UPDATES

BIOLOGICAL EFFECTS

Fluorescent Lights and Skin Cancer...A team of Australian researchers has failed to confirm a previous report of an association between exposure to fluorescent lighting and malignant melanoma. The new case-control study did find some suggestion of increased risk for certain types of skin cancer, but did not agree with the doubling of all melanomas reported in 1982. The 1982 paper, the first to report a link between exposure to fluorescent lights and skin cancer, did not win widespread acceptance because of a number of curious findings: while fluorescent lights at work were linked with melanoma, those at home were not; and the association was greatest for those parts of the body that are usually covered by clothing (see *MWN*, September 1982). The new study, by Dr. D.R. English and coworkers at the University of Western Australia, did find evidence of an increase in Hutchison's melanotic freckles on the head, neck and upper limbs with exposure to fluorescent lights without diffusers in residential rooms and small offices, and of an increase in the rate of "melanoma of unclassifiable histogenic type" with fluorescent light exposure. But the researchers suggested that these may have occurred due to chance. They concluded: "Our results are consistent with the view that the dose of UV radiation received from fluorescent lights is too small in comparison with that from the sun at least in Western Australia to have a measurable additional effect on risk of melanoma." The new study, "Cutaneous Malignant Melanoma and Fluorescent Lighting," appeared in the June 1985 *Journal of the National Cancer Institute*.

Delgado References... In our December 1984 issue, we reported a correction in the rise times of the magnetic field pulses used by members of Dr. Jose Delgado's research team in Madrid, Spain. The official correction was published in the *Journal of Anatomy, 140, p.721, 1985*....A paper describing the failure to find an effect of weak low frequency electromagnetic fields on chick embryos by Dr. Morton Miller and associates at the University of Rochester appeared in the *Journal of Anatomy, 139, pp.613-618*, 1984. As noted in our June 1984 cover story, this experiment was substantially different from those of Delgado and Dr. Jocelyne Leal, which yielded positive results....In September 1984, EPA's Richard Tell and Dr. Ezra Berman visited Delgado and Leal in Spain. A report on their visit is now available from Tell, Electromagnetics Branch, Office of Radiation Programs, EPA, PO Box 18416, Las Vegas, NV 89114, (702) 798-2440.

Static Magnetic Fields... Male workers exposed to static magnetic fields in a chloralkali plant had a normal rate of cancer and life expectancy, according to a Swedish study published in the October 19 issue of *Lancet*. Men who had worked in the plant at least a year were included in the study population. Dr. Lars Barregard and coworkers at the Department of Occupational Medicine at Sahlgren Hospital in Goteborg measured the magnetic fields in the plant to be between 4 and 29 millitesla. They noted that even though the fields in the plant were static, currents can be induced in the workers as they move around. They concluded: "The cohort studied was small but the confidence limits indicate that there is at least no greatly increased risk of cancer after many years of exposure to strong static magnetic fields."...In France, Dr. A. Bellossi has found that static magnetic fields of 300-800 millitesla had no effect on the growth and development of chemically-induced tumors in mice. See "The Effect of a Static Uniform Magnetic Field on Mice: A Study of Methylcholanthren Carcinogenesis," *Radiation and Environmental Biophysics, 23*, pp.107-109, 1984.

Behavioral Effects... The FDA's Center for Devices and Radiological Health (CDRH) has published the proceedings of a workshop on the effects of microwave radiation on behavior, held in Midway, UT, in March 1982. *Behavioral Effects of Microwave Radiation Absorption* was edited by the CDRH's Dr. John Monahan and Dr. John D'Andrea, who used to be at the University of Utah and is now with the Naval Aerospace Medical Research Laboratory in Pensacola, FL. Among the 14 papers presented at the workshop was one by Dr. Clifford Mitchell of NIEHS on "Soviet Research on Microwave-Behavior Interactions." A limited number of copies are available for free by writing to CDRH, FDA (HFZ-265), 5600 Fishers Lane, Rockville, MD 20857. Ask for publication No. FDA 85-8238 and include a self-addressed mailing label.

COMPATIBILITY & INTERFERENCE

Pesty Pest Control... Ultrasonic pest control devices can cause RFI to TV reception and other types of electronic equipment, according to the FCC — RFI has been reported in the 20-470 MHz frequency range. The devices drive away rats, mice and roaches with noise that is inaudible to humans. Fortunately, FCC staffers have found that the offending interference can be substantially reduced by making a minor change to the device. For more information, contact Joe Husnay, FCC Laboratory, (301) 725-1585.

Resources..."Taming EMI in Microprocessor Systems" by Don White, Kenn Atkinson and John Osburn of Interference Control Technologies, Inc., in Gainesville, VA, is the lead story in the December issue of *IEEE Spectrum*. In their well-illustrated article, the authors propose a systematic approach for dealing with EMI effects. They begin with a blood-chilling example of the dangers of EMI: A ladle of molten steel, moving along an overhead track at a plant in the eastern U.S. in 1983, prematurely poured the hot metal onto the factory floor, killing one worker and injuring four others. The cause of the accident was traced to a walkie-talkie. The RF signal — magnified by a temporary scaffold and picked up by a drop cord acting as an antenna — triggered a switch that caused the ladle to tip....In past issues, we have featured items on EPRI and IITRI research on the susceptibility of railroad signaling equipment to power line interference (see *MWN*, September and December 1983 and April 1985). Two papers from this effort appear in the December issue of *IEEE*

Transactions on Power Apparatus and Systems. The research on this type of EMI is continuing, and new results from Science Applications, EPRI and Southern Pacific Transportation Co. are scheduled to be presented at the IEEE's Power Engineering Society meeting in February (see Conference Calendar).

