approximately 100 people. For more information, contact: Harold Comerer, Engineering Foundation, 345 East 47th St., New York, NY 10017, (212) 705-7835.

BRAGS Proceedings... More than 150 people from 13 countries attended this year's meeting of the Bioelectrical Repair and Growth Society (BRAGS), held in Toronto, Canada. Among the highlights was a paper by Dr. G. Borsalino and coworkers on one of the first double-blind clinical studies, which indicates the efficacy of 75 Hz PEMFs in the treatment of osteotomies – the stimulation of bone growth following an operation. The conference *Transactions* with the 92 abstracts of the presentations are available for $45.00 from BRAGS, PO Box 64, Dresher, PA 19025.

Capri in the Spring... Do you want to take a short course on *Worldwide Non-Ionizing Radiation Safety Standards: Their Rationale and Problems* taught by lecturers from Italy, Sweden and the U.S.? Do you want to go to the Italian island of Capri in the spring? Next May 2-6, you can do both. For more information, contact: Dr. Om Gandhi, Department of Electrical Engineering, University of Utah, Salt Lake City, UT 84112, (801) 581-7743.

EMC Society Papers... Hugh Denny of the Georgia Tech Research Institute, the chairman of the 1987 *IEEE International Symposium on Electromagnetic Compatibility*, held in Atlanta, GA, August 25-27, reports that there were more than 1,100 attendees and exhibitors at this year's meeting. He said that there was a great deal of interest in both the measurement of radiation emissions from computing devices, and – to the surprise of many – the workshop on the shielding of cable and connectors. A copy of the symposium record containing the 88 papers presented is available from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060; order No. 87CH2487-7, $31.00 for IEEE members and $62.00 for non-members.

EM Bioeffects in Israel...A group of German and Israeli organizations is sponsoring an *International Symposium on Interaction of Electromagnetic Fields with Biological Systems*, which will be held March 21-24 in Tiberias on the Sea of Galilee, Israel. Many of the speakers listed in the preliminary agenda are new to the conference circuit. The official languages of the meeting will be English and German. For more information, contact: ORTRA, Ltd., 2 Kaufman St., Tel Aviv 61500, Israel, (3) 664825.

MILITARY SYSTEMS

GWEN's Impact... After releasing a draft environmental impact statement (EIS) in April on its Ground Wave Emergency Network (GWEN), the U.S. Air Force (USAF) completed a final EIS this September. It includes public hearing reports, comments on the draft and the USAF's responses. The GWEN communication system, operating at 150-175 kHz and designed to withstand the EMP of a nuclear attack, will consist of 127 relay nodes at 150-200 mile intervals across the continental U.S. The USAF has adopted a 50 V/m standard for public exposures to GWEN radiation (see *MWN*, January/February and November/December 1986). On September 2, the Conservation Law Foundation (CLF) in Boston, MA, sued the USAF for failing to complete a separate EIS for each tower site and for not acknowledging the possibility that GWEN towers could be the targets of nuclear attacks. The U.S. District Court for Massachusetts denied the CLF's motion for a preliminary injunction against the construction of two GWEN towers in Maine and ruled that the National Environmental Policy Act (NEPA) does not require the USAF to study the effects of nuclear war. However, the court did agree that the USAF should have prepared an EIS for each site. To request a copy of the GWEN Final EIS, contact: Robert Le Blanc, ESD/DE3, Hanscom AFB, MA 01731, (617) 271-6354.

OCCUPATIONAL HEALTH

Rating MW Protective Suits... Fabrics which can attenuate microwave radiation can also be flammable, thereby forcing a tradeoff between radiation overexposures and fire hazards. Drs. Bill Guy and C.-K. Chou tested five microwave-protection suits and only the one made of a new "improved" fiber provided a combination of shielding and fire resistance. In the first of two papers, both appearing in the November issue of the *IEEE Transactions on Microwave Theory and Techniques*, they describe their test results with four of the suits – those from Wave Guarde (used by AT&T), Milliken, Invascreen and the U.S. Navy. The Navy suit gave the best protection (34-49 dB), but was very flammable. In contrast, the Milliken suit was the most fire retardant, but its shielding performance was the poorest. In the second paper, Guy, who is at the University of Washington in Seattle, and Chou, who used to collaborate with Guy and is now at the City of Hope National Medical Center in Duarte, CA, report that Milliken and Body Guard, a division of Lion Uniform, have jointly developed a material that can attenuate 2450 MHz radiation by at least 25 dB, and 915 MHz radiation by 20 dB. The fabric can also be machine-washed many times with only a small loss of radiation shielding. Guy and Chou conclude that the Milliken-Body Guard suit "can provide good protection for microwave frequencies above 650 MHz," but that "more work is needed...to develop a suit suitable for protecting workers from high radiation levels at broadcasting (VHF) and shortwave (HF) frequencies" (see also *MWN*, December 1981).

OVENS

Better Bacon... Cooking bacon in a microwave oven prevents carcinogenic chemicals from forming and has no effect on

taste, say scientists at the National Center for Toxicological Research in Jefferson, AR. According to an item in the *New Scientist* (September 24) grilling or frying bacon produces high levels of nitrosamines, potent cancer-causing agents, while cooking bacon with microwaves for 45 seconds does not.

***The* Hot Seller...**More microwave ovens were shipped in October than any major appliance in any month in history, according to the Association of Home Appliance Manufacturers. The 1.3 million microwave ovens sent out exceeded all monthly shipments for dishwashers, refrigerators, washers or dryers. So far this year, 10.1 million microwave ovens have been shipped – a slight increase over last year.

PEOPLE

With the acquisition of a controlling interest in Electro-Biology Inc. (EBI) by Biomet Inc., all members of EBI's board of directors have been replaced – except for **Thomas Duerden**, EBI's CEO. The board had advised stockholders against accepting Biomet's $6.25-a-share offer....There have also been changes at Clini-Therm Corp., a leading manufacturer of hyperthermia equipment: **William Flaherty** has resigned as president and **Franklin Jarman**, a former president, has taken over on a temporary basis....**Terry Strong**, the head of the Office of Radiation Protection in Washington state, is the new chairman of the Conference of Radiation Control Program Directors....Dr. **Genevieve Roessler** of the University of Florida in Gainesville is stepping down as the editor-in-chief of *Health Physics* next September. A search for a replacement is underway.

STANDARDS

CISPR Publications... The International Special Committee on Radio Interference (CISPR) will soon publish a report on RFI limits for industrial, scientific and medical (ISM) equipment, which will include a discussion of how CISPR and the International Radio Consultative Committee (CCIR) should collaborate on their research efforts. The cost of the report, designated CISPR Publication 23, was not available at press time. In addition, CISPR has published an amendment to *Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus*, CISPR 14-1985, Amendment No. 1 to 1987 ($6.00). CISPR has also published – as six-month draft rules – *Limits and Methods of Measurement of Radio Interference Characteristics of Sound and Television Receivers*, CISPR/E (Central Office) 25, Amendment of 4.1 of CISPR 13 ($7.00) and five parts to a forthcoming document, *Sound and Television Broadcast Receivers and Associated Equipment Limits and Methods of Measurement of the Immunity Characteristics in the Frequency Range 0.15 MHz to 1 GHz*, CISPR/E (Central Office) 19-23 (the total cost for all five parts is $162.00). All publications are available, prepaid, from the American National Standards Institute, International Sales Department, 1430 Broadway, New York, NY 10018, (212) 642-4900. The ISM document will be available in a short time.

Swedish Radiation Devices... The Swedish Ministry of Environment and Energy has proposed new legislation for products that emit ionizing and non-ionizing radiation. If adopted, the requirements will take effect on July 1, 1988. At present, the text is only available in Swedish, but a translation is being prepared. The Swedish text is free, while the cost of the English version will be divided among those ordering copies. For more information, contact: JoAnne Overman, Office of Standards Code and Information, NBS, Administration Building Room A629, Gaithersburg, MD 20899, (301) 975-4037. Ask for regulation TBT/Notif.87.154.

ETC...

NIER in *Health Physics*...The December issue of *Health Physics* features a special section on non-ionizing radiation, with papers by Drs. Bill Guy, Tom Tenforde, Bill Kaune and Joe Elder. In addition, Dr. Maria Stuchly presents the proposed revised Canadian RF/MW exposure standard (see *MWN*, September/October 1987).

Reading List... The December issue of *The Sciences*, published by the New York Academy of Sciences, features an article on the blood-brain barrier by UCLA Professor William Pardridge – "The Gatekeeper: How Molecules Are Screened for Admission to the Brain."...Dr. Marvin Goldman of the Laboratory for Energy-Related Health Research at the University of California at Davis, who is the co-chairman of one of EPRI's radiation studies advisory committees (see p.7), argues in the October 30 *Science* that the radiation impact of the Chernobyl nuclear accident will be quite small....Corby Kummer describes the pleasures of cooking with a microwave oven and the status of the oven safety debate in "Fast Fish" in the December issue of *The Atlantic*....Confused about recent developments on superconductivity? Check out Philip Campbell's "primer" in the November 5 issue of *Nature*.... Sudden infant death syndrome (SIDS) may be connected to a baby's melatonin level. See the short item in the September 10 issue of the *New Scientist*....And in the magazine's November 5 edition, there is an item on "Magnetic Anomaly Upsets Migrating Birds."...N.B. Eastwood offers "Some Observations on Dowsing and the Human Magnetic Sense" in the September 19 *Lancet*.

Louis Slesin, editor of *Microwave News*, reviews the ELF bioeffects debate and the cutbacks in research funding in "Power Lines and Cancer: The Evidence Grows," which appears in the October issue of *Technology Review*, an MIT publication.

Florida Supreme Court Orders New Trial in ROW Cases

A unanimous decision by the Florida Supreme Court has overturned two large awards against Florida Power & Light Co. (FP&L) for property value losses of land adjacent to lots condemned for the right-of-way (ROW) of a 500 kV power line (see *MWN*, September/October 1986). The seven-judge panel ruled that expert testimony on power line health effects was "inflammatory" and "prejudicial," and should not have been allowed in an eminent domain case.

The court did *not* contest the allegation that power lines reduce the value of property along the ROW or that "public fear" has an impact on land values. In fact, the court found that a jury could, if it so believed, judge the reasonableness of an award on the public belief that power lines "attract alien beings in flying saucers." The judges concluded that, "Whether this fear is objectively reasonable is irrelevant to the issue of full compensation in an eminent domain proceeding." But the court *did* hold that "scientific testimony altered the focus of the trial and confused the issue to be determined."

Carlos Alvarez of the Tallahassee law firm of Hopping, Boyd, Green & Sams, who represented FP&L, told *Microwave News* that the court was essentially saying that, "You cannot turn an eminent domain case into a personal injury case. That would confuse the issue."

The two cases will now go back to a lower court to be heard by a new jury. In accordance with the Supreme Court ruling, expert witnesses will not be allowed to testify.

Florida Power & Light Co. vs. S.B. Jennings a/k/a Bryan Jennings, Jr., et al. and *Florida Power & Light Co. vs. Virginia Roberts et al.*, Supreme Court of Florida, Nos. 68,593 & 69,069; September 3, 1987.

Power Line Suit *(continued from p.1)*

telephone interview. "It legitimizes the EMF hazard issue. It will have a significant impact on every utility in the country."

Harris Leven, HL&P's attorney, takes a different view; his reading of the opinion indicates that the court has not ruled on the scientific legitimacy of the issue. "I think the jury is still out on the ultimate question of the health effects of EMFs. The issue is still inconclusive," he told *Microwave News*. He argues that a different jury could have arrived at a different conclusion based on the same scientific facts.

Power Line Has Been Moved

In 1986, the Texas Supreme Court refused to allow HL&P to use the power line pending the outcome of this appeal (see *MWN*, November/December 1986). HL&P subsequently rerouted the line around school property at a cost of $8.6 million, according to a spokesman for the utility.

Montague notes that in denying HL&P the use of the line, the Supreme Court reversed – by a unanimous 9-0 vote – a previous ruling by Judge Pressler. "It is probable they will overrule him again," Montague said. He added that HL&P has already made overtures to him to settle the case out of court. "Why would they rush to us wanting to settle if they had won?" he asked.

Judge Pressler awarded the school district $104,275 in damages, though HL&P had originally paid the school district $78,604 for the power line right-of-way. Leven and Montague also disagree on the significance of that award. Leven calls it something akin to rent for the time the line was on school property. Montague believes that the judge's award constitutes damages for trespass because the line was removed.

At the jury trial, HL&P called Dr. Edwin Carstensen of the University of Rochester, NY, as an expert witness on the health effects of power line EMFs. Montague called Dr. Harris Busch of the Baylor College of Medicine in Houston, TX; Dr. Jerry Phillips of the Cancer Therapy and Research Center in San Antonio, TX; and Dr. Nancy Wertheimer of the University of Colorado in Boulder.

CONFERENCES

1988 Conference Calendar

January 5-8: **National Radio Science Meeting,** University of Colorado, Boulder, CO. Contact: Prof. S.W. Maley, Dept. of Electrical Engineering, University of Colorado, Boulder, CO 80309.

January 27-31: **International Symposium on Work in a Hot Environment and Heat-Related Disorders,** Khartoum, Sudan. Contact: Dr. Moneim Attia, Chief, Occupational Physiologist, Ministry of Health, PO Box 303, Khartoum, Sudan.

January 31-February 5: **1988 Winter Meeting of the IEEE Power Engineering Society,** Penta Hotel, New York, NY. Contact: IEEE Society Special Services, 345 East 47th Street, New York, NY 10017, (212) 705-7895.

March 10-11: **14th Northeast Bioengineering Conference,** University of New Hampshire, Durham, NH. Contact: Dr. John LaCourse, Dept. of Electrical and Computer Engineering, University of New Hampshire, Durham, NH 03824.

March 21-24: **International Symposium on Interaction of Electromagnetic Fields with Biological Systems,** Plaza Hotel, Tiberias on the Sea of Galilee, Israel. Contact: ORTRA Ltd., 2 Kaufman St., 61500 Tel Aviv, Israel, (3) 664825.

March 27-April 1: **Electromagnetic Radiation: A Two-Edged Sword,** Sheraton Hotel & Spa, Santa Barbara, CA. Contact: Engineering Foundation, 345 East 47th St., New York, NY 10017, (212) 705-7835.

March 30-31: **24th Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP)**, Washington, DC. Contact: NCRP, 7910 Woodmont Ave., Suite 1016, Bethesda, MD 20814, (301) 657-2652.

April 8-12: **66th Annual Convention and International Exposition of the National Association of Broadcasters (NAB) and 42nd Annual Broadcast Engineering Conference, Las Vegas**, NV. Contact: NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5300.

April 10-17: **7th International Congress of the International Radiation Protection Association (IRPA)**, Centerpoint Convention Center and Hilton Hotel, Sydney, Australia. Contact: IRPA 7 Secretariat, GPO Box 2609, Sydney, NSW 2001, Australia, (02) 241 1478.

April 11-13: **4th International Conference on HF Systems and Techniques**, London, U.K. Contact: Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (1) 240-1871, ext. 222.

April 18-21: **1988 International Symposium on Radio Propagation (ISRP '88)**, Beijing, China. Contact: Prof. Sha Zong (Z. Sha), China Research Institute of Radiowave Propagation, PO Box 138/88, Xinxiang, Henan, People's Republic of China.

April 19-21: **1988 International Conference on Lightning and Static Electricity**, Oklahoma City, OK. Contact: Michael Glynn, FAA Technical Support Center, ACT-430, Atlantic City Airport, NJ 08405, (609) 484-4138.

April 19-22: **Instrumentation/Measurement Technology Conference (IMTC/88)**, San Diego, CA. Contact: Robert Meyers, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024, (213) 475-4571.

April 20-21: **IEEE 1988 National Radar Conference**, Ann Arbor, MI. Contact: University of Michigan Extension Service, Department of Conferences and Institutes, 200 Hill St., Ann Arbor, MI 48104, (313) 764-5304.

