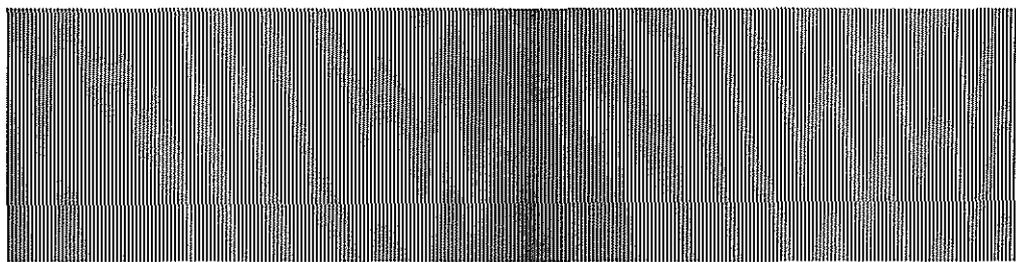


MICRO WAVE NEWS



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A Report on Non-Ionizing Radiation

November/December 1989

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Telephone Linemen Study Boosts Cancer Promotion Hypothesis

Cable splicers, a subgroup of telephone linemen, had significantly elevated rates of all cancers, especially leukemia, according to preliminary results of an ongoing epidemiological study at Johns Hopkins University (JHU). The splicers also had higher than expected rates of lymphoma and lung, prostate and colon cancer. The incidence of leukemia was seven times that of other workers in the telephone company; the rate of prostate cancer was more than four times higher.

Drs. Genevieve Matanoski, Elizabeth Elliott and Patrick Breyse of JHU's School of Hygiene and Public Health in Baltimore, MD, concluded that their "remarkable" results "are in keeping with a hypothesis of cancer promotion from electromagnetic field (EMF) exposure."

Measurements of on-the-job exposures indicate that the splicers had surprisingly low-level EMF exposures—a mean level of 4.3 mG.

Matanoski and Breyse announced their findings at the annual review of power line research, held in Portland, OR, November 13-16. In an interview, Matanoski said that she herself had been "surprised" by her results

Cancer Epidemiological Studies Worldwide

More than 22 major epidemiological studies of the potential link between EMFs and cancer are now under way in 12 countries. See pp.4-5 for a Microwave News special report.

—as were most of the attendees.

These new findings come from a survey of cancer among 50,582 young linemen at New York Telephone Company from 1976 to 1980. The study is an offshoot of an ongoing national epidemiological study of telephone workers who died of leukemia (see table on p.5). Most of the leukemia deaths were among older, retired workers. Matanoski initiated the second study to test the question: "Do young workers have an increased risk of leukemia associated with [EMF] exposure?" (The median age of the linemen in the New York study was approximately 40.)

At last year's review, Matanoski reported that, based on preliminary data, there was no evidence of an increased risk of leukemia in her national mortality survey (see *MWN*, N/D88). The team is still analyzing these data.

A Possible Breast Cancer Cluster

Matanoski found two cases of breast cancer among the 9,561 central office male technicians surveyed. In addition, she said that there may have been up to four more cases of breast cancer among the New York linemen.

(continued on p.8)

« Power Line Talk »

The EMF threat was a pervasive theme on television news shows coast-to-coast in November. In Los Angeles, KNBC headlined its three-day report *Wired to Kill?*; New York City's WNBC featured a variation—*Power to Kill?* On Chicago's WMAQ, the headline was *Trouble Overhead*, while Philadelphia's WCAU warned of *A Current Danger*. NBC's Bryant Gumbel interviewed Paul Brodeur on the November 28 "Today Show" in a segment titled *Electric Shock*. And in September, Montreal's CFCF-TV focused on VDTs with a four-part report on *Computers and the Unborn*.

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Even Johnny Carson is talking about EMFs. On October 26, America's favorite television talk show host offered his fans a look at the lighter side: "I saw a funny item in the paper. If you use an electric blanket for a prolonged period, it could cause cancer. There goes the last safe bedtime thrill."

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DOE's Ken Klein told KNBC that it would cost the U.S. approximately \$5 billion a year, every year for 20 years, to address the EMF problem.

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All the publicity about EMFs has caused hardly a stir in the U.S. Congress. At the Senate Committee on Governmental Affairs, chaired by John Glenn (D-OH), investigators have been looking into the issue. But just when it appeared that a hearing would be scheduled, staff turnover put EMFs on the back burner. Any action has been put off for now.... Congressman Frank Pallone (D-NJ) may get involved—his constituents are fighting a 230 kV power line proposed by Jersey Central Power & Light (see *MWN*, J/A89). He is drafting legislation which would set aside funding for the type of research recommended in the Congressional Office of Technology Assessment (OTA) report.

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In the absence of an agreed-upon mechanism of interaction, physicists continue to be highly skeptical that EMFs play a role in cancer development. In an opinion piece published in *Newsday* (October 29) and reprinted in other newspapers, Dr. Robert Park, the director of the Washington, DC, office of the American Physical Society (APS), asserted that, "There is, however, virtually no laboratory evidence of harmful effects from ELF and no known biological response to such fields that would lead one to expect harmful effects." Given that many such studies have in fact been published, we asked Park about the apparent inconsistency. "Some of this work is

very strange," he replied. "It is not surprising that you find people that report some kind of an effect." Park also drew a distinction between an "effect" and a "hazard." For instance, he said, we all respond to the smell of freshly baked bread, but it does not pose any risk. The APS Panel on Public Affairs is considering whether to issue a report on EMFs: "An informal subcommittee is looking into whether the APS can make a contribution," Park said.

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Critiques of Paul Brodeur's *New Yorker* series and of his newly published book, *Currents of Death*, are piling up. The latest—and the harshest—comes from the IEEE's Committee on Man and Radiation (COMAR), which characterizes Brodeur's writings as "an extremely biased assessment of the existing facts and scientific data." The COMAR members, whose comments were gathered by Dr. Eleanor Adair of the John Pierce Foundation in New Haven, CT, "believe that environmental issues are too important to be allowed to become,

EPRI Withdraws from Annual DOE Bioeffects Review

The Electric Power Research Institute (EPRI) has withdrawn its support for the annual review of research on the biological effects of power line electromagnetic fields (EMFs). The U.S. Department of Energy will continue to sponsor the meeting on its own.

At the opening session of the November meeting in Portland, OR, Dr. Leonard Sagan, the manager of EPRI's radiation program, said, "It's time to move on, for better or worse." Sagan cited the growing technical nature of the presentations and said that those doing contract research for EPRI will now be asked to present their data at the annual meeting of the Bioelectromagnetics Society.

DOE's Dr. Imre Gyuk, who spoke next, said that the meetings certainly will go on without EPRI.

Many of the attendees at the Portland review were disappointed. "There is an advantage to joint meetings," said a utility engineer with EMF responsibility. Others pointed out that the annual meeting is the only conference devoted solely to power line EMFs and that, in the ten years since the meetings began, they have provided a unique forum in which to exchange ideas. The fact that the meetings have no registration fee has no doubt also contributed to their success.

In an interview, EPRI's Dr. Charles Rafferty told *Microwave News* that EPRI contractors will be allowed, but not required, to attend the DOE annual reviews.

as characterized by Dr. Asher Sheppard, 'a part of the media circus in which the public is alternately scared to death and then passivated.' (A dozen years ago, COMAR issued a detailed analysis of Brodeur's *The Zapping of America*.)

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There is little doubt that the EMF issue has touched a nerve. The November 7 issue of *Family Circle*, featuring a "Radiation Alert" by Paul Brodeur, was the best-selling issue of the year, according to Executive Editor Susan Ungaro. The six million copies sold had a combined readership of approximately 23 million. Ungaro said that the article has generated a great deal of reader mail and that the magazine may do a follow-up....*Woman's Day*, *Family Circle's* principal competitor at the supermarket checkout counter, will soon try its hand at EMFs. Watch for an article in March....Even *People* magazine is getting on the bandwagon. It ran an interview with Brodeur on November 27.

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Everybody said it was just a matter of time. Landowners who live along the site of a proposed BC Hydro 138 kV power line in the area of Duncan, BC, are demanding that the Canadian utility buy their homes—as it did some of the homes along the 230 kV Dunsmuir-Gold River line on Vancouver Island (see *MWN*, M/J89, J/A89 and S/O89). But BC Hydro has refused, citing the BC Utilities Commission's criticism that it acted "imprudently" in making its unprecedented offer earlier this year. BC Hydro's Peter McMullan told us that the Duncan line is the first the utility has proposed since the commission hearings. One landowner, who already has a 138 kV line running through his farm, told the October 15 *Province*, a local newspaper, that he'll shoot "any Hydro person who sets foot" on his property. For his part, McMullan said that, "It's reasonable to assume that anytime we build or propose a new line, we will have people questioning us. EMFs are an ongoing issue. We accept that." As of November 17, BC Hydro had purchased 21 homes as part of its Dunsmuir-Gold River line buy-out offer.