GOVERNMENT

CIRRPC... Last year, Dr. George Keyworth, II, President Reagan's science advisor, set up the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), under the chairmanship of Dr. Alvin Young. One of CIRRPC's first tasks was to discover which radiation issues were of most concern to its 15 member agencies. Naturally, ionizing radiation problems dominated the list, but non-ionizing radiation did make the cut. In response to an April 25 request from EPA, CIRRPC's Science Panel set up a subpanel "to review existing research programs on radiofrequency health effects and to define appropriate research needs." Dr. Ross Adey of the VA Hospital in Loma Linda, CA, was chosen to chair the group; the other members are EPA's David Janes, Dr. Elliot Postow of the Naval Medical R&D Command and Dr. Moris Shore of the FDA's Center for Devices and Radiological Health. Adey told *Microwave News* that the subpanel report is now in draft form and should be completed in the near future. A copy of CIRRPC's *First Annual Report* is available from CIRRPC, 1346 Connecticut Ave., NW, Washington, DC 20036. (Note that Keyworth recently submitted his resignation to the President.)

INTERNATIONAL

ILO Report... The International Labor Organization (ILO) has released a report on the hazards of occupational exposures to non-ionizing radiation, prepared by the International Non-Ionizing Radiation Committee (INIRC) of the International Radiation Protection Association (IRPA). Approved in late 1981 but only recently published, *Occupational Hazards from Non-Ionizing Electromagnetic Radiation* (ILO Occupational Safety and Health Series Report No. 53) evaluates potential risks of ultraviolet, visible, infrared, microwave, radiofrequency and extremely low frequency radiation, as well as lasers. Based on pre-1981 literature, the document emphasizes the need for further studies of biological effects of RF/MW and laser radiation, but concludes that ELF fields — including those from power lines — are unlikely to present significant health risks. The IRPA/INIRC report also finds that there is uncertainty in the scientific literature about adverse effects of visible light. The first draft of the document was developed by John Villforth and Dr. P. Czerski of the U.S. FDA's Center for Devices and Radiological Health, Dr. Michael Repacholi of Canada's Radiation Protection Bureau (now with the Royal Adelaide Hospital in Australia) and David Sliney of the U.S. Army's Environmental Hygiene Agency. Copies of the document can be ordered for 17.50 Swiss francs from the ILO, CH-1211 Geneva 22, Switzerland.

MEASUREMENT

Power Line Exposures... Since 1979, the Bonneville Power Administration (BPA) has been quantifying occupational exposures to 60 Hz electric fields. A miniature, electric field monitor was developed and worn by BPA workers. According to the results reported by V.L. Chartier and A.S. Capon, both of BPA, and Dan Bracken, a consultant based in Portland, OR, "the job categories with the highest measured exposures are...230 and 500 kV line crews (linemen being the most exposed), 230 and 500 kV substation maintenance electricians and 500 kV substation operators." They found that, "Measured time of exposure above an equivalent unperturbed field of 4 kV/m represents only minutes per day even for the most exposed personnel." Their report appeared in the March 1985 issue of the *IEEE Transactions on Power Apparatus and Systems*....Under an EPRI contract, Dan Bracken has also compared the performance of the BPA meter with that of a conducting vest developed by EPRI. (These two electric field monitors were among ten power frequency meters that Bracken identified.) BPA employees wore the meters and the vests as they simulated electricians' tasks, in a truck near an energized test line and during a complete inspection of a 230 kV substation. The total exposures measured with the vest were "quite consistent" (within ten percent) among subjects inspecting the substation; the BPA meter was less consistent, with a 15-25 percent variation. The BPA meter gave even larger (30 percent) variations for the measured electric field for a given task. On the whole, the fields measured with both meters were lower than predicted — up to 80 percent lower in the substation — which Bracken attributes to insulation provided by shoes, asphalt and dry rock in the substation. The two types of meters yielded similar results when worn on the arm or hard hat. But when worn in the shirt pocket, the BPA meter gave readings that were 30-40 percent lower than those obtained in the other locations or from the EPRI vest. Bracken concluded that either meter could be used to determine exposures in an occupational study, but that only the vest was suitable for characterizing public exposures to low-level fields. The report, *Comparison of Electric Field Exposure Monitoring Instrumentation*, (EA-4085), June 1985, is available for $17.50 from Research Reports Center, PO Box 50490, Palo Alto, CA 94303, (415) 965-4081.

EMI Probe... Hewlett-Packard (HP) has introduced a new probe to help locate radiation emissions for EMI control. When connected to a spectrum analyzer, the HP 11940A Close-Field Probe can yield the signal strength and frequency of the offending radiator. The probe is a magnetic field sensor that provides highly repeatable results in the near field for frequencies between 30 MHz and 1 GHz. Introduced on November 1, the probe costs $500.00. For more information, contact Allan Armstrong, HP, 1424 Fountaingrove Parkway, Santa Rosa, CA 95401, (707) 577-2528.

Measurement Conference...A number of papers presented at the *2nd Annual Instrumentation and Measure-*

ment Technology Conference, IMTC-85, held last March in Tampa, FL, have been published in Part 1 of the December issue of the *IEEE Transactions on Instrumentation and Measurement.* Among the papers are "Methodology for Standard Electromagnetic Field Measurements" by a group from NBS in Boulder, CO, and "Comparison of Failure Mode Criteria in Electromagnetic Environments" by Joseph Mislan of Dodig in Washington, DC, formerly with the Naval Ship Systems Engineering Station in Philadelphia, PA. The latter paper describes the use of a proximity switch as a detector to allow comparison of susceptibility tests in TEM cells with those from open area test sites.