April 20-22: **4th Annual Meeting of the Electromagnetic Energy Policy Alliance (EEPA)**, Radisson Mark Plaza Hotel, Alexandria, VA. Contact: EEPA, 1255 23rd St., NW, Washington, DC 20037, (202) 452-1070.

April 24-30: **Magnetic Resonance Imaging 1988: 5th Annual National Symposium**, Buena Vista Palace, Disney World/EPCOT Center, FL. Contact: Florida Radiological Society, PO Box 17241, Tampa, FL 33682, (813) 873-2090, (800) 338-5901.

April 25-26: **25th Annual Rocky Mountain Bioengineering Symposium**, Air Force Academy, Colorado Springs, CO. Contact: Dr. Harry Valenta, Jr., Telectronics, 7400 S. Tucson Way, Englewood, CO 80112, (303) 790-8000.

May 10-12: **EMC Expo-88**, Washington Hilton Hotel, Washington, DC. Contact: Karen Smith, EMC Expo-88, PO Box D, Gainesville, VA 22065, (703) 347-0030.

May 14-18: **23rd Annual Meeting & Exposition of the Association for the Advancement of Medical Instrumentation (AAMI)**, Sheraton Washington Hotel, Washington, DC. Contact: Debbie Tritle, AAMI, 1901 North Fort Myer Dr., Suite 602, Arlington, VA 22209, (703) 525-4890.

May 16-19: **20th Annual Meeting of the Conference of Radiation Control Program Directors (CRCPD)**, Hyatt Regency, Nashville, TN. Contact: CRCPD, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 16-20: **1988 Nuclear EMP Meeting**, SRI International, Menlo Park, CA. Contact: K.F. Casey, JAYCOR, 39650 Liberty St., Suite 320, Fremont, CA 94538.

May 25-27: **1988 IEEE MTT-S International Microwave Symposium**, New York, NY. Contact: Jesse Taub, LRW Associates, 1218 Balfour Dr., Arnold, MD 21012.

June 1-3: **42nd Annual Frequency Control Symposium**, Stouffer Harborplace Hotel, Baltimore, MD. Contact: T.R. Meeker, 2956 Lindberg Avenue, Allentown, PA 18103.

June 6-9: **1st Congress of the International Society of Ocular Toxicology**, University of Toronto, Ontario, Canada. Contact: Continuing Education, Faculty of Medicine, University of Toronto, Toronto, Ontario M5S 1A8, Canada, (416) 978-2718.

June 6-10: **1988 IEEE AP-S International Symposium & URSI Radio Science Meeting**, Syracuse University, Syracuse, NY. Contact: A.T. Adams, 111 Link Hall, Syracuse University, Syracuse, NY 13244, (315) 423-4397/4393.

June 19-24: **10th Annual Meeting of the Bioelectromagnetics Society (BEMS)**, Westin Hotel, Stamford, CT. Contact: BEMS, 120 W. Church St., Frederick, MD 21701, (301) 663-4252.

June 27-30: **5th International Conference on Dielectric Materials, Measurements and Applications**, University of Kent at Canterbury, U.K. Contact: Conference Services, Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (1) 240-1871, ext. 222.

June 28-30: **9th International Wroclaw Symposium on Electromagnetic Compatibility (EMC)**, Wroclaw, Poland. Contact: W. Moron, EMC Symposium, 51-645 Wroclaw 12, Box 2141, Poland.

July 4-8: **33rd Annual Meeting of the Health Physics Society (HPS)**, Sheraton Boston & Towers, Boston, MA. Contact: HPS, 8000 Westpark Dr., Suite 400, McLean, VA 22102, (703) 790-1745.

July 12-15: **4th Joint Magnetism and Magnetic Materials – Intermag Conference**, Hotel Vancouver, Vancouver, British Columbia, Canada. Contact: Diane Suiters, Courtesy Associates, 655 15th St., NW, Suite 300, Washington DC 20005, (202) 639-5088.

July 24-29: **1988 Power Engineering Society Summer Meeting**, Hilton and Marriott Hotels, Portland, OR. Contact: IEEE Society Special Services, 345 East 47th St., New York, NY 10017, (212) 705-7895.

August 2-4: **IEEE 1988 International Symposium on Electromagnetic Compatibility**, Westin Hotel, Seattle, WA. Contact: Don Weber, Hamilton Engineering Inc., 2108 SW 152nd St., Seattle, WA 98166, (206) 244-0952.

August 15-19: **Gordon Research Conference on Bioelectrochemistry**, Plymouth State College, Plymouth, NH. Contact: Dr. Betty Sisken, Department of Anatomy, University of Kentucky, Lexington, KY 40506, (606) 257-5661.

August 29-31: **23rd Microwave Power Symposium**, Skyline Hotel, Ottawa, Ontario, Canada. Contact: International Microwave Power Institute, 13542 Union Village Circle, Clifton, VA 22024, (703) 830-5588.

August 29-September 3: **5th International Symposium on Hyperthermic Oncology (ISHO)**, Kyoto, Japan. Contact: Secretariat, ISHO, Health Research Foundation, Matsuo Bldg. 4F, Kawaramachi Marutamachi Sagaru, Kamigyo-ku, Kyoto 602, Japan.

September 12-15: **18th European Microwave Conference**, Folkets Hus, Stockholm, Sweden. Contact: Microwave Exhibitions & Publishers, 90 Calverly Rd., Tunbridge Wells, Kent TN1 2UN, U.K., (0892) 44027.

September 28-October 1: **3rd International Conference on Harmonics in Power Systems**, Nashville, IN. Contact: Dr. G.T. Heydt, School of Electrical Engineering, Purdue University, West Lafayette, IN 47907, (317) 494-3520.

October 9-12: **8th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS)**, Mayflower Hotel, Washington, DC. Contact: BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

November 3-7: **10th Annual Conference of the IEEE Engineering in Medicine & Biology Society**, Meridien Hotel, New Orleans, LA. Contact: Dr. Cedric Walker, Dept. of Biomedical Engineering, Tulane University, New Orleans, LA 70118, (504) 865-5866.

November 8-10: **Journées Internationales de Nice sur les Antennes (JINA'88)**, Nice, France. Contact: J.L. Guiraud, CNET/PAB – La Turbie, 06320 Cap D'Ail, France, 93.41.15.30.

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MICRO WAVE NEWS

Vol. VIII No. 6 A Report on Non-Ionizing Radiation November/December 1988

INSIDE...

HIGHLIGHTS pp.2-5

Beyond "Henhouse": Early PMF Exposure Is Most Effective
FCC Chairman Asks EPA To Reconsider Decision To Defer RF Guidance
NICHD Workshop on VDT Pregnancy Risks
HPM Pulses Suppress Startle Reflex in Mice
Call for a National EMP Bioeffects Study
EMP on "60 Minutes"
New Suit Filed To Block EMPRESS II
USAF Admits PAVE PAWS EED Hazard at Robins AFB
EMFs at NJ Stadium Among Highest In U.S.

ELF NEWS pp.6-10

The Talk of Phoenix
Planning for California Health Research
Telephone Workers: No EMF-Cancer Risk
Appraiser Devalues Land Near Power Line
Marcy-South Power Line Trial Witness Fees
Two Views on EMFs and Cancer: At Most a Small Risk
NYS Weighs a Second Power Lines Project
PES & APPA Statements on Health Effects

UPDATES pp.12-14

Black Hawk Helicopter EMI Update • Call for Cancer Papers • NIST on Cable EMI Shielding • TEMPEST Market Slows • Bioelectromagnetics in Italy • CDRH Publications Guide • BRAGS Proceedings • MW Heating Applications • Measuring Bioelectric Currents • ISM Standards • New PEMF Treatments • SAD Society in the Works • People in the News • USAF's Search for Bioeffects Mechanisms • VDT Radiation Q's & A's • Photonics • Notes on "Microwaving" • Holding Pattern for MLS • Will Microwaveland Be Next? • and more...

CONFERENCES pp.10-11

1989 Conference Calendar

Wertheimer and Leeper Reaffirm ELF-Fetal Loss Link

For the second time, Dr. Nancy Wertheimer and Ed Leeper have documented an association between fetal loss and exposure to extremely low frequency (ELF) electromagnetic fields (EMFs). In a new epidemiological study, to be published in the January 1989 issue of the *American Journal of Epidemiology*, they show that the risk of miscarriages among women living in homes with ceiling cable heat varied according to the season and that the EMFs from the heating systems can explain that variation.

In 1986, Wertheimer and Leeper identified a link between fetal loss and the use of electrically heated beds (see *MWN*, M/J86 and J/A88). The new results diminish the possibility that the previous electric blanket-water bed observation was due to overheating, because the women in the present study were unlikely to be exposed to excessive heat from the ceiling cable systems.

"The more commonly encountered baseboard electric heat does not generally cause excessive EMF exposure," Wertheimer told *Microwave News* in a telephone interview. Wertheimer, an epidemiologist, is based at the University of Colorado Health Sciences Center in Denver and Leeper,

(continued on p.15)

RTCA Seeks To Limit Computer Use During Takeoffs and Landings

A committee of the Radio Technical Commission for Aeronautics (RTCA) has officially recommended that airline passengers not use computers and other electronic devices during takeoffs and landings. The RTCA has also asked the Federal Communications Commission (FCC) to establish a new class of portable electronic devices approved for use on aircraft.

The RTCA first suggested limits on the use of electronic equipment aboard aircraft in 1984 (see *MWN*, S84), which the Federal Aviation Administration (FAA) has been following on an informal basis (see *MWN*, N84). The recommendations will undoubtedly add authority to those restrictions. They appear in a report which has been approved by the RTCA Executive Committee and which will be released in January; it supersedes a 1963 report with the same title. The RTCA, based in Washington, DC, is an advisory group to the FAA.

After five years of work, including numerous tests, the RTCA committee concluded that the probability of electromagnetic interference (EMI)

(continued on p.15)

HIGHLIGHTS

Beyond "Henhouse": Early PMF Exposure Most Effective

Chick eggs are most sensitive to pulsed magnetic fields (PMFs) during the early stages of development, according to new studies by Dr. Alexander Martin of the University of Western Ontario in London, Canada, and by Dr. Jocelyne Leal of the Ramón y Cajal Hospital in Madrid, Spain.

These new experimental findings are consistent with those of Dr. Hakon Frölen, who has reported that mouse fetuses are most susceptible to PMFs in the first phases of pregnancy (see *MWN*, S/O88).

Martin and Leal are both members of the "Henhouse" project, which, overall, showed that PMFs caused abnormalities in developing chick embryos (see *MWN*, M/A88). In the course of the project, each of the six participating labs ran the same experiment using identical protocols and equipment. A paper detailing the findings of the Henhouse project was submitted for publication in November. The new results are the first by project members now working independently.

As part of the Henhouse project, Martin, a developmental biologist, documented the strongest teratological effect among all six labs. In his new study, he exposed fertilized chick eggs to the same Henhouse PMF—1.0 μT pulses with 2 μsec rise and fall times and a 500 μsec duration with a repetition rate of 100 Hz—for the first 24 hours, first the 48 hours and second 24 hours of incubation. (In the Henhouse project, all six labs exposed the eggs for 48 hours.) Martin found that the embryos exposed for the second 24 hours showed no changes and that the proportion of abnormal embryos was essentially the same whether the eggs were exposed for the first 24 or 48 hours.

"These experiments clearly indicate that exposure to [PMFs] can modify or alter development of the chick embryo. The effects are detrimental....The results also indicate that the critically sensitive period occurs during the first 24 [hours] of development," Martin concludes in a paper published in the latest issue of *Bioelectromagnetics*, (*9*, pp.393-396, 1988).

In an interview with *Microwave News*, Martin said that in his next series of experiments, he plans to expose the eggs for only the first 12 hours of incubation. He added that a preliminary analysis shows that a specific type of abnormality was more likely than others. "This needs to be confirmed," he said.

In Leal's experiment, the repetition rate of the PMFs was reduced from 100 Hz to 30 Hz; Leal and coworkers found that, although the frequency of abnormal embryos was not statistically different from that in the control group, the number of "non-developed" embryos among the abnormals was significantly greater. At the same time, the proportion of abnormal and malformed embryos decreased.

Leal told *Microwave News* that the results indicate that the PMFs "arrest development at a very early stage, before the beginning of the organogenetic process." She presented her findings at the *8th Annual Meeting of the Bioelectrical Repair and Growth Society* on October 10 in Washington, DC.

After her presentation, there was some discussion of whether the pulse waveform or the repetition rate is the dominant force in causing the embryological changes.

In her Henhouse experiment, Leal found a small, but non-significant, increase in the frequency of abnormal embryos exposed to PMFs. In 1982, Leal first reported that PMFs could have profound effects on chick egg development, a finding which later prompted the Office of Naval Research to sponsor the Henhouse project.

Keijo Saali and Jukka Juutilainen, though not officially part of the Henhouse project, have been investigating the action of PMFs on chick eggs for a number of years (see *MWN*, M/J86). In their most recent paper, the two Finnish researchers, based at the University of Kuopio, report that the head-tail axes of the chick embryos have "a tendency to be oriented perpendicularly to the magnetic field"—and "thus have properties resembling those of magnetic dipoles."

They found that the PMF effect occurs "during [the embryos'] first stages of development." They note that, "Magnetic effects on orientation are less probable at later stages of development because of the large size of the embryo and the complex pattern of currents flowing in several directions."

Writing in *Annales Zoologi Fennici*, (*25*, pp.187-189, 1988), a journal published in Finland, Saali and Juutilainen conclude that, whatever the biophysical basis for the interaction, the mechanism may be the same as the one responsible for the teratogenic effect of low frequency PMFs. These Finnish results parallel those reported by Leal's group last year (see *Medical Science Research*, *15*, pp.531-532, 1987, and *MWN*, M/A88).

FCC Asks EPA To Reconsider RF Guidance Decision

The Chairman of the Federal Communications Commission (FCC), Dennis Patrick, has asked the Environmental Protection Agency (EPA) to reconsider its decision to defer issuing its radiofrequency (RF) radiation guidance.

In a November 29 letter, Patrick told EPA Administrator Lee Thomas that, "It will be difficult and time consuming to re-establish this effort at a later date," and that, "...the modest levels of funding necessary for the continuance of these activities would yield significant benefits to the public." Patrick decried the growing " 'patchwork' of inconsistent exposure standards" which will continue without EPA's exposure guidelines.

On September 29, EPA's Office of Radiation Programs officially announced that it was phasing out its non-ionizing radiation program and that it no longer planned to issue the RF guidance which was under development for a decade (see *MWN*, S/O88).

NICHD Workshop on VDT Pregnancy Risks

Should the National Institute of Child Health and Human Development (NICHD) wait for the results of an ongoing epidemiological study on the reproductive risks for video display terminal (VDT) operators before funding its own study? This was one of the questions discussed at a November 4 workshop sponsored by NICHD in Bethesda, MD. Interviews with many of the participants indicate a split decision, with the majority in favor of beginning a new study without waiting for the results of the ongoing National Institute for Occupational Safety and Health (NIOSH) study.

Dr. Robert Hiatt, one of the authors of the Kaiser Permanente study, which indicated an elevated risk of miscarriages among women working for more than 20 hours a week at a VDT (see *MWN*, M/J88), told *Microwave News* that the "NIOSH study will not resolve the issue; further work needs to be done."

The Kaiser study led Congressman Ted Weiss (D-NY) to ask NICHD to sponsor its own study. His intervention in turn prompted NICHD to convene the workshop. In a November 15 letter to NICHD Director Dr. Duane Alexander, Weiss reaffirmed "Congressional support for NICHD to fund a study."

Dr. Joe Leigh Simpson of the Department of Obstetrics and Gynecology at the University of Tennessee in Memphis, who chaired the NICHD meeting, argued for waiting. "I was not particularly alarmed going in [to the workshop] and I was not very alarmed going out," he said in a telephone interview. "VDT work presents a minimal risk and my personal belief is that NICHD should wait until the NIOSH study is completed." As for the possible radiation risks, Simpson dismissed them, saying that working at a VDT "is not any different from walking out in the sun."