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Two years ago in the pages of *Nature* (see *MWN*, J/F88), Dr. Ken Foster advocated an end to non-ionizing radiation research. But in a letter to *Science* (October 27), he said that he is willing to support more research if it is "carefully targeted" to reduce the "confusion" engendered by a bioeffects literature "filled with speculation and non-reproducible phenomena." Foster was responding to a *Science* editorial calling for increased support of 60 Hz health research (see *MWN*, J/A89). The editorial was prompted by the OTA report which, among its recommendations, suggested the adoption of a "prudent avoidance" of ELFEMFs (see p.6). Foster, however, believes

EMFs in the 1989 Popular Press

Business Week: Pam Black, "Rising Tension Over High-Tension Lines," pp.158-160, October 30....**Consumer Reports:** "Are Electric Blankets Safe?" pp.715-716, November....**Current Contents:** "Ill Effects From Power Lines and Appliances?" pp.9-10, September 18....**Denver Post:** Al Knight, "Danger of Electromagnetic Fields Debated," July 16....**Discover:** David Noland, "Power Play," pp.62-68, December....**Family Circle:** Paul Brodeur, "Radiation Alert," pp.85-90, November 7....**Forbes:** Peter Huber, "Electrophobia," p.313, September 4....**Ham Radio:** Craig Clark, "More Cause for Thought," pp.4,89, September....**The Institute (IEEE):** Karen Fitzgerald, "EM Field Effects Studied," September....**Longevity:** Ann Marie Cunningham, "Electromagnetic Shocks," pp. 92-93, October....**National Examiner:** Stephen Langer ("Med Man"), "Kids, Moms-To-Be: Avoid Electric Blankets," p.24, November 28....**New York Times:** William Stevens, "Scientists Debate Health Hazards of Electromagnetic Fields," p.C1, July 11....**The New Yorker:** Paul Brodeur, "Annals of Radiation: The Hazards of Electromagnetic Fields," June 12, 19 & 26....**Newsday:** Robert Park, "Does 60 Hertz Hurt?" Ideas, p.1, October 29....**Newsweek:** Geoffrey Cowley, "An Electromagnetic Storm," p.77, July 10....**People:** Dirk Mathison, "Feeling Fatigued and Forgetful? The Power Line Next Door May Be the Source of Your Burnout" (interview with Paul Brodeur), pp.137-141, November 27....**Progressive Architecture:** Thomas Fisher, "The Next Asbestos?" (editorial), p.7, August....**QST:** Ivan Shulman, "Is Amateur Radio Hazardous to Our Health?" pp.31-33, October....**Science:** Philip Abelson, "Effects of Electric and Magnetic Fields" (editorial), p.241, July 21....**73 Amateur Radio:** Wayne Green, "The Killer Blankets," pp.6,68, September....**Time:** Anastasia Toufexis, "Panic Over Power Lines," p.71, July 17....**USA Today:** Dan Sperling, "Electric Lines Spark New Cancer Fears," p.1, December 1-3....**Wall Street Journal:** Bill Paul, "IBM To Reduce Radiation from Future VDT Models," p.B1, November 22; Laurence Hooper & John Wilke, "IBM's Plan To Reduce VDT Radiation Fails To Impress Most Computer Makers," p.B3, November 24; Bill Paul, "Radiation Study Finds High Incidence of Cancer Among Phone Cable Spicers," p.B4, November 29; Bill Paul, "Men Exposed to [EMFs] in Study Have Slower Motor Responses," p.B4, December 6.

the bioeffects literature is too weak to support such an avoidance strategy.

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In the November issue of *Consumer Reports*, Consumers Union (CU) recommended that "children and pregnant women avoid electric blankets and pads," because "perfectly satisfactory alternatives, such as comforters, are available." The advice came in an article, "Are Electric Blankets Safe?" which accompanied an assessment of 21 electric blankets and pads. CU has now parted company with the FDA, which earlier this year told the American public that it "sees no reason" for people to stop heating their beds electrically (see *MWN*, M/J89).

EMF-Cancer Epidemiological Studies

I. Residential Studies

Institution	Principal Investigator(s)	Sponsor(s)	Endpoint(s)	Study Type: No. of Cases/ Controls	Exposures Assessments	Confounder(s) ¹	Approx. Date of Completion
Univ. of Leeds UK	David Clayden	CEGB	All CA/c	CC: 374/588	I	H	1989 ²
USC USA	John Peters	EPRI	L/c	CC: 232/232	D/I	Ch,IR,PO, Ps,Sm	1990
Univ. of Leeds UK	Ray Cartwright	CEGB	ALL,AML,CLL, CML,NHL	CC: 3200/3200	I	H	1990
Maastricht MS The Netherlands	Jan Meijers	Maastricht MS	All L,BC	Co:3549 people, 32-yr. follow-up	I	None	1991
Karolinska Inst. Sweden	Anders Ahlbom	Karolinska Institute, NBE	L/a,BC/a, all CA/c	CC: (300 L, 425 BC)/725; (200 CA/c)/140	D/I	E,H,PD, PO,SC	1991
NTU Taiwan, ROC	Ruey Lin	National Science Council	L/c,BC/c, lymphoma/c	CC: 216/422	D/I	Al,Ch,IR, MP,PO,Sm	1991
USC USA	Susan Preston-Martin	State of California	BC/c	CC: 300/300	D/I	Ch,IR,MP, PO,Ps,SC,W	1993
Univ. of Toronto Canada	Anthony Miller	OH	L/c	CC: 200/400	D/I	IR, PO	1993
Univ. of Helsinki Finland	Markku Koskenvuo	Imatran Voima Oy ³	CA,CA/c	CC ⁴ , Co ⁴	I	J,SC,Sm	1993
NCI/CCSG USA	Martha Linet Zdenek Hrubec	NCI	L(ALL)/c	CC: 1000/1000	D/I	Bz,Ch,E,EB,Fm,H, IR,MP,Pb,PD,PO, Ps,PVC,SC,Sm,Sv	1994
CCABC Canada	Richard Gallagher	EPRI,CEA, HWC	L/c	CC: 395/395	D/I	Bz,IR, PO,Ps	1994
IARC France	Peter Boyle	IARC	All L	CC: 1500/1500	D/I	Bz,EB,Fm,H,IR, PCBs,PO,Ps	1994

1. Partial list; 2. Results due in 1990; 3. A Finnish power company; 4. Numbers to be determined at a later date; 5. Dept. of Social and Preventive Medicine; 6. Data in this listing are unconfirmed.

Adapted and expanded from M. Coleman et al., *Bioelectromagnetics*, 11, 1990 (in press).

Abbreviations: Al: Alcohol; ALL: Acute lymphocytic leukemia; AML: Acute myelogenous leukemia; ANLL: Acute non-lymphocytic leukemia; BC: Brain cancer; BC/a: Adult brain cancer; BC/c: Childhood brain cancer; Bz: Benzene; CA: Cancer; CA/c: Childhood cancer; CC: Case-control; CCABC: Cancer Control Agency of British Columbia; CCSG: Children's Cancer Study Group; CEA: Canadian Electrical Association; CEGB: Central Electricity Generating Board; Ch: Chemicals; CLL: Chronic lymphocytic leukemia; CML: Chronic myelogenous leukemia; Co: Cohort; D: Direct measurements of individuals or workplaces; E: Ethnicity; EB: Electrically-heated beds; EDF: Electricité de France; EPRI: Electric Power Research Institute; FINEP: Brazilian Research Funding Council; Fm: Fumes; H: Type of Housing; HQ: Hydro-Québec; HWC: Health and Welfare Canada; I: Indirect estimate of exposure; IARC: International Agency for Research on Cancer; IR: Ionizing radiation; J: Job history; JHU-SPH: Johns Hopkins University School of Public Health; L: Leukemia; L/a: Adult leukemia; L/c: Childhood leukemia; MP: Medication of parents; MS: Medical school; N/A: Not available; NBE: National Board of Energy, Sweden; NCI: National Cancer Institute; NEA: National Energy Administration, Sweden; NHL: Non-Hodgkin's lymphoma; NIEHS: National Institute of Environmental Health Sciences; NIOH: National Institute of Occupational Health; NSPH-OCF: National School of Public Health, Osvaldo Cruz Foundation; NTU: National Taiwan University; OH: Ontario Hydro; Pb: Lead; PCBs: Polychlorinated biphenyls; PD: Population density; PO: Parents' occupations; Ps: Pesticides; PVC: Polyvinyl chloride; RF/MW: Radiofrequency/microwave radiation; ROC: Republic of China; SC: Social class; Sm: Smoking; Sv: Solvents; UNC: University of North Carolina; USC: University of Southern California; W: Drinking water.

Ongoing Residential and Occupational Epidemiological Studies of EMFs and Cancer

Epidemiologists in 12 countries are now investigating the possible link between electromagnetic field (EMF) exposures and cancer, particularly leukemia and brain tumors.

More than 22 major occupational and residential studies are under way in Australia, Brazil, Canada, Finland, France, The Netherlands, New Zealand, Sweden, Switzerland, Taiwan, the U.K. and the U.S. (where there are seven)—see tables at left and below.

