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EMF Research Must Continue

Canada May Limit RF/MW Eye Exposures from Mobile Phones

Compliance Problem for Walkie-Talkies?

A draft of a Canadian standard for radiofrequency and microwave (RF/MW) radiation would limit exposure to the eyes from cellular phones, a provision strongly opposed by industry. No other country has adopted a radiation standard for the eyes.

Canada's RF/MW rules have had limits on eye exposure since 1991, but so far these have not applied to walkie-talkies or cellular phones. The current controversy was sparked when Health Canada, the federal health agency, proposed an end to this exemption as part of a revision of the standard.

Dr. Art Thansandote of Health Canada's Radiation Protection Bureau in Ottawa declined to discuss what changes might be made to the guidelines, known as Safety Code 6, and refused to release a copy of the current draft. "The revision is still under way, and will not be completed for another six months," he said in a September interview.

"There has been quite a lot of resistance to the eye limit," Dr. Paul Cardinal, director of Aprel Laboratories in Nepean, Ontario, told *Microwave News*. But despite industry's intense opposition, said Cardinal, "Health Canada has not removed the eye requirement."

Aprel Labs is a member of the Radio Advisory Board of Canada (RABC), an industry group based in Ottawa. The government requested the RABC's comment on a new draft of Safety Code 6 in 1996, and has asked it to review later versions. The RABC has argued that the scientific basis for the eye standard is weak and that testing to prove compliance would be too expensive,

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DOE EMF Research Program Folds; Appeals To Continue Rebuffed

The long-running electromagnetic field (EMF) research program at the Department of Energy (DOE) shut down, perhaps for good, on September 30, the end of the U.S. government's 1998 fiscal year.

The DOE did not request funds from Congress to continue the program, which began in the mid-1970s, and Congress did not move to salvage the research effort.

"The DOE has said that as far as it's concerned, there is no reason for its role to continue," a congressional aide told *Microwave News*. He noted that the final report of the National Institute of Environmental Health Sciences (NIEHS) on the five-year EMF RAPID research program had not yet been delivered to Congress, and added, "Since the NIEHS is an agency of the Department of Health and Human Services (HHS), anything further would be

(continued on p.3)

NIEHS Working Group Report: Talk of Tucson and Washington

The National Institute of Environmental Health Sciences (NIEHS) has been hearing public reactions to its Working Group report that classified EMFs as possible human carcinogens (see *MWN*, J/A98). Here are some highlights of the Tucson, AZ, and Washington hearings, held September 14-15 and September 28, respectively. (Two more meetings were held, in San Francisco on October 1 and in Chicago on October 5.)

- In Tucson, Dr. Christopher Portier announced that the NIEHS had not yet decided what will be in NIEHS Director Kenneth Olden's report to Congress on the EMF RAPID program, but that it is "unlikely" to include a detailed risk analysis of EMF impacts on health. He said that it will "definitively" include the identification of EMF hazards and perhaps a dose-response analysis for childhood leukemia—but probably not for chronic lymphocytic leukemia among workers. In other words, the report will indicate whether there are health risks, but it is unlikely to quantify their relative size. Portier also pointed out that the Working Group report is only one of the inputs to Olden's report. Portier, the director of the NIEHS Lab of Computational Biology and Risk Analysis, predicted, in an October interview, that the "NIEHS' initial draft of the report will be ready in November or December." When asked when it will be sent to Congress, Portier answered, "My hope is within four weeks of the initial draft."

- Given that the Working Group voted to classify EMFs as "possible human carcinogens," what advice should be given to the public about possibly reducing EMF exposures? Dr. Indira Nair of Carnegie Mellon University in Pittsburgh was invited to explore possible options at the National EMF Advisory Committee (NEMFAC) meeting, also held in Tucson, on September 17. "Inaction is not an option," said Nair. She offered three strategies: "avoid when possible," "pursue research" and "keep people informed." She stressed that she "would err on the side of caution...because children are implicated." This is an "ethical," rather than a scientific, argument, she said. The NEMFAC members agreed to write a letter to Olden recommending that the NIEHS provide the public with information on "low- and no-cost options for minimizing personal exposure to EMFs, for those individuals who choose to exercise these options."

- Another oft-asked question in Tucson was how the Working Group would have classified EMFs if it had used the cancer guidelines developed by the Environmental Protection Agency (EPA). At the Washington meeting, *Microwave News* caught up with the EPA's Dr. Robert McGaughy, who has been evaluating EMF cancer risks for more than a decade. "If this were a chemical and we had some mechanistic data," McGaughy said, "there is no doubt that we would have classified EMFs as a B1 carcinogen—a probable human carcinogen." Of course, mechanisms are where the cancer connection is most controversial, but as far back as 1990, McGaughy and his staff judged EMFs to be probable carcinogens. They were overruled by senior managers, however. Instead, EMFs were called possible carcinogens (see *MWN*, M/J90), the same designation chosen by the NIEHS panel based on criteria developed by the International Agency for Research on Cancer. Later drafts of the EPA analysis continued to main-

Report Has Major Impact in Japan

The NIEHS Working Group report has stirred public concern over EMF health risks in Japan.

"Many people who oppose the utilities are using the report to fight transmission lines and substations," Dr. Tadashi Negishi of the Central Research Institute of the Electric Power Industry (CRIEPI) told *Microwave News*. "The utilities are facing a hard time," he said.

Professor Hiraku Takebe of the Atomic Energy Research Institute at Kinki University disagrees with the conclusions of the working group and criticized the NIEHS over the makeup of the panel. "There were too many epidemiologists on the committee," he said in an interview. Takebe, a geneticist who works on DNA repair mechanisms, blamed the media for reinvigorating the activists. "I am confident that the media are purposefully distorting the facts," he said.

CRIEPI's Negishi said that there has been an overreaction to the report in Japan because, in his opinion, many people are misinterpreting the "possible carcinogen" designation as an indication that EMFs "can" cause cancer. He maintained that this is especially true for newspaper and television reporters.

Even before the release of the working group's decision and report, the Japanese government had increased support for EMF health research (see *MWN*, M/J98). Negishi and Takebe were among 13 Japanese industry, academic and government officials at the DOE's EMF review and at the NIEHS public meeting, both held in Tucson, AZ, in mid-September. More people attended from Japan than from any other country outside the U.S.

tain that EMFs are a risk factor for cancer (see *MWN*, J/F98). A different view of how the EPA's analysis might have turned out was presented by Kathleen Shanley of United Illuminating Co. in New Haven, CT, on behalf of the Edison Electric Institute in Washington. Using a new set of guidelines, which are under review at the EPA but not yet adopted, Shanley said that animal studies showing the lack of an effect in two species would provide some assurance that there is in fact no cancer risk. "Our reading of the scientific data," she said, is that, "EMFs are not a threat to public health."

- Many people spoke at the public meetings, with varying degrees of eloquence. The most forceful presentations were those from breast cancer activists—not from the myriad groups that have sprung up over the years to oppose power lines. Indeed, the EMR Alliance, based in New York City, was not represented at the meetings, nor did it submit written testimony. Speaking on behalf of the West Islip Breast Cancer Coalition on Long Island, NY, Barbara Balaban argued for more research and more public information (see also p.3). She also urged action: "If EMFs may present a risk, then what is the harm in educating people about those measures they can take to avoid unnecessary exposure?" Balaban recommended the ALARA principle—that exposures should be as low as reasonably achievable.

more related to the HHS. I don't see the DOE coming back to it."

The congressional staffer suggested that utilities saw less need for research now that the RAPID program was coming to a close. "I think the utilities got into this because there was consumer concern, but at some point you have to come to a conclusion," he said. "That was the purpose of the five-year program."

Shirley Linde, the chair of the National EMF Advisory Committee, spearheaded a lobbying campaign directed at high-level DOE managers to try to save the program. To date, they have not committed any of the DOE's budget to continue health research. Last April, Linde presented the DOE with a petition signed by more than 1,000 breast cancer activists who wanted the program saved (see *MWN*, M/J98).

"It is reprehensible that research is stopping in the U.S. at a time when the NIEHS panel has pointed to a possible cancer risk," she told *Microwave News*. In June, a working group assembled by the NIEHS recommended that EMFs be classified as "possible human carcinogens" (see p.2 and J/A98). "How can we walk away when children are at risk?" she asked.

"This would not seem to be an opportune time for concluding EMF research," said Dr. Imre Gyuk, who has managed the DOE's program for more than ten years.

Gyuk held out some hope that the DOE might resurrect the research program. "A plan has been submitted at the request of senior management, and it is still being considered," he said in an interview in early October.

Speaking at the NIEHS public meeting in San Francisco on October 1, Nancy Evans, a Breast Cancer Fund board member who collected the signatures on the petition, urged that the DOE "core program" continue, in order to examine "the broad questions of health and disease related to the broad spectrum of non-ionizing electromagnetic frequencies."

With the EMF RAPID research program at the NIEHS also coming to an end, the federal government has essentially abandoned EMF health research—except for a few grants from the National Institutes of Health. The Electric Power Research Institute (EPRI) in Palo Alto, CA, is the last major source of funds in the U.S. Its 1998 EMF budget is approximately \$9 million, according to EPRI's Barbara Klein. The 1999 budget has not yet been set, she said.

At the NIEHS' September 14-15 public meetings in Tucson to hear comments on the working group's report, speaker after speaker urged that EMF research be continued, especially at the DOE. (The meetings were held during the DOE's annual EMF research review.) For instance, Marcus Barnes of Aerodyne Laboratories in Austin, TX, said that continuation of the DOE program is "crucial and imperative" in order not to "squander the last 20 years of research." And Dr. Carl Blackman of the Environmental Protection Agency (EPA) called the program a "national resource."

Because many of the speakers were researchers themselves, some might have interpreted their pleas as self-serving. But other speakers, who must give advice on EMF safety issues, made similar appeals. Gordon Miller, an industrial hygienist at the Lawrence Livermore National Lab in Livermore, CA, said that there was "clear evidence that the research needs to be contin-

ued" and pointed out that lingering uncertainty over health effects would spell trouble for the business community, especially for those in real estate who have to contend with depressed property values near power lines.

Is There a Campaign Against EMF Research?

At the Tucson DOE meeting, there were widespread rumors that the Edison Electric Institute (EEI), based in Washington, had lobbied Congress to discontinue all EMF health research. One source, who asked not to be identified, said that he had heard directly from congressional staffers that the EEI has "no interest" in continuing the DOE program. "They want this program to go away," he said.

But Richard Loughery, the EEI's director of environmental activities, unequivocally denied that the EEI is opposed to continued EMF research. "We are not up there [in Congress] lobbying against research. I can say this emphatically," he told *Microwave News* in an interview in Tucson.

Some industry groups are openly endorsing more EMF research. In a letter to the NIEHS, the American Public Power Association in Washington urged the institute to develop a health research program. And Douglas Bannerman of the National Electrical Manufacturers Association in Rosslyn, VA, told *Microwave News* that he favors continued research at the cellular level to understand mechanisms of interaction.

A number of utility representatives and consultants are arguing that, while research should continue, the effort should wait until its past achievements and future goals are evaluated. Ruth Greey, EMF issues manager at Ontario Hydro in Toronto, Canada, told the NIEHS at its Washington hearing on September 28 that she favored a "short hiatus" while public health research priorities are sorted out. Greey also noted that such a break would allow for the completion of some ongoing research projects—for instance, the Canadian and U.K. childhood cancer studies (see p.18).

Dr. Jack Sahl, a consultant based in Pasadena, CA, formerly with Southern California Edison, holds a position very similar to Greey's. He has told the NIEHS that, "Prior to deciding whether to fund new, or expand existing programs, we need to understand the goals and expected products of these programs."

