tower. In a January 21 release addressing community concern over potential radiation hazards, the company said the calculated power density at the base of the tower would be 0.02 uW/cm².... The organizers of the community group opposing RCA's application for an additional point-to-point station at its satcom facility in Vernon, NJ, (see *MWN*, November 1982) showed up at Ringwood's January public meeting on the ITT tower. RCA came too.... The November 1982 issue of the *Proceedings of the IEEE* is devoted to UHF-TV.... Telex Communications' Hy-Gain divi-

sion has issued a catalog of commercial, industrial and military HF, VHF and UHF antennas. For a copy, write to Hy-Gain, CIM Department, 8601 NE Highway Six, Lincoln, NE 68505.... Next year, your car radio might belt out the top 40 in stereo. Delco Electronics, a division of General Motors and the largest US maker of car radios, has decided to use Motorola's system for AM stereo radio. This is a major break in the standoff among three non-compatible systems hoping to win market acceptance. Harris Corp. and Magnavox are the losers in this round.

Compatibility & Interference...The FCC has closed its books on a notice of inquiry, adopted in December 1975, to investigate possible interference from spark-type ignitions to communication systems. In a memorandum, opinion and order released January 4, the commission states that there is little justification for pursuing the matter because the incidence of RFI from spark-type ignitions is decreasing and will probably continue to do so.... Video games, on the other hand, are another story. In mid-December, the AP featured a story about RFI complaints at a fire company in Milford, DE. Two video games had to be removed from the firehouse because they were interfering with land mobile units in the firetruck and confounding the transmission of alerts to the firemen's homes. The video game RFI problem may get worse after Christmas, according to an FCC staffer quoted by the AP, when all those games come out from under the trees....The Army Aviation R&D Command and NBS are planning a five-year effort to improve the army's EMC measurement program for helicopters, light aircraft and remote-piloted vehicles. The EMC program will include an assessment of shielding materials and military standards 461 and 462, as well as a study of the feasibility of establishing a government high-field-strength EMC test facility and a study of improved methods for electromagnetic pulse testing ....The FAA has signed a contract with the Department of Electrical Engineering at Ohio University in Athens to measure radiated emission from ISM equipment at an open field test site and at the actual location where the ISM equipment is operated. The FAA wants field strength measurements in the air over the ISM devices at a minimum of three different altitudes above the test site....The Energy and Environment Division of the Lawrence Berkeley Laboratory at the University of California has issued the *Proceedings of the Lighting-Electromagnetic Compatibility Conference*, held at the lab last March 18-19. A limited number of copies of the report (No. LBL-15199) are available from Dr. Rudy Verderber, Lighting Systems Research Group, LBL, Berkeley, CA 94720. Afterwards, it will be available from the National Technical Information Service, Springfield, VA 22161.

EMP...Concern over the possible impact of electromagnetic pulse (EMP) radiation on communications and energy systems continues to grow. While DOD has budgeted a major effort to protect vital military communication links from EMP disruptions, Edward Teller is worried about the EMP threat to industry. Writing in the October issue of the *IEEE Spectrum*, Teller speculates that in the event of heavy EMP radiation "it would be easier to enumerate the apparatus that would continue to function than the apparatus that would stop." Teller calls for the declassification of essential DOD documents because, unless precautions are taken, "the civilian economy faces the prospects of grinding to a halt in a nuclear encounter." With respect to the effects of EMP on electric power systems, a number of studies are already underway: the Zaininger Engineering Co. is characterizing EMP coupling and interactions for the Oak Ridge National Laboratory (Zaininger has subcontracted research on EMP effects on three phase circuits to the Dikewood Corp. and on magnetohydrodynamic-EMP surges on long transmission lines to the Mission Research Corp.) The Boeing Co. is looking at the effects of EMP on power system components for the Defense Nuclear Agency (DNA); DNA is also sponsoring the development of an advanced arrestor for EMP from surface nuclear bursts at General Electric. The Nuclear Regulatory Commission has contracted with Sandia National Laboratory for a major study of the effects of EMP on nuclear power plant safety systems; other related studies are planned. (Preliminary results from Sandia indicate that safety systems should not be damaged.) Most recently, Union Carbide, which runs Oak Ridge for DOE, has issued a RfP (No. 19-4456) for an assessment of the effects of EMP on utility electric power systems and for recommendations on how they can be protected....Much of the public awareness of EMP is attributable to articles by William Broad in *Science* and Janet Raloff in *Science News*. Broad has now written a popular piece, "The Chaos Factor," which is the cover story in the January/February issue of *Science 83*. Broad recently left *Science* to join the *New York Times*....A comparison of electromagnetic fields (in the frequency range 10^4–10^7 Hz) from nuclear EMP with those from lightning appears in the November issue of the *IEEE Transactions on Electromagnetic Compatibility*.

Government...Bruce E. Fein has been appointed general counsel at the FCC. Fein comes to the commission from the Department of Justice.... FDA has renewed the charter of its Technical Electronic Product Radiation Safety Standards Committee (TEPRSSC) for two more years. The date of the committee's next meeting has not been announced.

International...The Industrial Injuries Advisory Council in London, UK, is reviewing occupational risks associated with exposure to electromagnetic fields, including ionizing and non-ionizing radiation. For more information contact the council at Friars House, 157-168 Blackfriars Road, London SE1 8EU....Visiting Chinese scientist Zhi-Yuan Shen reports that the *Third National Symposium on Microwave Power Applications* will be held in China later this year; the exact date and place of the conference have yet to be decided. With respect to medical applications, he said that needles are being used as antennas to transmit microwaves in acupuncture treatments in Chinese hospitals. The needles transmit 1 GHz radiation.... Howard Bassen and John Monahan of the National Center for Devices and Radiological Health left for the Soviet Union in mid-January as part of the joint US-USSR research program on non-ionizing radiation (see *MWN*, July/August 1982). Bassen will be checking dosimetry at Dr. Mikhael Shandala's lab in Kiev, while Monahan will review the experiment's behavioral protocols. Afterwards, Monahan will visit other labs in Moscow and Leningrad.

Measurement...NBS has issued three new publications: (1) a new edition of its catalog, *Calibration and Related Measurement Services of the National Bureau of Standards* (SP 250-1982), which includes a special appendix listing contacts and prices for each service. It is available for $6.00 prepaid from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Stock No. 003-003-02446-5. The appendix is updated every six months free of charge; (2) *Metrology for Electromagnetic Technology: A Bibliography of NBS Publications* (NBSIR 82-1677). This volume, which covers papers and reports published by the bureau's Electromagnetic Technology Division staff between 1970 and 1981 on microwave circuits and pulsed electromagnetic phenomena among many other subjects, can be purchased for $9.00, prepaid, from the National Technical Information Service (NTIS), Springfield, VA 22161. Order No. PB 83-111658; (3) *Bibliography of the NBS Electromagnetic Fields Division Publications* (NBSIR 82-1673) lists the division's 1980–81 reports on measurement methods and standards as well as antenna systems and RFI. Available from NTIS for $6.00. Order No. PB 83-119776....A session at the *1983 Measurement Science Conference* held in Palo Alto, CA, January 20–21, featured three papers on automated testing techniques for microwave technology. Algie Lance of TRW Systems in Redondo Beach, CA, organized the session and presented one of the papers; the other two were by Mike Cuevas and John FitzPatrick, who both work at Hewlett-Packard. For more information, contact Lance at (215) 535-5167..

Medical Applications ... A hyperthermia unit manufactured by BSD Medical Corp. of Salt Lake City, UT, failed to receive premarket approval (PMA) from the FDA at a December 8–9 Radiologic Devices Panel meeting in Rockville, MD. An evaluation by officials at FDA's National Center for Devices and Radiological Health recommended approval for the cancer treatment unit with respect to safety and engineering, but there were some doubts about the machine's efficacy due to insufficient statistical controls in the submitted clinical data. BSD presented results from treatments with radiation and hyperthermia but not with radiation alone. Dr. J. William Dirksen, director of research and regulatory affairs at BSD told *Microwave News* that the company was in the process of generating the necessary data and that the company would resubmit the PMA application in early February. In 1981, Henry Medical Electronics' Magnetrode unit also failed to clear PMA (see *MWN*, May 1981). To date no hyperthermia device can be marketed to treat cancer....At the same meeting, there was discussion, initiated by the National Electrical Manufacturers Association (NEMA), on the possibility of changing the classification of NMR imagers from Class III to Class I or II, which do not require PMA. The panel expressed its interest in reclassification, but advised that it was up to NEMA to take formal action by filing a petition. In an interview, NEMA's Robert McCune said the group