Electric utilities are funding most of the studies. For instance, the Electric Power Research Institute (EPRI) is sponsoring all or parts of six different projects in the U.S. and Canada.

Unlike earlier efforts, the majority of the studies involve direct measurements as opposed to the use of surrogates for magnetic field exposures, such as job title or wire coding indexes. Also, a great deal of emphasis is being placed on controlling for possible confounders, that is, other factors which might be responsible for increasing cancer rates.

Most of the studies will begin to yield results in the early 1990s.

Savitz and Swedish Studies Completed

Recently, Dr. David Savitz of the University of North Carolina in Chapel Hill found an increase in brain cancer risk among electric utility workers (see next page).

In Sweden, Drs. Bengt Knave and Siv Tornqvist of the National Institute of Occupational Health (NIOH) in Solna have completed an epidemiological study of leukemia and brain cancer among workers in occupations with presumed exposures to extremely low frequency (ELF) magnetic fields.

Knave told *Microwave News* that the study will soon be submitted for publication. The final results were not available at press time.

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II. Occupational Studies

Institution	Principal Investigator(s)	Sponsor(s)	Endpoint(s)	Study Type: No. of Cases/ Controls	Exposures Assessments	Confounder(s) ¹	Approx. Date of Completion
USC USA	Joseph Bowman	EPRI	ALL,ANLL, CLL,CML	CC ⁴	D	Ch,IR, RF/MW	1990
JHU-SPH USA	Genevieve Matanoski Patrick Breyse	EPRI	All L except CLL	CC: 200/600	D	J	1990
JHU-SPH USA	Genevieve Matanoski Patrick Breyse	NIEHS, EPRI	All CA	Co: 391 CA	D	Age,J	1990
Univ. of Bern ⁵ Switzerland	Christoph Minder	Swiss National Fund	L, lymphoma	CC: 23/ 177 & 207	D/I	IR	1990
Monash MS ⁶ Australia	Michael Salzberg	N/A	Glioma	CC: 425/850	I	Ch,SC,Sm	1991
McGill Univ. Canada	Gilles Thériault	HQ,OH, EDF	L,BC, skin melanoma	CC: 6000/ 17000	D	Sm,IARC-Ch carcinogens	1991
UNC USA	David Savitz	EPRI	L,BC	Co: 215 L, 186 BC	D/I	PCBs,Sv	1991-92
NSPH-OCF Brazil	Sergio Koifman	FINEP	All CA	CC: 347/1129	I	Sm	1992
Wellington MS New Zealand	Neil Pearce Peter Bethwaite	Wellington MS	ALL,AML, ANLL	CC: 300/600	I	E,SC,Sv	1992
NIOH Sweden	Birgitta Floderus	NEA, NIOH	ALL,AML,CLL, CML,Glioma	CC: 200 BC, 300 L/1000	D/I	Bz,Fm,PD, SC,Sv	1992

Savitz Links Brain Cancer to Electrical Occupations

In a new study, Drs. Dana Loomis and David Savitz have found that electrical workers had a significantly elevated mortality from brain tumors. The two epidemiologists at the University of North Carolina in Chapel Hill base the association on an analysis of 410,651 deaths (including 1,095 from malignant brain tumors and 1,694 from leukemia) in 1985 occurring in the 16 states participating in the National Center for Health Statistics industry and occupation coding program.

The class of all electrical workers had a 50% greater than expected rate of brain cancer deaths—an odds ratio (OR) of 1.5 with a 95% confidence interval (CI) of 1.0-2.1. Much of this increase is attributable to the elevated risks among electrical and electronic technicians (OR=3.1) and among electric power repairers and installers (OR=2.4).

There was no elevated mortality due to all leukemias (OR=0.9, CI=0.6-1.3) or due to acute myeloid leukemia (OR=0.9, CI= 0.5-1.8) among all electrical workers. Two subgroups did have higher than expected rates of leukemia, however: electricians (OR=1.8) and electronic technicians (OR=1.9).

"These results are certainly more suggestive of an effect on brain cancer as compared to leukemia," Savitz told *Micro-wave News*. He added that it is still not clear whether the observed association is related to electromagnetic field (EMF) exposure or to some other aspects of the jobs.

These latest findings support an association between electrical work and brain tumors previously reported by a number of other researchers—Dr. Ruey Lin (see *MWN*, O84 and J/A85), Dr. Sam Milham (see *MWN*, J/A82 and M/A86), Dr. Marjorie Speers (see *MWN*, J/A88) and Dr. Terry Thomas (see *MWN*, S/O87). Speers's study found that the risk of brain cancer among utility workers was 13 times the expected rate for unexposed workers.

Loomis and Savitz presented their findings at the annual meeting of the Society for Epidemiologic Research in Birmingham, AL, in June. Their abstract appears in the *American Journal of Epidemiology*, 130, p.814, 1989. They are preparing a paper for publication that also includes data from 1986. "The results are essentially the same," Savitz said.

The two epidemiologists are also in the midst of a large occupational epidemiological study of brain cancer and leukemia for the Electric Power Research Institute (see p.5).

New Zealand Results

Dr. Neil Pearce of the Wellington School of Medicine in Wellington, New Zealand, and coworkers have published a new paper, which describes the brain tumor risks associated with various occupations, including electrical workers.

As previously reported, two types of electrical workers had increased rates of brain cancer—electrical engineers (OR=4.74, CI=1.65-13.63) and electricians (OR=1.91,

CI=0.84-4.33)—although electrical workers as a whole did not have an increased risk (OR=0.78, CI=0.39-1.59). The team notes that, "The increased risks found for electrical engineers and electricians...are difficult to interpret and may be due to chance."

See John Reif, Neil Pearce and James Fraser, "Occupational Risks for Brain Cancer: A New Zealand Cancer Registry-Based Study," *Journal of Occupational Medicine*, 31, pp.863-867, October 1989. See also their paper, "Case-Control Studies of Cancer in New Zealand Electrical Workers," *International Journal of Epidemiology*, 18, pp.55-59, 1989, and *MWN*, J/A89.

Colorado PUC Adopts "Prudent Avoidance" Strategy

On November 2, the Colorado Public Utilities Commission (PUC) announced that it will adopt a "prudent avoidance" strategy to minimize electromagnetic field (EMF) exposures from new power lines. The PUC will translate this initiative into statewide rules to find "low cost ways to limit potential dangers," such as re-stringing lines, centering lines in easements and using single pole construction.

The commission's decision followed soon after the Congressional Office of Technology Assessment (OTA) proposed this strategy for dealing with uncertain power line health risks. The Carnegie Mellon University group, which prepared the report for the OTA, suggested routing new lines to avoid populated areas (see *MWN*, J/A89 and S/O89).

The PUC's decision accompanied its tentative approval of a Public Service Company of Colorado proposal to increase the capacity of a 115 kV power line to 230 kV. In so ruling, the PUC reversed a December 1988 decision by the Douglas County Commissioners denying the utility's request for the upgrade primarily because of residents' fears of health risks.

A final order is expected in December.

At a September 11-18 hearing, the commission for the first time considered the issue of potential EMF effects, according to a PUC spokesperson.

Douglas County residents have long opposed the utility's proposal, claiming that upgrading the Daniels Park line—which runs through residential neighborhoods and near a school—would adversely affect residents' health and property values. They have called for Public Service to place the line underground. Burying the line would cost approximately \$15 million, as opposed to \$5 million for an overhead upgrade, according to the PUC.

The utility refused to consider this alternative, arguing that it has "no right to spend the customers' money to reduce something which the best experts say is not something to be worried about." At the hearing, William Martin, a Public Service vice president, maintained that, "There is no need to avoid the overhead construction of transmission lines if undergrounding them is simply to eliminate the effect of

magnetic fields." He said that, "We have no evidence that there is any need to...minimiz[e] the magnetic field's effect...."

The PUC agreed, at least in part, concluding that "the cost of burying the line was not justified in light of the fact that current medical evidence has not conclusively demonstrated detrimental health effects caused by [EMF] exposure."

On the other hand, Dr. Darwin Labarthe of the Baylor College of Medicine in Houston, TX, who appeared on behalf of the utility, did agree under questioning that a prudent avoidance strategy was worth pursuing.

Residents—though preferring burial of the line—also advocated this strategy. As Lawrence Herbert of Lakewood, CO, told the PUC, "I emphatically encourage the commission to begin mitigating the potential health crisis by removing the involuntary aspect of exposure to power line EMFs and to begin using magnetic fields as a constraint in the design and operation of our electrical energy system in the state of Colorado."

The commission also recommended that Public Service implement design changes in stringing the line to "reduce the [EMF] exposure on nearby residents" and that it conduct a survey within its territory to "determine where the highest exposures to [EMFs] are occurring."

Among those also testifying for the utility were Dr. Richard Bockman of Memorial Sloan-Kettering Cancer Center in New York City and Michael Silva of Energetech Consultants, Inc. in Campbell, CA.