Others countered that any break in funding would force researchers to move to new areas of research. This would mean that the whole field would lose years of expertise and talent, they argued. "It is a mistake to try to reassemble the program later," said Dr. Raymond Neutra, the head of the California EMF program, at the Tucson public meeting.

Last year, the *New England Journal of Medicine* called for an end to EMF studies: "It is time to stop wasting our research resources," argued Deputy Editor Dr. Edward Campion (see *MWN*, J/A97, also N/D96).

Among the institutions that have been supported by the DOE EMF research program are: government labs (Battelle PNL, Lawrence Berkeley and Oak Ridge), government agencies (EPA, National Institute for Standards and Technology and Veterans Administration), universities (Columbia, MIT, Stanford and the University of California) and an independent lab (Midwest Research Institute).

Analysis of Second Utility Worker Data Set Already Begun In Second Test of EMF–Heart Rhythm Hypothesis

Dr. David Savitz's epidemiological study linking EMFs and heart disease is still months from publication—but the first follow-up study is already under way.

"It's incredibly important to follow up and to answer the questions that have been raised," said Michael Herz of Pacific Gas & Electric (PG&E) in San Francisco. Herz told *Microwave News* that the utility is sponsoring the new study "based on PG&E's policy of educating its employees about the health issues of EMFs." The new study is a joint initiative of PG&E, Southern California Edison (SCE) and the Electric Power Research Institute (EPRI).

"We need to do this as quickly as possible," said Dr. Jack Sahl, adding that he has already started analyzing an existing data set on 40,000 SCE workers. These data were originally collected by Sahl, a former SCE employee, in a study of cancer and EMF exposure in the utility's workforce (see *MWN*, M/A93). Now a consultant based in Pasadena, CA, Sahl will investigate whether the SCE data show the same patterns of cardiac mortality found by Savitz.

In a paper that began circulating this summer, Savitz and Dr. Antonio Sastre describe an increased risk of two types of heart disease among 140,000 utility workers—an increase that Sastre had predicted, based on laboratory studies of reductions in heart-rate variability (HRV) and EMF exposure (see *MWN*, J/A98). The study will be published in the January 15, 1999, issue of the *American Journal of Epidemiology*.

HRV is a measure of the constant, natural variations in heart rhythm that result from the interplay of several reflexes controlling the heart—not the more dramatic changes that result from exercise or anxiety. HRV is increasingly used by cardiologists as a diagnostic tool, and several studies have found that it can predict the risk of certain heart conditions.

The reductions in HRV that Sastre and Dr. Charles Graham, both of the Midwest Research Institute (MRI) in Kansas City, MO, observed in their EMF studies led them to believe that EMFs might increase the risk of two kinds of heart disease associated with poor control of cardiac reflexes. This is exactly what was found when Savitz, of the University of North Carolina, Chapel Hill, tested the hypothesis against data from his earlier study of workers at five electric utilities—including PG&E (see *MWN*, J/F95).

The few studies on EMFs and cardiovascular risk have lumped together all types of heart disease, and most have not pointed to any increase. One exception, however, emerged from Sahl's own SCE worker study. In a subsequent analysis of overall mortality, published in 1997, Sahl compared cardiovascular mortality among SCE's office staff to that of field workers, such as linemen or meter readers. He found significant increases among nonmanagement field personnel, ranging from 42% to 71%—increases which their paper notes, but does not discuss.

"When I was doing the original analysis, I thought this would likely be due to lifestyle factors," Sahl explained in an interview. He pointed out that smoking, diet, alcohol consumption and other

lifestyle factors can all increase the risk of heart disease. "But now," said Sahl, "in light of the Savitz results, we should take another look." In fact, he added, "I suspect that we will support the Sastre hypothesis."

Sahl also found that SCE employees had a lower rate of death from cardiovascular disease than did the population as a whole, which he cited as an example of the "healthy worker effect"—the fact that people in poor health are less likely to be employed.

Sahl expects to have results from his cardiac analysis by the end of next June. He said he will try to replicate the approach of the Savitz heart study "as much as possible." Sahl added that the SCE data set includes some additional information: measurements collected with EMDEX II personal exposure meters; data on heart disease incidence, not just mortality; and more information on potential confounders.

"It is an important project," said EPRI's Dr. Robert Kavet, a coauthor of the Savitz heart study. He commented that Sahl's study is "an opportunity to look at a cohort with quality data."

"You shouldn't look only at magnetic fields," Kavet cautioned. "You have to understand the entire worker experience." He cited shift work, stress, contact currents and possible chemical exposures as some of the other factors that must be considered. Kavet also noted that Sastre's latest lab studies of HRV and EMF exposure, supported by EPRI, are not consistent with his original findings.

In experiments conducted at the MRI in 1997 and 1998, HRV seemed unaffected by EMF exposure. "The results were so unbelievably negative," Sastre told *Microwave News*. "We didn't see a thing."

Sastre explained that he was not surprised when continuous EMFs, at both 200 mG and 900 mG, showed no effect in the latest studies: This had been true for continuous exposures in earlier experiments, carried out between 1993 and 1995. But in a 1997 study conducted for EPRI (*Effects of Magnetic Fields on Cardiac Control Mechanisms*, TR-108251, November 1997), there was also no effect from intermittent exposures of 200 mG. In contrast, Sastre stated, in previous experiments at the same exposure, "We had good statistical power and the effect was very clear-cut."

Sastre noted that the EMF–HRV association was originally observed in experiments on EMFs and melatonin in which blood was drawn from subjects every hour overnight. Although blood was taken using a catheter, subjects' sleep was somewhat disturbed by the procedure. This slight arousal might interact with the effects of EMFs, Sastre's report to EPRI suggests. He said that an experiment now under way in his lab may shed some light on this.

Sastre also noted that some people might be more sensitive to EMFs than others, and that the number of subjects in each experiment was small. Finally, he said, the more recent experiments were conducted in a different facility, in which the earth's static magnetic field is somewhat different.

"I am troubled," said Sastre. "Obviously there are things about

this we don't understand." But at present, he said, "I still think it is a real effect—but we have not defined all the [necessary] conditions to make it evident."

Research on HRV and EMFs "should definitely be pursued," Dr. Raymond Neutra, head of the California EMF program, told *Microwave News*. "We continue to support future research," said PG&E's Herz, adding that, "I would also want to look at electric fields and contact currents in future studies."

Bank Refuses Mortgage, Citing Utility Substation Next Door

A New York bank has turned down a home owner's mortgage application after concerns were raised about EMFs from an electrical substation next door. The substation is operated by the New York utility Consolidated Edison.

"The bank wanted some documentation from Con Ed that the substation is not a health hazard or grounds for concern," home owner Susan Archer of White Plains, NY, said in an interview. A conference call was held around the beginning of July, "with me, the bank and Con Ed all on the line," Archer said. "Con Ed told us that the site had been tested for PCBs and that the levels are insignificant." In a move she may now regret, Archer asked whether Con Ed had measured EMFs at the site. In response, she stated, "Con Ed said they'd have to get back to us."

In mid-July, a Bank of New York (BONY) loan coordinator wrote to Archer, rejecting her request for an \$80,000 mortgage on the grounds that the house was insufficient collateral. BONY's appraiser's report warned that the substation might cause Archer's property "to suffer from environmental conditions." According to Archer, no other environmental factors besides EMFs and PCBs were ever mentioned.

"It doesn't add up," Archer contended. She inherited the house from her parents, owns the property free and clear—and said it was appraised at \$175,000. She said a BONY representative told her "that it was devalued by \$50,000 because it was next to the substation."

Michelle Zachensky, a vice president at BONY in Harrison, NY, told *Microwave News* that she could not discuss a specific loan application. But, she added, "We don't have a policy that if you're near a substation or the EMFs are higher, that we wouldn't grant a loan. I don't even know how we'd know about EMFs, anyway—we don't test for that."

After BONY refused Archer's request for a mortgage, Con Ed agreed to do an EMF survey at the substation. "They said that you can submit this report to BONY to show the bank that there's no problem," Archer explained.

"We did the survey as a courtesy to Ms. Archer," Con Ed spokesperson Michael Spall said in an interview. "We realized she was in a difficult spot." The survey was performed on August 7, but Con Ed did not send Archer a copy until mid-September, after it had been reviewed by Con Ed's legal department. Asked about the delay, Spall responded, "Obviously, there are legal and financial issues here, in terms of her home having its price reduced by her lending institution."

Con Ed's caution may have been increased by the media attention that Archer's case received. The August 7 EMF survey was filmed by CNN, and according to Archer, "When Con Ed saw that CNN was there, we had to wait another two hours for its PR person to get out there." The network ran a story about Archer on September 8.

Con Ed's survey states that 60 Hz EMFs at the border with Archer's property go no higher than 1.3 mG. Measurements at the edge of the substation building, which Archer says is eight feet from the border with her property, range up to 22.8 mG.

Archer's father, who had lived in the house since the 1950s, died of leukemia in 1994. "Until now, I had never thought about the health question," she told *Microwave News*.

EPRI Weighs Initiative on Neurodegenerative Disease

The Electric Power Research Institute (EPRI) may soon sponsor research on the possible link between EMFs and neurodegenerative disease. To that end, the institute hosted a workshop in Pajaro Dunes, CA, a beach resort near Monterey, July 30-31.

"We came to learn," said Dr. Robert Kavet of EPRI in Palo Alto, CA. "While we didn't become experts overnight, it helped us understand some of what it will take to design studies in this area." Kavet called the session "a cross-pollination experience." He told *Microwave News* that the meeting had helped EPRI establish relationships with some of the leading researchers on neurodegenerative disease.

"It was a good start," said Dr. Stanley Appel, a neurologist known for his studies of amyotrophic lateral sclerosis (ALS) and Alzheimer's disease. "Obviously, the next step is to plan specific research aimed at understanding mechanisms," added Appel, who heads the neurology department at the Baylor College of Medicine in Houston.

Appel explained that this would be easiest to do in the case of electric shock, since it is already known that electric shock can cause tissue damage and inflammation of the central nervous system (CNS). With other types of EMF exposures, Appel said, "There could be some definite CNS effects, but it's harder to translate existing data into mechanisms. There's still a lot of conjecture." Still, he said, both types of exposure should be studied.

A higher rate of ALS was found in a study of Danish utility workers, published this summer, but the researchers could not say whether shocks or other EMF exposures were the more likely cause (see *MWN*, J/A98).

Dr. Eugene Sobel, an epidemiologist who has studied EMFs, Alzheimer's disease and ALS (see *MWN*, J/F97), said he expects that EPRI's initial emphasis would not be on large epidemiological studies, but rather on laboratory and animal research. "This might include studies of amyloid beta or melatonin production in people exposed to EMFs at work," stated Sobel, of the University of Southern California in Los Angeles.

Kavet said that EPRI is still evaluating its approach to research on neurodegenerative disease.

New Epidemiology on Breast Cancer, Melatonin Hypothesis

The melatonin hypothesis on breast cancer, EMFs and light-at-night is one of the few well-defined mechanisms through which EMF exposure might act to increase cancer risks. Various studies have shown that melatonin has anticancer effects, and that melatonin levels can be reduced by exposure to light-at-night or to EMFs (see, for example, *MWN*, M/A97 and N/D97). Three new epidemiological studies add to the data on the melatonin hypothesis; of these, two lend support and one does not.

EMFs at Home and at Work

Looking only at residential or occupational histories may underestimate a person's total exposure to EMFs. Last year, Dr. Maria Feychting, Ulla Forssén and Dr. Birgitta Floderus, all of the Karolinska Institute in Stockholm, Sweden, showed that risk ratios for adult leukemia are higher when both sources of exposure are included (see *MWN*, J/A97). Now these researchers, together with Karolinska's Dr. Anders Ahlbom, have applied the same approach to female breast cancer.