Many of the participants pointed out that few complex health issues are resolved by one or two studies. Dr. David Savitz of the University of North Carolina in Chapel Hill said that, "The NIOSH study will be very informative, but it will not be definitive. The need will be there after the NIOSH study." Even Dr. Teresa Schnorr, who is directing the NIOSH study, said that, "Whatever the outcome [of my study], the question will not be resolved—people will want another study. It takes a number of epidemiological studies before a consensus forms."

Nevertheless, NICHD's Dr. José Rigau, the organizer of the workshop, said that "it would be reasonable" to wait for the NIOSH study because it will help in the design of the next round of studies. Savitz agreed that the next study will benefit from the last, but that this is not a good enough reason to wait because the delay will be measured in years, not months. Rigau stressed that the institute "welcomes" proposals on this subject.

Only one proposal is now before NICHD—a prospective epidemiological study by researchers at the Mount Sinai School of Medicine in New York City (see *MWN*, J85 and M/J87). NICHD is expected to announce early in 1989 whether it will fund the study. Mount Sinai's Dr. Michele Marcus said, "I think that this is an issue of pressing public health importance and more research is urgently needed."

HPM Pulses Suppress Startle Reflex in Mice

Laboratory mice exposed to an intense burst of sound immediately following a pulse of high-power microwaves (HPMs) do not react, new experiments at the Walter Reed Army Institute of Research (WRAIR) in Bethesda, MD, show.

"This is one of the most interesting microwave biological effects to be demonstrated in animals," WRAIR's Howard Bassen told *Microwave News*. The results were presented at the November meeting of the IEEE Engineering in Medicine and Biology Society in New Orleans, LA.

Dr. Howard Wachtel of the University of Colorado in Boulder and Bassen found that when mice were exposed to a single 1250 MHz HPM pulse within 500 msec of a loud (90 dB) burst of 20 kHz sound, they did not respond, behaving as if they did not hear it. The normal response, known as the acoustic startle reflex (ASR), is well-documented in animals and humans.

The team focused high-peak, low-average power HPMs on the head and neck region of female mice; each pulse lasted 1-10 μsec with a peak power of from ten to a few hundred kilowatts. Each pulse resulted in an absorbed energy of 0.2 J/Kg. The mice had a mid-brain peak specific absorption rate (SAR) of 0.2 Megawatt/Kg.

Bassen pointed out that the absorbed energy from a single pulse, which causes the startle suppression, is far below that allowed under the 1982 American National Standards Institute (ANSI) guidelines, which are keyed to an SAR of 0.4 W/Kg and a permissible energy absorption of 144 J/Kg.

The pulse energy appears to be the key factor in the ASR suppression. The Army team found the same inhibition with a 1 μsec 0.2 MW/Kg pulse as with a 10 μsec 0.02 MW/Kg pulse.

"Many questions remain to be answered. The mechanism of interaction may involve direct central nervous system inhibition or it might be mediated by the microwave hearing effect," Bassen said. He added that the results "cannot be attributed to bulk thermal effects," since each pulse causes less than a 0.00005°C temperature rise.

Although this is one of the first reports on the biological effects of HPMs, there is growing interest in this area due to the potential military applications of HPMs in the "Star Wars" and other programs (see, for instance, Dr. Keith Florig's cover story in the March 1988 *IEEE Spectrum*). The U.S. Air Force (USAF) has built an exposure facility at Brooks Air Force Base in San Antonio, TX, and is planning its own experiments. In a notice published in the October 14 *Commerce*

Business Daily, the USAF requested proposals from those wishing to conduct HPM behavioral studies. For more information, contact the USAF's James Merritt at (512) 536-2439. Last February, Brooks released *Behavioral Response of Rats Exposed to HPM Radiation* (USAFSAM TR-87-30), which is available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

Call for a National EMP Cancer Study

The incidence of chronic myelogenous leukemia (CML) among Boeing Co. workers exposed to electromagnetic pulse (EMP) radiation is much higher than expected, according to a preliminary analysis by Dr. Samuel Milham, Jr. "It is time to do a national study of EMP workers to see if it supports the Boeing data," he told *Microwave News*.

Mortality records compiled by Boeing show that within the last 20 years, two of the 360 company workers believed to have been exposed to EMP have died of CML. At least one other Boeing technician was diagnosed with CML. In addition, one worker died of non-Hodgkin's lymphoma.

CML is a very rare type of cancer. Milham estimates that only one case of CML is expected per 100,000 population per year—this translates to 0.07 cases among the 360 Boeing workers over a 20-year period. "The observed incidence is off the scale," Milham said.

Milham, an epidemiologist with the Washington State Department of Social and Health Services in Olympia who first identified a link between occupational exposure to electromagnetic fields and cancer (see *MWN*, J/A82), pointed out that even if you group all leukemias and lymphomas together, the observed incidence is still ten times the expected rate. "What is needed now is a study of all other workers exposed at the approximately 20 EMP facilities across the country," he said.

"60 Minutes" To Tackle EMP

Electromagnetic pulse (EMP) radiation and its possible link to leukemia will be the subject of a *60 Minutes* segment airing in early 1989. Mike Wallace, the weekly news show's senior investigator, will focus on the *Robert Strom v. Boeing* lawsuit, in which Strom, a former Boeing technician who developed leukemia, charges that the company knew that EMP exposure causes cancer but failed to warn employees or take precautions to protect them (see *MWN*, J/A88).

The last time *60 Minutes* addressed the issue of nonionizing radiation was over ten years ago, on June 19, 1977, with another Mike Wallace story, "Warning: Microwave Radiation."

Robert Strom, the third worker to develop CML, is suing Boeing, alleging that his condition is a result of EMP exposure (see *MWN*, J/A88 and S/O88). His class-action suit has focused national attention on the EMP–leukemia issue (see box at bottom left).

The data for Milham's study was obtained during pre-trial discovery by Strom's attorney, Michael Withey, of Schroeter, Goldmark & Bender in Seattle, WA. At this point, Milham said that he cannot add anything further about the data, because "Boeing has not been willing to share the men's work history."

New Lawsuit Seeks To Block EMPRESS II Again

The Foundation on Economic Trends, led by well-known activist Jeremy Rifkin, has filed a new lawsuit to block the operation of the U.S. Navy's second Electromagnetic Radiation Pulse Simulator for Ships (EMPRESS II) in the Atlantic Ocean off the coast of North Carolina (see *MWN*, J/A88).

"EMPRESS II poses a grave potential risk to the environment and public health and we intend to shut it down until the Navy conforms with federal laws governing environmental safety," Rifkin said. Joining the foundation in the suit are 24 North Carolina counties and municipalities, as well as the Albermarle Commission, a North Carolina regional planning agency.

The plaintiffs argue that the Navy's final environmental impact statement (EIS), issued earlier this year (see *MWN*, M/J88), is "grossly inadequate" because it fails to fully examine the effects on personnel in the vicinity of a pulsing simulator, as well as the effects on marine biota and migrating birds and on electronic communication and navigation systems.

In an interview with *Microwave News*, Andrew Kimbrell, the foundation's attorney, said that the EIS devotes only one paragraph to the ocean site selected by the Navy.

In a previous suit filed in 1987, Rifkin sought EISs on a number of Department of Defense (DOD) simulators, which resulted in a decision to close most of them down (see *MWN*, M/A87 and M/J88). Kimbrell said that the U.S. Army has not yet filed environmental analyses for its EMP generators and that the generators have not resumed pulsing. The same is true for EMPRESS I on Point Patience in the Patuxent River, he added.

The U.S. Air Force's EMP simulator at Kirtland Air Force Base in New Mexico was omitted from the 1987 complaint, but Kimbrell said that the foundation will soon file another suit in an effort to protect Air Force personnel at Kirtland.

A spokesman for the Navy said that testing of EMPRESS II, which began on June 6, 1988, in the Atlantic Ocean, ended on August 13. The Navy plans to resume operation early next summer and tests on ships are scheduled for the summer of 1990.

USAF Admits PAVE PAWS EED Hazard at Robins AFB

The U.S. Air Force (USAF) has acknowledged that the PAVE PAWS radar at Robins Air Force Base (AFB), GA, poses a risk to aircraft carrying electro-explosive devices (EEDs) and has imposed safety precautions for air traffic at the base, including deactivating the radar during a recent air show, prescribing a hazard zone for incoming aircraft and scrapping plans for upgrading the power output of the radar.

Major Robert Perry, a spokesman for the Air Force Space Command in Colorado Springs, CO, which operates the PAVE PAWS radar, stated that, "The reason for the restrictions is...the electromagnetic danger. We don't mess around with it. It isn't just an instrument problem. It is a danger to the plane, the crew, everything involved—the risk of a possible detonation of an explosive device," according to the November 13 *Atlanta Journal and Constitution.*

The PAVE PAWS–EED hazard has emerged as a major news story in Georgia following a report in *Microwave News* that the USAF was considering moving the Robins radar to limit the EED threat (see *MWN*, J/A88).

Although Perry granted a number of interviews early in November, he later declined to comment further, citing a lawsuit filed with the Department of Justice against the USAF. But a spokesman for the department told *Microwave News* that he was "unaware of any [new] litigation on the issue."

However, at press time, Perry confirmed to *Microwave News* that the radar was turned off during a November 6 air show at Robins AFB to allow USAF Thunderbirds to fly in the hazard zone. "We took the opportunity to use this time slot to schedule a normally required maintenance period," he said.

The USAF has long been aware of the EED threat; it was reviewed in the environmental impact statements prepared for the four PAVE PAWS radars now in operation. Nevertheless, the radar at Robins AFB was built close to an active runway. In a May 1988 report, Raytheon Co., the builder of PAVE PAWS, outlined a number of proposals to eliminate the hazard, including relocating the radar installation at a cost of $37.7 million. The USAF had also planned to upgrade the PAVE PAWS radar by a factor of ten (10 dB), which would have increased a plane's chances of flying through the radar's main beam and thereby activating any EEDs on board. But since the release of the Raytheon report, the USAF has abandoned plans for a power upgrade. And because of the costs, it has also decided not to implement any of Raytheon's proposals, according to the *Macon Telegraph and News.*

Sources told the Macon newspaper that the USAF is now relying on the 25-year-old phased array radar at Eglin AFB, FL, to fill in the gaps in coverage. The PAVE PAWS upgrade was expected to enable the USAF to close down the obsolete Eglin radar.

Among other restrictions cited by the Georgia papers is a new hazard zone—military planes are now prohibited from flying within one nautical mile of the PAVE PAWS radar, resulting in a shorter landing approach; in addition, all aircraft carrying EEDs are required to obtain permission to land and must use the runway farthest from the radar.

AM Levels in NJ Meadowlands Among Highest in Country

The radiofrequency (RF) radiation levels at New Jersey's Meadowlands Sports Complex, across the Hudson River from New York City, are higher than the levels to which almost all other U.S. residents are exposed, according to Richard Tell, a consultant based in Las Vegas, NV. There are 15 AM radio broadcast antennas within eight miles of the complex, five of which operate at 50 kW. Seven of the stations are within 1.8 miles of the sports complex.

Although the RF levels are below all human exposure standards, Tell notes that "...the typical outdoor fields strengths are sufficient (a) to exceed Defense Department limits appropriate to the use of electro-explosive devices...and (b) to induce significant RF currents...that could lead to a substantial probability for RF shocks and/or burns in workers." Tell's July report was released in late September by the New Jersey Sports and Exposition Authority, based in East Rutherford.

The RF survey is part of a three-pronged investigation prompted by a cluster of four cases of cancer among members of the New York Giants football team, which plays at the Meadowlands stadium.

An epidemiological study of stadium workers (non-players) is currently underway under the direction of Dr. Philip Landrigan of the Mount Sinai School of Medicine in New York City. A survey of toxic chemicals near the complex indicates that they "are most unlikely to represent a cause of concern," according to Landrigan, who told *Microwave News* that the epidemiological study should be completed in early 1989.

Four Giants players developed cancer—brain tumor, angiosarcoma, malignant lymphoma and Hodgkin's disease—between 1980 and 1986. An analysis by Dr. Frederick Cohen, the director of the Department of Oncology at the Beth Israel Medical Center in Newark, NJ, concludes that the four cases "do not meet the usual criteria of a cluster and must be considered a coincidence."

Tell's measurements show that the electric field strengths in "normally accessible areas" on the grounds of the complex ranged from a minimum of approximately 1 V/m to a maximum (very near radio station WFAN) of 16 V/m; the magnetic field varied from 0.8 mA/m to 25 mA/m. Inside buildings, the field strengths were "significantly reduced from outside measured values"; they were typically less than 0.3 V/m and 0.03 mA/m for electric and magnetic fields, respectively.

In the late 1970s, a childhood cancer cluster was identified at a Rutherford school (see, for example, the *New York Times*, p.1, May 2, 1978). Despite extensive investigations, the cause of the cluster was never discovered.

The Talk of Phoenix

If there were any doubts about the high stakes riding on the power line health debate, they were dispelled at this year's annual review of power line health research.* On the substantive side, the focus was on the reappraisal of past work, especially Dr. David Savitz's epidemiological study, rather than on any new results. But the process—who is paying for electromagnetic field (EMF) research and who is interpreting the findings—was also very much on people's minds.

The opening round began the day before the review at EPRI's special tutorial on *Cancer Biology and EMFs Research* when Dr. Tom Tenforde argued that, "The results of the Savitz study were highly equivocal." Later, Dr. Howard Wachtel, one of Savitz's coauthors, put some distance between himself and the published work, announcing that, "The epidemiological results are *not* attributable to a direct association between magnetic fields and childhood cancer." He explained that, "David [Savitz] and I lean in different directions."

Both Tenforde and Wachtel believe that the observed increase in childhood cancer is due to some still-unrecognized variable or set of variables. As Tenforde told *Microwave News*, "We should begin to look at other factors that are reflected by the wire codes [used as surrogates for long-term magnetic field exposures] and may somehow be associated with cancer risk. I'm just trying to suggest people take a fresh look at the data."

Most of the epidemiologists in Phoenix were skeptical. Dr. Raymond Neutra, the head of the California state health department's epidemiological studies section, pointed out that if the wire codes are in fact surrogates for something other than magnetic fields, then this factor "X" would have to be linked to cancer much more strongly than the codes, and that it is unlikely to turn up now. Neutra argued, as others have in the past, that the wire codes capture aspects of the true magnetic field exposure that are missed by spot field measurements.

Savitz agreed. "If wire codes are a proxy for some hidden variable, say air pollution," he told *Microwave News*, "then air pollution itself would have to be a very strong risk factor. Right now, we don't know of any risk factor that predicts strongly for childhood cancer."

Because Savitz's elevated cancer risks with *measured* magnetic field exposure are short of statistical significance (at the 5% confidence level), Tenforde contended that the link is less than reliable. When asked to respond, Savitz said that, "Statistical significance is not a critically important issue to me....It does not negate that the association was found—it says that a bigger study is needed to produce a more precise estimate of the association." Neutra had a similar view: statistical significance is not crucial, especially for a risk that has "such public health significance."

Tenforde, a biophysicist who recently joined the Battelle Pacific Northwest Labs in Richland, WA, presented some calculations by D.W. Keam, an Australian researcher, in which some of the cancer cases were reclassified, resulting in an overall weakening of the cancer link. Tenforde then applied the same type of analysis to Dr. Nancy Wertheimer and Ed Leeper's original 1979 data and reached a similar conclusion. Here again, the epidemiologists were unimpressed. Wertheimer pointed out that any time you manipulate data, "you get a bias of the odds ratio to the null"—that is, the effect tends to go away. Nor did Tenforde change Savitz's outlook—"These arguments do not cause me to question the original interpretation."

Wachtel made a different case, one based on the lack of a credible mechanism to explain the weak magnetic field effect. Wachtel, a professor of electrical engineering at the University of Colorado in Boulder, reasoned that it is "implausible" that 1-10 mG 60 Hz magnetic fields promote cancer when they induce currents which are "much smaller" than those occurring in the body naturally. Dr. Charles Polk of the University of Rhode Island in Kingston countered that the two types of currents are not directly comparable because the 60 Hz fields are coherent, unlike the natural currents which are made up of different frequencies.