Teachers at Florida Schools To Wear Magnetic Field Meters

A Florida judge has ordered teachers at four schools—including the Sandpiper Shores Elementary School—to wear meters to monitor electromagnetic field (EMF) exposures from nearby high-voltage power lines. In an October 13 order, Judge Timothy Poulton directed the Palm Beach County School Board to pay for the \$48,000 measurement program.

The order followed a court ruling in June that children at the Sandpiper school in Boca Raton may not play in the school grounds which border on the high-voltage lines (see *MWN*, J/A89). The suit was filed by three parents who sought to close the school because of potential EMF health risks (see *MWN*, S/O88, J/F89 and M/J89).

In October, a pilot survey revealed an average exposure of approximately 3 mG at the Sandpiper school, according to Dr. Vichate Ungvichian of the Electromagnetic Interference Laboratory at Florida Atlantic University (FAU) in Boca Raton. The reading was not representative of the levels to which the children are regularly exposed, however, because the volunteer—a Sandpiper school vice principal—spent most of the day in his office, Ungvichian said. FAU has been hired by the school board to direct the measurement project.

California PUC Calls EMF Rules "Premature"

In its final report to the state legislature, the California Public Utilities Commission (PUC) has recommended "no action at the present [time] to regulate [EMFs] around electric power facilities" because "such actions are premature given current scientific understanding."

The 1.5-inch-thick report, which was mandated by a 1988 state law (see *MWN*, M/J88 and S/O88), includes descriptions of the previously announced research projects funded by the state (see *MWN*, J/A89), the eight EMF reviews commissioned by the PUC (see *MWN*, N/D88 and M/A89), as well as a statement by the Electric Power Research Institute and public comments.

Copies of *Potential Health Effects of Electric and Magnetic Fields from Electric Power Facilities* are available for \$20.00 (free to public agencies), from: Documents Section, California PUC, 505 Van Ness Ave., San Francisco, CA 94102, (415) 557-1812.

Lawrence Marraffino, a Boca Raton attorney who represents the parents, told *Microwave News* that the three other schools in the program were selected as controls because they are "identical in design" to the Sandpiper school, but are not located right next to high-voltage lines.

If the levels measured at Sandpiper are significantly higher than those at the three other schools, the parents will again seek to shut the school down, according to Sharon Rausch, one of the parents who brought the original suit.

The program, which began in earnest on November 28, will continue for at least one year. FAU will provide monthly measurement reports to the parents and the school board, which will then submit them to the judge. The reports will later be made available to the public. Upon the program's completion, the school board will donate the six EMDEX-C meters it purchased for \$2,000 each to FAU.

The parents originally had requested that students at the school wear the 1.37 lb. monitors.

Over 100 teachers and teaching aides at the four schools have offered to participate in the program, Rausch said. Volunteers will wear monitors one day a week and will record their whereabouts—including proximity to electrical sources—every 15 minutes.

One meter will also be placed in the Sandpiper cafeteria—the room closest to the lines.

"We feel comfortable with the program the way it is now," according to Abbey Hairston, staff attorney for the school board. "The uncertainty has been bad for the school. We want to get rid of that cloud."

"It's very important that we get accurate information and this seems like the best way to get it," Rausch said. "This is the next step in a long process which may continue for years."

Telephone Linemen Study (continued from p.1)

It is unclear, however, whether these additional cases fall within the defined study population or constitute an abnormal clustering of an extremely rare type of cancer.

Only 900 cases of male breast cancer were expected for the entire United States in 1988, according to American Cancer Society statistics. (In contrast, 135,000 cases of female breast cancer were expected.) Breast cancer is most likely to affect older men, with the peak incidence among those 60 to 69 years old.¹ Prostate cancer often metastasizes to the breast, although this is rarely clinically recognized, according to a recent paper in *Cancer*.² The central office technicians also had elevated rates of lymphoma and oral and prostate cancer.

Dr. Richard Stevens of Battelle Pacific Northwest Labs in Richland, WA, has long suggested that EMFs may account for the high rates of breast cancer among women in industrialized countries³ (see *MWN*, J/F87). In Portland, Stevens told *Microwave News* that Matanoski's findings are "extremely interesting and exciting." For a number of years, Stevens has

Matanoski, EPRI & the Media

A few days before the DOE-EPRI meeting in Portland, OR, EPRI President Richard Balzhiser alerted the chief executive officers (CEOs) of all of the institute's member utilities to the impending announcement of Dr. Genevieve Matanoski's study results.

"These results...may attract national attention because they suggest an increased risk of cancer among workers exposed to EMFs," Balzhiser wrote in his November 10 letter.

EPRI also sent out a three-page "Questions and Answers" background paper on Matanoski's "unexpected" results to a number of newspapers. The *Wall Street Journal* ran a story on November 29, prompting the Associated Press to write its own version and put it on the wire. The following day, the Matanoski study made headlines in newspapers and on radio and television coast-to-coast. On December 1, it was featured on the front page of *USA Today*.

EPRI's unsolicited release of the Johns Hopkins findings surprised some journalists. As one veteran reporter told *Microwave News*, "Something has happened to make the big boys scared."

In his letter, Balzhiser advised the CEOs that, "These results are preliminary and clearly warrant further study." He went on to say that EPRI is "committed to pursuing this work objectively by providing support to outstanding researchers in the field, such as [Dr.] Matanoski. In addition, [EPRI] will be initiating research aimed at identifying technological options for addressing the issue, should this prove necessary."

Standard Incidence Ratios (SIRs)[§]

	Cable Splicers SIRs/No. Cases [†]	Central Office Technicians SIRs/No. Cases [†]
All cancers	1.81*/40	1.15/96
All gastrointestinal	1.76/11	1.02/28
Oral	1.38/2	2.45*/9
Stomach	-/0	∞/4
Colon	2.23/5	0.54/6
Lung	2.16/8	1.26/19
Leukemia	7.00*/3	1.07/2
Lymphoid	∞/2	∞/1
Myeloid	2.33/1	0.53/1
Brain	1.79/2	0.90/4
Lymphomas	3.59*/5	1.94/8
Multiple Myeloma	-/0	∞/1
Breast	-/0	∞/2
Prostate	4.38/3	3.48*/9
Bladder	0.60/1	0.78/5

§ SIRs are the ratios of observed to expected numbers of cancer cases, using nonline workers as the control group.

† Among 4,547 cable splicers and 9,561 central office technicians

* Statistically significant at the 95% level

∞ No cases expected

been trying to raise funds for a case-control study of female breast cancer and its possible link to EMFs—so far unsuccessfully.

Matanoski, Elliott and Breyse also have data on female telephone workers but they have not yet analyzed them.

In a telephone interview after the Portland meeting, Breyse pointed out that the workers in the central offices were exposed to different types of EMFs than were the other telephone linemen. The on-off switching of the equipment generated EMF spikes, which resulted in field exposures that were more complex than simple 60 Hz fields.

Matanoski told *Microwave News* that, "A study of animals exposed to these types of fields is now needed."

Breyse explained that he was unable to measure high frequency transients in the central offices because they are not picked up by the EMDEX meter used in the study. The EMDEX meter was developed by the Electric Power Research Institute (EPRI). It has a 3 dB bandwidth, picking up frequencies from 40 to 300 Hz, according to EPRI's Dr. Stan Sussman.

"It may be that the intensity of the fields isn't the right index of exposure," Breyse said. "The intermittent on-off switching might be more important in terms of biological activity."

In 1987, Drs. Craig Byus and Ross Adey reported that intermittent exposure to 60 Hz EMFs may result in a greater

risk of cancer promotion than does continuous exposure⁴ (see *MWN*, N/D87).

There was some variation in the 60 Hz magnetic field exposures. Among the central office technicians, the average levels ranged from 0.6 to 10.9 mG, with a mean of 2.7 mG. The cable splicers were exposed to average fields of 4.3 mG, ranging from 0.6 to 23 mG.

Breyse said that he wants to investigate further the EMFs in the central offices—but this may be difficult. Since the measurements were taken, the telephone company has replaced most of the older electromechanical switches with new solid-state electronic ones. The older units were operated manually by technicians, entailing EMF exposures. Today, it is virtually impossible to find large facilities still using the old switches. Breyse said that he might have to go outside the U.S. to measure EMFs from older equipment.

HIGHLIGHTS

IBM Markets Low VLF Radiation VDTs Worldwide

IBM has introduced a new line of computer terminals that are shielded to reduce magnetic fields. The move came "in response to an emerging customer requirement," Paul Snayd, manager of Video Display Terminals (VDTs) and Special Needs Programs at IBM's Personal Systems Division, told *Microwave News*. Previously, IBM sold low magnetic field terminals only in Denmark and Sweden.

The terminals meet the Swedish standards for very low frequency (VLF) magnetic fields, Rita Black, an IBM spokeswoman, said in an interview (see *MWN*, S/O88 and M/J89 for more on Swedish standards). When asked to estimate the cost of adding magnetic shielding, Snayd replied that it was "impossible to determine"—he said he could not separate it from the overall cost of the unit. The terminals are not shielded at extremely low frequencies (ELF).