In an earlier study of breast cancer and residential exposure alone (see *MWN*, N/D97), Feychting and colleagues had found that exposures above 1 mG led to a sevenfold increase in risk for women under 50 whose breast cancer was estrogen-receptor-positive (ER+). But EMF exposure did not increase risk among women of all ages, and the association for women who were younger and ER+ was of borderline significance—at least partly due to the small number of cases.

The current study looked at these data together with information on occupational exposures. Once again, there was no overall increase in breast cancer risk. "However," the Swedish researchers state, "there was a tendency toward an association for women under age 50," as well as for those with ER+ tumors. Women under 50 with higher exposures to EMFs both at home and on the job had over four times the risk of others, while ER+ women showed about a doubling of risk.

Estrogen stimulates the growth of tumors that are ER+. Since a reduction in melatonin results in increased levels of estrogen, the melatonin hypothesis suggests that EMF exposure might increase risk of ER+ breast cancer.

Speaking in mid-September at the U.S. Department of Energy's annual EMF research review in Tucson, AZ, Forssén cautioned that these associations could be a result of random variation. None of the increased risks she reported is statistically significant, due at least in part to the small number of cases. EMF exposure also appeared to show a protective effect for breast cancer among women over 50, or whose disease is not ER+.

Forssén told *Microwave News* that the Karolinska team plans to continue this line of research by looking at a group of women with high occupational EMF exposures, possibly sewing machine operators, in conjunction with information on the ER status of the breast cancer cases.

Dr. Tore Tynes of the Norwegian Radiation Protection Authority in Oslo called Forssén's findings "interesting," but hard to interpret because of the small numbers involved. "We have to sort out whether this is a large problem or not," said Tynes in an interview. "We need some large studies."

Water Beds, Electric Blankets and EMFs

Dr. Marilie Gammon of the Columbia University School of Public Health in New York City and colleagues examined the use of electric blankets, heating pads and water beds, and found no association with the risk of breast cancer. The study did not distinguish between the three different devices.

"We found little or no increase in risk [associated] with having ever used these devices, with continuous use during the night or with increasing duration of use," Gammon and colleagues report in the September 15 *American Journal of Epidemiology* (148, pp.556-563, 1998). They state that their work "does not support" the hypothesis that EMFs might be especially likely to increase risk for women who develop ER+ breast cancer.

Gammon's study drew on a few questions included in a larger study of breast cancer among younger women—the Women's Interview Study of Health. Interviews were conducted with 2,199 cases and 2,009 controls in metropolitan Atlanta, central New Jersey and the Seattle area.

"It is not possible to draw sound conclusions about breast cancer and electric bed heaters from this study," commented Dr. Nancy Wertheimer of Boulder, CO, "since it does not specify the type of heater or when it was used." She pointed out that EMF exposures from water beds can vary widely, depending on placement of the heater.

Since the study's interviews did not separate the use of water beds from the use of electric blankets, Gammon told *Microwave News*, her team tried to find data on patterns of use in the geographic areas where the study was conducted. Unfortunately, she said, no such data were available. But, she added, based on anecdotal reports in all three areas, "Our general feeling is that it's mostly electric blankets." Gammon said that she looks forward to seeing results from three ongoing EMF-breast cancer studies with measured field levels, by Drs. Scott Davis, Cristina Leske and Stephanie London (see *MWN*, S/O96 and N/D97).

Cancer Rates Among the Blind

Light-at-night can reduce melatonin levels in humans—with some exceptions. In most people who are totally blind, light does not affect melatonin production, and it has been hypothesized that blind people may have lower rates of cancer as a result.

A new study by Karolinska's Dr. Maria Feychting found a cancer rate among totally blind people that was about 30% lower than that in the Swedish population as a whole. The difference is statistically significant, and Feychting concludes that this "support[s] the hypothesis of a protective effect of melatonin on cancer development." The study appears in the September issue of *Epidemiology* (9, pp.490-494, 1998).

Feychting and Dr. Anders Ahlbom identified a cohort of 1,567 people who were completely blind and 13,292 people with severe visual impairment. The incidence of cancer among the completely blind was only 69% of that for the entire Swedish population. Among those not blind but visually impaired, there was a slight 5% reduction, which was marginally significant.

It has been suggested that a reduction in melatonin may specifically "increase susceptibility to sex hormone-related cancers"

such as breast cancer. But Feychting and Ahlbom found that, "Results for prostate cancer and female breast cancer were similar to the results for all cancers combined."

In an accompanying editorial, Dr. Robert Hahn of the Centers for Disease Control in Atlanta points to this finding and argues that if melatonin does reduce the risk of breast cancer, it does not or does not only do so by affecting sex hormones. A 1991 study by Hahn pointed to a lower rate of cancer among blind women in the U.S. (see *MWN*, S/O91). Feychting and Ahlbom write that their findings "suggest a mechanism by which

melatonin has an effect on cancer in general, such as...[being] an antioxidant and a free-radical scavenger."

Feychting points out that a weakness of her study is the lack of information on potential confounders, such as smoking. But results were similar for cancers that can be related to smoking versus cancers that are not related to smoking. And she points out that, "Several of the potential confounding factors would act in the opposite direction to the hypothesized effect of melatonin"—if, for example, blind women are less likely to have children, or do so at a later age.

HIGHLIGHTS

« Wireless Notes »

It is no longer too early for an epidemiological study to determine whether mobile phone use increases the risk of brain cancer. That is the conclusion reached at a meeting of scientists at the headquarters of the **International Agency for Research on Cancer** (IARC) in Lyon, France, September 1-2. Scientists from ten countries evaluated the results of preliminary surveys in Australia, Canada, France, Germany, Israel, Italy, New Zealand, Sweden and the U.K. and concluded that a sufficient number of people have used wireless phones for enough time to allow the detection of a possible effect on cancer risk—even a small one. "We had to be sure there were enough users five or more years ago," said Dr. **Elisabeth Cardis**, who heads IARC's radiation and cancer unit. An effect on cancer risk "would probably not be detectable in less than about five years from first use," she explained. The preliminary studies found that approximately 2% of adults in the nine countries were using mobile phones in 1992. Work will now begin on a detailed design for a large-scale, multi-country study, which is expected to include more than 3,000 people with brain tumors and a similar number of controls. Estimating users' past exposures to radiation emitted by their phones will be a central problem of the study, according to the IARC researchers. Participating scientists will seek funding from local, national and international sources. IARC anticipates that the study could begin as early as late 1999, with results expected in 2003 or 2004. "We presently have no evidence that mobile phone use is linked to brain tumors," said Dr. **Bruce Armstrong**, who chaired the September meeting, adding that, "If it is, the risk for an individual user is likely to be very small." Armstrong is director of the Cancer Control Information Center in Sydney, Australia.

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A recent visitor to **China** told us, "Everyone there is using a cell phone!" Well, maybe not everyone—but among the middle and upper classes in large Chinese cities, cellular phones are wildly popular. But some Chinese consumers are apparently concerned about possible health effects: A widely available device for "hands-free" use of mobile phones is being marketed with an anti-radiation pitch. The **Walkera** earphone/microphone combination promises that its use will "Protect Your Brain," "Guarantee Safer Driving" and "Prevent Radiation." Consumers are informed that, "Walkera eliminates the hazard of microwave ra-

diation, and provides you with clear sound and supreme convenience."

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The **Australian** government is sponsoring a major study on cellular phone radiation and cancer, following up on Dr. **Michael Repacholi's** finding of a doubling of lymphoma among GSM-exposed mice (see *MWN*, M/J97). "While the jury is still out on [mobile phones'] effects, this issue deserves money and resources, and we have committed both," said Trish Worth, a member of Parliament from Adelaide and Parliamentary Secretary for Australia's health ministry. The Aus\$1 million grant (approximately US\$615,000) is the largest so far in the government's Aus\$4.5 million RF/MW health research program, which was launched in 1996 (see *MWN*, N/D96). Three previous awards, totaling Aus\$215,000, were announced over the summer (see *MWN*, J/A98). There had been rumors that **Motorola** might fund its own replication of Repacholi's research, but spokesperson Norman Sandler told *Microwave News* that this is not the case. He said that Motorola will give the Australian team some technical assistance in the design of its exposure system, and may also donate some equipment. The research will be carried out at the **Institute of Medical and Veterinary Science** in Adelaide, where Repacholi did his original study, and will be led by the institute's director, Dr. **Barrie Vernon-Roberts**. Vernon-Roberts told Australia's *The Age* (September 10) that the study will provide a "definitive" answer to the question, "Can mobile phone-type radiation cause cancer in animal systems?" Results are expected by 2001.

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Dr. **George Carlo's** consulting firm, Health & Environmental Sciences Group Ltd. in Washington, has announced the appointment of **Thorne Auchter** as its chief operating officer. Auchter was head of the Occupational Safety and Health Administration during President Ronald Reagan's first term (1981-1984). In addition, **Jeffrey Nesbit** has joined the firm as the director of public policy. Nesbit was an associate commissioner for public affairs at the FDA and communications director for former Vice President Dan Quayle. The Health & Environmental Sciences Group states that it "specializes in assessing, communicating and managing risks to public health."

FCC Brokers Agreement on Cell Tower Moratoriums

Wireless industry representatives have agreed with state and local officials on voluntary guidelines for moratoriums on cellular phone towers and on an informal process for mediating disputes. The guidelines recognize moratoriums as appropriate policies for towns, a shift from industry calls for the Federal Communications Commission (FCC) to preempt all such delays.

The agreement is the most significant result to date of the FCC's effort to defuse the conflict over wireless antenna siting without invoking its preemption powers. In an August 5 press release, the FCC hailed the pact as "historic."

Nevertheless, some federal lawmakers are still pressing to shift siting authority from the federal government back to states and towns. On September 24, Sen. Patrick Leahy (D-VT) and nine cosponsors introduced S.2514, an updated version of Leahy's bill to repeal the 1996 Telecommunications Act's federal preemption clause (see *MWN*, N/D97). The earlier measure stalled in committee after its introduction last fall.

"The FCC rules should not stand," Leahy demanded in the Senate, arguing that, "To deprive states of the ability to protect their land from unsightly towers is wrong."

The pressure for legislation reflects the fact that local officials still face numerous restrictions in developing siting rules. For example, the Telecom Act prohibits communities from setting stricter limits for public exposure to RF/MW radiation from wireless antennas than those issued by the FCC (see *MWN*, M/A96 and S/O97). Wireless carriers have often invoked this provision when challenging siting decisions in court.

The new guidelines state that a moratorium may be adopted "when a local government needs time" to revise its zoning ordinance. Stoppages should be of fixed length. Ordinarily, a community will not need more than 180 days to write new zoning rules, but "all parties understand" that the process may take longer.

Whether a moratorium is in effect or not, wireless companies and local officials "should work cooperatively" to facilitate antenna siting, the guidelines state. Carriers are expected to provide "appropriate, relevant and nonproprietary information" to local officials, who are also encouraged to include public input.

Kenneth Fellman, who chairs the FCC's Local and State Government Advisory Committee (LSGAC), said that dealing with moratoriums "on a case-by-case basis" rather than through "broad national preemption" was a main goal of local officials. "This agreement achieves that goal," added Fellman, an attorney and member of the Arvada, CO, city council. Fellman drafted the agreement with representatives of the Cellular Telecommunications Industry Association (CTIA) and other industry groups.