was in the process of polling its member companies on the merits of such an action. . . .*The National Cancer Institute (NCI) has set up* a new committee, the Cancer Therapeutics Program Project Review Committee to advise NCI staff on "the merit review of applications requesting support for clinical and laboratory program project proposals." . . . In the latest issue of the *Journal of Bioelectricity* (Volume 1, Number 2, 1982), Drs. Stephen Smith and Jose Feola of the University of Kentucky College of Medicine report on experiments designed to see whether the pulsed magnetic fields used to heal nonunion fractures affected the course of malignant tumor development. *They used a pulse generator made by Electro-Biology (which also* supported the research) that emits a 5 millisecond train of 29 pulses, repeating at 15 Hz, inducing a peak magnetic field of about 20 gauss—an average field of 2–3 gauss. They found the magnetic field had: (1) little effect on survival, though there was a slight trend towards reduced survival; (2) a "quite remarkable" effect on internal organs; and (3) a general trend "towards the inhibition of the tumor and suppression of metastasis." As the authors themselves note, the results present "an interesting picture, not altogether easy to interpret." . . . *In the same issue of the Journal of Bioelectricity* Dr. Robert Becker, who recently retired from the Upstate Medical Center in Syracuse, NY, presents a review of "Electrical Control Systems and Regenerative Growth." . . . A group from Aberdeen, Scotland has used NMR to examine six patients in the first trimester of pregnancy, prior to termination. They report in the January 1/8 *Lancet* that the "fetal detail displayed by NMR is greater than that seen by ultrasound" and that there appear to be "no short or medium term side-effects." They caution, however, that "there is *insufficient information from animal work about [NMR imaging's] mutagen*icity to advocate the use of NMR in human pregnancy at this time." . . . Other recent NMR articles include a description of NMR imaging at Hammersmith Hospital in London in the November issue of *Radiography*, and "NMR Spectroscopy of Living Cells" by R.G. Shulman of Yale University in the January *Scientific American*. . . . IBM Instruments has agreed to help advance NMR imaging with grants of $1.9 million to Harvard Medical School's Brigham and Women's Hospital and $1.5 million to MIT's National Magnet Lab . . . . *Clini-Therm Corp. of Dallas, TX, will do R&D on cancer treatment for* Hyperthermia Associates of Nashville, TN, under a $440,000 contract. . . . Dr. Margaret Patterson has developed a "black box" that sends weak electrical signals into the brain to help addicts kick the habit. Her NeuroElectric Therapy works for drugs, alcohol and cigarettes. In a detailed article in the January *Omni*, Kathleen McAuliffe describes the box and Patterson's remarkable success rate. Interestingly, Patterson found that different frequencies helped different addictions: 75–300 Hz for narcotics and sedatives, lower frequencies for barbituates and approximately 2,000 Hz for cocaine and amphetamines. Patterson claims that her treatment does not cause any compensating "electronic addiction."

Ovens. . . A total of 4.07 million microwave ovens were shipped in 1982, down 7.9 percent from 1981, the record year for the industry. Despite the decline, sales have nearly doubled during the last five years. The Association of Home Appliance Manufacturers (AHAM), which compiles these statistics, believes that the future will be rosy: it points out that only one in four homes now has a microwave oven. . . . DOE has decided that energy efficiency standards for ovens, ranges and clothes dryers are not worth setting. In a final rule published in the December 22 *Federal Register* (47 *FR* 57198), the agency finds that such standards "would not result in a significant conservation of energy and would not be economically justified." When DOE first proposed a "no standard" approach, some congressmen voiced their displeasure (see *MWN*, June 1982). This time, Congress was in recess for the Christmas holidays and the rule passed relatively unnoticed . . . . Rubbermaid has introduced a line of microwave cookware made of a new material it calls "Micrel." The company claims the products are "virtually unbreakable and won't warp, even with drastic temperature changes from freezer to microwave oven to dishwasher, where it is bottom rack safe." . . . Magic Chef plans to introduce a new line of microwave ovens at the end of January.

Power Lines. . . The Minnesota Environmental Quality Board (MEQB) has concluded that the state's construction permit for the Cooperative Power Association-United Power Association 800 kV DC power line is adequate to protect public health and safety without modification. In its December 21 ruling, the board did order continued monitoring of the electrical environment around the line, however, and asked the Minnesota Department of Health to investigate the potential interference hazards of a line converter station to pacemakers. The board decision on the line running from a North Dakota coal field to Minneapolis/St. Paul, MN, follows the recommendations of its scientific advisory panel. The panel states in its report that "no additional standards are needed for safe operation of the line," though it also says that resolution of power line health effects issues "will definitely require well defined and replicated epidemiological studies," which in turn require more research on air ion concentrations. The advisors conclude that "the likelihood of long-term biological effects from the air ions generated by the line is considered to be low. However, we have virtually no direct information from any long-term studies of air ion effects." (See *MWN*, October and December 1982.) MEQB also reviewed a dairy cattle study by researchers at the University of Minnesota and reports on the state's program monitoring the electrical environment around the lines. For information on the availability of the reports, contact George Durfee, Manager, Power Plant Siting Program, MEQB, 15 Capitol Square Building, 550 Cedar Street, St. Paul, MN 55101.

Satellite Communications. . . The draft environmental impact statement (EIS) for Teleport, a satellite communications complex planned for Staten Island, NY, was released by the New York City Development Corp. and the Port Authority (PA) of NY and NJ on January 3. The facility would include 17 satellite antennas and eventually employ over 7,000 people. According to the draft, radiation levels near Teleport are not expected to exceed 3 uW/cm² — *well below the 50 uW/cm² limit proposed as a population standard* for New York City. Summary information in the EIS indicates safeguards in the project's design and operation would include continuous radiation monitoring and an alarm system, with an automatic cut-off, activated if radiation levels exceed 50 uW/cm². The facility would be surrounded by some form of wall to shield its antennas from external interference and to reduce RF/MW levels outside the site. Dr. Paul Tyler of the Defense Nuclear Agency reviewed the bioeffects literature for the statement, which *concludes that "no hazardous conditions have been identified at the power* density levels (maximum 3 uW/cm²) and radio frequencies (4 to 14 GHz) proposed for use" at Teleport. (Details are presented in a technical support document, *The Teleport Electromagnetic Energy Study*, 1982, by Ammann & Whitney, which was not yet available in late January.) Both Teleport, sponsored by the PA and Merrill Lynch, and an all-office development plan are considered in the EIS. A hearing on the project before the NYC Department of Environmental Protection and the NYC Planning Commission is *scheduled for February 2. (See MWN, June 1982.)* . . . RCA Americom's request to build a satcom station in the Indianola-Kingston area, near Seattle, WA, was denied by the Kitsap County Board of Commissioners for the second time on January 24. Company plans to site the facility on the county's Bainbridge Island and later in a forest near Kingston have met strong community opposition. Commenting on the ruling, Americom spokesman John Williamson said the company "will not pursue the Kitsap proposal at the present time," though "we still plan to start serving the Seattle area in *1983, from one location or another." The board refused RCA's application* last year but was asked to consider it again after the company filed suit in state court (see *MWN*, December 1982) . . . . A state superior court judge for nearby King County, WA, denied a citizen's group petition to block completion of Alascom's satcom station on Vashon Island. Members of Vashon for Quality Environment are likely to appeal the January decision to a higher court (see *MWN*, December 1982) . . . . The UN General Assembly has approved a resolution barring direct satellite transmissions across national borders *without the receiving country's consent. The December 10 vote* followed the endorsement of the measure by a UN special political committee in November. . . . *The Satellite Communications Market in Western Europe*, a 383-page report from Frost & Sullivan, includes estimates for various sectors of this market totalling over $8.5 billion by 1992. Report No. E564 costs $1,600 and is available from the company at 106 Fulton Street, New York, NY 10038, (212) 233-1080.

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VDTs... The Labor Education and Studies Center of the Canadian Labor Congress (CLC) has recommended in-depth studies to determine whether VDTs pose radiation risks. Citing concern over PCB's as well as very low frequency radiation, the center also urges that "long-term studies into reproductive hazards be undertaken immediately." The recommendations are included in its 241-page report on VDTs, which covers mainly non-radiation issues. A center survey of 2,330 Canadian workers found no evidence linking cataracts or reproductive problems to VDTs, but it cautions that only a study following a large group of workers over a long period could give conclusive results. The full report, *Towards a More Humanized Technology*, is available for $20, and a 46-page digest for $5, from the Center at 2841 Riverside Drive, Suite 301, Ottawa, Ontario, K1V 8N4, (613) 731-3052.... The Labor Council of Metropolitan Toronto reviews the CLC report in a special issue of its *VDT Newsletter* to be released this month. The council is also planning a conference on stress associated with VDT work on April 30. For information, contact the Council's VDT Committee, Room 407, 15 Gervais Drive, Don Mills, Ontario.... Several state legislatures may consider action on VDTs this year. In New York, a draft VDT safety bill sponsored by Brooklyn Assemblyman Frank Barbaro should be finished this month. And bills for establishing committees to investigate VDTs and possibly recommend legislation have been prepared by Connecticut's Committee on Labor and Public Employees (Study Bill 5132) and by Massachusetts' Committee on Commerce and Labor. VDT legislation proposed last year in Massachusetts (House Bill 2910) never reached the floor. (See *MWN*, April, 1982.)... NIOSH will investigate the relationship between stress and VDT work during an eight month study headed by Dr. Lawrence Scheifer at its laboratories in Cincinnati, OH. About 30 typists will participate. The project is not connected with two ergonomics studies now starting up under NIOSH's Dr. Michael Smith. (See *MWN*, December 1982.)... The North Carolina Occupational Safety and Health Project has asked interested union locals in the state to participate in a VDT worker survey on stress, ergonomics and potential reproductive problems. Contact Tobi Lippin, NCOSH, Box 2514, Durham, NC 27705.... Reports on new office technology appearing in the International Labor Organization's (ILO) *Social and Labor Bulletin* have been compiled and republished. The ILO book covers reports appearing since 1979 from a number of countries on such topics as general policy issues, labor relations and collective agreements, trade union viewpoints and the working environment. The 174-page *New Technologies: Their Impact on Employment and the Working Environment*, 1982, is available for $11.40 from ILO, Washington Branch, 1750 New York Avenue, NW, Washington, DC 20006.... Two Canadian researchers have concluded that "there are clearly no significant technological or economic problems in achieving emission levels far below the current regulatory limit" for X-ray emissions from VDTs. In the November 1982 *Health Physics*, C.A. Hirning and J.H. Aitkin of the Ministry of Labor in Toronto report: "As long as VDTs are being made with X-ray emissions as low as the vast majority of those currently available, there is no significant radiation risk to the users and no need for any additional regulatory action. If, however, a trend toward higher emission levels were observed... then the [as low as reasonably achievable] principle should be invoked to require manufacturers to reduce emissions again to the present negligible levels."... The Electronic Industries Association is working on a new standard, *Recommended Practice for Measurement of X-Radiation from Direct-View Television Picture Tubes*, TEPAC Publication No. 164. For information, contact the EIA, 2001 I Street, NW, Washington, DC 20006, (202) 457-4900.... A summary of the October 1982 *International Conference on Office Work and New Technology*, sponsored by Working Women should be available in March. For information, contact the organization at 1224 Huron Road, Cleveland, OH 44115.... Word processors have been the source of a different kind of office problem at Ford Motor Company in Dearborn, MI: a gambling operation handling over $5,000 a week. The January 10 *Computerworld* reports that state police nabbed three clerks who allegedly used their terminals to run a football betting pool. ●