A spokeswoman for Digital Equipment Corp. (DEC), based in Maynard, MA, said that DEC has been marketing low magnetic field VDTs for some time. The shielded DEC terminals cost \$200 more than comparable unshielded units.

The new IBM InfoWindow flat displays, which are also designed to reduce reflections and to improve resolution, were announced in September. At present, the monochrome and color terminals are available in the U.S. and Canada for use only with mid-range and mainframe computers. Terminals for personal computers will be introduced in the first quarter of 1990, Black said.

On August 17, 1987, IBM applied for a U.S. patent for a "relatively inexpensive" way to modify a cathode ray tube (CRT) to reduce magnetic fields at the operator's position. In its application, IBM stated that tests had "demonstrated dra-

The JHU team will most likely submit the results of both the New York and the national studies for publication in 1990.

The New York study is supported by the National Institute of Environmental Health Sciences and by EPRI. EPRI is the sole sponsor of the original leukemia mortality study.

1. H.Y. Yap et al., "Male Breast Cancer: A Natural History Study," *Cancer*, 44, pp.748-754, August 1979.
2. Robert M. Moldwin and Eduardo Orihuela, "Breast Masses Associated With Adenocarcinoma of the Prostate," *Cancer*, 63, pp. 2229-2233, June 1, 1989.
3. Richard Stevens, "Electric Power Use and Breast Cancer: A Hypothesis," *American Journal of Epidemiology*, 125, pp.556-561, 1987.
4. Craig V. Byus, Susan E. Pieper and W. Ross Adey, "The Effects of Low-Energy 60 Hz Environmental Electromagnetic Fields Upon the Growth-Related Enzyme Ornithine Decarboxylase," *Carcinogenesis*, 8, pp.1385-1389, October 1987.

Leukemia Linked to Chronic Microwave Exposure

Chronic exposure to microwave radiation may lead to the development of acute myelogenous leukemia (AML), according to a group of French physicians.

In a case report appearing in the October issue of the *British Journal of Haematology*, the doctors note that, to the best of their knowledge, this is the first reported case of AML attributable to microwaves.

A 46-year-old man who had worked as a microwave technician for 22 years was diagnosed with AML in November 1988. His job was to maintain powerful (up to 3 kW) microwave generators used in professional microwave ovens—the work involved turning each unshielded generator on for one minute, five or six times a day, six days a week. He was not exposed to any known carcinogenic chemicals on the job.

The technician had abnormally developed myeloid blood cells and genetic abnormalities, including a missing chromosome (No. 7) and a translocation. Treatment, which included chemotherapy and a bone marrow transplant, failed and he died four months after diagnosis.

See Eric Archimbaud et al., "Acute Myelogenous Leukaemia Following Exposure to Microwaves," *British Journal of Haematology*, 73, pp.272-273, October 1989. Archimbaud and coworkers are based at the Edouard Herriot Hospital in Lyon.

matic reductions in the unwanted radiation in front of CRTs."

A copy of IBM's application (No.084949) was obtained by *Microwave News* after IBM refused to release it due to its

HIGHLIGHTS

"proprietary" nature. Cynthia Stevens, an IBM spokeswoman in Armonk, NY, said that the patent has not yet been granted by the Patent and Trademark Office at the U.S. Department of Commerce.

According to the patent application, IBM can reduce VLF magnetic fields to a level five to ten times less than that from an unshielded CRT. At a distance of 55 cm from the neck ("yoke") of an unshielded CRT, the magnetic field is in the range of 1-2 μ T (10-20 mG). In the patent claim, IBM stated that its shielding system reduces that field to less than 0.2 μ T.

The shielding consists of a "magnetic shunt"—a ring made of magnetically permeable material—which is attached to the yoke of the CRT. In its application, IBM noted that: "The invention may be embodied in forms which are made of relatively inexpensive linear ferrite materials configured in shapes that are inexpensive to provide."

RF Radiation: Focus on Broadcaster Compliance

The magnetic fields at the base of quarter-wavelength AM radio towers are more likely to exceed safety standards than are electric fields, according to a survey by Richard Tell for the Federal Communications Commission (FCC). Tell, of Richard Tell Associates in Las Vegas, NV, also found that the FCC's model for predicting AM radiation levels tends to overestimate the necessary safety zones around broadcast towers.

In a second report, prepared for the National Association of Broadcasters (NAB), Tell found that, in many cases, radiofrequency (RF) "hot spots" from radio and television stations should not be interpreted as violations of the FCC's RF rules, which are based on the 1982 American National Standards Institute (ANSI) guidelines.

Last year, prompted by a petition from Hammett & Edison, a consulting engineering firm in San Francisco, CA, the FCC issued proposed guidelines for addressing hot spots (see *MWN*, S/O87 and S/O88). A final decision on these proposals is now before the FCC.

On the basis of measurements at four Las Vegas AM stations, three directional and one non-directional, Tell concluded that, "At locations very near the base of AM towers, there can be spatial variation in the RF field strengths." He advised that compliance assessment include measurements all around the perimeter of a tower to "insure finding the maximum field level."

Tell found that the FCC's OST Bulletin No.65, which presents a way of estimating RF fields from broadcast sources (see *MWN*, S/O85), is "very conservative"—that is, the models "over-predict" the actual field levels. This conclusion agrees with that of Dr. Robert Cleveland of the FCC and Edwin Mantiply of the Environmental Protection Agency. At the Bioelectromagnetics Society meeting last June, they re-

BENER Digest To End

The Office of Naval Research (ONR) has refused to renew its sponsorship of the quarterly digest of the technical literature on the *Biological Effects of Non-Ionizing Electromagnetic Radiation (BENER)*. The digest, which first appeared in 1974, will cease publication after the release of issue 13 (1), now at the printer.

When asked why the ONR would no longer support the digest, an ONR spokesman replied that it was because, "We no longer have a program in the [non-ionizing radiation] area." Other federal agencies had funded the digest before the Navy.

The digest is compiled by Dr. Bruce Kleinstein of Information Ventures, Inc. in Philadelphia, PA. Kleinstein told *Microwave News* that he is seeking new funding from several federal agencies, but none has yet come up with the necessary money.

Dr. Imre Gyuk, program manager for electromagnetic research at the Department of Energy (DOE) conceded that there was "little probability" that DOE would pick up the *BENER* digest. "It's worthwhile, but difficult to fit into our setup," he said.

The digest is distributed to 650 readers around the world at no charge.

ported that, based on their own AM surveys, in most cases "computer techniques over-predicted actual electromagnetic field levels."

Tell also told the FCC that the contact currents from some guy wires at AM stations can exceed 100 mA and that touching these wires can result in RF burns. He added that there are simple ways to control these risks.

Among Tell's other findings in his report to the NAB on very high frequency (VHF) broadcast stations: surface field strengths are not good indicators of the specific absorption rates (SARs) which can result from contact with the source; contact currents are meaningful surrogates of peak SARs; and simple meters can be built to measure contact currents.

"We have shown that there is a practical way to estimate peak SARs on-site for broadcast sources," Tell told *Microwave News*.

Electric and Magnetic Fields and Contact Currents Near AM Standard Broadcast Radio Stations (FCC/OET RTA 89-01), August 23, 1989, is available for \$15.95 plus \$3.00 shipping and handling from: National Technical Information Service, Springfield, VA, 22161, (800) 336-4700; order No. PB89234850. *An Investigation of RF Induced Hot Spots and Their Significance Relative to Determining Compliance with the ANSI [RF] Protection Guide*, July 3, 1989, is available free from: NAB Science and Technology Dept., 1771 N St., NW, Washington, DC 20036, (202) 429-5350. A report by Cleveland and Mantiply is due by mid-1990.

FAA Ranks Protecting Avionics From EMI as High Priority

The Federal Aviation Administration (FAA) has initiated a high priority program to protect electronic flight systems from high-power radiofrequency and microwave (RF/MW) radiation. The agency is now in the process of developing electromagnetic interference (EMI) standards and expects to issue proposed rules by the end of 1990, with final standards due in mid-1991.

The agency is considering barring susceptible aircraft from regions with high-power RF/MW sources in the 10 kHz to 14 GHz frequency range. For the present, the FAA has established interim shielding specifications: 200 V/m for new critical flight systems and 100 V/m for modified systems.

The agency's interest was sparked by reports of accidents attributed to EMI involving military aircraft equipped with advanced electronics, an FAA aerospace engineer told *Microwave News*. Over the past few years, such high-tech aircraft as the U.S. Army's Black Hawk and Apache helicopters and the U.K.'s Tornado have been plagued with EMI-related incidents (see *MWN*, N/D87, S/O88, N/D88 and M/A89). The engineer noted, however, that there have been no such incidents involving civilian aircraft.

While the FAA proceeds with developing new rules, the aviation industry is downplaying the seriousness of the problem, maintaining that it is still "premature" to regulate.

Economics are no doubt at the heart of the disagreement. As one seasoned EMI expert explained, "Anytime you increase the level of protection, you jack up the price of the equipment."