Since the Savitz results were first announced at the 1986 review, EPRI's ELF research budget has continued to grow and now surpasses that of the DOE, which has remained fairly constant. At the same time, most health agencies have struggled to keep their own budgets from disappearing—often, as in the case of the Environmental Protection Agency, without success.

Some experts, such as Dr. Ross Adey, are questioning EPRI's objectivity and whether some members of the ELF community are pocketing large fees by presenting a rosy view of the health risks at hearings and trials. In a presentation that was to be much discussed for the rest of the meeting, Adey drew a parallel between the way Dr. Leonard Sagan—EPRI's program manager for radiation studies—downplays the significance of research linking ELF fields to cancer and the way cigarette companies have long minimized the evidence implicating smoking with lung cancer and heart disease.

In a series of slides adapted from press clippings over the last year, Adey reviewed Sagan's interpretations of ELF research in general and of Adey's work in particular. For instance, in a December 6, 1987, article in the *San Francisco Examiner & Chronicle* on the emerging link between EMFs and cancer, Sagan is quoted as saying, "The evidence is too weak and inconsistent to worry about."

* *Biological Effects from Electric and Magnetic Fields, Air Ions and Ion Currents Associated with High Voltage Transmission Lines*, organized by the U.S. Department of Energy (DOE) and cosponsored by the Electric Power Research Institute (EPRI), October 30-November 3, 1988, Phoenix, AZ.

Adey also questioned how his and Dr. Craig Byus's work on ELF stimulation of ornithine decarboxylase (ODC) activity has been interpreted by Dr. H.B. Graves "and other hirelings of EPRI." This prompted a sharp exchange with Graves, who is a consultant for EPRI and the chief scientist at Crowell & Moring, a Washington, DC, law firm representing a number of utilities in power line litigation. Graves said, "I am a hireling of a utility....We are very proud of it and we do it very well."

Graves maintained that the Adey-Byus papers "are not indicative of cancer promotion," which in turn prompted Byus to clarify his position: "The fact that ODC is changing does not indicate transformation into a neoplastic state, it means we should be studying further to find out if the cell is becoming transformed and neoplastic."

At the close of the meeting, Sagan said that he did not want to discourage "controversy"—which he called "good"—but, rather, "divisiveness." Much-needed exposure assessments and epidemiological studies are now being funded, yet most of the results will not be available until the early 1990s. Until then, there may well be more dissension within the ELF research community.

Planning Underway for California Health Research

The research project on electromagnetic fields (EMFs) established by the California state legislature will probably include an epidemiological study of reproductive effects, Dr. Raymond Neutra of the state Department of Health Services (DHS) told *Microwave News*. Neutra said that the state will "try not to re-invent the wheel"—that is, an effort will be made to cover new ground, rather than repeat past efforts.

The new California law, enacted at the end of September, allocates $2 million for a three-year project to "conduct a study of any cancer and other medical risks which may be related to exposure to EMFs produced by electrical utility facilities" (see *MWN*, M/J88 and S/O88).

Under the law, the state Public Utility Commission (PUC) and the DHS will:

- Submit a report to the legislature by March 15, 1989, describing health risks associated with EMFs, especially for children who live or go to school near power lines and for occupationally exposed workers. The report will list high-priority research needs.
- Design and manage the research projects identified in the 1989 report, in coordination with ongoing federal, state, academic and industry initiatives.
- Prepare a report for the legislature by December 1, 1990, on the status of the research program, detailing—if deemed necessary—additional funding needs and legislation to limit exposures to EMFs.

Neutra, the head of the DHS's Epidemiological Studies and Surveillance Section, said that the PUC and DHS are asking knowledgeable experts in the field to recommend the next steps for cancer epidemiology, exposure assessment and behavioral effects. He said that he was interested in identifying a key cellular study and then asking a number of different labs to repeat it to see if they can get agreement—essentially setting up a Henhouse-type project for 60 Hz bioeffects (see *MWN*, M/A88).

Neutra said that the DHS is already planning an epidemiological study on the reproductive risks associated with drinking tap water and that adding questions on power line EMFs would not be difficult. The study may also provide an opportunity to investigate the health risks related to working at video display terminals (VDTs).

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Epi Study of Telephone Workers: No EMF-Cancer Risk

Preliminary data from a new epidemiological study show that telephone company employees exposed to electromagnetic fields (EMFs) do not have an increased risk of leukemia.

Dr. Genevieve Matanoski and coworkers at the Johns Hopkins University School of Hygiene and Public Health in Baltimore, MD, investigated all deaths from leukemia (except chronic lymphocytic leukemia) among active and retired telephone company employees from 1975 to 1980. They found no elevated leukemia risk among cable splicers, outside plant technicians, installers and repairmen and central office technicians. Cable splicers had the highest exposure to EMFs, followed by outside plant technicians.

The study is still incomplete; Matanoski is working to find missing records to increase the validity of the results. She presented her findings at the power line research review in Phoenix, AZ (see p.6), on November 3. The study is being sponsored by the Electric Power Research Institute.

Appraiser Devalues Land Near Marcy-South Power Line

A real estate appraiser testified at the Marcy-South power line trial that "fear of cancer" could lower property values near the 345 kV power line up to 90%, according to attorney Michael A. Gurda.

Gurda, of Gurda, McBride, Isseks & Smith in Middletown, NY, is representing 58 landowners who are seeking $66.5 million in damages from the New York Power Authority (NYPA) (see *MWN*, M/J88, J/A88 and S/O88).

Testimony at the trial is scheduled to end on December 16. In an interview with *Microwave News*, Tom Watson, of Crowell & Moring in Washington, DC, one of NYPA's attorneys, said that he did not expect a decision before the middle of 1989.

Carl Rosenbloom, of Bond, Schoeneck & King in Albany, NY, is NYPA's counsel for the real estate segment of the trial. The case is being heard in the New York State Court of Claims in Goshen, NY.

Marcy-South Expert Witness Fees

The fees for health experts listed below were supplied by a spokesman for the New York Power Authority (NYPA) and by Michael Gurda, of Gurda, McBride, Isseks & Smith, an attorney for the 58 landowners. The figures for the NYPA witnesses reflect fees plus expenses and disbursements as of November 23. Those for claimants' witnesses represent fees plus expenses and disbursements—rounded off to the nearest thousand—as of December 2.

Name	Amount Paid	Affiliation
NYPA Witnesses		
Dr. Stuart Aaronson	$70,250.98*	National Cancer Institute (NCI), Bethesda, MD
Dr. Richard Bockman	$56,950.70	Memorial Sloan-Kettering Cancer Center, New York, NY
Dr. Roswell Boutwell	$74,256.74	University of Wisconsin, Madison, WI
Dr. Edmund Egan II	$24,338.92	University of Buffalo, Buffalo, NY
Michael Silva	$61,080.00	Enertech Consultants, Inc., Campbell, CA
Dr. Lucius Sinks	$41,083.42	NCI, Bethesda, MD
Dr. Herbert Terrace	$54,153.69	Columbia University, New York, NY
Dr. Margaret Tucker	$12,978.04*†	NCI, Bethesda, MD
Dr. Ken Zaner	$33,512.74	Harvard Medical School, Cambridge, MA
Landowners' Witnesses		
Dr. Harris Busch	$20,000	Baylor College of Medicine, Houston, TX
Marvin Chatkoff	$6-7,000	University of Texas, San Antonio, TX
Dr. Andrew Marino	$20,000	LSU Medical Center, Shreveport, LA
Dr. Jerry Phillips	$10,000§	Cancer Therapy and Research Center, San Antonio, TX
Dr. Lennart Tomenius	$9,000	Stockholm, Sweden

* Under cross-examination, Aaronson and Tucker detailed their billing rates: Aaronson stated that he charged NYPA $250/hour. Tucker's fee was based on a $150/hour rate.

† As of November 23; NYPA anticipates further billings.

§ Phillips says that his total bill came to approximately $6,300.

Two Views on EMFs and Cancer: At Most a Small Risk

Two new assessments of the cancer potential from electromagnetic fields (EMFs) have recently appeared in the *British Medical Journal (BMJ)* and in *Cancer*. (See also *MWN*, J/A88 for other reviews.)

In "Living Under Pylons: If Electromagnetic Fields Are Carcinogenic the Effect Is Weak," a commentary in the *BMJ*, (*297*, pp.804-805, October 1, 1988), Dr. Tar-Ching Aw of the U.K.'s University of Birmingham Institute of Occupational Health concludes that:

> If ELF EMFs do cause leukemia or other malignancies, then a general increase in these malignancies in the general population might be expected as the use of electric power for each head of the population increases. Also children with leukemia exposed to ELF fields might be expected to be younger than those without such exposure. Neither of these propositions seems to be true. At the most, the carcinogenic potential of ELF EMFs must be weak. It may be that as the wavelength of electromagnetic radiation lengthens and the frequency decreases, the carcinogenic effect diminishes.
>
> Further studies to evaluate the health hazards from ELF EMFs should take into account the complexities of measuring the strength of magnetic fields separately from that of electric fields. A comprehensive, relevant and valid method for assessing exposure is needed. Standards on limiting exposure to magnetic fields have been developed in several countries, and it would be useful to make these standards uniform by basing them on sound scientific data.

Dr. Roy E. Shore of New York University's Institute of Environmental Medicine in New York City presents a second perspective in "Electromagnetic Radiations and Cancer: Cause and Prevention," *Cancer*, (*62*, pp.1747-1754, October 15 Supplement, 1988). He writes:

> Although the studies provide a suggestive thread of evidence for an association between leukemia, especially acute myeloid leukemia, and exposure to EMFs, several caveats should be noted. None of the studies had adequate measures of EMF exposure levels for individuals, particularly measurements of the electrical fields, which are thought to be more biologically relevant than the magnetic fields. In the occupational studies, many of the electric occupations (*e.g.*, welders) would have had exposures to other potentially toxic agents as well. The occupational information on death certificates appears to be inaccurate or incomplete for 20% to 25% of deaths. Proportional mortality analyses, which were used in most of the occupational studies, may often contain hidden biases. Given these intrinsic methodologic problems and the questionable biologic plausibility of the relationship, it seems premature to conclude that exposure to EMFs causes leukemia based on the generally small elevations in risk that have been found, but the possibility cannot be ruled out. [references omitted]

Shore also addresses other types of ionizing and nonionizing radiation in his paper, which was accepted for publication on October 30, 1987, and first presented at an American Cancer Society conference in June 1987.

His review of radiofrequency and microwave radiation is brief, addressing only a few cellular and epidemiological studies. He concludes that, "It seems unlikely that microwave radiation is carcinogenic, but a longer follow-up of the Navy radar technician cohort could significantly strengthen the existing evidence." (Shore is referring to the 1980 Robinette-Silverman epidemiological study of Navy personnel.)

NY State Considers a Second Power Lines Project

High-level negotiations are underway for a second New York State Power Lines Project (NYPLP-II) to investigate electromagnetic field (EMF) effects. Dr. David Carpenter, the dean of the New York State School of Public Health, who served as the executive secretary of the original NYPLP, has drawn up a list of research projects to be targeted by the NYPLP-II. Senior officials at the state's Public Service Commission (PSC) and at the Department of Health (DOH) are currently weighing his proposals.

On Carpenter's priority list are: a prospective childhood cancer epidemiological study with an assessment of exposures at home and at school; replications of two NYPLP studies—Dr. Kurt Salzinger's behavioral experiment and Dr. Richard Stevens's adult cancer study (taking into account new information regarding exposures from electrically heated beds); and an EMF–brain tumor study.

With more and more power line research being funded by the Electric Power Research Institute and by the U.S. Department of Energy, Carpenter is determined that, like the original project, the NYPLP-II be coordinated and run by a health-oriented state agency, such as the DOH. "I feel strongly that health hazards research should not be done exclusively by industry—it's the old problem of the fox guarding the chicken coop," he told *Microwave News* in an interview.

Who will pay for the four-to-five-year NYPLP-II is still unclear. New York state utilities footed the $5 million bill for the original project on the condition that they be exempt from funding future studies. Carpenter, however, believes that the utilities may decide that it is in their own best interests to support the NYPLP-II.

After the release of the NYPLP's final report in July 1987, New York State Commissioner of Health Dr. David Axelrod urged the National Cancer Institute (NCI) to follow up by sponsoring its own studies. The institute is planning a major study on the etiology of childhood cancer, which will include the possible role of magnetic fields (see *MWN*, M/A88). An NCI spokeswoman told *Microwave News* that a request for proposals for this study is in preparation. Otherwise, it seems that EMF effects are not a major health issue at NCI.

Carpenter said that he is somewhat dismayed by the NY PSC's interpretation of the NYPLP's final report—that the project's studies "revealed no evidence that magnetic fields pose a health hazard" (see *MWN*, M/A88). "Any logical person cannot conclude that there are no effects," he said. "It's

just wrong to imply that there are no hazards." He acknowledged that, for the moment, "it would be unrealistic to set the magnetic field limits at a few milligauss" because such a standard would alarm people and cause enormous dislocations.

IEEE-PES and APPA Issue Statements on Health Effects

Two new position papers on electromagnetic field (EMF) effects have recently been issued.

The Biological Effects of Power Frequency EMFs Working Group of the IEEE's Power Engineering Society (PES) has released a short report prepared under the aegis of William Feero, the chairman of the working group. The report, which was written by a task force made up of Dr. Lee Rosen of W/L Associates in Frederick, MD, Jack Lee of the Bonneville Power Administration in Portland, OR, and Jack Sahl of Southern California Edison Co. in Rosemead, CA, is based on six recent health effects reviews, including those from the World Health Organization and from the New York State Power Lines Project. It concludes:

> At present there is no consensus expressed in the reports as to which factor, the electric or magnetic field, is the more biologically important. Similarly, the roles of field strength, duration of exposure, and intermittent versus continuous exposure are also unknown. This uncertainty complicates efforts to develop and implement methods of exposure mitigation. There is no clear direction concerning whether to reduce fields, and if so by how much, or whether harmonics are a factor. Therefore initiation of mitigation without an adequate scientific base may not be effective. EPRI is beginning to address the question of what is actual human exposure, with plans for a national program of magnetic fields measurements. It is expected, however, that such an effort will take years before useful information is available. It will take additional years for the biological sciences to determine what component, if any, of exposure is a factor in health risks.

Feero, who is with Electric Research & Management Inc. in State College, PA, told *Microwave News*, "The report is for the power engineer who has not been following this topic." It will be published in the December issue of the IEEE's *Power Engineering Review*.

Meanwhile, the American Public Power Association (APPA) has adopted resolutions calling for "increased and sustained funding for EMF health effects research on the part of individual electric utilities, EPRI, and the federal government," and stating its support for "efforts to provide timely, accurate, and complete information on EMF effects research to electric consumers and the general public."

The APPA has earmarked $50,000—from a total 1989 research budget of $500,000—for two studies on EMFs from buried power lines and on line configurations which generate lower EMFs. But despite the APPA's professed goals, APPA Director of Research Michael Bergman refused to offer any details on these projects. A summary of current and planned research should be available in early 1989.

CONFERENCES

1989 Conference Calendar

January 29-February 3: **Winter Meeting of the IEEE Power Engineering Society,** Penta Hotel, New York, NY. Contact: IEEE Society Special Services, 345 East 47th St., New York, NY 10017, (212) 705-7895.

March 7-9: **8th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility,** Zurich, Switzerland. Contact: Dr. T. Dvorak, ETH Zentrum-IKT, 8092 Zurich, Switzerland, (1) 256-2790.

March 10-12: **2nd Meeting of the International Society for Bioelectricity,** Sheraton Hotel, Denton, TX. Contact: Patricia Burnett, Dept. of Orthopaedic Surgery, LSU Medical Center, PO Box 33932, Shreveport, LA 71130, (318) 674-6170.

March 18-23: **37th Annual Meeting of the Radiation Research Society (RRS) and 9th Annual Meeting of the North American Hyperthermia Group,** Westin Hotel, Seattle, WA. Contact: RRS, 1101 Market St., 14th Floor, Philadelphia, PA 19107.