MEDICAL APPLICATIONS

Resources... Fonar Corp. won a big victory in the NMR imaging (MRI) business on November 21, when a federal judge ruled that Johnson & Johnson (J&J) had infringed upon a Fonar patent. Analysts say that the decision could mean millions of dollars in damages and royalties for Fonar, based in Melville, NY, and a lot more business for the company's lawyers as they try to collect from other MRI manufacturers. Fonar's chairman, Dr. Robert Damadian, told *The New York Times* that the "decision shows there is justice for the little guy in America." J&J said it will appeal....Also on November 21, the Federal Health Care Financing Administration, which runs the Medicare and Medicaid programs, said that it would pay for MRI diagnostic exams for a variety of organs, but not for the heart or lungs, because of possible blurring due to movement....According to a survey by *Diagnostic Imaging* magazine (November), there were 217 MRI systems in operation in the U.S. as of October 1. Technicare, a J&J subsidiary, has sold 64 units and Fonar has sold just 14....On August 20, Clini-Therm won FDA approval to market its external microwave hyperthermia system; then on October 30, the Dallas-based company got FDA approval for its interstitial system, in which radiation is applied directly to the tumor. BSD Corp. of Salt Lake City, UT, is the only other company marketing hyperthermia systems.

MEETINGS

50/60 Hz Bioeffects... There will be a panel session on "Magnetic Field Effects" at the *Winter Meeting of the IEEE Power Engineering Society* in New York City. The session will be chaired by Bill Feero of Electric Research & Management, Inc., in Thomaston, ME. Among those scheduled to participate are: Drs. R.G. Olsen, Tom Tenforde, Bill Kaune, Mays Swicord and David Savitz (see Conference Calendar)....North American utilities are sponsoring an international symposium on *Health Effects of Electrical and Magnetic Fields: Research, Communication, Regulation,* September 17-19 in Toronto, Canada. According to John O'Grady of Ontario Hydro, the chairman of the organizing committee, the conference will focus on communication with the public and future government regulation on transmission lines (see Conference Calendar)....The DOE had been considering holding a similar type of meeting in Pittsburgh, PA, next November, but, given the utility symposium, those plans have been pushed back until 1987. Nevertheless, as in past years, there will be a DOE contractors' meeting in the fall of 1986. Anyone who is interested in attending the 1987 meeting, tentatively titled *International Conference on Biological Effects of 50/60 Hz Electric and Magnetic Fields,* should contact Ken Klein, Director, Office of Energy Storage and Distribution, CE-143, SE-052, DOE, 1000 Independence Ave., SW, Washington, DC 20585.

BRAGS... The *5th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS)* was held in Boston, MA, October 13-16. A copy of the *Transactions* of the meeting, including abstracts of the more than 50 papers and the BRAGS membership list, is available for $25.00 plus postage from BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180. Next year, the society will meet in Utrecht, Holland, October 19-22; Dr. Reba Goodman is the program chairperson for the conference.

Melatonin Congress... The *1st International Congress on Melatonin in Humans* was held in Vienna, Austria, on November 7-9. Organized by Dr. Franz Waldhauser of the University of Vienna and Dr. Richard Wurtman of MIT, the congress featured 22 papers and more than 40 posters; the proceedings will be published in the *Journal of Neural Transmission.* For more information, contact Wurtman at Room E25-604, Department of Applied Biological Sciences, MIT, Cambridge, MA 02139, (617) 253-6731. See also a report on the congress in the November 25 issue of *Newsweek.*

Electroheat... The Ontario Ministry of Energy and Ontario Hydro sponsored a one-day workshop on *Radiant Wave Electroheat* on December 2 in Toronto, Canada. Among the speakers were Dr. Phil Schmidt of the University of Texas at Austin on an "Overview of Electrothermal Processes" and Dr. Peter Jones of the U.K.'s Electricity Council on "New Developments in Dielectric Heating and Drying." For more information, contact Peggy Kurtin, Workshop Coordinator, Ministry of Energy, 56 Wellesley St. W., Toronto, Ontario M7A 2B7 Canada, (416) 965-1563....Next September 23-26, the British National Committee on Electroheat is holding a conference, *Heating and Processing – 1-3000 MHz,* at St. John's College, Cambridge, U.K. (see Conference Calendar).

PEOPLE

Drs. William Wisecup and **Lee Rosen** have left Aerospace Corp., but will continue to provide contract support for **Ken Klein** at the DOE's Electric Field Effects Research Program. They will continue to do their old jobs through Wisecup's consulting firm: W/L Associates, Ltd., Suite 401, 600 S. Frederick Ave., Gaithersburg, MD 20877, (301) 948-0642. For the record, the DOE has reorganized and Klein is now the director of the Office of Energy Storage and Distribution instead of the Division of

Electrical Energy Systems....**Edwin Bronaugh** of Electro-Metrics has become vice-chairman of ANS Committee C63 on EMC, replacing **Harold Gauper, Jr.,** who recently retired from GE, and AT&T Information Systems' **Donald Heirman** has taken over as chairman of C63 Subcommittee 1 from Bronaugh.

POWER LINES

Harmonics... The IEEE Working Group on Power System Harmonics has published "Power Line Harmonic Effects on Communication Line Interference," an overview of the problem, with examples of the possible complex interactions, in the September issue of the *IEEE Transactions on Power Apparatus and Systems*. The working group is chaired by A.A. Mahmoud of Iowa State University in Ames....William Horton and Saul Goldberg of California Polytechnic State University in San Luis Obispo describe "The Effect of Harmonics on the Operating Points of Electromechanical Relays" in the May issue of the *IEEE-PAS*....And in the December *IEEE-PAS*, H.J. Trussell and J.D. Wang of North Carolina State University's Center for Communications and Signal Processing in Raleigh show how adaptive least square filters can be used to reduce harmonic noise in "Cancellation of Harmonic Noise in Distribution Line Communications."...There will be a session on "Power System Harmonics," chaired by K.R. Chakravarthi of Southern Company Services in Birmingham, AL, at the February meeting of the IEEE's Power Engineering Society in New York City....The *2nd International Conference on Harmonics in Power Systems* will be held in Winnipeg, Canada, October 6-7. Professor G. Thomas Heydt of Purdue University, West Lafayette, IN, is the program chairman (see Conference Calendar).