The CTIA's Thomas Wheeler described the pact as a commitment to "give peace a chance." As part of the agreement, the CTIA is withdrawing its December 1996 petition asking the FCC to preempt all local moratoriums on new tower sites (see *MWN*, S/O97). Wheeler warned, however, that if moratoriums continue to delay the expansion of wireless networks, his organization "will not hesitate to revisit the issue with the commission."

In August 1997, the FCC asked for advice on how to deal

Bad Vibes in High Places?

Concern about EMF health effects may have reached 10 Downing Street, the London home of Prime Minister Tony Blair and his wife, Cherie. According to British press reports, Ms. Blair has been wearing a "bioelectric shield."

Ms. Blair, an attorney, was photographed wearing a pendant at the London premiere of the musical *Dr. Dolittle*. David Chambers of Swindon, Wiltshire, told the *Daily Telegraph* (July 20) that he is "convinced" the necklace in the photo is one of the shields his company imports from the U.S. for protection from harmful electromagnetic energy. Blair's office refused to comment, according to the *Telegraph*.

Hillary Rodham Clinton is said to have recommended the shield to Ms. Blair, the *Telegraph* reported. Charles Brown of Lavina, MT, whose BioElectric Shield and Comfort Products Co. makes the shields, told *Microwave News* he could "neither confirm nor deny" that Ms. Clinton has one. "I have to respect the patient's privacy," he said.

The shields range in price from \$140 in silver and brass to \$1,000 in gold. The company's web site states that they utilize "a specific configuration of quartz and other crystals" which "deflects electromagnetic energy." (For further details, visit: <<http://bioelectric-shield.com>>.) The market for personal EMF protection products is thriving: More than 23,000 shields have been sold, according to Brown.

Some British journalists regard Blair's new accessory with skepticism bordering on derision. The *Sunday Times* (July 19), for example, snickered that Blair may be seeking protection from "harmful rays from computers, fluorescent lighting—and, perhaps, even her husband."

Taking a more psychological view, the *Birmingham Post* (July 21) suggested that Blair's choice of jewelry expressed "a sinking paranoia" brought on by "living in an electronic age," adding: "Will we discover that microwaves can turn our brains into raisins?"

And Dr. Robert Park of the American Physical Society in Washington commented that, "Neither Cherie nor Hillary has been harmed by EMFs while wearing the pendant."

with moratoriums, especially those with no specific time limit (see *MWN*, S/O97). In an interview in the September 21 issue of the trade magazine *RCR*, FCC Chairman William Kennard argued that preemption "should be a last resort" (see *MWN*, M/A98).

The LSGAC and the wireless industry also worked out an informal process for settling disputes concerning moratoriums. Wireless companies and local officials can ask the FCC to assign volunteer mediators to review delays. After hearing both sides, the two mediators—one each from industry and local government—will offer a solution to the contending parties, who may accept or reject it. All parties retain the right to take their grievances to court.

The LSGAC will continue to discuss contentious aspects of antenna siting with the wireless industry, Fellman told *Microwave News*. Areas that Fellman would like to explore include the Telecom Act's ban on local regulation of RF/MW radiation. But he noted that there are no further proposals on the table.

FDA Cautions Physicians on EMI from Anti-Theft Systems

The Food and Drug Administration (FDA) has issued an advisory to physicians on electromagnetic interference (EMI) from anti-theft systems and metal detectors to implanted pacemakers, defibrillators and spinal cord stimulators.

"The number of reported significant patient injuries is very low," the September 28 letter emphasizes. Still, "to be on the safe side," the FDA's Center for Devices and Radiological Health (CDRH) suggests the following "simple precautions" for people with implanted medical devices:

- Do not stay near the system longer than necessary, and do not lean against it.
- Ask security personnel not to hold hand-held metal detectors near implanted devices.
- Be aware that anti-theft systems at store entrances may be hidden or not obviously visible.

"We do not think that we have a major public health problem at this time," said Dr. Elizabeth Jacobson, CDRH's deputy director for science, "but we would like it to stay that way." Jacobson pointed out that implanted devices are becoming more common, and that the use of "more and more sophisticated microcircuitry" makes them more vulnerable to interference. She spoke at a September 24 meeting of FDA's Technical Electronic Product Radiation Safety Standards Committee (TEPRSSC) in

Magnetic Field Therapy Not the Greatest, Ali Decides

Boxing legend Muhammad Ali tried magnetic field therapy this summer, but soon quit in disgust.

Ali, who has Parkinson's disease, was treated at Dr. Jerry Jacobson's clinic in Boca Raton, FL. Jacobson's "resonance" therapy uses very weak magnetic fields—in the nanogauss range—at frequencies ranging from below 1 Hz to 100 Hz.

In an interview, Jacobson, formerly a dentist, conceded that the fields are well below background levels, but said he has identified frequencies that can trigger a desired response.

Ali tried the therapy at Jacobson's invitation, according to Ali's spokesperson, Jill Siegel. She told *Microwave News* that Ali was annoyed when Jacobson told the press that the former champion was at the clinic. Ali now has "zero interest" in pursuing the therapy, Siegel said.

In an August 6 press release, Jacobson said he was "disappointed" that Ali did not stay "long enough for the treatment effects to hold." But Siegel said that Ali and his wife, Lonnie, "saw no signs of improvement" from the therapy.

Investors have been eager to support Jacobson. Last March, a private placement of restricted shares in his company, Pioneer Services International, was increased to \$670,700 after the initial offering of \$450,000 was oversubscribed, a company press release announced. (In July, the company was renamed Jacobson Resonance Enterprises.)

Jacobson is also using EMFs to treat chronic pain from osteoarthritis, as well as epilepsy and migraines.

Gaithersburg, MD.

At the TEPRSSC meeting, Dr. Michael McIvor of the Heart Institute of St. Petersburg in Florida reported that acoustomagnetic anti-theft systems caused EMI among 48 of 50 volunteers with implanted pacemakers. He found that swept RF devices produced no interactions. There was no EMI to defibrillators.

The FDA considers McIvor's study to be "the single most comprehensive study on the issue," said Mitchell Shein of the CDRH. McIvor's findings appear in the October issue of *PACE* (21, pp.1,847-1,861, 1998). He first presented them at a conference last year (see *MWN*, S/O97).

McIvor's findings are "of no consequence whatsoever," Dr. Warren Harthorne of Massachusetts General Hospital in Boston told TEPRSSC. "In over 30 years of experience of treating thousands of pacemaker recipients," Harthorne said, "I am not aware of any patient who has been harmed or injured by [anti-theft] devices." In an editorial in the same issue of *PACE*, Harthorne argues that three of the four types of EMI observed by McIvor are "of no clinical relevance." The fourth, in which a pacemaker fails to fire, could cause some symptoms—but only "if the patient lingered long enough in the field."

Serious symptoms are rare, McIvor said, but not impossible. He described a 28-year-old man who passed out in an anti-theft system's gates: "When he fell down, he fell out of the magnetic field, so he woke up. He stood up. He passed out. He stood up. He passed out—until a nurse came by and dragged him out."

McIvor points to acoustomagnetic anti-theft systems as the source of most serious EMI and calls for posting warning signs. But Harthorne argues that, "If you start placing signs in stores, you're going to have a rash of hysterical patients who will then have symptoms that they never would have had otherwise."

"Whose responsibility is it to get the message out to patients?" asked TEPRSSC's Dr. Victoria Marx of the University of Michigan, Ann Arbor. Dr. Victor Parsonnet of Newark Beth Israel Medical Center in New Jersey answered that he would not bring up anti-theft systems with his patients, and, if asked, would tell them simply not to worry about it. "You don't want to alarm them," he explained. Parsonnet and Harthorne are both consultants to Sensormatic, a leading maker of security systems.

"We were never intending to send this advisory directly to patients—it would only scare them," FDA's Jacobson told *Microwave News*. She stressed that it was addressed to physicians "to make sure that the appropriate information is out there."

Jim Putzke of the Health Industry Manufacturers Association said that the most common neurostimulators today are spinal-cord stimulators that control pain. But, he added, devices are now being used to treat Parkinson's disease, tremors, urinary incontinence and more. "Almost everything that you can possibly imagine" is being experimented with, he said.

CDRH's Jon Casamento said that the FDA had received several reports of EMI from security systems to spinal-cord stimulators: "Most of these interactions were very painful, and patients even reported being jolted or thrown to the floor." Jacobson said that the FDA does not know of any ongoing studies of EMI with spinal-cord stimulators.

The FDA's advisory can be found on the Internet at: <www.fda.gov/cdrh/safety/easnote.html>.

according to Cardinal and others.

David Bell of the manufacturers' group Electro-Federation Canada in Toronto said, "I think Health Canada is now somewhat uncomfortable with this eye standard—not because there's no scientific data whatsoever that support it, but because the department was not aware of the extreme economic impact it would have." In an interview, Bell said that Health Canada would now have to decide "whether they'll dig in their heels, or back off and say they were wrong." He warned that overly strict regulations "could shut off the flow of technology to Canada, technology which is perfectly acceptable to Europe and the U.S."

The question of ocular effects from RF/MW radiation has been little-studied. While several labs have worked on the problem, the scientific work most often cited in support of an eye exposure limit is a series of studies conducted by Henry Kues of Johns Hopkins University in Laurel, MD (see box below).

The wireless industry contends that Kues's work cannot serve as the basis for a standard for eye exposure. Bell called Kues's results "interesting," but argued that they "do not represent a scientific consensus."

Health Canada's Thansandote said his agency is undertaking its own research on RF/MW effects on the eyes, in association with the Eye Institute of the University of Ottawa. But, he said, results will not be available before March. That is also when the revision of Safety Code 6 and a Royal Society of Canada report on RF/MW safety are to be released. The latter is being prepared at Health Canada's request (see p.11).

Even if Health Canada applies the eye limit to cellular phones, it will probably not require that they be tested to show compliance. The mandatory regulations for cellular phone manufacturers are drawn up by another government agency, Industry Canada, which will likely require proof of compliance with the eye limit

Kues's RF/MW Eye Experiments at Center of Canadian Controversy

Canada's proposed limit for eye exposure is largely due to a series of experiments by Henry Kues of Johns Hopkins University's Applied Physics Lab in Laurel, MD.

Kues's work has been conducted over a period of 15 years—but the wireless industry is unimpressed. "The eye limit is based on a study that has never been reproduced, even though there have been attempts to do so," asserted Dr. Paul Cardinal of April Labs, expressing a common industry view. But Kues says that a real replication of his experiments has never been attempted.

Kues has repeatedly observed damage to the corneas of monkeys after exposure to RF/MW radiation (see *MWN*, J/A83, S/O86, J/A87, J/A88 and S/O91). He found that pulsed signals showed the strongest effects, causing changes in the eyes at exposure levels as low as 2.6 W/Kg. When pulsed radiation was used in conjunction with anti-glaucoma drugs, the effect was magnified, with changes observed at specific absorption rates (SARs) down to 0.26 W/Kg. Kues also observed some effects from continuous wave (CW) signals, but only at higher SARs—a minimum of 5.3 W/Kg.

Only one published study has been cited as an attempted replication of Kues's work. In a paper in *IEICE Transactions on Communications* (E77-B, pp.762-765, 1994), Dr. Yoshitsugu Kamimura of Utsunomiya University in Japan reported no changes in the eyes of five RF/MW-exposed monkeys. But each monkey in Kamimura's study was exposed only once, while Kues used repeated exposures. Moreover, Kamimura used only CW radiation. Kamimura himself noted these differences and wrote that studies with pulsed radiation and repeated exposures are essential to an evaluation of Kues's work.

Also cited as a failed replication of Kues's experiments is a study by Dr. Shin-tsu Lu and colleagues at the Armstrong Lab at Brooks Air Force Base in San Antonio, which was presented in June at the *20th Annual Meeting of the Bioelectromagnetics Society* in St. Pete Beach, FL.