March 27-28: **15th Annual Northeast Bioengineering Conference,** Northeastern University, Boston, MA. Contact: Dr. Vinay Ingle, Department of Electrical and Computer Engineering, Northeastern University, 360 Huntington Ave., Boston, MA 02115, (617) 437-3008.

March 28-31: **INTERMAG '89 Conference,** Mayflower Hotel, Washington, DC. Contact: Diane Suiters, c/o Courtesy Associates, INTERMAG '89, 655 15th St., NW, Suite 300, Washington, DC 20005, (202) 639-5088.

March 29-30: **IEEE AESS National Radar Conference,** Sheraton Park Central Hotel, Dallas, TX. Contact: IEEE AESS Radar Conference, Attn: Russell Logan, PO Box 1000-262, McKinney, TX 75069.

April 2-7: **IEEE/PES Transmission and Distribution Conference and Exposition,** Convention Center, New Orleans, LA. Contact: Don Preston, Louisiana Power & Light Co., 317 Baronne St., PO Box 60340, New Orleans, LA 70160, (504) 595-2274.

April 4-7: **6th International Conference on Antennas and Propagation,** University of Warwick, U.K. Contact: Institution of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

April 5-6: **25th Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP),** Vista International Hotel, Washington, DC. Contact: NCRP, Suite 800, 7910 Woodmont Ave., Bethesda, MD 20814, (301) 657-2652.

April 12-14: **5th Annual Meeting of the Electromagnetic Energy Policy Alliance (EEPA),** Radisson Mark Plaza Hotel, Alexandria, VA. Contact: Richard Ekfelt, EEPA, 1255 23rd St., NW, Suite 850, Washington, DC 20037, (202) 452-1070.

April 14-16: **Electrobiology Today: An International Symposium in Honor of Luigi Galvani,** Bologna, Italy. Contact: Organizing Secretariat, O.I.C., Via G. Modena, 19, 50121 Florence, Italy, (055) 57.78.22-57.10.82.

April 24-28: **International Conference on Radar,** Versailles, France. Contact: International Conference on Radar, 11 rue Hamelin, F-75783 Paris Cedex 16, France, (1) 45 05 71 69.

April 25-27: **IEEE Instrumentation and Measurement Technology Conference (IMTC)**, Washington, DC. Contact: Robert Myers, IMTC Conference Coordinator, 1700 Westwood Blvd., Suite 101, Los Angeles, CA 90024, (213) 475-4571.

April 29-May 2: **67th Annual Convention of the National Association of Broadcasters (NAB)**, Convention Center, Las Vegas, NV. Contact: NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5300.

April 30-May 3: **10th Annual Meeting of the Canadian Radiation Protection Association**, New Victoria Conference Center, Victoria, British Columbia, Canada. Contact: Lutz E. Moritz, TRIUMF, 4004 Wesbrook Mall, Vancouver, B.C. V6T 2A3, Canada, (604) 222-1047.

April 30-May 5: **6th Annual Magnetic Resonance Imaging National Symposium**, Hyatt Orlando, Disney World/EPCOT Center, FL. Contact: Florida Radiological Society, Program Committee, PO Box 17241, Tampa, FL 33682, (813) 873-2090 or (800) 338-5901.

May 7-12: **175th Meeting of the Electrochemical Society**, Los Angeles, CA. Contact: Electrochemical Society, 10 South Main St., Pennington, NJ 08534.

May 9-12: **2nd Dresden Symposium on Electrostimulation**, Dresden, G.D.R. Contact: Dr. K.-J. Schulze, Medical Academy "Carl Gustav Carus," Clinic of Orthopedics, Fetscherstrasse 74, Dresden, 8019 G.D.R.

May 13-17: **24th Annual Meeting and Exposition of the Association for the Advancement of Medical Instrumentation (AAMI)**, Cervantes Convention Center, St. Louis, MO. Contact: AAMI, 3330 Washington Blvd., Suite 400, Arlington, VA 22201, (800) 332-2264.

May 23-25: **IEEE National Symposium on Electromagnetic Compatibility**, Radisson Hotel, Denver, CO. Contact: Dave Hill, PO Box 4056, Englewood, CO 80155, (303) 497-3472.

May 31-June 2: **43rd Annual Frequency Control Symposium**, Denver Marriott City Center Hotel, Denver, CO. Contact: T.R. Meeker, 2956 Lindberg Ave., Allentown, PA 18103.

June 4-9: **International Symposium on Charge and Field Effects in Biosystems**, Virginia Commonwealth University (VCU), Richmond, VA. Contact: Jackie Elston, Conference Coordinator, College of Humanities & Sciences, Box 2019, VCU, Richmond, VA 23284, (804) 367-1674.

June 13-15: **1989 IEEE MTT-S International Microwave Symposium**, Long Beach, CA. Contact: Reynold Kagiwada, c/o LRW Associates, 1218 Balfour Dr., Arnold, MD 21012, (800) MICROWAVE.

June 18-22: **11th Annual Meeting of the Bioelectromagnetics Society (BEMS)**, Sheraton El Conquistador Conference Center, Tucson, AZ. Contact: Dr. W.G. Wisecup, BEMS, 120 West Church St., Frederick, MD 21701, (301) 663-4252.

June 25-29: **34th Annual Meeting of the Health Physics Society (HPS)**, Albuquerque, NM. Contact: HPS, 8000 Westpark Dr., Suite 400, McLean, VA 22102, (703) 790-1745.

June 26-29: **14th Annual Conference of the Australian Radiation Protection Society**, Perth, Western Australia. Contact: ARPS-14 Conference Convenor, c/o Radiation Protection Office, Queen Elizabeth II Medical Centre, Verdun St., Nedlands, 6009, Western Australia, Australia, (09) 389 2262.

June 26-30: **IEEE AP-S International Symposium & URSI Radio Science Meeting**, Red Lion Inn, San Jose, CA. Contact: Dr. Ray King, General Chairman, Lawrence Livermore National Laboratory, L-156, Livermore, CA 94550, (415) 423-2369.

July 9-14: **1989 IEEE PES Summer Meeting**, Hyatt Regency, Long Beach, CA. Contact: IEEE Society Special Services, 345 E. 47th St., New York, NY 10017.

July 24-27: **1989 SBMO International Microwave Symposium**, Maksoud Plaza, São Paulo, Brazil. Contact: Dr. Octavio Andrade, IMT–Escola de Engenharia Mauá, Estrada da Lágrimas, 2035, 09580 - S. Caetano do Sul - São Paulo, Brazil, (011) 442-6944.

August 1-3: **4th International EMC EXPO-89**, Sheraton Hotel, Washington, DC. Contact: Jeff Eckert, PO Box D, State Route 625, Gainesville, VA 22065, (703) 347-0030.

August 7-11: **Non-Ionizing Radiations: Biophysical and Biological Basis, Applications and Hazards in Industry and Medicine**, Massachusetts Institute of Technology (MIT), Cambridge, MA. Contact: Director of Summer Sessions, Room E19-356, MIT, Cambridge, MA 02139.

August 22-25: **International Symposium on Antennas and Propagation**, Tokyo, Japan. Contact: Dr. Takashi Katagi, Mitsubishi Electric Corp., 325 Kamimachiya, Kamakura, 247 Japan, (0467) 44-8862.

August 28-September 1: **6th International Symposium on High Voltage Engineering**, Westin Canal Place Hotel, New Orleans, LA. Contact: Professor P.B. Jacob, Electrical Engineering Dept., Mississippi State University, PO Drawer EE, Mississippi State, MS 39762, (601) 325-3912.

August 29-September 1: **2nd International Symposium on Antennas and EM Theory**, Shanghai, People's Republic of China (PRC). Contact: Professor Mao Yukuan, Xidian University, 2 Taibe Rd., Xi'an, PRC.

September 4-8: **2nd International Conference & Workshop on Electromagnetic Interference & Compatibility (INCEMIC)**, Bangalore, India. Contact: Dr. G.K. Deb, Electronics and Radar Development Establishment, C V Raman Nagar, Bangalore - 560 093, India.

September 4-8: **2nd International Symposium on Recent Advances in Microwave Technology**, Beijing, People's Republic of China. Contact: Dr. Banmali Rawat, Dept. of Electrical Engineering/Computer Science, University of Nevada, Reno, NV 89557, (702) 784-6927.

September 8-10: **International Symposium on Electromagnetic Compatibility**, Trade and Industry Center, Nagoya, Japan. Contact: Professor Y. Miyazaki, Toyohashi University of Technology, Toyohashi, 440 Japan, (0532) 47-0111, ext. 576.

September 11-14: **Work with Display Units 89 (WWDU89)**, Queen Elizabeth Hotel, Montréal, Québec, Canada. Contact: WWDU89, Institut de Recherche en Santé et en Sécurité du Travail du Québec, 505 boul. de Maisonneuve Ouest, Montréal, Québec H3A 3C2, Canada, (514) 288-1551.

September 17-20: **9th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS)**, Cleveland Clinic Hotel, Cleveland, OH. Contact: Executive Secretary, BRAGS, PO Box 64, Dresher, PA 19025.

September 21-23: **10th Conference of the European Society for Hyperthermic Oncology**, Amsterdam, The Netherlands. Contact: Congress Office, Bureau PAOG–10th ESHO, Tafelbergweg 25, 1105 BC Amsterdam, The Netherlands, (20) 566-4801.

September 24-30: **10th International Conference on Bioelectrochemistry and Bioenergetics (BEC X)**, Centre Culturel des Prémontrès, Pont-à-Mousson, France. Contact: Prof. René Buvet, BEC X, 23, allée de la Toison d'Or, F.94000 Créteil, France; or (in the U.S.) Martin Blank, College of Physicians and Surgeons, Columbia University, 630 W. 168th St., New York, NY 10032, (212) 305-3644.

September 26-28: **11th Annual Electrical Overstress/Electrostatic Discharge Symposium**, Hyatt Regency, New Orleans, LA. Contact: Bob Rountree, Texas Instruments Inc., 12201 Southwest Freeway, MS 631, Houston, TX 77001, (713) 274-2067.

September 26-28: **International Conference on Lightning and Static Electricity**, University of Bath, U.K. Contact: Laura Christie, Principal Conference Organizer, ERA Technology, Ltd., Cleeve Rd., Leatherhead, Surrey KT22 7SA, U.K.

September 26-29: **International Conference on High Frequency/Microwave Processing and Heating**, Arnhem, The Netherlands. Contact: KEMA, PO Box 9035, 6800 ET Arnhem, The Netherlands.

UPDATES

BIOLOGICAL EFFECTS

USAF's Search for Mechanisms... Dr. David Erwin of the USAF's School of Aerospace Medicine (USAFSAM) presents "an overview of present knowledge" of the mechanisms of interaction of RF/MW radiation with tissues, with special emphasis on the USAFSAM's own research. Erwin stresses thermal responses; he devotes only two paragraphs to non-thermal effects. His review appears in the November 1988 issue of *Aviation, Space, and Environmental Medicine, 59,* pp.A21-31, a supplement to issue No.11.

Call for Papers... Dr. Harry Brown, the editor of *Cancer Biochemistry Biophysics,* is inviting researchers investigating the link between EMF effects and cancer to submit manuscripts to the journal. "Our intent is that we become a major publication in this subdiscipline," according to Brown. He is planning to increase the frequency of publication, which is now quarterly, and to speed up the printing schedule—the time between a paper's submission and its publication. He is interested in both original studies and review articles. Brown himself recently wrote a major review on EMFs and cancer (see *MWN*, J/A88). For more information, contact Brown at: Biochemistry Department, Cook College, Rutgers University, New Brunswick, NJ 08903, (201) 932-9728.

COMPATIBILITY & INTERFERENCE

NIST on Cable Shielding... The NIST is developing guidelines to evaluate the shielding effectiveness of cables and connectors against EMI from pulsed radiation with fast rise times and high-frequency components, such as from high-power microwaves (HPM), as well as from lightning and EMP. According to NIST's Myron Crawford, cables are the most likely electronic component to pick up electromagnetic energy, leading to EMI. When asked whether improperly shielded cables may have contributed to EMI-induced helicopter crashes (see Military Applications on p.13), he replied, "It's a possibility." The NIST, formerly known as the NBS, can determine the shielding effectiveness of cables from 14 kHz to 18 GHz with dynamic ranges up to 130 dB. Staff engineers have already examined the cables beyond the RF barrier in the payload bay of the space shuttle for Martin Marietta and tests of other aerospace systems are planned. Crawford said that while the NIST develops methods for testing cables, solutions are the client's responsibility. For more information, contact: Myron Crawford, Division 723.03, NIST, Boulder, CO 80303, (303) 497-5497.

TEMPEST Market... Sales of TEMPEST products continue to grow, albeit at a slower pace than predicted last year. According to Frost & Sullivan (F&S), the market will expand from $1.01 billion in 1987 to over $2 billion in 1993—considerably less than the $2.9 billion by 1992 predicted in a similar report issued last year (see *MWN*, S/O87). A spokeswoman for F&S said that there have been many changes in the industry, which, in fact, prompted the early revision of the report. F&S estimates that the largest segment of the market is for TEMPEST-rated personal computers: $253 million in 1987, which is expected to grow to $389 million by 1993. *The U.S. Military TEMPEST Equipment Market* (No.A1956) is available for $2,150 from: F&S, 106 Fulton St., New York, NY 10038, (212) 233-1080.

GOVERNMENT

CDRH Publications Guide... The FDA's Center for Devices and Radiological Health (CDRH) has released a *Publications Index,* which lists medical device and radiological health documents published by the center and/or authored by its staff from 1978 through 1986. The 240-page catalogue, which is indexed by title keywords, author and accession number, includes scientific journal articles, published abstracts and technical reports. The center plans to update the index every other year. A copy is available for $28.95, plus a $3.00 handling charge, from: National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161. Specify NTIS Accession No.PB89120372/AS.

MEDICAL APPLICATIONS

New PEMF Treatments... Two new reports published in consecutive issues of *The Lancet* confirm the benefits of treating localized circulatory problems and muscle atrophy due to immobilization with PEMFs. In the September 24 issue, researchers at the Karolinska Institute in Stockholm, Sweden, report that breast reconstruction patients, who were treated locally with 80 Hz square pulses with a duration of 0.4 msec, experienced an increase in localized blood flow. The researchers conclude that their study and others indicate that electrical nerve stimulation "should be tried in ischaemic surgical flaps and possibly other ischaemic skin conditions such as leg ulcers."...And according to a report in the October 1 issue by a research team from the Universities of Edinburgh and Dundee in Scotland, U.K., led by Dr. J.N.A. Gibson, electrical stimulation prevented muscle atrophy in immobilized thigh muscles. Seven patients in casts for fractured tibias were given muscle stimulators generating 30 Hz square wave pulses on a 2 sec on–9 sec off cycle and designed to be used one hour a day at home. After six weeks, their injured and healthy legs showed similar levels of muscle mass and rates of muscle protein synthesis. Patients who did not use the stimulators showed evidence of muscle wasting in their immobilized legs. See also a letter in the October 29 *Lancet* prompted by Gibson's report.

SAD Society in the Works...A group of researchers who share an interest in visible light therapy and circadian rhythms are banding together to form the *Society for Light Treatment and Biological Rhythms.* Although still in the planning stages, the organization already includes psychiatrists, psychologists and physiologists. Many of the members do research on

seasonal affective disorder (SAD)—a winter depression caused by deprivation of natural light—while others focus on therapies for sleep disorders and for controlling biorhythms among night shift workers and jet lag sufferers. According to founding member Dr. Michael Terman of the New York Psychiatric Institute in New York City, the group hopes to put out a newsletter covering current research and general society news. An electronic mail linkup and a press liaison for publicizing new developments are also being considered. For more information, contact: Dr. Michael Terman, NY Psychiatric Institute, 722 West 168th Street, Box 50, New York, NY 10032, (212) 960-2200.