Resources... The following papers were recently published: "Transmission of Electric Power at Ultra-High Voltages: Current Status and Future Prospects" by Harold Scherer, Jr., and Gregory Vassell of American Electric Power Services Corp. in Columbus, OH, in the August issue of the *Proceedings of the IEEE*...."Power Line Frequency Electric and Magnetic Fields: A Pilot Study of Risk Perception" by Dr. M. Granger Morgan and coworkers at Carnegie-Mellon University in Pittsburgh, PA, and Paul Slovic and coworkers at Decision Research in Eugene, OR, in *Risk Analysis, 5*, 139-149, 1985...."HVDC: Wheeling Lots of Power" by Glenn Zorpette in the June issue of *IEEE Spectrum*. Zorpette is an associate editor of the magazine.

STANDARDS

Power Line Noise & ESD... The IEEE has published *Procedures for the Measurement of Radio Noise from Overhead Power Lines and Substations*, a revision of ANSI/IEEE 430-1976, for public comment. The proposal is available for $7.50 from Sandra Phillips, IEEE, 345 East 47th St., New York, NY 10017. Ask for standard BSR/IEEE 430. Comments are due by January 21....The Electronic Industries Association (EIA) has released *Distributor Requirements for Handling Electrostatic Discharge Sensitive (ESDS) Devices*, JEDEC Publication No.108, and *Packaging Material Standards for ESD Sensitive Items*, EIA Interim Standard No.5-A. JEDEC No.108 was developed by a committee chaired by Ralph McCullough of Texas Instruments, and IS-5-A was developed by a committee chaired by George Kahler of AT&T Technologies. Copies of JEDEC No.108 cost $5.00 and copies of IS-5-A cost $15.00; both from Standards Sales Office, EIA, 2001 Eye St., NW, Washington, DC 20006, (202) 457-4966.

VDTs

Resources...A team of three Pittsburgh, PA, area physicians has published a case report on a 33-year-old man suffering from a skin rash that was probably caused by exposure to a VDT. Drs. Lawrence Feldman and William Eaglstein of the University of Pittsburgh's Department of Dermatology and Dr. Robert Johnson of Franklin, PA, concluded that electromagnetic emissions other than ultraviolet (UV) radiation were the "most likely etiologic factor in this man's condition," which included redness, burning and itching on his hands and forearms. The rash, which lasted for 15 months, cleared up when he spent extended periods away from his terminal; he tested negative for sensitivity to 41 materials from his office. Reporting their results in the February 1985 issue of the *Journal of the American Academy of Dermatology*, the doctors noted that they could not be certain of the cause of the rash because they did not have detailed information about the types of radiation emitted by the VDT, although they tested and ruled out UV. They concluded that as the use of VDTs increases, "more and more patients will surface with this reaction. When sufficient numbers of patients are located, a possible cause may be uncovered."...The DC electrical environment and ion concentrations (both positive and negative) near VDTs are similar to those which occur commonly indoors, according to Drs. Jonathan Charry and William Bailey of the Institute for Basic Research in Staten Island, NY, and Dan Bracken, a consultant based in Portland, OR, in a study paid for by IBM. Their paper, "Evaluation of the DC Electrical Environment in Proximity to VDTs," appears in the October 1985 *Journal of Environmental Science and Health*, published in New York City by Marcel Decker....The Canadian Center for Occupational Health and Safety (CCOHS) has developed a two-day course on measuring VDT radiation. CCOHS researchers Dr. Karel Marha and David Charron will teach the course. Marha has published a series of reports for CCOHS on VDT radiation and, with Charron, was one of the first investigators to detail the distribution of the very low frequency fields near flyback transformers (see *MWN*, December 1983). The course, which costs $100.00 and has a limited enrollment, was offered once in December, and CCOHS plans to offer it again in the spring. For more information, contact Mrs. Bev Strugnell, CCOHS, 250 Main Street East, Hamilton, Ontario L8N 1H6, Canada, (416) 523-2981.

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MICRO WAVE NEWS

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1987 Conference Calendar (Part I)

ELF Magnetic Field-Childhood Cancer Link Supported by Major Epidemiological Study

A long-awaited epidemiological study supports an association between exposure to extremely low frequency (ELF) magnetic fields and childhood cancer, especially leukemia. The ELF-cancer link was first reported by Dr. Nancy Wertheimer and Ed Leeper in 1979.

Speaking at a meeting of researchers working on power line health effects in Denver, CO, on November 20, Dr. David Savitz, an epidemiologist at the University of North Carolina in Chapel Hill, said that "prolonged exposure to low-level magnetic fields may increase the risk of developing cancer in children."

Savitz, working with Drs. Frank Barnes and Howard Wachtel, of the University of Colorado in Boulder, found a statistically significant association between all types of childhood cancer and external magnetic fields, as characterized by a wiring configuration index.

In fact, for some high exposure groups, the cancer risk was more than five times higher than for controls -- though the numbers were small. Wertheimer told *Microwave News* that her unpublished data for the same subsets showed a similar pattern.

In the seven years following the publication of their landmark

(continued on p.12)

What's Next?

"It is time to accept that something is happening and to find out under what conditions it happens," Dr. Nancy Wertheimer and Ed Leeper told *Microwave News*, after hearing Dr. David Savitz report the replication of their 1979 study linking childhood cancer to alternating magnetic fields.

"The most important next experiment is an epidemiological study relating cancer to the use of electrically heated beds, because, first, these entail different types of exposures, which are both intermittent and more intense -- and the results could therefore give you important information," they added. "Second, there are simple ways for water beds to be designed to ensure no field exposure; electric blankets could also be fixed, though with greater difficulty."

(continued on p.12)

HIGHLIGHTS

Italian Researchers Find Developmental Effects in Rats Exposed to Low-Level RF Radiation

An Italian research team has documented serious reproductive and developmental effects among rats exposed to extremely low levels of radiofrequency (RF) radiation. Dr. Santi Tofani of the Public Health Laboratory in Ivrea and coworkers have concluded that "a specific action of RF radiation," rather than a thermal effect, caused the statistically significant increase in resorptions, as well as lower body weight gain and incomplete cranial ossification among the fetuses.