Lu found no structural damage to the retinas of monkeys due to exposure to high peak power microwaves at average retinal SARs of 4-20 W/Kg. While he observed some functional changes that may be an early indicator of mild injury, Lu stated that the Armstrong Lab data suggest that these are probably reversible.

"In all fairness," said Kues, "I don't think it's a true replication." He noted differences in the two groups' diagnostic protocols: "I don't think they've done electron microscopy, which is where we saw most of the changes."

More important, Kues said, the pulse waveform used in his experiments was "totally different" from that which Lu's group employed. He explained that Lu used a "soft-pulse radar," as opposed to the "very sharp, almost square, waveform" with which Kues observed robust effects.

"It depends on your definition of replication," responded Lu. "We simply followed normal protocols—but yes, the pulse Kues used and what we used are different." As for the question of electron microscopy, Lu argued that this was not the only technique used by Kues, and that in his early experiments Kues had described changes that could be observed with an ordinary microscope.

Kues called interactions with anti-glaucoma drugs "one of the most important aspects of the whole issue." But despite the fact that this was where Kues found the strongest effects, there has never been any attempt to replicate this work. According to the U.S. Food and Drug Administration (FDA), over two million Americans use anti-glaucoma medication.

Kues said his work does not prove any hazard from cellular phones, noting that most use CW signals. Even digital systems do not use "the traditional pulsed signal with a 1,000-fold difference between average and peak power," he said. "It's hard to compare our experiments to cellular phone technology," he concluded.

The FDA has declared that it is important to study possible ocular effects of cellular phone radiation, and has urged the industry-sponsored group Wireless Technology Research (WTR) to do so (see *MWN*, M/A97). Yet neither WTR nor the FDA has funded any research along these lines. Neither have individual wireless companies, though Hewlett-Packard did fund a study by Kues on the effects of CW millimeter waves on the eyes (see *MWN*, M/A96 and M/J97).

Unfortunately, Kues said, there has been little interest "in funding basic research into RF/MW ocular effects." Kues will soon be closing his bioeffects lab due to lack of funding.

only for higher-power "push-to-talk" radios like walkie-talkies.

"Tests and computations were carried out by several manufacturers, including Ericsson, Motorola and Nokia, for several cellular and PCS models in normal operating mode," said Dr. Veena Rawat of Industry Canada's Spectrum Engineering Branch. "These showed that phones that met the general 1.6 W/Kg exposure limit were below the 0.2 W/Kg eye limit as well." Therefore, Rawat told *Microwave News*, Industry Canada will not require separate eye exposure tests for hand-held cellular phones.

"All three manufacturers reported that their eye-specific SAR tests came out at or below 0.1 W/Kg," confirmed Norman Sandler of Motorola, in Schaumburg, IL. He said that Motorola's tests used the phone in the normal position, next to the ear.

Walkie-talkies operate at a higher power than cellular phones and are often held directly in front of the face, with the antenna close to one eye. Industry Canada does plan to require that they be tested to prove compliance with the eye limit. Motorola, Ericsson and other companies oppose this, and Rawat said that discussions on this point are continuing.

"I would expect that some walkie-talkies will have trouble meeting the Canadian 0.2 W/Kg standard," commented Dr. Niels Kuster of the Laboratory for EMF and Microwave Electronics at the ETH in Zurich, Switzerland, an opinion shared by April Labs' Cardinal.

Electro-Federation Canada's Bell warned that companies selling on an international basis "can't afford to develop two versions of everything." He asserted that if walkie-talkies must prove compliance with the eye limit, "it would get rid of half of the push-to-talk radio in Canada."

Rawat took a different view, suggesting that Canadian rules could influence the marketplace in the United States: "In the U.S., there is no eye limit—but the folks building the radios are building them for the North American market. So they will have to find ways to show that they can meet the eye requirement."

The final revision of Industry Canada's regulations should be published in November, according to Rawat. If so, they would be completed before Health Canada's Safety Code 6, which is supposed to be the basis of the regulations. But Rawat does not see this as a problem, since Industry Canada has based its work on the most recent draft of the revised Safety Code 6. "We are working closely with Health Canada," she explained. "If there were any major changes being considered, we would know about it."

Bell said that the standard-setting discussions have been difficult. On the one hand, he said, Health Canada does not see economic issues as its responsibility; on the other, manufacturers are not medical experts. But he is optimistic about the final result. "Industry Canada has worked hard to build a bridge between us, and has been trying to come up with requirements that are reasonable," said Bell. "There are no bad guys here."

When Canada first adopted a limit for eye exposure, as part of Safety Code 6 in 1991, transmitters operating at less than 7 W were exempt from all exposure standards (see *MWN*, S/O87 and J/A91). The eye requirement therefore did not apply to walkie-talkies and cellular phones.

In the U.S., a similar 7 W exclusion was abandoned in 1996, when the Federal Communications Commission adopted its current RF/MW regulations (see *MWN*, J/A96).

Royal Society of Canada To Review RF/MW Health Risks

The Royal Society of Canada (RSC) in Toronto has established an expert panel to assess potential health risks from human exposure to RF/MW radiation. The panel's report, due in March, will focus on cellular phones and towers.

"We were convened at the request of Health Canada to look at the adequacy of Canada's RF/MW safety standard," said the panel's chair, Dr. Daniel Krewski of the University of Ottawa. Among the questions to be considered is whether the standard, known as Safety Code 6, should address "non-thermal effects," according to an August 4 RSC statement.

"When this report is issued, it will be the most comprehensive and credible overview of the scientific literature anywhere," Dr. William Leiss, chair of the RSC Committee on Expert Panels, told *Microwave News*.

"There's a lot of public concern about the new wireless technologies," Leiss noted. He pointed to controversies over cellular tower construction and commented, "People go to their government and ask, 'What can you tell me about this?'—and the answer is, virtually nothing."

Revision of Safety Code 6 began in 1993, according to Health Canada spokesperson Lynn Lesage. Asked why the RSC's evaluation was requested so late in the process, Lesage responded, "Given the concerns that have been raised in public lately, the department decided it would be beneficial to ask an independent group of experts to look at the issues."

"The only reason the government asked for this panel is that citizen activists lit enough matches between their toes," said Milt Bowling of Public Against Cellular Tower Emissions (PACT) in Vancouver, BC. Bowling said that PACT and other groups had pressed hard for an independent evaluation of RF/MW safety issues, and that no decisions should be made before the RSC report is completed.

David Bell of Electro-Federation Canada suggested that Health Canada had asked for the RSC report because "they have a hot potato on their hands." Bell told *Microwave News*, "They didn't realize at first that it was hot, and now they would like to hand it off to someone else."

Lesage said that the RSC panel's work and Health Canada's revision of Safety Code 6 will proceed in tandem—both will be released at about the same time. But, she added, "We're not going to hold back the release of the revised Safety Code 6 if the panel report is not ready." If the RSC report is delayed, Lesage said, it would be taken into account at a later time.

"We will make the March deadline," the RSC's Leiss declared. He stressed the panel's independence, noting that the government had not been consulted on its membership, and would not receive an advance copy of the report.

The panel members are: Dr. Craig Byus, University of California, Riverside; Dr. Barry Glickman, University of Victoria, BC; Dr. Daniel Krewski, University of Ottawa; Dr. Gregory Lotz, U.S. National Institute for Occupational Safety and Health, Cincinnati; Dr. Rosemonde Mandeville, Biophage Inc., Montreal; Mary McBride, British Columbia Cancer Agency, Vancouver; Dr. Frank Prato, University of Western Ontario, London; and Dr. Donald Weaver, Queen's University, Kingston, Ontario.

Hot New Papers

Michael Bracken et al., "Correlates of Residential Wiring Code Used in Studies of Health Effects of Residential Magnetic Fields," *American Journal of Epidemiology*, 148, pp.467-474, September 1, 1998.

"In a study carried out in southern Connecticut in 1988-1991...[w]omen who lived in very-high-current configuration wiring coded homes were more likely to be in manual jobs and their homes were older (built before 1949, odds ratio (OR)=73.24, 95% confidence interval (CI) 29.53-181.65) and had lower assessed value and higher traffic densities (highest density quartile, OR=3.99, 95% CI 1.17-13.62). Because some of these variables have themselves been associated with health outcomes, the possibility of confounding of the wiring code associations must be rigorously evaluated in future EMF research."

W.T. Kaune, M. Feychting, A. Ahlbom, R.M. Uhlich and D.A. Savitz, "Temporal Characteristics of Transmission Line Loadings in the Swedish Childhood Cancer Study," *Bioelectromagnetics*, 19, pp.354-365, 1998.

"Swedish transmission line load currents were not stable over long periods, so that contemporaneous load current (or a contemporary magnetic field measurement) was not a good surrogate for historical load current (or historical magnetic fields). The results provide a potential explanation for the failure of the Swedish study to find an association between leukemia and contemporaneous magnetic field levels measured many years after the etiologic period, and suggest that the inclusion of load-current data could significantly improve the quality of historical field calculations."

A.W. Preece, K.A. Wesnes and G.R. Iwi, "The Effect of a 50 Hz Magnetic Field on Cognitive Function in Humans," *International Journal of Radiation Biology*, 74, pp.463-470, 1998.

"This study has presented evidence for power frequency magnetic fields at less than recommended intervention levels [6 G vs. 16 G] as having some effect on cognitive function in humans. In particular, elements of short-term memory are adversely affected although there is no evidence or otherwise of a continuing effect. In contrast, there is no evidence of such effects from a static magnetic field of the same magnitude....It would be particularly interesting to repeat this study with different fields to look for evidence of a dose-response, perhaps concentrating on those functions that appeared to be affected."

Two Packs a Day vs. Three Packs a Day

S. Milham, "Carcinogenicity of Electromagnetic Fields," *European Journal of Oncology*, 3, pp.93-100, 1998.

"[T]he best explanation for the low risk ratios found in the EMF [epidemiological] studies is that the controls are exposed. In Table 14, I present the basic data of the Doll and Hill (1956)* British physicians smoking-lung cancer study. Notice that a high relative risk is achieved only when heavy smokers are compared to nonsmokers. Comparing heavy smokers to light or moderate smokers gives risks a lot like what we see in EMF studies. I submit that the EMF equivalent of nonsmokers does not exist in the industrialized world."

Adapted from Table 14—Relative Risk of Dying from Lung Cancer for British Male Physicians, by Smoking Category

Heavy Smokers vs....	Relative Risk
Nonsmokers	23.7
Light Smokers	3.5
Moderate Smokers	1.9

*R. Doll and A.B. Hill, "Lung Cancer and Other Causes of Death in Relation to Smoking: A Second Report on the Mortality of British Doctors," *British Medical Journal*, 2, pp.1,071-1,081, 1956.

Robert Malyapa et al., "DNA Damage in Rat Brain Cells After *In Vivo* Exposure to 2450 MHz Electromagnetic Radiation and Various Methods of Euthanasia," *Radiation Research*, 149, pp.637-645, June 1998.

"[T]he guillotine method of euthanasia is the most appropriate in studies relating to DNA damage. Furthermore, we did not confirm the observation that damage is produced in cells of the rat cerebral cortex or hippocampus after a 2-hour exposure to 2450 MHz CW microwaves or at 4 hours after the exposure."

FROM THE FIELD

Future Research Needs—EMF Epidemiology

At the close of the NIEHS' EMF Working Group meeting in Minneapolis in June, each of the four small groups was asked to draft an agenda for future research. These were to be considered for inclusion as an appendix to the Working Group's report. As it turned out, only the epidemiology small group (adult and childhood combined) completed this assignment, according to NIEHS' Dr. Christopher Portier, who coordinated the meeting and coedited the Working Group's report. The research agenda for EMF epidemiology, which is reprinted below, was written by Dr. Maria Feychting of the Karolinska Institute in Stockholm, Sweden, with the assistance of the other members of the epidemiology group. (For a list of members of this and the other small groups, see MWN, J/A98; see also p.2.)