Measuring Bioelectric Currents... Researchers at Arizona State University in Tempe have developed a non-invasive method to measure low-level bioelectric currents in small animals. In a paper published in the October issue of *IEEE Transactions on Biomedical Engineering*, Drs. Bruce Towe and Mohammed Rezaul Islam make use of the Lorentz forces generated by the current flowing through biological media exposed to magnetic fields to trigger acoustic vibrations detectable by a microphone. Towe and Islam believe that their method is cheaper and easier than the SQUID. At this point, however, it is unclear whether their technique—which worked successfully on hamsters—can be extended to humans.

MEETINGS

Bioelectromagnetics in Italy... An international symposium on *Electrobiology Today* will be held in Bologna, Italy, April 14-16. The meeting is in honor of Luigi Galvani (1737-1798), the famed anatomist whose experiments with frogs opened up the study of animal electricity. Galvani was born and died in Bologna. The meeting will be divided into three parts—biophysics, biology and clinical orthopedics—and promises to have an international cast of researchers. See the 1989 conference calendar on p.10 for contact address....The following month, May 10-19, a short course will be held in Erice, Sicily, on *Optical Sources, Lasers and Synchrotron Radiation: Biological Effects and Hazard Potential.* The course will focus on risks to the eyes and the skin. The National Science Foundation has some travel funds available for a limited number of U.S. students. For more information on the course and travel grants, contact: Dr. David Sliney, U.S. Army Environmental Hygiene Agency, HSHB-MR-LL, Aberdeen Proving Ground, MD 21010; or Dr. Martino Grandolfo, National Institute of Health, Physics Laboratory, Viale Regina Elena, 299, 00161 Rome, Italy.

BRAGS Proceedings... The *8th Annual Meeting of the Bioelectrical Repair and Growth Society* (BRAGS) was held in Washington, DC, October 9-12. A copy of the *Transactions*, which includes abstracts of the 69 papers and posters presented at the meeting, as well as a directory of the society's membership, is available for $45.00 (including postage) from: Executive Secretary, BRAGS, PO Box 64, Dresher, PA 19025.

MILITARY APPLICATIONS

Black Hawk EMI Update..."EMI does raise safety of flight concerns with respect to the Black Hawk" helicopter, Michael Stone, under secretary of the Army, acknowledged in a September 2 memorandum to the DOD Inspector General (see *MWN*, S/O88). On September 30, the Army submitted plans for EMI shielding modifications for the Black Hawk to the U.S. Senate Appropriations Committee's subcommittee on defense. J.R. Sculley, assistant secretary of the Army, told the subcommittee that the total projected cost for shielding existing and future Black Hawks is $175,000,000—$72,000 for each new helicopter and $84,000 for each old one. The shielding program, which is already underway, is expected to be completed by 1992. Earlier, the Army had considered plans to employ the same EMI protection specifications—up to 200 V/m—as those used by the U.S. Navy for shielding its Sea Hawk helicopter; the estimated cost was $450,000,000.

OVENS

Heating Applications...A MW dryer which reportedly dries laundry 30% faster than a conventional model may soon be on the market. The "Miracle Dry," manufactured by Micro Dry Inc. of Tulsa, OK, uses less energy, needs no special air vents and can be plugged into any wall socket, according to the September issue of *High Technology Business*. Micro Dry also claims that its product can kill bacteria in fabric. But two researchers at the Associated Sciences Research Foundation in Marlborough, NH, warn that heating cotton underpants in a MW oven to destroy the fungus responsible for yeast infections may cause them to catch fire, reports the latest issue of IMPI's *Microwave World*....Gerling Laboratories has issued a newly expanded sales catalogue of industrial MW components and systems operating at the ISM frequency of 2.45 GHz. To order a copy, contact: Gerling Labs, 1132 Doker Dr., Unit 1, Modesto, CA 95351, (209) 521-6549....Chemists looking for a way to accelerate chemical reactions might try a MW oven. According to a feature story in the *New Scientist* (November 12), heating with MWs can speed up some organic reactions by a thousand times or more.

Notes on "Microwaving"... Cooking fish in a MW oven may be the best way to preserve omega-3 fatty acids, which are increasingly believed to lower cholesterol and help prevent heart disease. According to an article in the *Wall Street Journal* (November 7), a University of Massachusetts food scientist claims that, although cooking in high temperatures can remove up to one half the omega-3, microwaving does not alter the oil content....Libraries may no longer have to resort to expensive methods to fumigate their books. *Science News* (October 29) reports that a Syracuse, NY, researcher suggests tossing the books in the MW for a minute to get rid of insects.

UPDATES

PEOPLE

Professor **Ted Grant** and Dr. **Camelia Gabriel** are branching out from the ivory tower—they have formed "University Microwave" to provide dielectric measurements services and to advise U.K. industry on RF and MW safety. They will both retain their positions at the University of London's King's College....**Lynn Claudy**, formerly with Hoppman Corporation in Chantilly, VA, has joined the National Association of Broadcasters as a staff engineer. He is also an adjunct professor of physics at The American University in Washington, DC....Dr. **Tom Rozzell**, the founding editor of the *Bioelectromagnetics Society Newsletter*, has stepped down. Rozzell has been editing the newsletter since 1978. The society's board of directors is expected to announce a permanent replacement soon....**James Hill**, president of EMXX Corp. and a founder of the IEEE's EMC society, died on October 30 at his home in Ohio.

STANDARDS

ISM Rules...CISPR has released a six-month draft rule revising its Publication 11, *Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical (ISM) Radiofrequency Equipment (Excluding Surgical Diathermy Apparatus)*, CISPR/B(Central Office) 23. A copy is available for $45.00 from: International Sales Department, ANSI, 1430 Broadway, New York, NY 10018. ...In 1987, the Hong Kong Telecommunications Authority released regulations on *Radio Interference Limits and Methods of Measurements for ISM RF Equipment*, excluding surgical diathermy units and RF welding machines. For a copy of the standard, which is scheduled to be adopted in December 1988, contact: Office of Standards Code and Information, Administration Bldg., Room A629, NIST, Gaithersburg, MD 20899, (301) 975-4037. Specify TBT/notif.88.198.

TECHNOLOGY

Holding Pattern for MLS... The Federal Aviation Administration (FAA) is backing a 17-month study on the microwave landing system (MLS). The proposed study is part of a three-year FAA program designed to address airline pilot and operations personnel concerns about the need for and the capabilities of the MLS, according to *Aviation Week and Space Technology* (October 10). These actions follow the General Accounting Office's (GAO) recommendation that the FAA halt plans for purchasing additional MLSs until their potential operational and economic benefits have been adequately demonstrated. The MLS was originally intended to replace the Instrument Landing System (ILS), which, like the MLS, helps aircraft land in conditions of limited visibility. Designed to increase airport capacity and reduce flight delays, the MLS was selected to become the primary system for military and civilian use amid concerns over the ILS's reliability. Developmental problems, however, have delayed the installation of MLSs, while ILS capabilities have been updated and improved. The FAA has asked Congress to appropriate over $1 billion for MLS conversions, but, in its May 1988 report to the House subcommittee on transportation, the GAO concludes that the FAA has not adequately demonstrated the need for the MLS. (Congress turned down FAA requests for MLS funding in FY87 and FY88 pending operational tests and a strategy review.) For its part, the Air Transport Association (ATA), which represents 21 U.S. airlines, opposes the costly MLS, although ATA officials have acknowledged that ILS limitations—particularly, FM radio band interference on the ILS frequency—may ultimately force its members to accept the MLS. In the meantime, the GAO recommends reserving previously purchased MLSs for airports where ILSs cannot be used and for operational testing, while retaining the ILS as the primary landing system in the U.S. For a copy of the GAO report (No.GAO/RCED-88-118), contact: U.S. General Accounting Office, PO Box 6015, Gaithersburg, MD 20877, (202) 275-6241. Single copies are available free of charge.

Traveling Light... The worldwide market for photonics—the use of visible light to gather, process and transmit information—is growing by leaps and bounds, according to a research panel of the National Research Council. In its report, *Photonics: Maintaining Competitiveness in the Information Era*, the panel states that systems powered by photons are faster, more resistant to EMI and have a larger information-carrying capacity than those powered by electrons. Possible applications include telecommunications, computer networks, optical sensors for robots and advanced imaging equipment. A copy of the council report is available for $11.95, prepaid, from: National Academy Press, 2101 Constitution Ave., NW, Washington, DC 20418, (202) 334-3313.

VDTs

Radiation Q's & A's...A new booklet covering the basics of what is known about VDT radiation has been prepared by David Charron of the Canadian Centre for Occupational Health and Safety (CCOHS). The 11-page report, *Health Hazards of Radiation from Video Display Terminals: Questions and Answers* (P88-15E), was released in July 1988 and is available in French and in English from: CCOHS, 250 Main St. East, Hamilton, Ontario L8N 1H6, Canada, (416) 572-2981. Single copies are free for Canadians and cost $3.00 (U.S.) for all others.

ETC...

Will Microwaveland Be Next?...A Maine resident who challenged a state law prohibiting the alteration of license plates won the right to change his plate to read "Radiationland," instead of "Vacationland," as an expression of his opinion of nuclear energy, according to the October 16 *New York Times*.

RTCA on Electronic Devices Aboard Aircraft *(continued from p.1)*

from electronic devices used aboard aircraft is "small" because a number of unlikely conditions must be present to cause a disruption. Frank White, the chairman of the RTCA committee, does not think there is much of a risk: "Some years ago, I offered $1,000 of my own money to any passenger carrying an electronic device who could cause it to interfere and no one has yet collected."

Nevertheless, the risk was deemed great enough for the RTCA to seek certain limits on the use of computers and radios aboard aircraft. As White told *Microwave News*, "You have got to play it smart and restrict their use during takeoffs and landings." With respect to intentional radiators such as cellular phones and remote-controlled toys, the committee recommends that they never be operated aboard aircraft. As far as computers are concerned, White said that limiting their use makes sense because the portables are just like tray tables and should be stowed during takeoffs and landings.

No In-Flight FM Radio Use

According to White, of all unintentional radiators, FM receivers present the greatest risk of EMI. "If I were making FM radios, I would label them 'not for use aboard aircraft,' " he said. "Computers are less of a problem now, but that could change as their clock frequencies rise." He explained that the majority of an aircraft's communication and navigation systems operate above 100 MHz—specifically in the 108-136 MHz band; thus the interfering signal would have to come from a computer's fifth-or-higher harmonic, which is usually too weak to cause EMI. "In any case," White said, "it would cost less than 25 cents to detune any circuits that cause resonances and emit powerful harmonics."

A probabilistic analysis included in the RTCA report estimates the chance of interference with a Boeing 727's instrument landing system (ILS) localizer is less than one in a million. The FAA ran on-the-ground and in-flight tests with an FM radio on a 727; even when the radio was placed next to a window, where there is the least attenuation, and when all other conditions believed to be necessary to cause EMI were met, there was no interference with the ILS.

The report suggests that the FCC require that devices rated for use aboard aircraft meet Class B limits for electric field radiated noise and the German VDE (Verband Deutscher Elektrotechniker) limits for magnetic field noise—no similar U.S. standard now exists. White admitted that he is doubtful that the FCC would act quickly on this recommendation because the commission is already in the midst of revising its Part 15 rules. "The probability of a new category in the next year or two is extremely small," he said.

The two-volume report, *Potential Interference to Aircraft Electronic Equipment from Devices Carried Aboard*, is full of test data and EMI incident reports. One appendix lists 29 such cases, of which 19 were instances of suspected interference to OMEGA receivers which came to the attention of the U.K. Civil Aviation Authority; six involved VOR, ILS and glide slope. The RTCA committee notes that after the manufacturer improved a particular type of OMEGA receiver, no more incidents were reported.

White stressed that manufacturers of computer and other portable electronic devices cooperated with his committee and were most helpful in the preparation of the RTCA report.

ELF-Fetal Loss Link *(continued from p.1)*

a physicist, runs Monitor Industries in Boulder, CO.

In homes with cable heating, Wertheimer and Leeper estimated—through measurements and calculations—the magnetic and electric fields to be approximately 10 mG and 10-50 V/m, respectively, when the heat was on. Electrically heated beds generate magnetic and electric fields of up to 15 mG and 250 V/m. In most houses, the ambient fields are, respectively, less than 1 mG and about 10 V/m.

As in their electric blanket study, Wertheimer and Leeper compared seasonal variations in miscarriage rates in one group of women—rather than compare two different groups—to control for possible confounding variables, such as smoking, age and socioeconomic status. They found the greatest fetal loss during months when the weather became increasingly colder and the use of electrical heat was on the rise.

The key to Wertheimer and Leeper's analysis is that the highest rate of fetal loss was observed *not* in the coldest months, when EMF exposure from electric heating is highest, but, rather, in the progressively colder months when EMF exposure is increasing. According to their hypothesis, strong EMFs cause the "silent" death of the fetus—silent because both the pregnancy and the loss go unrecognized by the mother. The "recognized" loss occurs when the fetus has undergone some development prior to the EMF exposure; the fetus survives the earliest stages of the pregnancy only to be miscarried when the exposure reaches a higher level.

The ratio of recognized fetal loss among women in cable heated homes to that among women living in houses with other types of heating was found to be greatest during increasingly colder months and lower when temperatures climbed. These two trends averaged out so that, for both groups, the proportion of birth records with a reported fetal loss was approximately the same.

The cable heating study was based on birth records from Eugene and Springfield, OR, for 1983 and 1985. Wertheimer and Leeper investigated fetal losses that occurred within a year prior to conception of a liveborn infant, because fetal losses that "occur so near a successful pregnancy are usually spontaneous...rather than induced...."

Wertheimer and Leeper are best known for their landmark 1979 study which showed that children living in homes near high current power lines had a higher rate of cancer than those living in homes away from such lines. Their electric blanket study appeared in *Bioelectromagnetics*, 7, pp.13-22, 1986.

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MICRO WAVE NEWS

Vol. IX No. 6 A Report on Non-Ionizing Radiation November/December 1989

INSIDE...

ELF NEWS pp.2-9

Power Line Talk:
EMFs on TV & in Print • Congressional Indifference • BC Hydro's New Battle • CU on Electric Blankets • COMAR Responds to Brodeur • Physicists' Skepticism • Foster Now Favors Research
EPRI Withdraws From Annual DOE Review
EMFs in the Popular Press
Ongoing Cancer Epidemiological Studies
Savitz Links Brain Cancer to EMFs
Colorado Favors "Prudent Avoidance"
Florida Teachers To Wear EMF Meters
California Calls EMF Rules "Premature"
Matanoski, EPRI and the Media
Telephone Linemen Risk Table

HIGHLIGHTS pp.9-11

IBM Markets Low VLF Radiation VDTs
Leukemia Linked to Chronic MW Exposure
RF Radiation Compliance Issues
BENER Digest To End
FAA Ranks EMI Protection as High Priority
NIER in Nordic Countries

FROM THE FIELD p.15

Swedish Academy of Sciences on Low-Level EMF Mechanisms of Interaction

UPDATES pp.13-14

More on PAVE PAWS and EEDs • People in the News • Bioelectromagnetic Association Launched in Europe • McDonald's Fights EMI • Power Lines No Hazard to EEDs • KGB's Low Frequency Signal • Membranes and Cancer Proceedings • Baby Crib Party Line • Recent Papers • and more....

CONFERENCES pp.12-13

1990 Conference Calendar

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 Breysse 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 Breysse 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 ELF EMFs (see p.6). Foster, however, believes the bioeffects literature is too weak to support such an avoidance strategy.

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 Splicers," p.B4, November 29; Bill Paul, "Men Exposed to [EMFs] in Study Have Slower Motor Responses," p.B4, December 6.

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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:3549people, 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 Breysse	EPRI	All L except CLL	CC: 200/600	D	J	1990
JHU-SPH USA	Genevieve Matanoski Patrick Breysse	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 *Microwave 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 Enertech Consultants, Inc. in Campbell, CA.

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.

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.

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 countries[3] (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 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 Breysse also have data on female telephone workers but they have not yet analyzed them.

In a telephone interview after the Portland meeting, Breysse 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."

Breysse 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," Breysse 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

Standard Incidence Ratios (SIRs)§

	Cable Splicers	Central Office Technicians
	SIRs/No. Cases†	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

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."

risk of cancer promotion than does continuous exposure[4] (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.