Tofani's group continuously exposed rats to 100 uW/cm^2 of 27.12 MHz radiation, a specific absorption rate (SAR) of 1.1x10^{-4} W/Kg, for up to 20 days during pregnancy.

If replicated, the results will undoubtedly force a complete reevaluation of the health impact of RF radiation. (Thousands of workers are exposed to 27 MHz radiation from RF sealers and heaters.) As Dr. Joe Lary of the National Institute for Occupational Safety and Health in Cincinnati, OH, told *Microwave News*, "*If* it is true, it would blow the top off the whole RF field." He has published a number of studies on the teratological effects of RF radiation (see *MWN*, November 1982 and October 1983). Lary said, however, that, based on the existing literature, he still believes that the RF teratological effect is a thermal one.

Many current exposure standards are based on the assumption that an SAR of 0.4 W/Kg is safe -- a level *4,000 times* greater than that used by Tofani's team. Indeed, if confirmed, this study might undermine the utility of SARs as measures of exposure risk. As the Italian team commented, "It is evident that mean SAR is an inadequate parameter in forecasting the potential biological risks of exposure to RF radiation."

A number of those interviewed about the Tofani study agreed that it was well done and, if replicated, will be extremely important. All the experts stressed the need to repeat the experiment. Some asked whether metal utensils were used in the animal cages. In a letter to *Microwave News*, Tofani, the director of the lab's physics branch, said that the animals were given food and water in "earthenware."

Lary's studies, as well as those at microwave frequencies by Dr. Ezra Berman of the Environmental Protection Agency in Research Triangle Park, NC, and by Dr. Ronald Jensh of Jefferson Medical College in Philadelphia, PA, showed that non-ionizing radiation can cause reproductive effects. However, those studies used much higher exposure levels than used by Tofani, with SARs above 5 W/Kg (see *MWN*, December 1982, April and June 1984).

Tofani and coworkers divided 40 pregnant rats into three groups: 20 were exposed for all 20 days of the experiment, 10 were exposed for the first 6 days and 10 were exposed for days 6 through 15. 20 rats served as controls.

Half of the dams in the first two exposure groups and two of those in the third group experienced total resorptions of their litters. The 50% total resorption rate was statistically significant for the first two groups. The researchers noted that this finding "suggests that this effect is linked to exposure during the very early stage of the egg's development, causing unfavorable conditions for implantation." They added that the concentration of resorptions in certain, as opposed to all, the litters "leads us to suppose that the effects must be ascribed to an action of RF radiation on the dam."

All three groups of exposed dams gained weight more slowly than did the controls, with the dams exposed for the longest time gaining weight the slowest. Among the viable fetuses, there was a significantly higher incidence of incomplete cranial ossification (indicating a delay in development) in all three exposure groups, with the highest rate among those exposed from days 6-15.

The paper by Tofani *et al.*, "Effects of Continuous Low-Level Exposure to Radiofrequency Radiation on Intrauterine Development in Rats," appeared in the October issue of *Health Physics*, *51*, pp.489-499.

OSHA's RF/MW Standard

On October 2, a federal district court judge denied a Freedom of Information Act (FOIA) request by *Microwave News* to release documents related to the Occupational Safety and Health Administration's (OSHA) decision to stop work on a new exposure standard for radiofrequency and microwave (RF/MW) radiation.

In late 1983, OSHA quietly stopped revising its 10 mW/cm^2 RF/MW standard, which had been ruled voluntary, and therefore unenforceable, by the courts (see *MWN*, November 1983). *Microwave News* took OSHA to court when the agency refused to explain why it had abandoned the development of a mandatory standard. OSHA claimed that many of the documents were exempt under Section 5 of FOIA, which allows agencies to withhold papers that are part of their deliberative process. Federal Judge Pierre Leval agreed with OSHA.

There continues to be no federal safety standard to protect workers from overexposure to RF/MW radiation, nor are there any indications that OSHA has any plans to update its voluntary limit. OSHA did release some documents and portions of others; these will be reviewed in a future issue of *Microwave News*.

Mechanisms and Cellular Effects Stressed at BRAGS Meeting

There were a couple of disappointments at the *6th Annual Meeting of the Bioelectrical Repair and Growth Society (BRAGS)*, held October 19-22 in Utrecht, The Netherlands, but they had less to do with the more than 50 papers presented than with the dearth of travel funds and the vagaries of scientific exchanges between Eastern and Western Europe.

Utrecht had been selected as the meeting site to make it easier for both Eastern European researchers and Western European teams to attend. Although representatives from the Soviet Union, Bulgaria, and the German Democratic Republic were scheduled to speak, all cancelled in the weeks before the meeting. Just as disappointing, according to Dr. Reba Goodman, the organizer of the scientific program, was the poor turnout by Western Europeans, who had pressed for a local site.

On the scientific side, the meeting did offer a new look at Drs. Abe Liboff and Bruce McLeod's cyclotron resonance theory. Liboff, of Oakland University in Rochester, MI, and McLeod, of Montana State University in Bozeman, have now tested their theory in a biological model -- *Amphora coffeaformis*, a simple diatom whose movement depends on the concentration of exogenous calcium.

Liboff and McLeod believe that the mechanism behind electromagnetism's stimulatory effect in fracture healing -- as well as many other observed biological effects -- may lie in ionic fluxes through cell membrane channels. Tuning a Helmholtz system to the cyclotron resonance point for the calcium ion, they demonstrated that stimulation with a 16 Hz magnetic field at a peak amplitude of 0.209 Gauss (G) induced 86% of the diatoms to move across an agar gel surface rich in calcium, when the Earth's static magnetic field was adjusted to 0.209 G. Only 10% moved through the calcium-rich agar in control dishes not exposed to the field. Harmonics of 16 Hz were also biologically effective.

Liboff told *Microwave News* that there is an as-yet-unknown reason why the peak intensities of the AC and DC fields are so closely matched. He also said that he is currently applying the cyclotron resonance theory to studies of human lymphocytes.