Childhood Cancer

In considering future research, it is useful to assess the likely impact of additional studies on the assessment of the possible association between exposure to magnetic fields and the occurrence of childhood cancer. Results of the meta-analyses of magnetic field exposure and childhood cancer suggest that additional studies of designs similar to those already conducted will do little to affect the average result (meta-analysis) of the studies unless there are several thousand subjects in the

study. A study of this size is unlikely if not impossible. Therefore, innovative designs will be needed to provide useful information.

There are three areas in which this innovation might be particularly useful: (1) increasing the exposure gradient among subjects; (2) conducting more sophisticated analyses of existing data; and (3) improving the exposure assessment measurements.

Increasing the Exposure Gradient

One major limitation of the previous studies of magnetic field exposure and childhood cancer is the low prevalence of high exposure subjects. More information is needed about the risk associated with very high exposure levels, e.g., exposures at or above 0.4 or 0.5 μT (4-5 mG). There are currently at least three ongoing large studies of childhood leukemia and ELF EMFs (two in Canada and one in the U.K.). A new study is being planned in Italy and there are plans to expand the existing German study.¹ All of these use (or plan to use) long-term measurements of the magnetic fields in the children's homes. It is still unclear if the studies are large enough to include a sufficient number of highly exposed children to improve upon the scarcity of highly exposed subjects.

Until we see the results from at least the ongoing studies, a worthwhile design for a new study of childhood cancer and residential ELF EMF exposure would be a replication of the Nordic studies with mag-

netic fields calculated from historical data on transmission line loads and configurations.

Innovative designs in countries with larger populations, modeled after the Nordic studies, could also be developed to include more highly exposed subjects. Such designs could sample populations living in close proximity to high voltage transmission lines, where homes can have exposures as high as 3 or 4 μT (30-40 mG). At least one such pilot study is under way in the U.S., using a geographic information system (GIS) to identify the relevant cohort.

Conducting More Sophisticated Analyses of Existing Data

Analyses using dose-response models (both linear and nonlinear) for the analysis of measured exposure data may provide additional insights. They also may allow for comparisons across different exposure metrics by looking at comparable regression slope estimates.

Pooling existing data into a single analysis will increase the number of highly exposed subjects and may allow for consideration of complex dose-response models. There is one ongoing EU project that will pool data from all Nordic countries, the U.K., Germany, the NCI-CCG study and one of the Canadian studies.

Improving Exposure Assessment Methods

Childhood leukemia studies could also be improved by using area monitors which measure exposures based on biological interaction mechanisms. Such monitors would need to measure frequency ranges adjacent to ELF (VLF and static magnetic fields), high frequency transients and the detailed characteristics that can be computed by waveform capture.² In addition, exposure assessment methods to accurately characterize electric field exposure need to be developed. With such techniques, dose metrics based on biomechanism research can be measured with precision, enabling epidemiologic studies to test mechanistic hypotheses directly.

Few studies have evaluated the effect of exposure from sources other than power lines. With adequate estimates of ELF EMF exposures from appliances, such studies could provide valuable information. The ideal childhood study would combine EMF exposures from transmission lines, distribution lines, ground currents, and appliances, but that ideal would require several breakthroughs in exposure assessment methodology.

Adult Cancer

The exposure assessment methods have become more sophisticated over time, but work-shift measurements have primarily been made for electric utility workers, and only a few studies have made measurements of occupational exposures in the general population. The majority of measurements have been made for male workers, and there is a substantial need for better characterization of the exposures for female workers.

New studies of leukemia or brain tumors must improve the exposure assessment methods considerably to provide useful information, and should be designed as population-based studies with considerable efforts to keep nonparticipation rates low. One way to improve exposure assessment would be to use personal monitors with the capabilities (discussed above) to measure biologically relevant exposure metrics. Job exposure matrices can also be improved by incorporating location and source information along with job titles.³ In addition, residential and occupational exposures should both be assessed when possible.⁴ To study residential exposures alone does not seem worthwhile for adult cancers.

To date, few high-quality studies have examined cancers other than leukemia and nervous system tumors. With other cancers, priority should be given studies designed to test specific mechanistic hypotheses (e.g., a risk confined to estrogen-receptor-positive breast cancer, an increased risk for hormone dependent tumors, etc.). There are at least three ongoing large case-control studies of ELF EMF exposure and female breast

cancer. It is not clear yet if these studies will have a large enough number of young women and complete information about estrogen receptor status.

The improvement of the exposure assessment methods mentioned above is also important in new studies of other cancer end points, as well as using a population-based design with proper selection of controls. Considering the shortcomings in the exposure assessment methods used previously for female occupations, a few studies focusing on occupations known to entail high exposure levels (e.g., seamstresses) may be worthwhile.

Other Outcomes

Although evidence for many of the outcomes evaluated at the Working Group meeting was judged to be inadequate, some outcomes are of higher priority for future research due to the evidence to date.

Further research is warranted to replicate the recent observation by Savitz et al.⁵ of exposure-dependent excess risk in utility workers for sudden death due to arrhythmias and acute myocardial infarctions. The potential health implications of these findings need to be further examined using relevant ICD codes in other existing cohort studies with appropriate magnetic field exposure assessment (e.g., the Southern California Edison cohort⁶ and the Hydro-Québec component of the Canada-France study⁷). Hypothesis-driven occupational studies relating magnetic field variations to measures of heart rate variability, diastolic blood pressure (another predicted morbidity end point) and individual lifestyle characteristics in stratified samples of workers are also of interest.

Further research is needed on the possible association between occupational ELF EMF exposure and Alzheimer's disease. Useful information can be provided by studies that are population-based and use improved exposure assessment techniques, collect information about occupational histories and have valid confirmation of diagnoses and proper control selection techniques. There is no need for further exploratory studies.

Another outcome where additional research is needed is amyotrophic lateral sclerosis (ALS). Again, useful information can best be provided by studies that are population-based and use improved exposure assessment techniques, collect information about occupational histories and have valid confirmation of diagnoses and proper control selection techniques. As for Alzheimer's disease, there is no need for further exploratory studies. Evaluation of confounding from electric shock is essential in studies of ALS.

1. J. Michaelis et al., "Combined Risk Estimates for Two German Population-Based Case-Control Studies on Residential Magnetic Fields and Childhood Acute Leukemia," *Epidemiology*, 9, pp.92-94, 1998.
2. M. Methner and J. Bowman, *Hazard Surveillance for Workplace Magnetic Fields: I. Walk Around Sampling Method for Measuring Ambient Field Magnitude; II. Field Characteristics from Waveform Measurements*, Cincinnati: National Institute for Occupational Safety and Health, 108pp., March 1998.
3. A. Miller et al., "Leukemia Following Occupational Exposure to 60 Hz Electric and Magnetic Fields Among Ontario Electric Workers," *American Journal of Epidemiology*, 144, pp.150-160, 1996.
4. M. Feychting, U. Forssén and B. Floderus, "Residential and Occupational Magnetic Field Exposure and Leukemia and Central Nervous System Tumors in Adults," *Epidemiology*, 8, pp.384-389, 1997.
5. D. Savitz et al., "Magnetic Field Exposure and Cardiovascular Disease Mortality Among Electric Utility Workers," *American Journal of Epidemiology*, to be published January 15, 1999.
6. J. Sahl, M. Kelsh and S. Greenland, "Cohort and Nested Case-Control Studies of Hematopoietic Cancers and Brain Cancer Among Electric Utility Workers," *Epidemiology*, 4, pp.104-114, 1993.
7. G. Thériault et al., "Cancer Risks Associated with Occupational Exposure to Magnetic Fields Among Electric Utility Workers in Ontario and Québec, Canada, and France: 1970-1989," *American Journal of Epidemiology*, 139, pp.550-572, 1994.

U.K. Meeting on Mechanisms and Consequences of 50/60 Hz EMFs

On September 24-25, the U.K.'s University of Bristol hosted a symposium on Mechanisms and Consequences of Power Frequency Electromagnetic Field Exposures. The meeting was sponsored by the Institute of Physics and Engineering in Medicine and the Institution of Electrical Engineers, with support from the university. The symposium program and abstracts of the speakers' papers are posted on the university's Web site: <www.bris.ac.uk/Depts/Medphys/meeting.html>. Drs. Alan Preece and Joe Eavis of the university's Department of Medical Physics and Bioengineering filed the following report. Preece can be contacted at <a.w.preece@bristol.ac.uk>.

Possible mechanisms of interaction between EMFs and living systems were examined through reviews of behavioral effects and epidemiological studies, with special emphasis on breast cancer, childhood cancer and neurodegenerative diseases. Societal issues including risk perception and legal action were also discussed, as were the potential economic and legal consequences to the electric utilities and the insurance industry.

Speakers were asked to consider whether there are health consequences from exposure to power frequency EMFs—and if so, what are they and what are their implications? These questions were considered in the following context:

- The energy associated with these fields is too low to act as a conventional carcinogen.
- Some epidemiological evidence points to an association.
- Few reproducible biological effects have been demonstrated.

Dr. Ted Litovitz of the Catholic University of America in Washington cited many examples from labs around the world indicating that EMFs can cause cellular changes that can be either beneficial or detrimental. He explained that different cell lines could respond to applied stimuli in different ways, thereby confounding attempts at replication. Litovitz also noted that cells can adapt to an applied stimulus so that their response may change with time.

Also addressing the question of reproducibility, Dr. Ross Adey of the University of California, Riverside, argued that the convergence of experimental data, and not necessarily exact duplication, should be the key objective. Turning to work from his lab, Adey said that EMFs interact by disrupting communication between adjacent healthy cells. (Tumor cells show a similar lack of intercellular communication.) His favored mechanism centers on the ability of EMFs to influence the lifetime of free radicals. This could explain the suspected EMF association with ALS and Alzheimer's—and possibly the proliferation of cancer cells—by disrupting apoptosis (programmed cell death).

Dr. Richard Luben, also of the University of California, Riverside, agreed that there is little question that EMFs can cause cellular changes. He pointed out that EMF effects on human breast cancer cells have now been reproduced in four different labs, including his own. He stressed, however, that biological effects cannot, at this stage, be linked with carcinogenesis and that they are a long way from explaining the epidemiological findings.

This view was seconded by Dr. Gary Boorman of the U.S. NIEHS, who pointed to the mixed results from the EMF RAPID research program. He noted that the bioeffects issue is still open, with mechanistic studies neither proving nor disproving epidemiological associations.

On the other hand, Prof. Denis Henshaw of the University of Bristol presented experimental results supporting his hypothesis that seeks to explain the epidemiological results. He proposed four mechanisms whereby power lines can interact with pollutant-laden airborne particles, leading to increased human doses, particularly for the skin and lungs.

Dr. Zenon Sienkiewicz of the U.K.'s National Radiological Protection Board reported that EMFs can cause specific and consistent changes

in the learning behavior of mice, rats and humans. These effects are reproducible but not permanent. While there is no doubt that intense EMFs can cause these effects, the key question is whether there are low-level effects and, if so, whether they are small, transient and reversible.