Microwave News has published *VDTs: Health and Safety*, an 80-page booklet with an index containing all of our 1981–2 coverage of video display terminal issues. Copies are available prepaid for $5.95 plus $1.00 for postage and handling from: *Microwave News*, PO Box 1799, Grand Central Station, New York, NY 10163. For bulk rates (over 10 copies), please call us at (212) 794-9633. (US funds please. If your check is not drawn on a US bank, please add $3.00 per order.)

SHORT COURSES

• March 2–4: *Mobile Communications Engineering*, Washington, DC. Fee: $685. Contact: George Washington University, Continuing Engineering Education, Washington, DC 20052, (800) 424-9773.

• March 7–8: *EMI/Testing Praxis*, suburban Philadelphia, PA. Fee: $495. Contact: R&B Enterprises, 1050 Colwell Lane, Conshohocken, PA 19428, (215) 828-6236. Repeated • May 16–17.

• March 7–11: *Microwave Circuits: Theory and Applications*, Vienna, VA. Fee: $850. Contact: Continuing Education Institute, 10889 Wilshire Blvd, Suite 1000, Los Angeles, CA 90024, (213) 824-9545. Repeated • April 4–8 in Palo Alto, CA.

• March 7–11: *MIL-STD 461/462 & System-Level EMI Testing and Procedures*, Washington, DC. Fee: $965. Contact: Don White Consultants, PO Box D, Gainesville, VA 22065, (703) 347-0030.

• March 14–17: *Computational Methods in Electromagnetics*, Champaign, IL. Fee: $580. Contact: Southeastern Center for Electrical Engineering Education, 11th & Massachusetts Avenue, St. Cloud, FL 32769, (305) 892-6146.

• March 14–18: *Spread-Spectrum Techniques and Vulnerability*, New York, NY. Fee: $565 (IEEE), $715 (non-IEEE). Contact: IEEE Continuing Education, Attn: Rosanne Santangelo, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0600 x 328.

• March 21–23: *MM Wave Technology*, Washington, DC. Fee: $650. Contact: Palisades Institute for Research Services, 201 Varick St., New York, NY 10014, (212) 620-3377. Repeated • April 5–7 in San Francisco, CA.

• March 22–25: *Grounding and Shielding*, Orlando, FL. Fee: $760. Contact: Don White Consultants, see March 7 above.

• March 24–25: *Hazardous Electromagnetic Radiation and Its Biological Effects*, Washington, DC. Fee: $625. Contact: George Washington University, see March 2 above.

• March 28–April 1: *EMI Design and Testing*, Orlando, FL. Three one-day sessions on *Requirements & Testing per FCC Docket 20780*, *Designing to Meet FCC Docket 20780* and *Printed Circuit Board and Wiring Design for EMI Control*. And one two-day session on *Grounding, Bonding and Shielding*. Fee: $260 for one-day sessions and $495 for two-day sessions. Contact: R&B Enterprises, see March 7 above. Repeated: • April 11–15 in San Francisco, CA; • April 18–22 in Los Angeles, CA: • May 2–6 in Chicago, IL; and • May 9–13 in Boston, MA.

• March 29–31: *Interference Control: An Introduction to EMI/RFI/EMC*, Washington, DC. Fee: $760. Contact: Don White Consultants, see March 7 above.

• April 5–8: *Millimeter-Wave Radar*, Washington, DC. Fee: $780. Contact: George Washington University, see March 2 above.

• April 12–14: *Advanced Radar Technology*, Washington, DC. Fee: $685. Contact: George Washington University, see March 2 above.

• April 18–22: *Spectrum Management*, Washington, DC. Fee: $855. Contact: George Washington University, see March 2 above.

• April 25–29: *Communications Satellite Engineering*, Fee: $855. Contact: George Washington University, see March 2 above.

• May 2 & 4: *EMI Test and Evaluation*, San Jose, CA. Fee: NA. Contact: Don White Consultants, see March 7 above. This course will be given at the *Test & Measurement Expo*. A number of other courses and workshops are also scheduled. For more information, contact Meg Bowen, (617) 254-1445.

• May 16–20: *Basic Radiological Health Course*, San Antonio, TX. Fee: $450. Contact: University of Texas Health Science Center, Medical School Continuing Education Services, 7703 Floyd Curl Drive, San Antonio, TX 78284, (512) 691-6295.

• May 23–27: *Radar Systems and Technology*, Washington, DC. Fee: $855. Contact: George Washington University, see March 2 above.

• June 6–10: *Advanced Radiological Health Course*, San Antonio, TX. Fee: $550. Contact: University of Texas Health Science Center, see May 16 above.

• June 13–17: *Radiation Safety Officer's Course*, San Antonio, TX. Fee: $600. Contact: University of Texas Health Science Center, see May 16 above.

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Microwave News invites contributions to *From the Field*, our monthly column featuring news and opinions from the RF/MW community. Letters from readers are also welcome.

EPA RF/MW Report Revised

The Environmental Protection Agency (EPA) has revised its draft report on the biological effects of radiofrequency and microwave (RF/MW) radiation and now states that significant effects occur at a specific absorption rate (SAR) of about 1 W/Kg. The report being prepared by EPA's Office of Research and Development (ORD), under the direction of Dr. Joe Elder, will form the basis of the first national exposure limits for the general population. EPA's limits are known as the RF/MW "guidance."

The 1 W/Kg SAR is four times lower than the threshold level cited in the 1982 American National Standards Institute (ANSI) safety guidelines, which apply to both occupational and public exposures. ANSI used a safety factor of ten to arrive at its exposure limit of 1 mW/cm^2 at body resonant frequencies of 30-300 MHz, based on an SAR of 0.4 W/Kg. EPA has not yet indicated what kind of a safety margin it will use for its RF/MW guidance.

EPA is surveying FM stations to assess the economic impact of its guidance. See p.3.

At a January meeting to review the new ORD draft, David Janes, who heads the group preparing the guidance at the Office of Radiation Programs (ORP), told *Microwave News* that the revisions have not significantly changed the report's conclusions and will not affect the numbers in the draft guidance. It is rumored that the agency will propose a 100 uW/cm^2 limit at certain frequencies, though no details have yet been made public.

(continued on p.2)

Congressional Pressure in Radar Accident Investigation

The Secretary of the Air Force has joined the investigation into the radiation accident at Clear Air Force Station in Alaska. The Air Force's Office of Environment and Safety and its Surgeon General will review the ongoing investigation and report back to the Secretary.

The growing interest in the September 14 accident in which six workers were over-exposed to radar radiation follows a call for a new investigation by Alaska Congressman Don Young. In a January 14 letter to Air Force Secretary Verne Orr, Young asked for a new survey of the workers' radiation exposure by a "neutral party at the earliest possible date" and a "full scale investigation of the internal safety practices and procedures at Clear Air Force Station." Young, a Republican who is Alaska's only congressman, asked Orr to look into the accident personally.

The six workers, all civilian technicians, have charged that there was a gross misunderstanding of radar radiation at Clear and that there were extensive delays in providing them with expert medical attention. In addition, they have questioned the reliability and accuracy of the Air Force's September 22 accident simulation (see *MWN*, November 1983).

(continued on p.2)

Radar Accident (continued from p.1)

Young's Letter

In his letter to Orr, Congressman Young wrote: "I am convinced that the Air Force and the civilian contractor have not cooperated in good faith with the affected employees." He added that some of the test equipment used in the accident simulation run by the Air Force and FELEC Services was "defective, improperly calibrated and improperly employed by operating personnel."