Besides providing a biological model of osteogenesis, Liboff and McLeod's work also supports the proposition that relatively weak magnetic fields -- natural or man-made -- could distort research results or the reproducibility of such results. "The fields, remember, are of the order of magnitude of the Earth's magnetic field," Liboff cautioned. "That makes [these findings] even more intriguing, because it points out the possibility that you could have variations from one lab to another that are very marked -- in fact, even within the same laboratory."

In the question-and-answer period, several BRAGS members took exception to the implications drawn by Liboff and McLeod, asking whether the magnetic fields were strong enough to exert a significant effect in human studies or even in tissue culture experiments. For instance, Dr. Carl Brighton of the University of Pennsylvania School of Medicine in Philadelphia argued that the field was so low that he doubted that it could have any effect.

Dr. Reba Goodman, reporting on her study of extremely low frequency (ELF) electromagnetic effects on protein synthesis at Columbia University in New York City, put forward the idea that "identification of biological deviations can provide standards for identifying inadvertent environmental exposure to electromagnetic fields." Goodman and Dr. Ann Henderson of Hunter College, also in New York City, have found that pulsed asymmetric signals of 1.5, 15 and 72 Hz and sine waves of 60 and 72 Hz induced new signal-specific polypeptides in cells from larval flies. These signals could also augment, decrease or even completely suppress polypeptide synthesis. Goodman said that the work demonstrated that these changes were not induced by heat shock -- an accidental, experiment-related increase in temperature.

Researchers from the University of Modena, Italy, reported that exposure to low frequency pulsed electromagnetic fields (PEMFs) increased RNA synthesis in

Clash Over Reproducibility of Dixey-Rein 500 Hz Results

Dr. Richard Dixey of St. Bartholomew's Hospital in London, England, used the BRAGS meeting as a forum to defend a 1982 report in which he and his coworker Glen Rein claimed that low-intensity 500 Hz pulsed magnetic fields potentiated the release of ^{3}H-labeled noradrenaline from cultured nerve cells (*Nature, 296*, pp.253-256, and *MWN*, May 1982). That report was one of four challenged by L.A. Coulton at the *International Conference on Electric and Magnetic Fields in Medicine and Biology* (see *MWN*, May/June 1986).

Coulton and coworkers at the University of Sheffield in England failed to reproduce the results of any of the four studies, despite careful replication of experimental methods, and so advised "a cautionary interpretation of the many positive effects of magnetic fields in the literature."

Dixey answered that charge by noting that Coulton "used an entirely different assay system despite a comprehensive description of the protocol in the original publication." In so doing, Coulton's pH value during the assay strayed from the 7.4 that Dixey asserted is critical to reproducing his results.

lymphocytes from leukemia patients by 231%, compared with a 24% increase in lymphocytes from healthy subjects. Dr. Ruggero Cadossi and his colleagues also found that PEMFs increased cell division induced by phytohemagglutinin (PHA) -- a plant protein that enhances mitogenesis -- by 69% in lymphocytes from patients with the AIDS virus. The same 72-hour exposure increased cell division by only 18% in lymphocytes from patients with chronic lymphocytic leukemia. (AIDS patients have a defect in their B-cell growth factor, whereas leukemia patients do not.)

Invited to "make a leap of faith" and speculate on the common deficiency among these cells that might be linked to the response to PEMFs, Dr. Cadossi was circumspect: "We don't know if we are [directly] increasing the synthesis of RNA, or if the cells are stimulated [by PEMFs] to use more of the B cell growth factor available." In either case, Dr. Cadossi concluded, the results "strongly support" the Modena group's hypothesis that PEMFs spur the release of B-cell growth factor in culture media.

Dr. Claudio Franceschi, also of the University of Modena, joined colleagues from the Universities of Bologna and Padua in a separate report on PEMF effects on the proliferation of human lymphocytes. They cultured lymphocytes from 37 donors, including 18 healthy individuals at least 75 years old and one patient with myotonic dystrophy (chronic, progressive muscular atrophy) who were included because they have an impaired response to PHA. Although a 50 Hz PEMF was not itself mitogenic, it did increase the mitogenic response to PHA and it did so more effectively in the elderly patients and in the myotonic dystrophy patient than in the other subjects.

In a study designed to determine the optimal frequency for reversing or preventing disuse osteoporosis, Drs. Kenneth McLeod and C.T. Rubin, of the Tufts University School of Veterinary Medicine in Boston, MA, used young adult breeder turkeys as models. After inducing osteoporosis in one wing of each bird, and leaving the other wing to serve as a control, they applied PEMFs of various frequencies to both wings for 1 hour a day for 8 weeks. Cross-sectional areas of the ulna decreased an average of 18% in turkeys that wore inactive electromagnetic coils. 4-200 kHz signals caused an average decrease of 7.8%; 4-30 kHz induced an increase of 0.6%; and 75 Hz-3 kHz caused an *increase of 77.4%*. As earlier work had suggested, the most effective frequencies were those closest to endogenous biological frequencies of 1 kHz or less.

Other reports and scores of posters, from 13 countries, updated attendees on the use of electrical stimulation for repairing nonunion fractures, treating idiopathic scoliosis in children, regenerating nerve cells, and treating soft tissue injuries in both humans and horses.

Copies of the 1986 *Transactions*, including abstracts of all presentations and posters, can be purchased for $45.00 each from the Executive Secretary, BRAGS, PO Box 64, Dresher, PA 19025, (215) 659-5180.

Microwave Weapons

The Strategic Defense Initiative (SDI), popularly called "Star Wars," has long been known to include RF and microwave weapons, although these usually receive second billing to particle beams, lasers and railguns. Their status may soon change.

In their October 29 syndicated column, Rowland Evans and Robert Novak claimed that the Soviet Union used high-power "ground-to-space microwaves" to disable U.S. reconnaissance satellites "on more than one occasion in the past six months." They went on to note that the radiation, which they later called a "short-wave electromagnetic pulse" beam was fired from a ground station near the Afghan border.