Prof. Ray Cartwright of the U.K.'s University of Leeds reviewed the EMF-childhood cancer epidemiological literature, as well as the ongoing U.K. childhood cancer study, which is the largest to date. He commented that the greatest statistical power would come from pooling data from different studies. Next, Prof. Paul Elliott of the Oxford (U.K.) Small Areas Statistics Unit reviewed residential studies of adult cancers and power lines. He suggested that there is some evidence of an increased risk of adult leukemia and non-Hodgkin's lymphoma but no statistically significant risk for brain cancer or for breast cancer. He outlined a U.K. pilot study which found some evidence of an increased risk of leukemia and brain tumors near high voltage overhead power lines but that had a very low statistical power. Elliott is extending the study to look at all lines above 132 kV.

Dr. Eugene Sobel of the University of Southern California in Los Angeles discussed the epidemiological studies of breast cancer and neurodegenerative diseases. Studies of Alzheimer's and ALS consistently show elevated associations for EMF exposures, although they are often not statistically significant. Sobel has put forward the hypothesis that EMFs can contribute to increased production of amyloid beta, which in turn leads to the development of Alzheimer's.

Dr. Brian Stollery, a psychologist at the University of Bristol, showed how people's attitudes have changed since World War II: Today, new developments are viewed with suspicion. Atomic bombs, Chernobyl, BSE (commonly known as mad cow disease) and genetically modified food have fueled public anxiety, in large part because the risks are uncertain and hard to explain and quantify. It may be that conceding a risk and quantifying it may be the best way to quell anxiety. For example, the public does not see radon as much of a health hazard.

The problems facing the insurance industry were outlined by Christian Brauner of the Swiss Reinsurance Co. in Zurich and Alastair Speare-Cole of the Aon Group Ltd. in London. Brauner argued that EMFs are a phantom risk, though one that can cause anxiety and provoke a successful legal action. Speare-Cole considers possible EMF claims to be a small risk, compared, for example, to the millennium bug. But Brauner warned that they could cause large consequences for the industry as a whole.

The legal issues were addressed by Alan Fisher of Dibb Lupton Alsop and Martyn Day of Leigh, Day & Co., both in London. Fisher believes that the legal system can handle technological problems such as power lines and mobile phones using "the precautionary principle" without changing the existing framework of the law. Day, on the other hand, is concerned that individuals have to bear the costs of a product found to be harmful after it has gone to market, and argues that industry should be liable because it made the profit.

At the close of the meeting, the U.K.'s Dr. John Swanson of the National Grid Co. and the Electricity Association emphasized that industry must balance what he called the phantom risk of EMFs with the real risk of shock. The utilities are trying to keep power lines away from existing homes but believe that local planning authorities should not object on safety grounds if developers want to build new homes under old lines—given the lack of a proven health risk. Recent surveys have shown only a low level of public concern. The only groups to benefit from legal challenges, Swanson argued, are lawyers.

Overall, the presentations supported the probable association between EMFs and childhood leukemia, but the mechanisms of interaction are still far from clear. Biological changes have been established, but there is no evidence that these are deleterious.

Clippings from All Over

[S]iting new transmission and distribution lines is far from [a] simple process...In fact, it's nearly impossible. Just ask the utilities that have been seeking permission for years to build new transmission wires—nobody wants them nearby.

—William Brier, vice president for marketing and communication, Edison Electric Institute, Washington, letter to the editor, "Nobody Wants Those Ugly Electricity Wires," *Wall Street Journal*, p.A23, September 10, 1998

"Whether it is disguised as a plastic tree or not, it is going to be very tall, an invasion on the visual environment. If I want to see a plastic tree, I'll take myself off to Legoland."

—Ian Leiper, Beaconsfield, Buckinghamshire, U.K., on the plan of telecommunications firm Orange to erect an 80-foot cellular tower designed to resemble a Scots pine in his town, quoted in "Plastic Pine Drives Residents up the Pole," *BBC Online* (Internet), August 7, 1998

"It's radiating us 24 hours a day. I cannot protect myself against this radiation."

—Linda Evans, former star of television series *Dynasty*, on RF/MW emissions from wireless telephone antennas near her home in Rainier, WA, quoted by Joel Coffidis in "Linda Evans Leads Fight Against Cellular Phone Tower," the *Olympian* (WA), p.1, August 27, 1998

"If you're trying to beat the government, don't bother."

—Robert Curtis, Occupational Safety and Health Administration (OSHA), Salt Lake City, explaining that, due to understaffing, OSHA is enforcing its rules on RF/MW radiation only in response to complaints, quoted by Brad Smith in "Time Running Out for RF Compliance," *Wireless Week*, p.96, September 28, 1998

The melatonin hypothesis merits continued systematic investigation.

—Dr. Robert Hahn, Centers for Disease Control and Prevention, Atlanta, editorial, "Does Blindness Protect Against Cancers?" *Epidemiology*, 9, p.483, September 1998 (see pp.6-7)

One project, somewhat ominously dubbed "Soul Catcher," seeks to develop a computer that can be implanted in the brain to complement human memory and computational skills. In addition, it would enable the gathering of extrasensory information—in this case, data transmitted by wireless networking.

—Rob Fixmer on research by British Telecommunications PLC, in "The Melding of Mind and Machine May Be the Next Phase of Evolution," *New York Times*, p.F6, August 11, 1998

If an astrophysicist can study the origin of the universe without apology, should an epidemiologist have to apologize for work that is so practical?

—Drs. Kenneth Rothman, Boston University School of Medicine, Boston, Hans-Olov Adami, Karolinska Institute, Stockholm, Sweden, and Dimitrios Trichopoulos, Harvard School of Public Health, Boston, in "Should the Mission of Epidemiology Include the Eradication of Poverty?" *Lancet*, p.810, September 5, 1998

"We've demonstrated that you can transmit the biological effect by E-mail between Chicago and Paris. With this approach, you could transfer the activity of a drug by means of standard telecommunications technology."

—Dr. Jacques Benveniste, Digital Biology Laboratory, Clamart, France, explaining the research for which the *Annals of Improbable Research* gave him one of its 1998 "Ig Nobel" prizes, quoted by Steve Nadis in "French Scientist Shrugs Off Winning His Second Ig Nobel Prize," *Nature*, p.535, October 8, 1998

"One is for mummy, two for daddy, three for grandma. That's all the kid has to know."

—Joao Mendes Dias, director of product marketing, Telecel Comunicacoes Pessoais SA, Portugal (Airtouch Communications is its majority owner), on Vitamina K, a wireless phone marketed to 8- to 15-year-old children, quoted by Gautam Naik in "Prepaid Plans Open Up Cellular Phone Market," *Wall Street Journal*, p.B1, September 16, 1998

"MICROWAVE NEWS" FLASHBACK

Years 15 Ago

- Studies at Chicago's IIT Research Institute show that voltages induced by nearby power lines can cause railway signaling systems to malfunction, mistakenly displaying a green light in place of red.
- The U.S. is "quietly stepping up research on microwave beam weapons," writes AP reporter Barton Reppert. Such technology would be used to disrupt electronic systems in enemy weapons and defenses.
- In its new contract with Boston University, a clerical workers' union becomes the first in the U.S. to have the right for pregnant VDT operators to be assigned alternative work.

Years 10 Ago

- In pretrial discovery for a lawsuit filed by a former employee, Robert Strom, Boeing releases an internal memo stating that "the whole chemical balance within the body is disturbed" by electromagnetic pulse radiation.
- Sweden's Dr. Hakon Frölen confirms his 1987 finding that pulsed

magnetic fields can cause increases in fetal deaths in mice.

- In response to the EPA's decision to close down its non-ionizing radiation program, the agency's Science Advisory Board tells EPA Administrator Lee Thomas that "the agency must not totally abandon its work in the area."

Years 5 Ago

- NIOSH plans to study a cluster of seven brain tumors among employees working in the newsroom of the *St. Louis Post-Dispatch*, where magnetic fields as strong as 80 mG have been measured.
- Officials from several federal agencies decline to attend a CTIA-sponsored symposium held to plan a wireless phone safety research program after the FDA's Dr. Elizabeth Jacobson questions whether the CTIA program would be "objective or credible."
- Personnel at two U.S. Air Force bases, the Armstrong Lab in Texas and the Phillips Lab in New Mexico, disagree on the health risks of RF/MW radiation. Phillips' Dr. Cletus Kanavy says that "something is drastically wrong" with Armstrong's denial of nonthermal biological effects.

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BRAIN TUMORS

Better Diagnosis Means More Case Reports...Between 1973 and 1994, there was a 35% rise in the reported incidence of childhood brain cancer in the U.S. But a team of NCI researchers in Bethesda, MD, contends that this probably reflects improved detection of tumors rather than an actual increase in the disease. Writing in the September 2 issue of the *Journal of the National Cancer Institute (JNCI, 90, pp.1,269-1,276, 1998)*, Dr. Malcolm Smith and coauthors report that a statistical analysis of NCI data on malignant childhood brain cancer reveals that the rate of incidence fits a "jump model" of change more closely than a "linear model." That is, the rate was relatively constant before rising quickly in the mid-1980s, and then became steady again at a higher value. The fact that the data are more consistent with the jump model, the authors conclude, "supports the hypothesis that the observed increase in incidence somehow resulted from changes in detection and/or reporting." An actual increase in brain cancer would have been more evenly spread over the 22 years, they contend. The team expected to find the increase confined mostly to 1984 and 1985 because magnetic resonance imaging (MRI) came into wide use as a diagnostic tool at that time. MRI allows the detection of brain tumors that go unnoticed by computerized tomography (CT), which previously had been the most sensitive diagnostic technique for brain cancers. Their hypothesis also gains support, the authors write, from data showing that less virulent gliomas in the brain stem and cerebrum account for most of the overall rise in malignant brain cancer in children. These tumors are those "for which MRI is most contributory, since MRI is more sensitive" than CT in detecting them. In an accompanying editorial in the *JNCI*, Dr. William Black, a radiologist at Dartmouth Medical School in Hanover, NH, writes that, "Although a concomitant environmental cause of increased incidence cannot be completely excluded, it is unlikely." (See also *MWN, J/F91* and *J/A91*.)

Cluster Prompts Lawsuit Against Amoco...In August, four former employees and surviving relatives of three others sued Amoco Corp. in Cook County Circuit Court in Chicago. A cluster of seven brain tumors at the company's Naperville, IL, research center led the plaintiffs to conclude that on-the-job exposures caused the cancers. The seven employees had been involved in similar chemical research projects and spent time in the same three-building complex. Each developed the same type of tumor—a glioma. The suit contends that their work at the center exposed them to "defective, unsafe and/or unreasonably dangerous chemicals," according to the August 28 *New York Times*. At Amoco's request, the *Times* reported, researchers at the University of Alabama, Birmingham, and at Johns Hopkins University in Baltimore reviewed the medical records of the center's 8,000 past and present employees, and found 19 cases of brain cancer. The seven glioma cases among personnel working in a limited area within the center represent a sevenfold excess over the expected rate, Amoco's chief epidemiologist told the *Times*. Five of the seven men had worked in the same building, and three of them were assigned to the same lab—now closed. In 1993, a survey by a team at Johns Hopkins found that petroleum refinery workers were exposed to magnetic fields as high as 2 G, averaged over a shift (see *MWN, J/F94*).

CONFERENCE PROCEEDINGS

EMFs and Molecular Oncology...The July 1998 issue of *Electro- and Magnetobiology* (Vol.17, No.2) includes a selection of papers from the *International Life Sciences Conference '97* and the *2nd Slovenian-Croatian Meeting on Molecular Oncology Today*, held jointly in Slovenia last October. The annual life sciences conference emphasizes an interdisciplinary approach, according to Dr. Gregor Sersa of the Institute of Oncology in Ljubljana, Slovenia, who headed the organizing committee. The theme for 1997 was the biophysics and biology of tumors and, in an introduction, Sersa writes that EMF bioeffects were a major topic. For instance, one paper addresses the use of electric fields to make tumor cell membranes more permeable to certain molecules; another describes how application of low-level direct current can increase the effectiveness of anticancer treatments. For ordering information, contact: Marcel Dekker Inc., (212) 696-9000; Fax: (212) 685-4540.