Young pressed Orr for a new simulation of the accident "in order to reestablish employee trust in their government and its agencies."

Captain Johnny Whitaker, an Air Force spokesman, told *Microwave News* that no new simulation of the accident was planned. He said that there is no deadline for the continuing investigation. "It will take whatever time is necessary," he said.

Alaska Senators Ted Stevens and Frank Murkowski, both Republicans, have endorsed Young's efforts, but, for the moment, are letting him take the lead in applying pressure on the Air Force.

In an interview, an aide to Senator Stevens said that the senator was pleased with the way Congressman Young was pursuing his inquiry. Earlier, Stevens had announced that he was satisfied with the Air Force's investigation.

Senator Murkowski has expressed concern over the medical attention the workers had received. In a December 5 letter to General James Hartinger, the commander-in-chief of the North American Air Defense (NORAD) Space Command in Colorado, Murkowski wrote: "I am particularly concerned about those who feel that they have not received adequate attention almost three months after the accident." He went on to ask "why there are still so many unanswered questions from the workers at this late date."

Before the Air Force Secretary became involved, the investigation into the accident was being handled by the Air Force Inspection and Safety Center at Norton Air Force Base, CA. The center is under the aegis of the Air Force's Inspector General.

Clear Air Force Station is operated for the Air Force by FELEC Services Inc., a subsidiary of ITT.

Mishap Report

At the end of December, the safety center released a "mishap report" on the Clear incident. The report states that it "appears" that the workers were exposed to radiation for eight minutes. This has been contested by the workers, who believe the exposure was longer —perhaps as long as 17 minutes.

The report also details the approximate levels of exposure experienced by the six men while they were performing routine maintenance on one of the Ballistic Missile Early Warning System (BMEWS) radars. According to the Air Force report, the workers' exposures ranged from a maximum of 105 mW/cm^2 for Karl Kepler to 12-19 mW/cm^2 for Richard Eldridge and John Jessup. Two of the men, Ronald Foster and Edward Forsling, were exposed to 45-55 mW/cm^2 and one, William Emmons, to 90 mW/cm^2. Two electricans who were at the base of the radar when the power was turned on were exposed to less than 25 uW/cm^2.

One of the workers expressed doubts about the relative intensities of the exposures. In an interview, Eldridge disputed the Air Force's contention that he and Jessup received a fraction of Emmons's dose. "Emmons could not have been standing more than three feet away from us," he said, "because he was supervising our welding." Emmons confirmed to *Microwave News* that he was very close to Eldridge at the time of the accident; he estimated that they were about 18 inches apart. Emmons added that he might have been a little closer to the trap door leading to the screen of the radar antenna.

Other recent developments concerning the radar accident include:

- The Alaska Department of Labor's Division of Labor Standards and Safety issued two citations against FELEC Services for over-exposing six workers to radiation. The citations carry a penalty of $840. On January 6, Ralph Drew, FELEC's manager at Clear, notified the state that the company would contest the citations.
- John Jessup and Ronald Foster went to Brooks Air Force Base for a medical examination in January. The other four men were examined at Brooks in October. The two FELEC employees originally declined to go to Brooks because they lacked confidence in Air Force objectivity.
- On February 1, Thomas Lucas, a field attorney with the National Labor Relations Board (NLRB) is scheduled to meet with Eldridge to hear his grievance regarding his dismissal from FELEC on November 10 (see *MWN*, December 1983).
- Repeated requests by *Microwave News* for the accident report prepared by FELEC Services went unanswered. ●

EPA Guidance (continued from p.1)

Report Revisions

At a January 24-25 meeting in Research Triangle Park, NC, a special EPA Scientific Advisory Board (SAB) panel found that the revised ORD report provides a satisfactory review of the literature and a sound basis for setting exposure guidelines. Its approval follows extensive revisions in ORD's treatment of thermal physiology, the backbone of the first draft.

ORD rewrote its summary and conclusions to accommodate criticisms made at the panel's first meeting last September (see *MWN*, October 1983).

Instead of focusing on thermoregulatory response thresholds, the draft now cites a range of considerations for pinpointing the onset of significant bioeffects at 1 W/Kg, including effects on endocrine gland function, blood chemistry, hematology and immunology. The authors also state that behavioral changes can occur in certain environments at lower threshold SARs than those cited by ANSI. In addition, they mention one experiment which indicates RF/MW radiation may be a cancer promoter and another which shows radiation may affect brain cells. Finally, the special

susceptiblity of the central nervous system to radiation and the need for more research on calcium efflux are noted.

In the initial draft, ORD calculated that human thermoregulatory response was triggered by SARs of about 0.27 to 0.81 W/Kg, or 1.2 to 2.6 mW/cm^2 at body resonant frequencies.

At the September panel meeting, Dr. Eleanor Adair and other panelists warned that EPA's ORD should not have estimated human thermal response thresholds from animal data. Accepting this criticism, ORD concluded that these thresholds cannot be adequately predicted given the lack of human data.

Although thermoregulation was the most thoroughly discussed and revised area of the report, panelist Dr. Stephen Cleary advised at the close of the January meeting that the time devoted to this topic does not reflect its importance regarding regulation of public exposures.

ORD agreed to a number of additional minor changes at the January meeting and has a little work left to do. For example, EPA's Dr. Carl Blackman will write a brief review of post-1980 literature on calcium efflux.

On the whole, the panel decided that the addition of papers published after 1980 would not affect the basic conclusions of the report.

Panel Recommendations

In addition to tentatively approving the report, the panel decided to outline a number of research areas that it believes EPA should pursue after the guidance is set. In a draft of the cover letter they will send to SAB Chairman Dr. Norton Nelson, the panel members singled out the effects of frequency modulation, chronic versus acute exposures, partial body versus whole body exposures, high power pulsed sources versus ones that are adequately characterized by average power, and several other topics.

Panel chairman Dr. Charles Susskind suggested that a final draft of the report be sent to SAB Director Dr. Terry Yosie by mid-February so that the board's executive committee can review it before its April meeting. The executive committee must approve the final report.

Speedy approval could be important for ORP, which is pushing to complete a draft guidance and supporting material by June 1. The proposal will not be released before the bioeffects report is issued and must itself receive final EPA approval and pass a review by the Office of Management and Budget.

Both the revised report, *Biological Effects of Radiofrequency Radiation,* No. EPA-600/8-83-026A, and the cover letter must still be reviewed by the following panel members who were unable to attend the meeting: Drs. Barbara Chang, Carl Durney, Steven Horvath, Abraham Lilienfeld and Charlotte Silverman.

Panel members attending the meeting were Drs. Eleanor Adair, Stephen Cleary, Arthur Guy, Sol Michaelson, Mary Ellen O'Connor and Chairman Charles Susskind. Yosie and SAB Executive Secretary Dr. Douglas Seba were also present.

EPA's guidance will only apply to federal facilities, but since it is the first and only federal exposure rule for the general public, it will become the de facto US standard. The draft has already circulated among federal agencies for review.

EPA Surveys FM Stations

EPA is surveying over 1,000 FM radio stations to better assess the economic impact of its planned public exposure guidance for RF/MW radiation. Officials at the agency's Office of Radiation Programs (ORP) in Las Vegas, NV, anticipate that the survey will show that public exposures to FM radiation are lower than EPA models currently predict.

Though the agency is evaluating the potential effect of the guidance on all types of broadcasters, the survey is limited to FM (88-108 MHz) because, as a class, these stations are estimated to produce the highest public exposures falling within the 500 kHz-100 GHz range of the guidance.

According to the cover letter sent out with the questionnaires last month, participation is voluntary but a "prompt and accurate response will help to insure that a realistic estimate" of the economic effect of the guidance is achieved.

In an interview with *Microwave News,* EPA's Ric Tell explained that land use data from the questionnaires will indicate whether or not areas near the stations with high RF/MW levels are accessible to the public. An inaccessable area will not be considered a public hazard. Of the more than 4,000 FM stations in the US, the agency sent questionnaires to those estimated to produce the highest exposure levels.

The agency has asked broadcasters how close the public can get to the targeted FM antennas and whether there are other broadcast sources either sharing a station's tower or in the immediate area, as in an antenna farm.

Although the guidance will only be enforceable for government facilities, private sector broadcasters are likely to be required to meet EPA limits by the Federal Communications Commission (FCC). Commission policy is still not set, but it has proposed rules that would require compliance from new or modified facilities. The FCC has yet to say how it will deal with existing broadcasters.

EPA will summarize the survey responses and then forward the data to a team at Lawrence Livermore National Laboratory in California, which is preparing the economic assessment for EPA (see *MWN,* December 1981). The agency hopes to have the proposed guidance and its supporting aterial ready for publication in early June.

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HIGHLIGHTS

Navy Loses ELF Suit

On January 31, Federal Judge Barbara Crabb ruled in favor of the State of Wisconsin and Marquette County, Michigan, and stopped all work on Project ELF, the Navy's submarine communications system. The Navy must now prepare a supplemental environmental impact statement (EIS) before construction can resume.