Evans and Novak did not cite their sources, and no one else picked up the story -- not even *Aviation Week*, which closely follows such developments. The magazine did note in its November 3 issue that each of the military services, as well as the Department of Energy and the SDI office, would describe their high-power microwave weapon programs to industry representatives at a conference at Kirtland AFB, NM, during the first week of December. Also on the conference agenda was a classified briefing on the "Possibility of a Soviet RF Weapon Program."

EPA on RF/MW Exposures

If you have ever wondered how much non-ionizing radiation you are exposed to, the Environmental Protection Agency (EPA) has published a report that will answer your questions.

For more than ten years, EPA staffers have been measuring ambient radiation levels all over the U.S. -- for example, near certain types of high-power sources, such as radio and TV stations and civilian and military radars. Now, Norbert Hankin of EPA's Office of Radiation Programs has assembled all this information in a handy, easy-to-use format.

Overall, most Americans are exposed to very small levels of non-ionizing radiation. According to surveys in 15 cities, more than 99 percent of the residents are exposed to less than 1 uW/cm^2 at AM, FM and TV frequencies. However, in high-rise buildings near FM and/or TV antennas, the levels can be much higher. For instance, EPA has measured power densities of 230 uW/cm^2 on the roof of the Sears Tower in Chicago and 375 uW/cm^2 on the roof of the Coty Tower in Honolulu.

The report also includes a lot of useful data on satellite stations and radars. The strength of the main beams of some tracking radars can be quite high at great distances -- up to

100 uW/cm² at nearly five kilometers from the antennas of some large-diameter units.

The 83-page document, *The Radiofrequency Radiation Environment: Environmental Exposure Levels and RF Radiation Emitting Sources* (EPA 520/1-85-014), is full of tables, diagrams and references. While supplies last, you can order a free copy from Norbert Hankin [ANR-461], Office of Radiation Programs, EPA, 401 M St., SW, Washington, DC 20460.

RF Lighting Rules: Conflicting Views

The Federal Communications Commission's (FCC) proposed limits on radiated emissions from radiofrequency (RF) lighting devices have pitted lighting manufacturers who seek to market the "new and innovative" products against broadcasters who fear that the new lights will cause unacceptable RF interference (RFI). In comments filed with the FCC in response to its May 16 proposal, the two sides disagreed as to whether these limits, designed to protect against RFI to AM radio and other broadcast sources, are inadequate, excessive or even necessary.

The commission's rules address frequencies below 30 MHz for radiated RFI; limits for conducted RFI (through power lines) have already been proposed (see *MWN*, May/June 1986). Liliane Volcy, an FCC official, said the commission will not act on the pending proposal before March 1987.

The National Association of Broadcasters (NAB) applauded the FCC's efforts but urged that the standards be regarded as an interim measure only. Citing what it called the technical complexity of the issue and stating that there is considerable uncertainty as to whether these limits can prevent RFI to AM broadcasts, NAB pressed for further research before the FCC adopts permanent standards. NAB suggested an interim standard of 4.5/F uV/m (where F is in MHz) for 0.45-1.705 MHz at 30 meters, instead of the proposed 24/F uV/m, and added that it prefers a 3-meter measuring distance. In the meantime, NAB said "some standard is better than having no standard at all."

The American Radio Relay League (ARRL), although in favor of federal regulation, criticized the FCC's limits as "too high," adding that they would result in "considerable" RFI. ARRL also opposed the 30-meter distance, offering a 10-meter compromise. Additionally, ARRL recommended that lighting devices carry labels warning consumers of potential RFI problems.

The North American Philips Corporation, a major vendor of lighting devices, and the National Electrical Manufacturers Association (NEMA) also opposed the FCC's proposal but for the opposite reason: the limits are unnecessarily restrictive and are not justified, they argued.

Stating that the proposal was "premature" and that it would impede the development of new RF lighting products, Philips concluded, "Substantially less restrictive standards -- particularly in the 1.705-4.0 MHz range would suffice...." NEMA argued that regulation below 490 kHz is unnecessary, because there are no licensed communication systems in that band.

There also was disagreement as to whether different standards should apply in consumer and commercial settings. Claiming that there is "no rational way" of distinguishing between the two, NAB suggested dropping the distinction and urged that all RF lighting comply with the stricter, consumer standard. Philips favors dual standards for frequencies in the AM radio range only. ARRL and NEMA support more restrictive standards for equipment intended for residential use. Consolidation of the standards, NEMA said, would "reverse the commission's long-held recognition of the vastly different environments" in which RF devices operate.

Amador Corp., an EMC testing company based in Almelund, MN, argued that the FCC "does the public a genuine disservice every time it allows such distinctions as 'consumer' and 'non-consumer' to occur." Amador's James Johnson urged the commission to adopt "strict standards for RF lighting devices."

The Health Physics of Non-Ionizing Radiation

March 9-13, 1987
Merrimack, New Hampshire

This comprehensive one-week course, sponsored by the University of Lowell, will provide the health physicist with an overview of the problems associated with using non-ionizing radiation in both an industrial and public environment. It is clear that the use of non-ionizing radiation continues to cause concern to workers and the general public. Many misconceptions have clouded the appreciation of the actual hazards associated with this type of radiation. Among the topics which will be covered include: radio-frequency and microwave radiation, lasers, optical and ultra-violet sources, and extremely low frequency (ELF) and magnetic fields. Starting from first principles, this course will provide the operational health physicist with the tools to start a comprehensive non-ionizing surveillance program appropriate for their particular application. The emphasis will be on hazard calculations and introduction to the currently available field instrumentation. Current research into the biological effects of non-ionizing radiation will also be explored, as well as federal and state legislation in this area. Evening sessions will provide an opportunity for participants to discuss their own applications as well as to work problem sets. The fee for this course is $950, and approval for Continuing Education Credits (CEUs) by the American Board of Health Physics is pending. For more information contact either Dr. John Leonowich at (609) 339-3860 or Dr. Kenneth Skrable at (617) 453-1045.