In an FAA position paper issued this spring, the agency cited the increased use of advanced digital technology that is susceptible to interference and the "dramatically" higher power levels from radio, TV and radar emitters as reasons for concern. The use of composite materials with "lower shielding effectiveness" was also noted. The combination of these three developments results in an "increased susceptibility level of electrical and electronic systems to electromagnetic fields," the FAA concluded.

Describing the existing rules as "inadequate," the FAA called for federal aviation regulations to protect electrical and electronic systems from high energy fields and also called for radiated energy emitters to be monitored and controlled.

At a July 12 briefing, the FAA predicted maximum RF/MW field strengths that could be encountered by aircraft—the so-called "threat envelope." In the 1-10 MHz frequency band, field strengths may be as high as 1 kV/m; in the 1-10 GHz range, they may reach 14 kV/m. Shipboard radars are among the common sources of such powerful fields, according to the FAA aerospace engineer.

The FAA has concluded that the "predicted environment is real" and that "critical electrical and electronic systems must be protected."

The Society for Automotive Engineers (SAE) and the Radio Technical Commission for Aeronautics (RTCA) have set up special subcommittees to define test methods and to update the RTCA environmental standards for critical systems, respectively. In a draft report issued at the end of last year, an RTCA committee recommended that airline passengers not use computers and other electronic devices during takeoffs and landings to guard against EMI (see *MWN*, N/D88).

In a July 24 letter to the FAA, Stanley J. Green, vice president of the General Aviation Manufacturers Association (GAMA), claimed that instances in which civilian aircraft have been affected by high energy RF/MW fields have been rare and that "the problems seem to be extreme nuisances rather than specific safety issues." Green's letter followed the July 12 briefing at which GAMA and other industry groups discussed high energy RF/MW fields with the FAA.

In contrast to the FAA, Green contended that "properly designed digital systems and composite-airframes are less susceptible to [these fields]...than their analog avionics and metal airframe counterparts" and that "all observed or suspected [interference] events have been with 'older' aircraft."

With regard to the EMI-related military accidents, Green added that "the critical flight systems on most of these aircraft were analog systems."

Industry would also like to see more controls on RF/MW emitters. "How can you tell the manufacturers that they have to meet these levels without putting some controls on the sources?" Green told *Microwave News*.

See also *Avionics System Design for High Energy Fields* (DOT/FAA/CT-87/19), available from: National Technical Information Service, Springfield, VA 22161.

NIER in Nordic Countries

Agencies in Denmark, Finland, Norway and Sweden have relatively large research programs on non-ionizing electromagnetic radiation (NIER). A review of their efforts is now available in a report issued by the Swedish National Institute of Radiation Protection (NIRP).

The report is the proceedings of a conference held at NIRP on May 29-30, 1989. The first day was devoted to optical radiation, and the second to extremely low frequency (ELF), very low frequency (VLF), radiofrequency (RF) and video display terminal (VDT) radiation.

Among the topics covered were: Swedish surveys of VDT emissions, Swedish research on ELF and VLF radiation effects on chromosomal aberrations and on VLF effects on pregnant mice, NIER legislation and standards in Sweden and Finland, Finnish RF meters and a listing of ongoing research.

A copy of *2nd Nordic Meeting on Non-Ionizing Radiation* (Report No.89-15) is available for 50 Kr. (approximately \$8.00) from: Peter Williams, NIRP, Box 60204, S-104 01 Stockholm, Sweden, (08) 729-7100.

CONFERENCES

1990 Conference Calendar

January 3-5: **3rd International Conference on Fundamentals of Bone Growth: Methodology and Applications**, University of California, Los Angeles (UCLA), CA. Contact: Dr. Andrew Dixon, Schools of Dentistry and Medicine, 63-090 CHS, UCLA, Los Angeles, CA 90024, (213) 825-1761.

February 4-9: **IEEE Power Engineering Society Winter Meeting**, Westin Peachtree Plaza, Atlanta, GA. Contact: Nancy Heitmann, IEEE Special Services, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855, (201) 562-3882.

February 13-15: **14th Symposium on Explosives and Pyrotechnics**, Holiday Inn Crowne Plaza, Burlingame, CA. Contact: E&P Affairs, Franklin Research Center, 2600 Monroe Blvd., Norristown, PA 19403, (215) 666-3026.

February 13-15: **Instrumentation/Measurement Technology Conference (IMTC), Emerging Measurement Technologies**, Red Lion Inn, San Jose, CA. Contact: Robert Myers, 3685 Motor Ave., Suite 240, Los Angeles, CA 90034, (213) 287-1463.

February 18-22: **34th Annual Meeting of the Biophysical Society**, Convention Center, Baltimore, MD. Contact: Biophysical Society, 9650 Rockville Pike, Bethesda, MD 20814, (301) 530-7114.

March 25-28: **1st International Congress on Therapeutic Electromedicine and Lasers**, Hyatt Regency, Jerusalem, Israel. Contact: Dr. Zion Singer, Open University of Israel, PO Box 39328, Tel Aviv, 61392 Israel.

March 26-27: **16th Annual Northeast Bioengineering Conference**, Pennsylvania State University, University Park, PA. Contact: Roger P. Gaumond, Bioengineering Program, 230 Hallowell Bldg., Pennsylvania State University, University Park, PA 16802, (814) 865-1407.

March 30-April 3: **44th Annual Broadcast Engineering Conference and 68th Annual Convention of the National Association of Broadcasters (NAB)**, World Congress Center, Atlanta, GA. Contact: Engineering Conference Committee, NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5346.

April 1-5: **74th Annual Meeting of the Federation of American Societies for Experimental Biology (FASEB)**—includes the *International Society for Bioelectricity*, Washington, DC. Contact: FASEB Office of Scientific Meetings, 9650 Rockville Pike, Bethesda, MD 20814.

April 4-5: **26th Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP)**, Mayflower Hotel, Washington, DC. Contact: NCRP, 7910 Woodmont Ave., Suite 800, Bethesda, MD 20814, (301) 657-2652.

April 7-12: **38th Annual Meeting of the Radiation Research Society and 10th Annual Meeting of the North American Hyperthermia Group**, Sheraton Hotel & Tower, New Orleans, LA. Contact: Radiation Research Society, 1101 Market St., 14th Floor, Philadelphia, PA 19107, (215) 574-3153.

April 16-21: **2nd International Symposium on Microwave Processing of Materials**, San Francisco, CA. Contact: Materials Research Society, 9800 McKnight Rd., Suite 327, Pittsburgh, PA 15237.

April 17-20: **International Magnetics Conference (INTERMAG'90)**, Metropole Hotel, Brighton, U.K. Contact: Courtesy Associates, 655 15th St., NW, Suite 300, Washington, DC 20005, (202) 639-5088.

April 24-27: **Electrical Potpourri**, Transmission Line Mechanical Research Center, Haslet, TX. Contact: Richard Kennon, EPRI, PO Box 10412, Palo Alto, CA 94303.

April 25-27: **6th Annual Meeting of the Electromagnetic Energy Policy Alliance (EPA)**, Radisson Mark Plaza Hotel, Alexandria, VA. Contact: Richard Ekfelt, EEPA, 1255 23rd St., NW, Washington, DC 20037, (202) 452-1070.

May 1-3: **6th International Ionospheric Effects Symposium**, Washington, DC. Contact: Ionospheric Effects Symposium Coordinator, Code 4180, Na-

val Research Laboratory, Washington, DC 20375.

May 5-9: **25th Annual Meeting of the Association for the Advancement of Medical Instrumentation (AAMI)**, Anaheim Marriott Hotel, Anaheim, CA. Contact: AAMI, 3330 Washington Blvd., Suite 400, Arlington, VA 22201, (800) 332-2264, or (703) 525-4890 (in VA).

May 6-10: **Annual National Conference on Radiation Control**, Marriott Hotel, Salt Lake City, UT. Contact: Conference of Radiation Control Program Directors, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 6-11: **12th World Congress on Occupational Safety and Health**, Congress Centrum, Hamburg, F.R.G. Contact: Hamburg Messe und Congress GmbH, Postfach 30 24 80, D-2000 Hamburg 36, F.R.G., (040) 35 69 22 42.

May 7-10: **IEEE 1990 International Radar Conference**, Marriott Crystal Gateway Hotel, Arlington, VA. Contact: Robert Hill, ITT Defense, 1000 Wilson Blvd., 30th Fl., Arlington, VA 22209.

May 7-11: **IEEE AP-S International Symposium & URSI Radio Science Meeting**, Dallas Convention Center, Dallas, TX. Contact: Dr. Oren Kesler, PO Box 860130, Plano, TX 75086, (214) 952-3772.

May 8-10: **IEEE MTT-S International Microwave Symposium**, Dallas, TX. Contact: Tatsuo Itoh, c/o LRW Associates, 1218 Balfour Dr., Arnold, MD 21012.

May 13-14: **Annual Meeting of the Society for Light Treatment and Biological Rhythms (SLTBR)**—a satellite of the annual meetings of the *American Psychiatric Association*, May 12-17, and the *Society of Biological Psychiatry*, May 9-13, New York, NY. Contact: SLTBR Annual Meeting, 722 West 168th St., Box 50, New York, NY 10032.