Wisconsin Attorney General Bronson La Follette had charged that the Navy's 1977 EIS failed to take into account recent studies on the health effects of extremely low frequency (ELF) radiation as well as changes in the proposed antenna design (see *MWN*, July/August 1983). The suit was filed on July 20, 1983 in US District Court for Western Wisconsin.

The judge not only barred further construction of the ELF antenna in northern Wisconsin and Michigan's Upper Peninsula, but stopped the placement of receivers on submarines. The Navy has not yet announced whether it will appeal the decision.

The verdict came as we go to press with this issue. We will publish a more detailed story with excerpts from the judge's 69-page decision next month.

EPA and NIEHS To Replicate Delgado Study

Researchers at the Environmental Protection Agency (EPA) and the National Institute for Environmental Health Sciences (NIEHS) will attempt to replicate Dr. Jose Delgado's experiment which found that very weak, pulsed magnetic fields affect growth and development. The work reported by Delgado's lab in Spain has received widespread attention because it showed that magnetic fields less intense than the earth's produced severe effects.

Dr. Ezra Berman, an expert in teratology at EPA's Health Research Laboratory in Research Triangle Park, NC, told *Microwave News* that the experiment must be repeated "simply because the results are so unusual." The replicate study could get underway by the end of this summer.

Delgado's group at the Centro Ramon y Cajal Hospital in Madrid found significant malformations in chick embryos exposed to pulsed magnetic fields of 0.12, 1.2 and 12 microTesla (uT) for 48 hours at frequencies of 10, 100 and 1000 Hz. Delgado reported that the most marked effect occurred at 100 Hz and 1.2 uT (see *MWN*, March 1983 and *Journal of Anatomy, 134*, 533, 1982).

In a recently published follow-up experiment, Delgado showed that pulse shape was the key variable in achieving an effect (see *MWN*, November 1983 and *Journal of Anatomy, 137*, 513, 1983).

Berman said the US effort will attempt to repeat the experiment as closely as possible but with more eggs. He noted that Delgado worked with a total of 68 eggs, while the US experiment will probably use 40 to 50 eggs per exposure group.

Current plans call for running the experiment at NIEHS facilities at North Carolina State University in Raleigh. The institute's Dr. Don McRee will perform the exposures and Berman will examine the eggs. Ric Tell, from EPA's Office of Radiation Programs in Las Vegas, NV, will handle the critical job of designing the exposure conditions. The exposures will take about three months to complete.

Both Berman and Tell stress that the main difficulty in doing the study is that no one knows exactly how Delgado's group set up its experiment. The researchers hope they will get more detailed information.

Tell has tried to reproduce the Delgado experiment himself with no success and told *Microwave News* he is very pleased that people with greater expertise will try it.

The importance of Delgado's study is magnified by the general lack of research on extremely low frequency (ELF) fields. EPA is just beginning to turn its attention to this area. According to an EPA spokeswoman, the agency hopes to develop an ELF research program in the coming years, now that its work on a general population guidance for the 500 kHz-100 GHz range is nearly complete. Congress has also taken an interest in ELF and last year directed the agency to investigate the effects of 60 Hz power line radiation (see *MWN*, June 1983).

Shortwave Radiation Linked to Heart Disease

Chronic exposures to 27 MHz radiation have been associated with heart disease in a new epidemiological study of male physical therapists. This report is believed to be the first from the US to make this link, although a number of Soviet and Eastern European studies have associated radiofrequency and microwave radiation with heart ailments.

Health data from 3,004 therapists who used ultrasound, infrared, microwave and shortwave diathermy equipment were analyzed. Only the link between shortwave (27 MHz) diathermy and heart disease was statistically significant. The study by Dr. Stanford Hamburger, James Logue and Phyllis Silverman of the Food and Drug Administration's (FDA) National Center for Devices and Radiological Health is reported in the *Journal of Chronic Diseases, 36*, 791, 1983.

The paper does not address the pregnancy outcomes of the therapists' wives. In a telephone interview, Silverman said that the pregnancy data from the survey are being prepared for a second paper.

The data used in this study were collected by Dr. Jeanne Stellman under a two-year FDA contract while she was at the American Health Foundation. In 1980, Stellman reported preliminary results which indicated a number of adverse health effects among the therapists including hypertension, hearing disorders, bilateral cataracts and blood and endocrine disorders —but not heart disease. Stellman is now at Columbia University in New York City.

Stellman told *Microwave News* that recent analyses confirmed her earlier findings, but she could not explain the

differences between her results and those of FDA. Stellman is in the process of writing up her results in a number of papers and expects to publish them later this year. She said that her study had been delayed by a shortage of funds: "It took the Office of Management and Budget (OMB) a year to approve my questionnaire, and after that I ran out of money." Stellman said that she has been finishing her research in her spare time.

Silverman suggested that the two sets of results might be due to differences in the statistical techniques used by FDA and Stellman.

Another possible explanation lies in the data sets analyzed by FDA and Stellman: each reports a different response rate. The FDA group claims a response rate of 58 percent, while Stellman has questionnaires from 68 percent of the original sample. Silverman said that while she believes the FDA group did not have about 400 of the original Stellman questionnaires, they did have a computer tape with all the data. (Only those cases that were accompanied by questionnaires were included in the FDA analysis.) A check of the missing responses indicated no obvious pattern of adverse health effects, according to Silverman.

New Jersey Weighs ANSI's RF/MW Exposure Standard

New Jersey is moving forward with plans to adopt a radiofrequency and microwave (RF/MW) radiation exposure standard based on the new American National Standards Institute (ANSI) guidelines. The proposed rules, which at their strictest level would limit public exposures to 1 mW/cm^2 in the 30-300 MHz frequency band, were discussed at two public hearings last month.

In a statement issued before the January 24 and 31 hearings, the New Jersey Commission on Radiation Protection maintains that the ANSI C95.1-1982 standard "represents a consensus of current thinking by scientists active in this discipline," and that it is "extremely conservative, thereby assuring a wide margin of safety." The commission is composed of representatives from state government and the private sector and has the authority to set state radiation standards.

According to the commission, the action is a response "to the public's apprehension concerning misuse of radiofrequency radiation in the absence of national safety level guidelines." Commission member Eugene Fisher of the state's Bureau of Radiation Protection told *Microwave News* that the group "is not confident that a federal standard will be in place in the near future."

If no major revisions are required, the eleven-member New Jersey committee could approve the standard in February.

Massachusetts, the first state to set RF/MW population limits, took a different standard-setting approach last year and adopted a rule five times more strict than ANSI (see *MWN*, November 1983).

One of the commission's main objectives is economic. It believes that a standard will help in eliminating "unnecessary time delays in the installation of new facilities with a cost saving to industry which will ultimately result in a reduction in the cost of such service to the public." Several communications companies planning to build new facilities or expand existing ones in New Jersey have met stiff community resistance over the RF/MW safety issue (see *MWN*, November 1982 and November 1983). A number of residents opposing new broadcast sources have announced that they believe the proposed standard is too high.

The New Jersey rules would apply only to public exposures in the 300 kHz-100 GHz frequency range. In addition to broadcast sources, the frequency-dependent standard would include an emission standard for microwave ovens. Emissions from units built after 1971 would be limited to 5 mW/cm^2 measured at a distance of 5 cm and to 10 mW/cm^2 for those built before 1971. The draft's wording regarding ovens is unclear and Fisher reports that an appliance manufacturers' group is proposing new language for this section of the rule.

In addition to the January hearings, the public was invited to comment on the action in writing before February 3. Submissions are being collected by Fisher at the Department of Environmental Protection, Bureau of Radiation Protection, 380 Scotch Road, Trenton, NJ 08628.

The committee members are Max Weiss, Chairman, AT&T Bell Telephone Laboratories; Benjamin Sonnenblick, Rutgers University; Henry Powsner, Princeton Medical Center; Seymour Baron, Burns & Roe; Fred Sterzer, RCA Laboratories; and representatives from the New Jersey Departments of Health, Labor and Environmental Protection.

Ontario Hydro Plans VDT-Pregnancy Research

Researchers at Ontario Hydro have announced they will investigate possible links between pregnancy problems among VDT operators and electromagnetic (EM) radiation from terminals. In a progress report on their continuing work on VDTs, the scientists recommend both a laboratory and an epidemiological study. The latter, which would be more costly and take longer, may not be undertaken.

The report, "Hazards Assessment of Video Display Units [HAVDU] — Report on Phase I Activities," concludes that there is no danger to operators from ionizing radiation, including X-rays, but stops short of dismissing EM radiation risks. The Ontario Hydro investigators measured EM fields and charges from flyback transformers, low-voltage circuitry and display screens.

The Ontario Hydro report recommends "an experiment involving the exposure of small animals to [EM] fields be performed to gain evidence on potential adverse pregnancy outcomes due to exposure to the types and magnitudes of the [EM] fields generated by a VDT." In an interview after the report was released, Ontario Hydro's Robert Facey told *Microwave News* that this study will use VLF fields between 15 and 17 kHz. Ontario Hydro will spend $50,000

and solicit $40,000 from outside sources for this research. The company will fund the entire project if external help is not available, Facey added.

The proposed epidemiological study would cost $500,000 and take four years to complete. Its purpose would be to increase the "limited" data available on pregnancy outcomes among VDT operators. Ontario Hydro's Phase I report calls for a limit of $100,000 on its total contributions and recommends that the company solicit additional funds starting in April 1984 unless a similar study is underway elsewhere.