Breysse 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. Breysse said that he might have to go outside the U.S. to measure EMFs from older equipment.

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.

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 dramatic 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

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.

"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 μT (10-20 mG). In the patent claim, IBM stated that its shielding system reduces that field to less than 0.2 μT.

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 reported 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.

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.

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 (EEPA),** 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, Naval 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: IEE, 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 Brésoles, 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, Egry 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

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 addressed 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, analagous 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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MICRO WAVE NEWS

Vol. X No. 6 A Report on Non-Ionizing Radiation November/December 1990

INSIDE...

ELF NEWS pp.2-5

The Talk of Denver
New Power Lines Restricted in Whatcom County, WA, and in Rhode Island
Reducing EMFs in Oregon
Prudent Avoidance in California
U.K.'s National Grid Funds EMF Studies
$1 Million Stray Voltage Award

HIGHLIGHTS pp.5-9

Two RF/MW Liability Suits Filed
Excerpts from EPA EMF Report
USAF Blasts EPA Report
USAF Letter-Writing Campaign
CIRRPC To Review EMF Health Effects
White House Recommends EMF Experts

NEW PUBLICATIONS pp.12-13

Books and Reports: Annotated Listings

UPDATES pp.9-11

USAF OKs PAVE PAWS Modification • EPRI Workshops on Epidemiology and Dosimetry • Adey on EMF-Chemical Synergy • NRC's GWEN Committee • Two Medical EMF Patents Granted • MWs and Leukemia Debated • People in the News • MW Coffee and Cookies • MW Popcorn Hazards • More from Paul Brodeur • "Macworld" Goes to Washington • MW Ovens in "Consumer Reports" • and more...

CONFERENCES pp.14-15

1991 Conference Calendar

CLASSIFIEDS p.16

White House Sets Conditions for Release of EPA Cancer Report

Expert Panel's Assessment Delayed

The public release of the Environmental Protection Agency's (EPA) draft assessment of electromagnetic fields (EMFs) and cancer has been delayed following strong objections from the White House and from the U.S. Air Force. In addition, the formal review of the EPA report by the agency's Science Advisory Board (SAB) will not be concluded until a new evaluation has been completed.

On November 26, a day before the draft report was scheduled to be released, Dr. Allan Bromley, the President's science advisor, asked senior EPA officials not to issue the report pending another review by the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), according to knowledgeable sources. CIRRPC is an offshoot of the White House Office of Science and Technology Policy (OSTP), which is headed by Bromley.

Under a compromise worked out between the White House and EPA, the agency will hold up the public release of the cancer assessment until late December and the SAB panel will review the CIRRPC report when it is completed. The CIRRPC review group is still in formation and is not expected to begin work until January. Its report will take a minimum of six months to be completed—almost certainly longer (see story on p.8).

David Cohen, a spokesman in the office of EPA Administrator William Reilly, confirmed that there had been "negotiations" with the White House. "We felt it was a fair request," he said, referring to the White House's insistence on waiting for the CIRRPC review. Sources indicated that Reilly

(continued on p.6)

Some Hand-Held Two-Way Radios May Present Health Risk

Computer calculations indicate that hand-held two-way radios can emit radiation levels that exceed health standards. They also call into question the advisability of the exemption for devices with an input power of seven watts (7 W) or less, which is included in many health guidelines.

At last summer's Bioelectromagnetics Society (BEMS) meeting in San Antonio, TX, Dr. Niels Kuster of the Swiss Federal Institute of Technology in Zurich and Dr. Quirino Balzano of Motorola, Inc. in Plantation, FL, reported that their computer models indicate that a 7 W radiation source operating at frequencies above 400 MHz would deposit more than 8 W/Kg in human tissue at a distance of 2.5 cm. At 800-900 MHz, a frequency used

(continued on p.11)

ELF NEWS

The Talk of Denver

This year's DOE power line review* offered few surprises. There were no bombshells in Denver, CO, as compared to Dr. Gene Matanoski's revelations at last year's meeting in Portland, OR. If there was one lesson to take home from Denver, it was that the electromagnetic field (EMF) problem remains elusive, with no agreement yet on the most important aspect of EMF exposures. To be specific, what is it about the magnetic field that could promote cancer? And are the epidemiologists measuring the right parameters in their attempts to estimate EMF exposures?

The thesis that the pineal gland is sensitive to EMFs got a boost from preliminary data indicating a suppression of nighttime melatonin levels among two species exposed to power line fields. Dr. Fred Stormshak of Oregon State University in Corvallis reported that ewes living under a 500 kV power line—with ambient magnetic fields of 15–50 mG and electric fields of 4–7.5 kV—had a 20–25% reduction in serum melatonin.

Outside the lecture hall, there was talk of even larger reductions among baboons exposed to 60 Hz EMFs at the Southwest Research Institute (SWRI) in San Antonio, TX. SWRI's Dr. Walter Rogers did not formally present these results and refused to discuss them. "I'm not going to talk to you about this. The information belongs to the sponsors," Rogers told *Microwave News* as he walked away from an interview.

The SWRI project is primarily funded by the Central Research Institute of Electric Power Industry (CRIEPI) in Tokyo, Japan. Izumi Nishimura of CRIEPI's Abiko Research Laboratory also declined to discuss the experiment, saying only that there were no results yet.

Dr. Bary Wilson, who, with other members of the Battelle group in Richland, WA, has been working on the pineal–EMF link for over a decade, reported that intermittent exposures to magnetic fields are more effective than continuous exposures in reducing nighttime melatonin in rats.

The importance of intermittent exposures was a thread that ran through many of the talks. Dr. Russel Reiter of the University of Texas Health Science Center in San Antonio presented results suggesting that the on-and-off switching of a magnetic field is a key parameter for explaining observed changes in pineal function (see *MWN*, S/O90). And Dr. Charles Graham of the Midwest Research Institute in Kansas City, MO, reported that he observed the greatest physiological effects among humans exposed to EMFs immediately after the field was turned on and immediately after it was turned off. Like Wilson, Graham concluded that "intermittent exposure may be more biologically active than constant exposures."

These results support those presented some years ago by Drs. Craig Byus of the University of California, Riverside, and Ross Adey of the VA Hospital in Loma Linda, CA, who observed similar trends in their experiments with ornithine decarboxylase (see *MWN*, J/A83 and N/D87).

Intermittent exposures can result from moving in and out of an EMF or from being exposed to a source that switches on and off. Each entails a different type of exposure. Moving in and out of the field may tax the body's homeostatic power to acclimate to new electromagnetic environments. An EMF source that switches on and off, such as an electric blanket, generates EMF pulses that result in exposures not only to extremely low frequency (ELF) fields but to high frequency radiation as well.

Wilson verbalized what was on many people's minds when he advised that, from now on, EMF exposure systems and assessments should include any transient or high frequency components, as well as absolute field strengths.

Dr. Nancy Wertheimer and Ed Leeper, who are based in Boulder, CO, highlighted the importance of another new variable in gauging EMF exposures—the direction of the magnetic field. By adding this information to Dr. David Savitz's childhood data set and Dr. Richard Stevens's adult data set—the two epidemiological studies sponsored by the New York State Power Lines Project (see *MWN*, N/D86)—they found higher risk ratios than were originally reported.

Wertheimer and Leeper stressed that average magnetic fields inclined at less than 60° from the horizontal "may prove to be an index to something else that can be more directly or meaningfully related to cancer risk." For instance, these types of ambient EMFs may often be due to ground currents, which can vary considerably over time, and, as Wertheimer pointed out to *Microwave News*, they might point once again to the importance of intermittent exposures.

A group from the California Department of Health Services in Berkeley also concluded that Savitz had probably underestimated the risk of cancer from EMFs by using spot measurements and wire codes as surrogates for magnetic field exposures. Christianna Williams and coworkers measured EMFs in the San Francisco bay area and compared them to the exposures indicated by the surrogate indices. Williams's pilot study showed that there was probably "considerable misclassification," leading to a conclusion of a smaller cancer risk than would have been observed with more complete exposure information.

The California group will take a more detailed look at how misclassification of exposures can bias risk estimates when they send a team to do measurements in Denver, the site of the original Wertheimer-Leeper and Savitz studies (see *MWN*, J/A89).

Dr. Susan Preston-Martin of the University of Southern California (USC) in Los Angeles also raised the possibility that EMF cancer risks could turn out to be higher than previously believed. She announced that the incidence of astrocytomas (brain tumors) among males occupationally exposed for more than ten years was more than ten times the expected rate; in an earlier published analysis, Preston-Martin had reported a fourfold increased risk after more than five years of EMF exposure (see *MWN*, M/A90). Her finding closely parallels that of Dr. Terry

**The Annual Review of Research on Biological Effects of 50 and 60 Hz Electric and Magnetic Fields*, Denver, CO, November 5-8, 1990. Organized by the U.S. Department of Energy (DOE); cosponsored by the American Public Power Association and the Edison Electric Institute.

Thomas, who found a more than tenfold increase among workers exposed on-the-job for 20 years (see *MWN*, S/O87). Preston-Martin noted that neither soldering nor solvents could account for the increased tumor risk.

The Denver meeting was the first in many years not to be cosponsored by the Electric Power Research Institute (EPRI), but there are indications that the divorce is not working out (see *MWN*, N/D89). Some attendees were disappointed by the absence of many of the EPRI researchers. And those who had been at the EPRI utility meeting a few weeks earlier in Austin, TX, reported that there was some grumbling because of the lack of new results.

There had been suggestions that USC's Dr. John Peters would report on his EMF–childhood cancer study in Austin. He didn't; neither did he attend the Denver meeting. The delay encouraged speculation about what the results might show—especially when those who had been in Austin reported that Peters, when confronted with the perennial question "Would you buy a home next to a power line?" answered that he might, but only if he did not have young children. Some observers were quick to interpret the answer as a clear indication that Peters, like Savitz, had confirmed the original Wertheimer-Leeper EMF link.

When later asked by *Microwave News* if there was any substance to this line of argument, Peters replied with an amused "No." He did say that he hopes to have his results ready for the EPRI epidemiology workshop in February (see p.9).

In an interview with *Microwave News* after the Denver meeting, EPRI's Dr. Leonard Sagan left open the possibility that EPRI will rejoin the annual review. "My preference is that all the participating agencies sponsor the EMF review, including the National Cancer Institute, the National Institute for Occupational Safety and Health and the Environmental Protection Agency," he said.

Despite all the new attention to EMFs over the last year, funding levels have not increased—not even for the study of pineal effects, which many think is the key to finding a mechanism of interaction. "It's really been tough," Reiter said in an interview. "Frankly, I am discouraged by the lack of funding"—he explained that he has yet to receive "a single penny" for EMF research and that he had come to Denver at his own expense. Reiter said that if he had some money, he would work on defining those parameters of the field that are important and the mechanisms involved.

New Power Lines Restricted in Washington and Rhode Island

Unprecedented power line siting restrictions have been imposed on both coasts. In November, Whatcom County, WA, voters chose to confine new power lines above 115 kV to industrially zoned areas, and in October, the East Greenwich, RI, town council passed a three-year moratorium on new lines above 60 kV. In both cases local citizens' groups called for the restrictions in response to utility proposals for new lines.

If the trend towards regulating power lines on a local level continues to gain momentum, it could become a problem for the utility industry, according to Richard Loughery, manager of environmental programs at the Edison Electric Institute in Washington, DC. "We would prefer a single state standard. Potentially it could become a nightmare if we have a multitude of local standards to deal with," Loughery told *Microwave News*. Several states have imposed electromagnetic field (EMF) limits for the edge of utility right-of-ways (ROWs), and during the most recent session of congress, Rep. Frank Pallone (D-NJ) discussed a national EMF limit for ROWs (see *MWN*, M/A90 and J/A90).

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Ballot Initiative in Washington

Voters in Whatcom County, WA, approved a citizens' initiative restricting power lines exceeding 115 kV to industrial areas. Citizens Initiative No.4-90 marks the first successful power line siting referendum in the U.S. The immediate effect will be to disrupt Puget Power & Light Company plans to build two new 230 kV transmission lines to carry hydroelectric power from Canada.

The measure could be overturned in court because county laws forbid zoning by initiative. No challenge is expected, however. "You won't see us in court filing suit over this issue anytime soon," Puget Power representative Jude Noland told *Microwave News*.

"People are telling us something," said County Planning Director Dan Taylor, adding that, "No matter how the measure fares in court, there is a message there that we have to pay attention to."

The Whatcom County vote stood out in a year in which many other environmental referendums were rejected. California's "Big Green" and New York's environmental bond propositions both failed, yet the Whatcom County power line initiative passed by a nearly two-to-one margin.

Before the election, Bellingham Neighbors Opposing Power Encroachment (NOPE) successfully persuaded Puget Power to run the northern parts of the lines through an existing Bonneville Power Authority (BPA) right-of-way rather than create a new corridor near a number of homes. But NOPE continued to object to Puget Power's intention to run the rest of the lines through

heavily populated areas of Bellingham, and is using the initiative to force the utility to employ the existing BPA corridor for the rest of the lines as well. NOPE collected over 6,000 signatures to qualify the measure for the November ballot.

Puget Power allocated $100,000 to fight the NOPE initiative. Noland said that the utility is currently considering a number of alternatives to the lines.

Three-Year Moratorium in Rhode Island

On October 9 the town council of East Greenwich, RI, banned all new power lines above 60 kV for three years. The ordinance came about in response to widespread citizen concern about the EMFs from proposed new 345 kV and 115 kV lines which the Narragansett Electric Company plans to run through parts of East Greenwich. This is the first moratorium on power line construction in the U.S.

Narragansett Electric has appealed the decision to the Rhode Island Public Utilities Commission (PUC), contending that the 345 kV line is needed by 1994 and that the three-year moratorium could prevent it from adequately providing power to western Rhode Island.

Public concern over power line safety had previously prompted Governor Edward DiPrete to set up a committee—headed by PUC Chairman James Malachowski—to study EMF health effects. An interim report, issued in September, recommended further study and a policy of prudent avoidance to limit exposures.

Reducing EMFs in Oregon

Pacific Power and Light, an Oregon utility, recently announced that it will use a "delta" tower design that will nearly halve the EMF levels along the edge of the right-of-way (ROW) of a proposed 500 kV power line.

The total additional cost of the new towers is approximately $2.4 million, about 3.5% of the total cost of the project.

David Stewart-Smith of the Oregon Department of Energy (DOE) told *Microwave News* that the new delta design will reduce levels at the edge of the ROW to 30–35 mG, down from the earlier estimates of 56 mG for the original "flat" tower design. Electric field levels will also be almost halved. The new towers will be 20 feet taller than those originally planned.

Puget Power, which received a permit to build the 130-mile Eugene–Medford line in 1982, hit a roadblock when residents living near the proposed line banded together to fight the utility's plans. The ensuing controversy led the DOE to assemble a panel of experts to review the literature on ELF health effects (see p.13).

On October 26, the state Energy Facility Siting Council unanimously approved the utility's proposed changes for the line, which also include a one-year extension of the site certificate deadline to December 31, 1994.

Prudent Avoidance in California

The California Public Utilities Commission (PUC) has ordered the Southern California Edison Company (SCE) to follow a policy of "prudent avoidance" to limit EMFs from a proposed 220 kV power line in the Mojave Desert. The PUC also mandated that SCE provide those living, working and playing near the new line's right-of-way with literature on EMF health risks, but did not specify a source for the written material.

The proposed 38-mile line is expected to cost over $50 million and to be in operation by late 1992. In its September 12 decision, the PUC advised caution with regard to EMFs, stating that, "All that is certain is that we do not know enough to dismiss the issue entirely....until the scientific findings are more definitive, we will require SCE to take responsible, low-cost steps to avoid unnecessarily exposing people to these fields."

Rhode Islanders for Safe Power (RISP) pushed for the three-year moratorium because of the need for further research on the health effects of EMFs and because it "was the least noxious formula and the most likely to be sustained by the PUC," RISP's Ed Seiler told *Microwave News*. If the moratorium is overturned, RISP may request the town council to order the more expensive alternative of burying the lines, Seiler said.