May 20-24: **1990 International Geoscience and Remote Sensing Symposium (IGARSS '90)**, College Park, MD. Contact: Dr. James A. Smith, Code 623, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, (301) 286-7282.

May 23-25: **44th Annual Frequency Control Symposium**, Stouffer Harbor Place Hotel, Baltimore, MD. Contact: Dr. R.L. Filler, U.S. Army Electronics Technology and Devices Lab, ATTN: SLCET-EQ, Fort Monmouth, NJ 07703, (201) 544-2467.

June 5-7: **4th International Conference on Advanced Infrared Detectors and Systems**, London, U.K. Contact: Institution of Electrical Engineers (IEE), Savoy Pl., London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

June 10-14: **12th Annual Meeting of the Bioelectromagnetics Society (BEMS)**, Marriott Riverwalk Hotel, San Antonio, TX. Contact: BEMS, 120 W. Church St., Frederick, MD 21701, (301) 663-4252.

June 11-13: **11th Annual Meeting of the Canadian Radiation Protection Association**, Saint John, New Brunswick, Canada. Contact: Dr. J.J. Paciga, Health Physics Dept., Point Lepreau Generating Station, PO Box 10, Lepreau, New Brunswick E0G 2H0, Canada, (506) 659-2220.

June 11-14: **Conference on Precision Electromagnetic Measurements**, Westin Hotel, Ottawa, Ontario, Canada. Contact: National Research Council of Canada, Bldg. M19, Montreal Rd., Ottawa, Ontario K1A 0R6, Canada, (613) 993-9009.

In Our Next Issue...

- Book Reviews
- Power Line EMF Meters

June 17-22: **Health Physics Society (HPS) Summer School: Assessing Non-Ionizing Radiation Hazards**, Fullerton, CA. Contact: John Elliott, California State University, Radiation Safety Office, Fullerton, CA 92634, (714) 773-2687.

June 24-28: **35th Annual Meeting of the Health Physics Society (HPS)**, Anaheim, CA. Contact: HPS, 8000 Westpark Dr., Suite 400, McLean, VA 22102, (703) 790-1745.

June 26-29: **10th International Wroclaw Symposium on Electromagnetic Compatibility**, Wroclaw, Poland. Contact: Dr. W. Morón, Box 2141, 51-645 Wroclaw 12, Poland.

July 15-19: **1990 IEEE Power Engineering Society Summer Meeting**, Marriott Hotel, Minneapolis, MN. Contact: Bruce F. Wollenberg, Control Data Corp., Energy Management Systems, 2300 Berkshire Lane N., Plymouth, MA 55441, (612) 553-4357.

July 23-27: **5th International Conference on Radio Receivers and Associated Systems**, Churchill College, Cambridge, U.K. Contact: IBE, see June 5-7 above.

July 23-27: **1990 Bioelectrochemistry Gordon Conference**, Proctor Academy, Andover, NH. Contact: Dr. Mays Swicord, FDA, [HFZ-114], 5600 Fishers Lane, Rockville, MD 20857, (301) 443-7153.

July 23-27: **Non-Ionizing Radiations: Health Physics & Radiation Protection**, Massachusetts Institute of Technology (MIT), Cambridge, MA. Contact: Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139, (617) 253-2101.

August 13-15: **Annual Meeting of the International Society of Environmental Epidemiology**, Berkeley, CA. Contact: Dr. Raymond Neutra, Epidemiology Studies Section, Dept. of Health Services, 2151 Berkeley Way, Berkeley, CA 94704, (415) 540-2924.

August 21-23: **IEEE International Symposium on Electromagnetic Compatibility**, Washington Hilton Hotel, Washington, DC. Contact: Dr. William G. Duff, Atlantic Research Corp., 5390 Cherokee Ave., Alexandria, VA 22312, (703) 642-4049.

August 27-29: **25th Annual Microwave Power Symposium**, Sheraton Tech Center, Denver, CO. Contact: Robert LaGasse, International Microwave Power Institute, 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

August 28-31: **7th International Conference on Electromagnetic Compatibility**, University of York, U.K. Contact: IEE, see June 5-7 above.

August 28-September 5: **23rd General Assembly of the International Union of Radio Science (URSI)**, Praha, Czechoslovakia. Contact: Prof. V. Zima, Institute of Radioengineering and Electronics, Czechoslovak Academy of Sciences, 182 51 Praha 8, Czechoslovakia.

September 10-13: **12th Annual Electrical Overstress/Electrostatic Discharge (EOS/ESD) Symposium**, Lake Buena Vista, FL. Contact: Betty

Post, EOS/ESD Association, 201 Mill St., Rome, NY 13440, (315) 339-6937.

September 10-13: **20th European Microwave Conference**, Intercontinental Hotel, Budapest, Hungary. Contact: Microwave Exhibitions & Publishers, Ltd., 90 Calverley Rd., Tunbridge Wells, Kent TN1 2UN, U.K., (0892) 544027.

September 18-21: **3rd Asia-Pacific Microwave Conference**, Sunshine City Prince Hotel and Convention Center, Tokyo, Japan. Contact: Prof. Yoshiyuki Naito, c/o Business Center for Academic Societies Japan, 3-23-1 Hongo, Bunkyo-ku, Tokyo 113, Japan, (3) 817-5831.

September 22-28: **23rd International Congress on Occupational Health of the International Commission on Occupational Health**, including a mini-symposium on *Exposure to Low-Frequency Electromagnetic Fields—An Occupational Health Hazard?* Montréal, Québec, Canada. Contact: Congress Secrétariat, 58 de Brésolles, Suite 2, Montréal, Québec H2Y 1V5, Canada, (514) 499-9835.

September 26-28: **Energy and the Environment Conference & Exhibition**, Denver, CO. Contact: Electric Utility Consultants, Inc., PO Box 20351, Englewood, CO 80156.

October 4-6: **International Conference on Harmonics in Power Systems**, Budapest, Hungary. Contact: Dr. Andras M. Dan, Budapest Technical University, Dept. of Power Systems, 1111 Budapest, Egy Jozsef u.18., Hungary, 361-666-438.

October 14-17: **10th Anniversary Meeting of the Bioelectrical Repair and Growth Society (BRAGS)**, Penn Tower Hotel, Philadelphia, PA. Contact: Executive Secretary, BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

October 17-19: **EPRI EMF Utility Seminar**, Four Seasons Hotel, Austin, TX. Contact: Robert S. Banks Associates, Inc., PO Box 10574, University Station, Minneapolis, MN 55414, (612) 623-4646.

October 26-28: **International Congress on Molecular Changes by Microwaves**, Vienna, Austria. Contact: Prof. Gert Lubec, 99 Muswell Ave., Muswell Hill, London N10 2EJ, U.K., (01) 883-9095.

October 28-November 1: **IEEE Power Engineering Society (PES) International Power Meeting—India**, New Delhi, India. Contact: T.W. Hissey, Leeds & Northrup Co., Sumneytown Pike, North Wales, PA 19454, (215) 699-2000.

November 1-4: **12th Annual International Meeting of the IEEE Engineering in Medicine & Biology Society**, Wyndham Franklin Plaza Hotel, Philadelphia, PA. Contact: Dr. Nihat Bilgutay, Electrical and Computer Engineering Dept., Drexel University, Philadelphia, PA 19104, (215) 895-2257.

November 13-15: **JINA '90 International Symposium on Antennas**, Nice, France. Contact: Secrétariat JINA '90, M. Guiraud, CNET-PAB Centre de La Turbie, 06320 La Turbie, France, (33) 93 41 15 30.

UPDATES

COMPATIBILITY & INTERFERENCE

Big Mac Attacks...EMI with electronic restaurant equipment has prompted McDonald's Corp., the world's largest fast-food chain, to develop its own EMC standards. In the September/October issue of *EMC Technology*, Fernando Esparza, a McDonald's EMC expert, describes how a number of McDonald's restaurants have been plagued by mysterious electrical glitches. For example, cash register drawers at one drive-thru restaurant kept opening by themselves until it was

discovered that the ghost-like withdrawals coincided with visits by police cars equipped with high-power communications gear. Every time a police car responded to a call while at the drive-thru window, the cash drawers shot open. Installation of an RF filter resolved the problem. Another restaurant reported frequent "ghost orders" on its system—spurious requests for burgers, fries and drinks. In this case, conducted—rather than radiated—signals were responsible. A power line filter cleared up the phantom orders. Esparza notes that McDonald's felt compelled to set its own standards due to the

UPDATES

lack of published EMC limits. Copies of McDonald's *Electrical Disturbance Standards* are available for \$12.25 from: ICT Publications Group, PO Box D, Gainesville, VA 22065.

Power Lines No Hazard to EEDs...An analysis by Thomas Baginski of Auburn University in Auburn, AL, indicates that overhead transmission lines and substations do not present a risk to electro-explosive devices (EEDs). Even under worst-case conditions, the induced currents from electric or magnetic fields will not detonate an unshielded EED. Baginski's paper appears in the *IEEE Transactions on Electromagnetic Compatibility*, 31, pp.393-395, November 1989.