The scientists also propose to measure magnetic fields near VDTs in Phase II using techniques similar to those used to characterize electric fields in Phase I.

EM fields from the flyback were in the very low frequency (VLF) range (15.8-18.5 kHz) with average (root mean square) field strengths between 3 and 30 V/m at 30 cm from the front of the terminal. These emissions are pulsed and Ontario Hydro researchers measured peak values as low as 4 V/m and as high as 170 V/m.

Electrostatic fields of up to 7,000 V/m were measured. Fields from the electronic circuitry were less than 1 V/m.

The report cautions that all the EM readings are approximately ten times the real exposure levels as a result of the measurement method used. Dr. Stuart Harvey, who supervised the EM testing, explained that the meter used in the laboratory gives a reading that exceeds actual levels by this amount.

The significance of these radiation readings is unclear. "No experimental data were uncovered which directly demonstrate evidence of biological harm due to fields generated by VDTs; however, conversely, to our knowledge there is no published work which shows the absence of such effects," the study explains.

With regard to ionizing radiation, measurements failed to find emissions above ambient levels in 80 percent of the units tested. The remainder of the units produced readings two to four times that of background apparently due to the presence of potassium-40, a radioactive isotope, in the glass screens. These levels are of "no medical significance" according to the researchers.

Ergonomic guidelines available to VDT users and supervisors are inadequate, according to the report. In most cases guidelines are not compatible or consistent. The study recommends design standards for desks, chairs, keyboards, screen characteristics and lighting.

Project HAVDU was started in 1982 in response to a labor-management agreement, and to concerns among company scientists that VDT work is a "cause of anxiety among women employees." The Phase I report was presented to Ontario Hydro's Board of Directors in mid-November and became publicly available in mid-January. The projected completion date for Phase II is April 1985.

Copies of the full report can be ordered from Mr. Robert Facey, Safety Services, Ontario Hydro, 757 McKay Road, Pickering, Ontario L1W 3C8, Canada. The cost per copy is $13 US, $16 Canadian. A 35-page summary is available from the same address for $4 US, $5 Canadian.

SHORT COURSES

March 5-6: ***Grounding, Bonding & Shielding,*** San Francisco, CA. Fee: $495. Contact: R&B Associates, 20 Clipper Rd., W. Conshohocken, PA 19428, (215) 825-1960. Repeated ***March 8-9:*** Los Angeles, CA.

March 5-7: ***Planning for and Operating an NMR Imaging Facility,*** Washington, DC. Fee: $750. Contact: Continuing Engineering Education, George Washington University (GWU), Washington, DC 20052, (800) 424-9773.

March 12-15: ***Modern Microwave Measurements,*** Washington, DC. Fee: $895. Contact: Continuing Education Institute (CEI), 5410 Leaf Treader Way, Columbia, MD 21044, (301) 596-0111 or (213) 824-9545.

March 12-15: ***Computational Methods in Electromagnetics,*** Galveston Island, TX. Fee: $650. Contact: Ann Beekman, Southeastern Center for Electrical Engineering Education (SCEEE), Central Florida Facility, 11th & Massachusetts Ave., St. Cloud, FL 32769, (305) 892-6146.

March 12-16: ***Radiowave Propagation for Communications Systems Design,*** Orlando, FL. Fee: $875. Contact: GWU, see March 5 above.

March 15-16: ***Lightning Protection,*** Orlando, FL. Fee: $625. Contact: GWU, see March 5 above. Repeated ***June 4-5:*** Washington, DC.

March 19: ***Applying Military Electromagnetic Compatibility Specifications,*** St. Louis, MO. Fee: $295. Contact: Jean Tucker, ECOS Environmental Solutions, 205 W. Harrison St., Oak Park, IL 60304, (312) 383-2505. Repeated ***April 16:*** Chicago, IL.

March 19-23: ***Flat-Panel and CRT Technologies,*** Los Angeles, CA. Fee: $895. Contact: UCLA Extension Short Course Program, PO Box 24901, 6266 Boelter Hall, Los Angeles, CA 90024, (213) 825-1047.

March 20-22: ***Grounding & Shielding,*** Sunnyvale, CA. Fee: $815. Optional fourth day for $235. Contact: Don White Consultants Inc. (DWCI), Star Route 625, PO Box D, Gainesville, VA 22065, (703) 347-0030.

March 22-24: ***NMR: A Primer for Radiologists,*** Hilton Head Island, SC. Fee: $375. Contact: K.V. Pyles, Foundation for Education in Magnetic Resonance, 111 Glade Park East, Kittanning, PA 16201, (412) 545-7085.

April 3: ***EMC: The FCC Means Business,*** Boston, MA. Fee: $595. Contact: Carol Clark, McGraw-Hill Seminar Center, 331 Madison Ave., Suite 603, New York, NY 10017, (212) 687-0243.

April 9-10: ***Grounding, Bonding & Shielding,*** Washington, DC. Fee: $625. Contact: GWU, see March 5 above.

April 30-May 4: ***EMC Design & Measurement for Control of EMI,*** San Diego, CA. Fee: $995. Optional fifth day for $235. Contact: DWCI, see March 20 above.

April 30-May 4: ***NBS Noise Measurement Seminar,*** Boulder, CO. Fee: $775. Contact: Sunchana Perera, Div. 723.05, National Bureau of Standards, Boulder, CO 80303, (303) 497-3546.

April 30-May 4: ***High Frequency Spectrum: New Concepts and Technologies,*** Washington, DC. Fee: $875. Contact: GWU, see March 5 above.

May 7-11: ***Microwave High Power Tubes and Transmitters,*** Washington, DC. Fee: $875. Contact: GWU, see March 5 above.

May 7-11: ***Microwave Circuits Design: Linear Circuits,*** Palo Alto, CA. Fee: $895. Contact: CEI, see March 12 above. Repeated ***June 4-8:*** Boston, MA.

May 7-11: ***Electromagnetic Interference and Control,*** Washington, DC. Fee: $875. Contact: GWU, see March 5 above.
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May 8-11: ***Modern Antennas,*** Washington, DC. Fee:$675. Contact: Linda Billard, Technology Service Corp. (TSC) 8555 16th St., Suite 300, Silver Spring, MD 20910, (800) 638-2628.

May 15-17: ***An Introduction to EMI/RFI/EMC,*** Los Angeles, CA. Fee: $815. Contact: DWCI, see March 20 above.

May 21-23: ***Hazardous RF Electromagnetic Radiation,*** Washington, DC. Fee: $695. Contact: GWU, see March 5 above.

FROM THE FIELD

Responses to Dr. Robert Becker's Letter on Use of Electromagnetic Stimulation for Bone Growth

In our November issue, we published a letter sent to the FDA by Dr. Robert O. Becker on the risks associated with the growing use of medical devices that apply direct currents and pulsed electromagnetic fields to stimulate bone growth. Published below are the FDA's response to Becker and a letter to Microwave News *from Dr. C. Andrew L. Bassett.*

Dear Dr. Becker:

The Food and Drug Administration (FDA) has completed its initial review of your concerns regarding the safety of electromagnetic stimulation of biological tissues as a treatment therapy. The agency believes it is essential to continually evaluate the safety and effectiveness of electromagnetic stimulation as the technology evolves and new data accumulates. We would like, therefore, to thank you for your comments and encourage you to submit any additional comments or relevant data, as you feel appropriate.

We are familiar with most of the information you provided. The bulk of the data you refer to has only recently become available (articles dated 1982 and 1983). As you observed there is little, if any, corroborating evidence for much of the recent research you cited.

As you know, the agency has approved three premarket approval applications for devices involving electromagnetic stimulation for healing of bony defects. These approvals were based on all the information available at the time of approval. These approvals required that four-year follow-up examinations be performed by the sponsor on all patients in the approved trials. These examinations were explicitly requested to substantiate "long-term" safety and effectiveness of the approved devices. This four-year time period has not been reached by all patients; thus, the data which will address many concerns is incomplete.

Furthermore, we are also aware of the need to proceed judiciously in the clinical application of a new therapeutic modality such as electromagnetic stimulation. This agency has determined that all such devices are significant risk devices. As such, any sponsor wishing to clinically investigate these devices must receive FDA approval for an investigational device exemption (IDE) prior to initiating the trial. Therefore, we will continue to evaluate the most up-to-date information available regarding the safety and effectiveness of these devices.

Thank you again for your comments. If you have any questions regarding this matter contact me at (301) 427-7156.

Carl A. Larson, Ph.D.
Director, Division of Surgical and Rehabilitation Devices
Office of Medical Devices
National Center for Devices and Radiological Health
Food and Drug Administration, Silver Spring, MD 20910

To the Editor:

Dr. Robert O. Becker has called for a moratorium on clinical application of "bone growth stimulators" because he postulates a possible link between such devices and "malignant transformation." Anyone who has followed his writing and statements will recognize that this position has not changed for the past ten years. In fact, at the 1973 New York Academy of Sciences Conference on "Electrically-Mediated Growth Mechanisms on Living Systems," Dr. Becker sounded his first alarm, "When this field began to open up and clinical use was being postulated, and some patients were actually undergoing treatment, I raised the question of possible induction of malignant cellular changes." [1]

During the intervening ten years, more than 40,000 patients have been treated with various electrical devices to modify bone formation by one mechanism or another, without a single report of malignancy as the result of such use. Extensive laboratory investigations of these devices have taken place *in vitro* and *in vivo* all over the world, again, with no evidence that they *induce* cancer. This point is conceded by Becker, himself, in his FDA letter.