MEETINGS

RF/MW Dosimetry...A NATO Advanced Research Workshop on *Radiofrequency Radiation Dosimetry: Its Relationship to the Biological Effects of Electromagnetic Fields* was held in Gozd Martuljek, Slovenia, October 12-16. One of the objectives of the meeting was to help revise the *RF Radiation Dosimetry Handbook*. For more information, contact: Jon Klauenberg at Brooks AFB, TX, at Fax: (210) 536-3977, or E-mail: <b.jon.klauenberg@aloe.brooks.af.mil> or Damijan Miklavcic at the University of Ljubljana by Fax: (386+61) 1264658, or E-mail: <damijan@svarun.fe.uni-lj.si>.

MELATONIN

Breast Cancer Among Flight Attendants...Since 1995, three studies have pointed to an elevated breast cancer rate among female flight attendants in Canada, Finland and the U.S. Scientists have pointed to several factors as possible causes: ionizing radiation, pesticides—and now a drop in the hormone melatonin. In 1995, Finnish researchers reported in the *British Medical Journal* (*BMJ*, 311, pp.649-652, 1995) that flight attendants had a risk of breast cancer almost twice as high as that in the general population. The following year, the *BMJ* published a Danish study that showed a similar increase (312, p.253, 1996). An elevated rate of breast cancer has also been found among American flight attendants, Dr. Daniel Wartenberg of the Environmental and Occupational Health Sciences Institute in Piscataway, NJ, reported in a letter to the *BMJ* this June 20 (316, p.1902, 1998). Wartenberg stated that this increased risk shows some association with exposure to the pesticide DDT, which was routinely used in airline cabins until the 1970s. Now Dr. Anthony Mawson of Carolinas Health Care System in Charlotte, NC, has advanced another reason as to why flight attendants may be at greater risk: lower melatonin levels caused by chronic jet lag. "Jet lag disrupts the function of the pineal gland, which secretes melatonin in response to darkness," Mawson wrote in a research letter in the August 22 issue of the *Lancet* (352, p.626), adding that it takes several days in a new time zone to recover fully. "Breast cancer is associated with decreased melatonin production," he noted, and the hormone has been shown to inhibit the growth of human breast can-

POSTDOCTORAL/CAREER DEVELOPMENT FELLOWSHIP ON HEALTH EFFECTS OF NIR

The National Institute for Occupational Safety and Health (NIOSH) is seeking a postdoctoral fellow to conduct research on new methods for measuring worker exposures to biologically important characteristics of electric and magnetic fields at radio frequencies and extremely low frequencies. The fellowship is designed for a recent PhD with a strong physics or engineering background who wants to start a career in occupational health research. The 2-3 year fellowship includes a stipend of at least \$38,000, dependent on qualifications. This position includes an option to take university courses in health physics and industrial hygiene, as a start for a career in occupational health. Qualifications include a PhD in physics, engineering, or industrial hygiene, the ability to work well with a multidisciplinary research team, and a strong background in EMF theory, computer programming, and electronics. Deadline for applications is January 15, 1999.

For more information on applications, interested candidates should contact: Dr. Joseph Bowman, NIOSH, Mail Stop C-27, 4676 Columbia Parkway, Cincinnati, OH 45226. Phone: (513) 533-8143, E-mail: <jdb0@cdc.gov>.

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cer cells. Mawson concluded with three predictions that follow from this hypothesis and that can be readily tested: Female flight attendants should have lower melatonin levels than controls, breast cancer risks should go up with length of employment and melatonin levels should go down. Dr. John Toy of Britain's Cancer Research Campaign expressed interest in this hypothesis in an interview with *The Independent* (August 21), a U.K. newspaper, but warned that women should not respond by running out to buy melatonin. "Melatonin is not harmless and can have serious side effects," Toy emphasized, "including low blood pressure, nightmares and sleep disorders" (see also *MWN*, M/A96, M/J96 and J/F98).

PEOPLE

Dr. **Indira Nair** has been appointed vice provost for education at Carnegie Mellon University in Pittsburgh....Dr. **Mary Elizabeth Jacobs** is now "on detail" as the deputy director of the Office of Blood Research and Review at the FDA's Center for Biologics Evaluation and Research. She was formerly the director of the Division of Life Sciences at the FDA's Center for Devices and Radiological Health....EPRI has given Dr. **Paul Zweacker** of the Dallas electric utility TU Services its Technology Transfer Award for 15 years of "encouragement and support" of EPRI EMF research. The institute calls him an "EMF Research Champion." Zweacker is also a member of the National EMF Advisory Committee....Dr. **Jerome Beers** has begun a research fellowship in functional MRI at the Massachusetts General Hospital NMR Center in Boston....President Clinton has named Dr. **David Michaels** of the City University of New York Medical School to serve as the assistant secretary of energy for environment, safety and health.

Keeping Current: Follow-Up on the News

- ◆ A major epidemiological study of EMFs and childhood leukemias, led by Mary McBride of the British Columbia Cancer Agency in Vancouver, has been submitted for publication. No word yet on when it will appear in print.
- ◆ Dr. Murray Finkelstein of the Ontario Ministry of Labor in Toronto reports that the U.S. National Institutes of Health have turned down his request for a grant to investigate melanoma and testicular cancer among highway patrolmen (see *MWN*, J/A98).
- ◆ In his weekly Internet column (October 2), Dr. Robert Park of the American Physical Society (APS) in Washington writes that the APS Executive Board has voted to stand by its 1995 conclusion that an EMF-cancer link is not "scientifically substantiated" (see *MWN*, M/J95). Subsequent research has "uncovered no evidence" of EMF health effects, the board contends.
- ◆ In the October issue of *Health Physics*, ICNIRP's Rüdiger Matthes answers questions about the commission's new EMF and RF/MW exposure limits (see *MWN*, J/A98). The issue also includes two comments on the limits from the Netherlands.
- ◆ Following postponements by both sides, the citizens and labor groups challenging the FCC's limits for RF/MW exposures will probably meet the FCC in the federal appeals court in New

York City the week of December 14 (see p.8 and *MWN*, N/D97 and J/A98).

- ◆ The Iridium satellite phone system's "agreement in principle" with European radio astronomers (see *MWN*, J/A98) has run into problems. There is still no deal on time-sharing after 1999. The concessions made by U.S. astronomers "are unacceptable to us," a Dutch astronomer told *Science* (October 2). "We are not willing to give up daytime observations," he added.
- ◆ Those who want to keep up with U.S. and international standards are advised that the American National Standards Institute in New York City now has an online version of its biweekly update, *ANSI Standards Action*. It can be found at: <www.ansi.org>.

As We Go to Press

◆ ◆ ◆ On October 14, Melissa Bullock withdrew her lawsuit against Northeast Utilities, which had been filed in December 1991 in the Connecticut Superior Court in New Haven (see *MWN*, J/F92). Bullock had developed a brain tumor, which she claimed was caused by EMFs from power lines and a nearby substation in Guilford, CT. The trial was scheduled to begin in January. More on this in our next issue. ◆ ◆ ◆

Unfinished Business: EMF Research Must Continue

Does EMF exposure increase your risk of cancer? Most epidemiological studies say yes—but the increase is not large, compared to smoking cigarettes.

But some epidemiologists say that EMF studies are like comparing two-pack-a-day smokers to those with a three-pack-a-day habit. The problem is that EMFs are so ubiquitous in industrialized societies that unexposed controls are impossible to find.

Dr. Samuel Milham decided to look into this analogy, and went back to the data in Sir Richard Doll's classic paper on tobacco. What he found is startling (see p.12). Compared to non-smokers, heavy smokers were 24 times more likely to get lung cancer. But compared to light smokers, their risk was only three-and-a-half times higher. Compared to moderate smokers, heavy smokers' odds were only twice as bad.

Of course, the fact that this is true for tobacco doesn't prove a thing about EMFs. It's only an analogy. To see if it holds up, we have to look a little deeper.

First, it is striking that we still know so little about who is exposed to what. Milham did the first EMF occupational study over 15 years ago (see *MWN*, J/A82). Yet only recently did we recognize that sewing machine operators have higher EMF exposures than do electric utility workers (see *MWN*, S/O95).

Sources of EMFs turn up in surprising places. For example, Swedish researchers reported last year that steel-belted radial tires can expose automobile passengers to EMFs as high as 50 mG. Thus, an office worker with a long commute might have more exposure than a utility worker. A suburban kid who gets shuttled around in his parents' car might have more exposure than a child living within sight of a power line. Who is the exposed individual, and who is the control?

And the problem is not just the many sources of EMF exposures, but also whether they will be accurately measured. One reason the EMFs from tires went unnoticed for so long is that they tend to be at frequencies below 40 Hz, and are filtered out by most 50/60 Hz meters. This has been demonstrated by Milham, a consultant in Olympia, WA (see *MWN*, M/A98).

Incomplete measurement of EMFs can blur estimates of risk in many ways. At the beginning of the EMF health debate, the focus was on exposure to electric fields. Magnetic fields soon moved into the limelight, pushing electric fields into the background. But two years ago, Dr. Anthony Miller of Canada's University of Toronto found that the highest risk for leukemia came when *both* electric and magnetic fields were taken into account (see *MWN*, J/A96).

Looking at either exposure separately tells less than half the story, Miller found. Utility workers with high magnetic field exposure had a leukemia risk one-and-a-half times greater than expected. But those with high exposure to magnetic *and* electric fields had an 11-fold increase in risk.

An even larger risk was observed by Dr. Gilles Thériault of McGill University in Montreal in his study of workers at Hydro-Québec (HQ) (see *MWN*, N/D94). Lung cancer risk was 17 times higher than expected for workers most exposed to high frequency transients.

These results from Miller and Thériault have two things in common. One is that people with the highest exposures to specific types of EMFs can have much higher cancer risks. If most EMF studies are like comparing light smokers to heavy smokers, the work by Miller and Thériault may be like studying people who chain-smoke Camels. Investigating highly exposed workers should be a top priority.

Second, both findings have been more or less ignored. Despite double-digit risks, they are rarely mentioned in the EMF debate. It is astonishing that they have prompted little or no follow-up—in fact, HQ cut off Thériault's access to the study's data (see *MWN*, N/D94).

Too many people have uncritically accepted the idea that if there is a risk from EMFs, it must be small. This unproven assumption is used as an argument to slash research funding. And as we report on p.1, this has now become official U.S. policy. The DOE's EMF research program has folded, and there is no more government funding for EMF health research.

But there are both moral and pragmatic reasons why EMF research must continue.

To point out that it is impossible to be unexposed to EMFs in modern society is not a complaint against electricity. We are not Luddites, calling for a return to the past. Electric power has become so widespread precisely because of its tremendous social benefits. But the result is that EMF exposure is no longer a matter of individual choice. Whether or not you use an electric hair dryer, you will be exposed to EMFs—possibly from sources of which you are completely unaware. A society that has made electric power such an intimate part of daily life has a responsibility to see that it is used safely.

The practical reasons for research on EMFs are even stronger. Many possible health risks are relatively unexplored. This is true for heart disease, Alzheimer's and breast cancer—all diseases that are extremely common. If any one of these proves to be a genuine hazard, even a small risk would carry a tremendous social cost. EMFs are too ubiquitous to ignore.

We are just beginning to understand how EMFs can affect our health, but too many people are in a hurry to come to a conclusion. It is shortsighted, to say the least, for a country with a \$6 trillion economy to think it cannot spare even a few million dollars to investigate the safety of something so pervasive—and essential—as electric power.

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