INTERNATIONAL

European Society Off and Running...On December 15, the European Bioelectromagnetics Association (EBEA) will be officially launched in Madrid, Spain (see *MWN*, M/J89). The founding members are: Drs. Alessandro Chiabrera (Italy), Richard Dixey (U.K.), Maurice Hinsenkamp (Belgium), Jocelyne Leal (Spain) and Bernard Veyret (France). Still under discussion are the specific details of a planned cooperative agreement between EBEA and the U.S.-based Bioelectromagnetics Society (BEMS). For more information, contact: Dr. Jocelyne Leal, Department of Research, Hospital Ramón y Cajal, Carreterra de Colmenar, Km 9, Madrid 28034, Spain, (1) 336-8699.

MEETINGS

Membranes and Cancer...The New York Academy of Sciences has published the proceedings of a conference on *Biological Membranes in Cancer Cells*, held in Perugia, Italy, in June 1988. The conference was held in honor of Dr. Britton Chance's 75th birthday. The proceedings are collected in Volume 551 of the *Annals of the New York Academy of Sciences*, December 30, 1988.

MILITARY SYSTEMS

More on PAVE PAWS and EEDs...The PAVE PAWS radar at Robins AFB, GA, poses a "possible risk to aircraft with internal [electro-explosive devices] EEDs," the USAF admitted in a September letter to Senator Sam Nunn (D-GA). Last year, the USAF acknowledged that planes with *external* EEDs may be in danger when flying through the radar's main beam (see *MWN*, J/A88 and N/D88). Soon after, Nunn, chairman of the Senate Armed Forces Committee, asked the USAF to investigate the potential hazards and the long-term adequacy of the current system (see *MWN*, J/F89). In his September 1989 letter, released in late November, Major General Burton Moore assured Nunn that the USAF is implementing "procedures to ensure aircraft with internal EEDs are also protected," but also that the procedures "will not reduce the scope of Robins AFB air operations or restrict planning for future operations." Nunn was far from satisfied, however. On November 20, he wrote back that the USAF has not "fully ad-

ressed all of the issues I raised" and that the letter "raises a number of additional questions"—i.e., "Is the [USAF] still attempting to find a solution that...restores both unrestricted flight operations and uninterrupted radar operations?" Meanwhile, USAF Lt. Col. Joseph Purka told Stuart Leavenworth of the *Macon Telegraph and News* (November 23) that a PAVE PAWS power upgrade "hasn't been ruled out."

PEOPLE

Dave Janes, who was in charge of EPA's non-ionizing radiation program before his retirement in October, is now a consultant working with Dr. **David Rosenbaum** at Risk Analysis Corp. in McLean, VA. Rosenbaum is a former director of EPA's Office of Radiation Programs (ORP). **Marty Halper** has taken over Janes's post as the head of the ORP's Analysis and Support Division. Halper comes from EPA's Office of Toxic Substances....Dr. **Jan Walleczek** has joined Dr. **Robert Liburdy**'s Bioelectromagnetics Research Facility at the Lawrence Berkeley Lab in Berkeley, CA, as a visiting scientist. Walleczek's work is being sponsored by the West German DFG, analogous to the U.S.'s NSF.

RESOURCES

Of Particular Interest...Drs. M.A. Uman and E.P. Krider provide a fascinating look at "Natural and Artificially Initiated Lightning" in the October 27 *Science*....In the December *Scientific American*, Drs. Jeremy Bloxham and David Gubbins describe "The Evolution of the Earth's Magnetic Field."

ETC...

Baby Party Line...If you hear a baby crying, it might not be your own—if you use a walkie-talkie baby monitor. Parents in a Miami, FL, neighborhood who own Fisher-Price crib monitors have been picking up the cries of their neighbors' infants—and their neighbors' conversations—according to a Knight-Ridder news service report in the November 2 *Washington Post*. The problem is overlapping signals, says Fisher-Price; other brands of baby monitors are equally vulnerable in neighborhoods with many young families. The units consist of a transmitter placed in the crib and a receiver placed near the parents. For its part, Fisher-Price suggests that parents turn off the monitors when they're not using them because "somebody could be listening" in.

The KGB Signal...Boris Yeltsin, the populist politician who swings in and out of favor in the Soviet Union, has told a reporter that the KGB has an ELF device that can stop a human heart from beating. In an interview with Radio Liberty, a U.S.-backed shortwave radio station in West Germany, Yeltsin said that KGB agents told him that they have a device which emits a powerful 7-11 Hz signal which can stop the heart. According to Yeltsin, the KGB agents said that, "If emergency medical aid isn't close at hand, it's all over." The radio interview was reported by the *Baltimore Sun* on October 20.

Swedish Academy of Sciences on Low-Level EMF Effects

On May 25-27, the Royal Swedish Academy of Sciences held a workshop on Interaction Mechanisms of Low-Level Electromagnetic Fields [EMFs] in Living Systems—Resonant Phenomena (see MWN, M/A89). Reprinted below are the conclusions from that meeting. Dr. Bengt Nordén is with the Chalmers University of Technology in Göteborg and Dr. Claes Ramel is with Stockholm University.

Soon after the meeting, a working group, whose members included Nordén and Ramel, issued a statement. This was later withdrawn and replaced by the version presented here.

During the past decade there has been an increasing concern that weak, low-frequency [EMFs] might have significant effects on biological systems. With the intent of promoting understanding of possible basic interaction mechanisms, the Environmental Committee of the Royal Swedish Academy of Sciences organized an international workshop on the subject *Interaction Mechanisms of Low-Level Electromagnetic Fields in Living Systems—Resonant Phenomena*. The workshop concentrated on some recently reported phenomena indicating that weak, extremely low frequency [EMFs] might interact in an apparently resonant manner with certain cellular systems. The presentations by the invited speakers included studies of biosynthesis, ion-transport phenomena, and epidemiological studies, and the effects of fields of varying frequency and strength on these systems. In addition, theoretical considerations of resonance interactions were presented, more specifically, calculations based on the so-called cyclotron resonance model.

The epidemiological studies seem to indicate a slight overall increase in the relative risk of cancer, especially childhood cancer, associated with residential exposure to magnetic fields. Exposure of *Drosophila* and human cells was reported to show altered signal- and cell-specific patterns of transcription and translation following short cellular exposure to low-frequency [EMFs]. It appears also that the release of certain chemical species, such as Ca^{2+} ions from cellular tissue, varies in a frequency-specific manner (with so-called "frequency windows") with applied AC and DC magnetic fields. The effects are observed only in certain field strength ranges (so-called "amplitude windows"), at field strengths typically several orders of magnitude lower than in the *Drosophila* experiments. Field-induced changes have also been reported in ornithine decarboxylase activity and protein kinase C activity, effects which have been associated with cell proliferation with possible connection to cancer promotion. There were also brief reports on electromagnetic effects in a variety of other biological systems.

On the whole, it was difficult to make a critical assessment of the available experimental evidence since no clear and reproducible pattern emerged from the results. Most groups had chosen to work on

systems of widely different nature and level of complexity and although the majority of observations suggested that weak, low-frequency [EMFs] could affect biological functions, it was not always easy to relate and compare the individual studies.

Several mechanisms of interaction have been proposed, mainly focusing on the cell membrane as a possible site of action for the reported effects, for instance, the generation of coherent waves along the membrane surface. The mechanistic model based on cyclotron-like resonance of ion transport through membrane channels appeared, however, to be the only quantitatively formulated model which has been used so far to interpret the experimental results. This model is attractive in the sense that it could account for the frequency and amplitude windows as well as the experimentally observed relationship between the charge-to-mass ratio of the ion and the frequency and strength of the magnetic field. On the other hand, it has serious shortcomings with respect to the predicted magnitude of effects in biological structures, as pointed out by several workers. The region of space inside a channel, for instance, is extremely small and constrains the particle motion to such an extent that the absorption of energy in the low-frequency range was shown to be many orders of magnitude smaller than the thermal energy. This problem becomes less serious for particle paths extending over cellular dimensions, although at this macroscopic level, the frictional forces can be anticipated to be significant, and with a reasonable estimate of their magnitude, they were found to eliminate completely the resonance phenomenon.

These problems could not be resolved and instead it was argued that the search for a physical mechanism might be more fruitful if directed towards the realm of collective phenomena.

The fact that current physical-chemical models cannot provide adequate explanations of the reported observations of biological effects of [EMFs] has made this research area controversial. As a consequence, there is a reluctance among research workers to enter this debated field and the present status of the research efforts is characterized by scattered contributions, rather than the wide and systematic approach required to solve the important scientific problems concerning the effects and possible hazards of [EMFs].

In order to consolidate the experimental evidence, future research should aim at demonstrating the presence (or absence) of field effects on properties of well-characterized systems at the lowest possible level of complexity. This should facilitate replication by other independent groups and also help strengthen the link between theory and experiment. Considering the complexity and multidisciplinary nature of the problems, it is recommended that different interdisciplinary research groups coordinate their work.

Bengt Nordén
Claes Ramel

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