In the United States, where the electrical devices have been regulated by the FDA since 1979, there is a legal requirement for device manufacturers to report all untoward reaction and, to my knowledge, the cancer issue is a "non-issue" at the present time.

I will not attempt to point out or correct each of the inaccuracies which are contained in the letter. Interested readers are referred to the appended bibliography for details, which can place the issues in a more comprehensive light. There are two main inaccuracies, however, which deserve attention by your readers. The first concerns safety testing and is embodied in his sentence, "When the FDA approved these devices there were no studies on the effects of...magnetic fields on embryonic growth and development or malignant growth." The facts are: extensive data from teratologic and toxicologic studies in animals were made available to the FDA for the two pulsed electromagnetic field (PEMF) modes which were approved. These included documentation of a lack of chronic-exposure PEMF effects on multiple soft tissues and organs such as the heart, kidneys, liver, spleen, adrenals, lung and brain, among others. Furthermore, mice mated, delivered and reared through the F5 generation (constantly exposed individually to two types of PEMFs) showed no birth, development or functional abnormalities. In addition, both pulse modes were tested on Meth A sarcomas in Balb/C mice and were demonstrated to have no effect on tumor weight, mitotic indices, tumor microanatomy or behavior. Similarly, both pulses had no effect on normal animal longevity or the spontaneous tumor incidence in Swiss Webster mice. All of these data were submitted to the FDA as part of the pre-market approval and continuing monitoring processes. Under the Freedom of Information Act, I believe, these findings have been available to one and all, if they were concerned. As a matter of record, the safety of these two pulse modes has been investigated, independently, both in academic and commercial settings, and the original assessments confirmed.

The second critical issue which deserves comment is what I call the "lumping syndrome." No one would consider saying to a physician or a scientist, "I treated my patients with drugs" without specifying the agents, their dose, their routes or schedules of administration. Yet, electrical modalities of a wide variety, are now being "lumped" into the "bone growth stimulator" heading with little or no evidence that each fits [2]. Similarly, because one type of time-varying electromagnetic field produces an untoward effect under *highly selected* circumstances, *all* such fields frequently are impugned. Conversely, because PEMFs are effective in a given clinical setting, entrepreneurs who try a "coattail" approach, either are unaware, themselves, of the very selective nature of pulse specifity or are counting on an uninformed user, when "equivalency" is claimed.

With every passing month it is more and more clear that both different and similar pulses can cause different biological effects in different tissues at different times in the cell cycle [3-14]. In fact, the postulated importance of frequency, amplitude and cell cycle "windows" to achieve selected alterations in cell function is now supported by a considerable body of scientific data. Falling prey to the "lumping syndrome" signals a lack of familiarity with those data.

(continued on p.8)

FROM THE FIELD

Finally, a moratorium on FDA-approved clinical applications of *selected* PEMFs, clearly, is not justified by the facts. Deleterious effects have not been reported in the more than 20,000 patients treated with these two pulse modes. The longest follow-up, now, is nine years and the method has been used successfully on a number of occasions to heal ununited fractures in bone with quiescent (treated) primary tumors. In none of these individuals has there been any evidence of "re-lighting" the tumor for intervals exceeding five years post-treatment. Let us not risk "throwing the baby out with the bath water."

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[3] C.A.L. Bassett et al., in *Electrical Properties of Bone and Cartilage: Experimental Effects and Clinical Applications,* C.T. Brighton et al. eds. New York: Grune and Stratton, 1979, pp. 427-441.
[4] S. Fitton-Jackson and C.A.L. Bassett in *Tissue Culture in Medical Research (II),* R.J. Richards and K.T. Rajan eds., Oxford, England: Pergammon Press, 1980, pp.21-28.
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[7] C.A.L. Bassett et al., *Journal of Bone and Joint Surgery, 64A,* 888, 1982.
[8] R. Goodman et al., *Science, 220,* 1283, 1983.
[9] I.A. Cook and C.A.L. Bassett, *Orthopedic Transactions (Journal of Bone and Joint Surgery), 7,* 361, 1983.
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[12] S.D. Smith and A.A. Pilla in *Mechanisms of Growth Control,* R.O. Becker, ed., Springfield, IL: Charles C. Thomas, pp. 137-152, 1981.
[13] W.R. Adey, *Biosystems, 8,* 163, 1977.
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UPDATES

BIOLOGICAL EFFECTS

Collection of Papers... The IEEE Press has assembled into one large volume a collection of more than 60 papers on the interaction of RF/MW radiation with living systems. The papers, reprinted as they were originally published, are divided into seven groups, each with an introduction and a list of references. *Biological Effects of Electromagnetic Radiation* was edited by Dr. John Osepchuk of Raytheon with the help of Drs. James Frazer, Om Gandhi, Arthur Guy, Don Justesen, Sol Michaelson and John Mitchell. The 593-page collection is available for $47.95 to IEEE members and $79.95 to non-members from IEEE Press, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060.

COMMUNICATIONS

WARC... Delegates from 112 nations have gone to Geneva, Switzerland, for the World Administrative Radio Conference's (WARC) five-week meeting on high frequency (shortwave) communications. For a review of the issues to be addressed, see the January 9 *Broadcasting*....The FCC has amended its rules to comply with the "Final Acts" of the 1979 WARC. The commission states that this action "provides domestic radio spectrum users with protection from harmful interference as provided by international regulations." The FCC's lengthy discussion of the rules and the public comments they generated, and a modified table of frequency allocations, appear in the January 19 *Federal Register.*

COMPATIBILITY & INTERFERENCE

Aircraft RFI... At the first meeting of the Radio Technical Commission for Aeronautics (RTCA) Special Committee 156 on "Potential Interference to Aircraft Electronics Equipment from Devices Carried Aboard" on December 1-2, a testing program was initiated to determine if there is an RFI problem caused by the use of computers aboard planes (see *MWN,* October 1983). Representatives from the airlines, the air frame manufacturers and the FAA will gather path loss data by simulating the decay of emissions through windows and the aircraft itself. At the same time, the computer companies will check the emissions from various devices. It was noted that radiation levels allowed under RTCA/DO-160A are more stringent that those allowed under FCC Part 15 and that the stricter limits may be needed to prevent harmful RFI. The next meeting of SC-156 is scheduled for February 28-29. In the meantime, the committee members agreed that interim steps to stop passengers from using computers during flight, including during take offs and landings, were not necessary.

Sonic Cable TV Fine Upheld... The FCC has refused to rescind its $6,000 fine against Sonic Cable TV (serving Grover City, Arroyo Grande and Pismo Beach, CA) for leaking signals which interfered with amateur radio communications (see *MWN,* November 1982). The commission did not find Sonic's procedural and substantive arguments persuasive: "Sonic has chosen to raise a plethora of unmeritorious arguments to mask its rule violations." The FCC responded to Sonic's charge that it was the victim of "selective prosecution" by noting that although the "commission's limited resources may result in violators going unpunished, this does not mean we cannot impose sanctions against those we find violating our rules."

Immunity Task Group...ANSI C63's ad hoc committee on enhancing the immunity of home electronic equipment to RFI is moving ahead. Meetings were held in October and December and another is planned for February 10 at the FCC Labs in Columbia, MD.vAt that time, the committee plans to put the final touches on a questionnaire, which will

be published in the American Radio Relay League's (ARRL) magazine, *QST*. FCC's Dan Yates, a member of the committee, pointed out that the questionnaire is virtually identical to the one used by the commisson's Field Operations Bureau for reporting RFI complaints. Meanwhile, the Electronic Industries Association's Consumer Electronics Group has completed its measurements on the immunity of TVs and VCRs; the results are under review. As work on TVs and VCRs winds up, the committee will soon begin studying cordless phones and home security systems. Don Heirman of AT&T Information Systems Labs, the committee chairman, said that the new and the old efforts will continue simultaneously.

NBS Noise Seminar...NBS is holding a week-long seminar on precision noise measurements, stressing applications in antenna and communication systems, April 30 to May 4 in Boulder, CO. Taught by members of the Noise Metrology Group in NBS' Electromagnetic Fields Division, the seminar costs $775. For more information contact NBS' Sunchana Perera, (303) 497-3546.