In an interview, Narragansett Electric spokesman Charles Moran said that the company has not started to develop an alternative route for the $44 million 345 kV project and is counting on the PUC to overturn the moratorium. Moran said that EMF levels at the edge of the ROW of the 345 kV line would not exceed 20 mG.

RISP, which was formed in January 1990, has some 300 members. RISP President Jeff Jacober and East Greenwich Town Solicitor Daniel Procaccini described RISP's work at the power line congressional hearing last July (see *MWN*, J/A90).

U.K.'s National Grid Funds EMF Cellular Studies

The U.K.'s National Grid Company has awarded six contracts to British universities and research institutes to study the effects of power frequency electromagnetic fields (EMFs) on cellular interactions. The total amount of the contracts, which will run for two or three years, is about £600,000 (approximately $1.2 million).

The National Grid Company, one of the four successor companies to the Central Electricity Generating Board (CEGB), which was dissolved in March 1990, is responsible for the transmission of electric power in England and Wales. (Distribution is the responsibility of regional electricity companies.) It has also taken charge of the CEGB's EMF research program.

The projects—which were selected by an independent steering committee chaired by Dr. Charles Suckling, a member

of the Royal Commission on Environmental Pollution and formerly a general manager of research and technology at ICI, plc—are as follows:

- *"The Effects of Low Frequency EMFs on Cellular Transcription in Sciara and Drosophila Salivary Glands"*—Drs. M. Anderson and A.J. Birley, School of Biological Sciences, University of Birmingham;
- *"Rapid Biochemical Responses in Cultured Cells to Power Frequency EMFs"*—Drs. J.C. Metcalfe and T.R. Hesketh, Department of Biochemistry, University of Cambridge;
- *"Effects of Low Frequency Magnetic Fields on Single Ion Channels"*—Dr. S.B. Hladky, Department of Pharmacology, University of Cambridge;
- *"Effects of Low Frequency Alternating Magnetic Fields on Short-Term Responses of Haemopoietic Stem and Progenitor Cells to Specific Growth Factors"*—Prof. T.M. Dexter and Dr. R.E. Dale, Paterson Institute for Cancer Research, Manchester;
- *"The Uptake of Ca^{++} in a Frequency Dependent or 'Resonant' Manner as Indicated by Changes in the Mobility of Diatom Strains Sensitive to the Ca^{++} Concentration in Their Support Medium"*—Dr. R. Dixey, St. Bartholomew's Hospital, London, and Dr. J.C. Green, Plymouth Marine Laboratory;
- *"Influence of Low Frequency EMFs on Ion Flux Through Reconstituted Membrane Channels"*—Prof. R. Pethig and Dr. H. Morgan, Institute of Molecular and Biomolecular Electronics, University College of North Wales, Bangor.

The National Grid Company is also funding in-house exposure assessments. In 1988, the CEGB launched a major epidemiological initiative to study new diagnosed childhood cancer cases in England and Wales (see *MWN*, M/A88). Results of two EMF–childhood cancer studies at the University of Leeds (see *MWN*, N/D89) are expected to appear in the *British Journal of Cancer* "in due course," according to a company spokesman.

$1 Million Stray Voltage Award; Major Study in Wisconsin

A jury in Minnesota has awarded $1 million to a family of dairy farmers who contended that their cows' milk production was substantially decreased by stray electrical voltage. On October 9, after a two-and-a-half-week trial in the Sibley County District Court, the jury agreed with Dale ZumBerge and his family that Northern States Power (NSP) Company had been negligent in not correcting a 13-year chronic stray voltage problem.

The utility has filed a posttrial motion objecting to a number of aspects of the case. The stray voltage levels at the ZumBerge farm "could not have had an impact on dairy production," NSP attorney Jim Altman told *Microwave News*.

The return wire of the ZumBerges' distribution system was the source of the problem, James Kaster, the family's Minneapolis, MN-based attorney, said in a telephone interview. Readings inside the family's barn were as high as 2.5 V in 1984. Subsequent complaints by the ZumBerges prompted NSP to attempt to eliminate the stray voltage. Yet the levels were still 1.5 V in 1987 and 1 V in 1989, according to Kaster.

In neighboring Wisconsin, the state Public Utilities Commission (PUC) is initiating an ambitious study of the effects of the electrical environment on dairy livestock. Stray Voltage Analysis Team leader Daniel Dasho told *Microwave News* that the study will "look beyond the normal stray voltage problem" by examining the individual and combined effects of electromagnetic fields (EMFs), ground currents and direct currents. Dasho added that, in light of the international attention being paid to the EMF issue, the Wisconsin PUC wants to contribute to the "nationwide information base."

HIGHLIGHTS

Two Cancer Victims File Suit Against RF/MW Companies

In separate actions in October, two men who claim that they developed cancer from exposure to radiofrequency and microwave (RF/MW) radiation filed $25 million product liability suits in New York against the equipment manufacturers and operators. Thomas Ford, a former U.S. Navy radar technician, claims that exposure to shipboard radars caused him to develop chronic health problems and, ultimately, non-Hodgkin's lymphoma (NHL). Michael Dowgiallo, an electrician, alleges that acute exposure to RF/MW radiation caused his stomach cancer.

Ford and Dowgiallo are represented by John Sweeney of Sweeney & Pafundi in Agoura Hills, CA. Sweeney has handled other RF/MW cases in the past, including that of a former Navy radar technician with cataracts who received a $131,000 settlement in 1988 (see *MWN*, M/A88). Kenneth Henrie of Henrie & O'Boyle in Wantagh, NY, is serving as Sweeney's local counsel.

In a telephone interview, Sweeney predicted that there will be more and more litigation, noting that "there is a growing awareness that electromagnetic fields (EMFs) are connected to cancer."

Radar Exposure off the Vietnam Coast

Thomas Ford served aboard a Navy destroyer between 1965 and 1967. According to his wife, Kathy, who is a co-plaintiff, Ford was positioned directly beneath the ship's main navigational radar units and in front of the gun control radar unit for an average of 16 hours a day. For a period of six months when his ship was on maneuvers off the coast of Vietnam, the gun control radar was on almost all the time.

Two years after his discharge from the Navy, Ford began to show signs of immune system impairment. In 1988, at the age of 41, he was diagnosed with NHL. Ford was denied a "service-connected" disability claim from the Veterans Administration (VA) in 1989 on the ground that, "There is no scientific evidence to suggest a link between non-ionizing radiation exposure from

radar and cancer."

This year, however, the VA announced that it will honor all NHL-related disability claims from Vietnam veterans—following the March 1990 release of a Centers for Disease Control study showing that Vietnam veterans are at an increased risk for NHL. Those serving on ships off the Vietnam coast have the highest risk, according to the report. Kathy Ford expects her husband's claim will now be approved, but the Fords have not yet received official notification.

Ford's legal complaint, which was served on October 17, names AT&T, GE, Raytheon, GTE Products Corp. and Lockheed, all makers of shipboard radars for the Navy, as defendants.

Sweeney expects that the defendants will try to use the military contractors' defense authorized by a 1988 U.S. Supreme Court decision, *Boyle v. United Technologies*, but he believes that the case is "clearly outside the limits of the doctrine," primarily due to the contractors' failure to warn the government of the real risks involved.

"I have no doubt of the causal relationship between Ford's exposure and his illness. He had a particularly intense exposure, unusual even for a military man," Sweeney told *Microwave News*.

Atop the Chrysler Building

For several months in 1980, Michael Dowgiallo installed lights on the exterior of the tower of the Chrysler Building in New York City. During that time, Dowgiallo claims that he was exposed to high levels of RF/MW radiation from FM antennas and MW transmitters, often just a few inches away from him.

Dowgiallo's supervisor had expressed concerns about the safety of working near the RF/MW transmitters, according to Dowgiallo, but was subsequently assured by Eastern Communications of Long Island City, NY, the owner of the equipment, that the transmitters posed no hazard to workers. In a December 15, 1980 letter to JKC Realty, the owner of the Chrysler Building, however, Eastern stated that its antennas were "HOT" and could be "considered dangerous up to a ten-foot radius" and that, "Exposure to this type of radiation at a distance of less than eight to ten feet for protracted periods of time may have effects that will not show up for years."

In 1979, an employee collapsed while working near FM transmitting equipment on the 77th floor of the Chrysler Building. The Occupational Safety and Health Administration (OSHA) did an RF survey and found a maximum level of 2.5 mW/cm^2 about six feet from an antenna element. OSHA concluded—based on its then current standards—that workers inside the building were not at risk from excessive RF exposure, but recommended that workers not be allowed within six feet of the radiating antenna element.

Dowgiallo was diagnosed with stomach cancer in 1988 at the age of 39. Although it has not typically been linked to EMF exposures, Dr. Genevieve Matanoski of Johns Hopkins University reported in 1989 four cases of stomach cancer among approximately 9,000 New York Telephone Co. central office technicians (who were exposed to complex EMFs), where none were expected (see *MWN*, N/D89).

Dowgiallo's complaint was served on October 25. Dowgiallo and his wife Sharon name JKC Realty, Eastern Communications, the International Brotherhood of Electrical Workers Local No.3 and Robert B. Samuels, Inc. (his employer) as defendants. They have also filed a workers' compensation claim.

For more on RF/MW litigation, see *MWN*, D82, J/F83, Jn84, My85, S/O85, J/F86, M/J86, S/O86, M/A88, M/J89 and S/O89.

White House Holds Up EPA Report (continued from p.1)

himself was involved in the negotiations.

An earlier draft of the EPA report, *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields*, released last June, concluded that studies of extremely low frequency (ELF) EMFs and leukemia, lymphoma and brain cancer among children and workers "show a consistent pattern of response that suggests, but does not prove, a causal link" (see *MWN*, M/J90). The report attracted widespread public interest when *Microwave News* reported that EPA staffers had recommended that ELF EMFs be classified as "probable human carcinogens" and radiofrequency and microwave radiation be classified as "possible human carcinogens." The report was issued without any classifications following a March meeting at the White House.

The forthcoming draft of the EPA report—called the "external review draft"—also does not include any classifications of the carcinogenicity of EMFs because of "uncertainties" about the mechanism of interaction. The draft concludes that epidemiological studies "show a consistent pattern of response which suggests a causal link" (see p.7 for excerpts).

Three EPA officials attended the November 26 meeting at the White House: Drs. Erich Bretthauer, the assistant administrator for research and development, William Farland, the director of the Office of Health and Environmental Assessment (OHEA) and Robert McGaughy, the lead author of the document. Bretthauer refused to be interviewed by *Microwave News*, Farland did not respond to phone calls and McGaughy said that he could not comment on the meeting.

Calls to Bromley's office were referred to OSTP's Dr. Kenneth Yale, who did not answer requests for comment.

The White House request for EPA to wait for the CIRRPC review follows a similar request from the Air Force (see p.7). In an October 2 letter to EPA, Brigadier General Paul Gleason of the Office of the Air Force Surgeon General opposed publication of the EPA report until both the CIRRPC review and an analysis by the National Research Council of the Air Force's Ground Wave Emergency Network (see p.9) are completed.

Gleason's letter accompanied a 33-page blistering critique of the EPA report which charges the authors with having "biased the entire document toward EMF-induced carcinogenicity." The Air Force concludes that, "It is astonishing that the

Excerpts from EPA's EMF Report

The following is excerpted from the Executive Summary of the forthcoming external review draft of EPA's report, Evaluation of the Potential Carcinogenicity of Electromagnetic Fields, *dated October 1990 and obtained by* Microwave News *in November.*

In conclusion, several studies showing leukemia, lymphoma and cancer of the nervous system in children exposed to magnetic fields from residential 60 Hz electrical power distribution systems, supported by similar findings in adults in several occupational studies also involving electrical power frequency exposures, show a consistent pattern of response which suggests a causal link....

At this time, such a characterization regarding the link between cancer and exposure to EMFs is not appropriate because the nature of the interaction between EMFs and biological processes leading to cancer is not understood....

Because of these uncertainties, it would be inappropriate at this time to classify the carcinogenicity of EMFs in the same way as the agency does for chemical carcinogens....With our current understanding, we can identify 60 Hz magnetic fields from power lines and perhaps other sources in the home as a possible, but not proven, cause of cancer in humans....

U.S. EPA would place its imprimatur on this report."

Gleason stated that, "If published, the report will contribute to needless public anxiety, and have serious impacts on capabilities and costs of Air Force programs."

The SAB will assemble a panel of experts to review the draft report at a public meeting in the Washington area on January 14-15 and, if necessary, January 16 (if the release of the report is not delayed further). Dr. Genevieve Matanoski of the Johns Hopkins University School of Hygiene and Public Health in Baltimore, MD, will chair the SAB's Non-Ionizing Electric and Magnetic Fields Subcommittee of the Radiation Advisory Committee. Dr. David Bates of Vancouver, Canada, will be the vice chairman.

Kathleen Conway, the SAB staff officer responsible for the review, told *Microwave News* that there will be as many as 18 experts on the panel. At press time, the selection process had not yet been completed.

Conway said that she had received numerous nominations for membership on the panel. For example, she said that EPA had been sent recommendations from the Edison Electric Institute, the Electric Power Research Institute, the White House (see p.8) and Crowell & Moring, a Washington, DC, law firm which has represented a number of utilities in power line siting battles. "We considered over 200 experts," Conway said.

The SAB is being cautious about the makeup of the EMF panel because of the attention being paid to another SAB committee, which is investigating the health risks of environmental (passive) tobacco smoke. A number of the members of that committee are consultants to the cigarette industry and EPA came close to removing one antismoking advocate from the panel after complaints from the Tobacco Institute.

Copies of EPA's draft report will be available from: Dr. Robert McGaughy, [RD-689], OHEA, EPA, 401 M St., SW, Washington, DC 20460, (202) 382-5898.

U.S. Air Force Labels EPA Report Biased and Political

The October 2 Air Force review of the Environmental Protection Agency (EPA) cancer assessment document—prepared by a team of "radiofrequency (RF) effects scientists" led by Drs. David Erwin and James Merritt at the Brooks Air Force Base School of Aerospace Medicine, TX—begins with a quote from the Roman historian Tacitus: "Some believe all manner of hearsay evidence; others twist truth into fiction; and both sorts of error are magnified by time." The Air Force argues that the EPA authors present "no evidence of causation between electromagnetic fields (EMFs) and cancer, but rather argue as if this hypothesis were accepted fact."

The Air Force claims that the authors "consistently neglect the majority of negative studies and concentrate most of their discussion on weak positives of dubious value." Blasting the report's statements on the "consistency" of the evidence and on the need for more research, the Air Force charges that "these are political statements and not scientifically derived conclusions."

"Our reviewers of this document are convinced that there is no suggestion that EMFs present in the environment today induce or promote cancer," the Air Force concludes.

The Air Force dismisses the report's section on extremely low frequency (ELF) epidemiological studies, claiming that, "The overall weight of epidemiologic evidence is so slight as to be almost nonexistent; certainly not sufficient to justify further large expenditures of scarce research resources."

With regard to the report's survey of animal studies, the Air Force argues that any credible effects are most likely due to heat-induced stress, rather than to "some other property of RF radiation." The Air Force even suggests that ELF effects on the pineal gland are heat-related.

In contrast to most EMF researchers, government officials and industry representatives, the Air Force maintains that, "In general, there is sufficient research being carried out in various laboratories commensurate with the urgency of the problem."

Letter-Writing Campaign

One member of the Air Force team that wrote the report appears to be on a one-man crusade to correct what he perceives as published errors about EMFs. Dr. James Jauchem has had a flurry of letters published in popular and scientific journals—for instance, *Nature* (October 4), *The Lancet* (October 6), *The Bulletin of the Atomic Scientists* (November 1990), *Science* (November 9) and the *British Journal of Haematology* (see p.9). In general, Jauchem criticizes the "lay media" for providing "misinformation on the alleged hazards of EMFs." Not surprisingly, his statements closely parallel some of the arguments presented in the Air Force review of the EPA cancer assessment. Jauchem, a research physiologist, has written a number of papers in recent years on the thermal effects of RF radiation.