Resources... The Soviet "Woodpecker" transmitter is causing interference problems again, according to an item in the December *QST*. The magazine quotes a Norwegian official as saying that the Woodpecker, located in Kiev, is interfering with almost a tenth of the radio traffic over the shortwave band in Norway....An article in the November 3 *New Scientist* cites the dangers of trying to use signals from high power CB radios to confuse the electronics of gas station pumps. There is no way of knowing whether the radiation will make the gas meter run faster or slower. And there is the risk that it can trigger an explosion. In fact, author Barry Fox notes, this effect has been exploited in the Northern Ireland conflict....A.J. Mauriello of Radiation Sciences, Inc., in Lansdale, PA, and J.M. Clarke of the Air Force's Electronics Systems Division at Hanscom AFB have published "Measurement and Analysis of Radiated Electromagnetic Emissions from Rail-Transit Vehicles" in the November *IEEE Transactions on Electromagnetic Compatibility*....The Office of Technology Assessment (OTA) cites EMI as one barrier to magnetic levitation systems for high-speed intercity passenger service. See OTA's *US Passenger Rail Technologies*, available for $4.75 from the Government Printing Office, Washington, DC 20402. Order No. 052-003-00938-2....EMI problems in the automobile industry were featured in a December 20 *New York Times* article by John Holusha....Papers are being solicited for the *6th Symposium and Technical Exhibition on Electromagnetic Compatibility* to be held at the Swiss Federal Institute of Technology in Zurich, March 5-7, 1985. The theme of the conference is "protection of the electromagnetic environment." Professor Ralph Showers of the University of Pennsylvania is again serving as the chairman of the Technical Program Committee. Abstracts are due before March 15, 1984. For more information, contact: Dr. T. Dvorak, ETH Zentrum-IKT, 8092 Zurich, Switzerland, 256-2790....NASA has issued a RfP (No.5-79683/235) to "determine critical areas of EMI/EMC interaction between the spacecraft and electronics payload and identify areas where potential EMI problems exist." The space agency anticipates awarding one contract in March.

GOVERNMENT

IEEE Spectrum... Watch for the March issue of *IEEE Spectrum*, which will feature a major article on the current regulatory climate in Washington, DC, as it affects the use of non-ionizing electromagnetic radiation.

INTERNATIONAL

Hungarian Standards... In 1982, Hungary proposed new safety standards for workers and the general population. The proposal is comparable to other Eastern European RF/MW health standards and is more stringent that the new ANSI guidelines and other Western standards. For 300 MHz-300 GHz, the draft exposure limit for the general population is 10 uW/cm^2, while for workers it is 1 mW/cm^2. For 30 kHz-30 MHz, the limits are 20 V/m and 50 V/m for public and occupational exposures respectively; for 30-300 MHz, they are 10 V/m and 20 V/m respectively. Higher exposure levels are permitted for short periods of time, but the absolute maximum levels for *all* individuals are (1) 30 kHz-30 MHz: 1000 V/m; (2) 30-300 MHz: 500 V/m; and (3) 300 MHz-300 GHz: 10 mW/cm^2. The proposed limits do not differentiate between CW and pulsed radiation. The Hungarian paper was translated by Information Ventures, Inc., and is excerpted in its most recent edition of *Biological Effects of Non-Ionizing Electromagnetic Radiation* (Vol. VIII, No. 1, October 1983). A limited number of copies are available from the Office of Naval Research, Code 441, 800 North Quincy St., Arlington, VA 22217 (include a self-addressed mailing label).

MEDICAL APPLICATIONS

BSD's Hyperthermia Units Approved... On November 28, the FDA approved BSD Medical Corporation's BSD-1000 hyperthermia system as "safe and effective" for marketing to hospitals and clinics (see FDA's notice in the January 25 *Federal Register*). The BSD unit, which is designed to treat tumors within two inches of the skin surface with electromagnetic energy, can operate at frequencies between 50-1000 MHz. It is the first hyperthermia device to win FDA approval. Two months later, on January 27, BSD followed up its first success by winning clearance for its new mobile unit, the BSD-300, which generates heat with radiation in a narrower frequency band. The portable unit uses the same technology and applicators as the BSD-1000. The devices are now available for sale by prescription, to be used under the supervision of a licensed physician.

Resources...A multinational group of researchers has devised an innovative method of removing tumor cells from bone marrow. The tumor cells are rendered magnetic by targeting them with monoclonal antibodies which are bound to polystyrene microspheres containing magnetite. The bone marrow can then be "cleaned" with a magnet. Up to

99.9 percent of the tumor cells can be removed with this technique, which is described in the January 14 *Lancet*....The December issue of the *IEEE Engineering in Medicine and Biology Magazine* features five papers on "Therapeutic Uses of Electrical Stimulation." Topics include pain control, growth stimulation of bones, nerves and limbs, electroacupuncture, and soft tissue healing.... General Electric has published a pamphlet, *Parameters Determining the Appearance of NMR Images*. A copy is available at no charge from GE's Medical Systems Operations, PO Box 414, Milwaukee, WI 53201.

MILITARY SYSTEMS

Fourth PAVE PAWS Radar... The Air Force's Electronic Systems Division has awarded Raytheon's Equipment Division a $61.2 million contract to build, install and test a fourth phased array, PAVE PAWS, radar near Goodfellow AFB in Texas. Last November, the AF announced plans for the third PAVE PAWS radar at Robins AFB in Georgia at a cost of $76.9 million (see *MWN*, December 1983). Two other PAVE PAWS radars are already operational at Otis Air Guard Base in Massachusetts and at Beale AFB in California. The radars, which are more than ten stories tall, have two walls, each with 5,354 individual antennas. They can detect sea-launched ballistic missiles 3,000 miles away.

POWER LINES

Progress Report on NY Studies... The Scientific Advisory Panel of the New York State Power Lines Project will meet March 25-26 to review progress on its 16 ongoing studies. Plans for two epidemiological studies just getting under way at the University of Colorado in Denver and the Battelle Pacific Northwest Laboratory in Richland, WA, will be included in the discussions (see *MWN*, September and November 1983). The public is invited to the second day of the meeting, which will be held at the Health Department Labs in Albany. Project Administrator Michael Rampolla said that a written semiannual progress report will be released at the end of this month. For details, contact Rampolla at the NY Power Lines Project, New York State Department of Health, Center for Laboratories and Research, Empire State Plaza, Albany, NY 12201, (518) 474-7888.

Resources...A team from Hydro-Quebec's research institute, IREQ, has studied the corona, electric field and ion-current performance of a ± 900 kV bipolar HVDC transmission line. The results on radio interference, audible noise, corona loss, electric field and ozone generation are presented in the January 1984 issue of *IEEE Transactions on Power Apparatus and Systems*....A session on "Transmission Line Electric Field Effects" is scheduled for February 2 at the IEEE Power Engineering Society's winter meeting in Dallas, TX. Three presentations are planned: one on measurements of E-fields from transmission lines in residential environments by a team from Electric Research & Management; and two on methods of evaluating human exposures to 60 Hz E-fields by Dr. D. Deno of GE and M. Silva of Enertech, and by a group of Japanese researchers....The Minnesota Environmental Quality Board (MEQB) has issued two reports on the state's ± 400 kV DC power line. *A Health and Safety Evaluation of the ± 400 kV DC Power Line*, prepared by a seven-member advisory panel, concludes that "based on currently available scientific literature, there is no indication that the Cooperative Power Association/United Power Association ± 400 kV DC power line represents a risk of effects, symptoms or damage to the health of the general public as a result of short term exposures." One of the experts filed a dissenting report. *A Statistical/Epidemiological Study of Bovine Performance Associated with the CPA/UPA DC Power Line in Minnesota* found no significant changes in milk production or quality among herds near the line. Each report is $13.00, including handling charges, from the MEQB, 100 Capitol Square, St. Paul, MN 55101. An executive summary of each report is available free....There are now 13 gigawatts of HVDC capacity in the world, with 20 GW under construction and a projected annual growth rate of 15 percent a year through 1990, according to an article in the January issue of *IEEE Spectrum*, p.72. The report features a list of the major HVDC projects completed, built or planned around the world with a detailed map of the lines in the US....The General Accounting Office has prepared a report for the Secretary of DOE on *Expanding the Pacific Northwest/Southwest Intertie — Benefits and Impediments*. Report No. GAO/RCED-84-38, November 4, 1983 is available from GAO, Document Handling and Information Services Facility, PO Box 6015, Gaithersburg, MD 20760, (202) 275-6241.

STANDARDS

ANSI Conference... The American National Standards Institute (ANSI) is sponsoring a one-day conference on *Standards and the Law* on March 27 at the Marriott Crystal Gateway Hotel in Arlington, VA. Topics to be covered include the legality of standards, their anti-trust implications and their use in product liability cases. The registration fee is $150. On March 28, ANSI will hold a *Seminar on Administering Domestic Standards Activities*, which has a fee of $50. Those who register for both will receive a $25 discount. For more information, contact Ms. Dolly McKelvey, ANSI, 1430 Broadway, New York, NY 10018, (212) 354-3300.

Oven Leakage...FDA's National Center for Devices and Radiological Health has issued a final rule on its amended procedures for measuring leaks from microwave ovens. In 1980, the Association of Home Appliance Manufacturers had objected to the FDA proposal but both sides reached an agreement in November 1981 (see *MWN*, May 1981 and January/February 1982). Now the FDA has promulgated the rule (46 *Federal Register* 57481, December 30, 1983); and it will take effect on July 2, 1984. For more information contact FDA's Melvyn Altman, (301) 443-3426.

Resources...ANSI's C63 Committee on Radio-Electrical Coordination is proposing to change its name to Committee on Electromagnetic Compatibility and to widen its scope to include setting guidelines on immunity. Meanwhile, its new