FROM THE FIELD

Letter from China

We received the following report from Qiner Yang, who works with Dr. Chiang Huai at Zhejiang Medical University in Hangzhou in the People's Republic of China. The text has been copyedited by Microwave News.

More than 120 experts attended the *2nd Chinese Scientific Conference on Bioelectromagnetics*, held in Hangzhou, China, October 27-30, 1986. At the conference, which was sponsored by the Chinese Biophysics Society, the Chinese Biological and Medical Engineering Society and the Chinese Electronics Society, the founding of the Bioelectromagnetics Committee of the Chinese Biological and Medical Engineering Society at the Microwave Institute, Zhejiang Medical University, was announced. This was the first great gathering for engineers, biologists and hygienists on bioelectromagnetics since the *1st Chinese Scientific Conference on Bioelectromagnetics* in 1984.

The major reports were on the following subjects: (1) theoretical dosimetry; (2) biological effects of electromagnetic fields; (3) public and occupational health protection from electromagnetic fields; and (4) biological and medical application of electromagnetic fields. Other reports addressed the substantial progress towards the use of microwaves for birth control in both animal studies and in pilot clinical studies in which ten-year data have been collected [see *MWN*, September/October 1985]. There were also reports on new work, such as a study on combined effects of microwave and ionizing radiation.

In panel discussions, the conferees reviewed three subjects of concern and controversy: (1) radiation systems and absorbed dose; (2) cellular and genetic effects, as well as tumor-promoting effects of electromagnetic fields; and (3) electromagnetic field distribution in living systems and measurement of near fields. In other sessions, panelists expressed concern over the promotion of tumors by electromagnetic fields, an area in which some of the panelists plan to work.

The questions raised at the conference may urge engineers, biologists and hygienists in bioelectromagnetics to work more closely with each other so that research on bioelectromagnetics may be more organized and systematic in the future. The next conference will probably be held in Xian in the spring of 1989.

NRPB on Greenham Common

We received the following letter in response to "Zapping at Greenham Common?" in our September/October issue.

Dear Sir:

I hope your reporter misunderstood Mrs. Kim Besly and Mr. Frank Cook about their requests to the National Radiological Protection Board to provide microwave measuring equipment for use near Greenham Common. Mrs. Besly asked for advice and was twice lent a wide-band instrument sensitive enough to detect microwave fields well below those capable of producing physiological effects. On the first occasion a zero adjustment fault developed, but on the second the instrument worked correctly before and after the loan. Mr. Cook subsequently asked me to repeat the loan, about which he already knew. Mr. Cook's constituency, Stockton North, is nowhere near Greeham Common and I declined the request.

Yours faithfully,

H.J. Dunster, Director
National Radiological Protection Board
Chilton, Didcot, Oxfordshire, U.K.

Adey & Sheppard and Milham Respond to Foster & Guy

In our last issue, we cited Drs. Kenneth Foster and Arthur Guy's article, "The Microwave Problem," published in the September issue of Scientific American. *In its December issue, the magazine published letters by Dr. Allan Frey of Randomline, Inc., and by Dr. Louis Slesin, editor of* Microwave News, *together with replies from the authors. The letters printed below were also sent to the editors of* Scientific American. *Foster and Guy refused permission to print their replies to these letters.*

September 25, 1986

The article "The Microwave Problem" promised to discuss the perplexing environmental problems raised by the ever-increasing utilization of electromagnetic fields over a wide-ranging spectrum resulting in widespread low-level exposure. However, we found only a detailed exposition of one not too surprising fact: since microwave photons do not have the energy required to ionize molecules, significant biological effects from high levels of exposure involve tissue heating. The article does not even hint at the other mechanism for biological effects which involves cooperative reactions in biomolecular systems. Cooperativity is now recognized as a key to many fundamental properties of living matter, for example, cooperative interactions give retinal receptors sensitivity to the level of single photons, set the auditory threshold at the level of Brownian movements of atoms, and establish the S-shaped curve for oxygen binding to the hemoglobin molecules. In like manner, cooperative interactions may be responsible for a broad spectrum of biological effects in situations where microwave exposure occurs without significant heating.

In addition to ignoring the evidence for athermal interactions, Foster and Guy offer a deplorably superficial treatment of biological and public health issues. Apparently fascinated by thermal changes, they fail to point out that the vast majority of the population is never exposed to thermal doses, either in the workplace or in domestic environments. For most people, biomedical concerns about potential hazards involve low-level fields. Therefore, the intricacies of thermal doses of microwaves, which comprised the bulk of the article, are entirely beside the point.

Readers of *Scientific American* deserve a detailed, critical and responsible account of the excellent body of cell and molecular biology from laboratories worldwide which has opened doors to awareness of mechanisms underlying the sensitivities of living tissues to microwave and other electromagnetic fields. Statements by Foster and Guy that "some of the data are inconsistent and inconclusive," or, "often unreliable," and that in consequence, available evidence "does not suggest a mechanism by which significant changes could occur," are a travesty of the realities of current knowledge.

Undeniably, Foster and Guy are wedded to the thermal interaction mode. But should that excuse their loss of objectivity when discussing research of life-long exposures in Guy's laboratory which showed a surprising 18 malignant tumors among 100 exposed rats (not mice, as they wrote) compared to 5 in the controls? They all but dismiss the results with arrant nonsense about the low cancer incidence in the control population and state that, by comparison with historical rates, the cancers among exposed animals were not excessive. Of course, biological experiments require controls just because animal populations vary unpredictably. The authors' argument is untenable. Their apology for the elevated cancer incidence has all the aspects of an option more often exercised by politicians: If the facts are unattractive,

bury your head in the sand (i.e., statistics) and hope no one will notice the odd posture. Incredibly, from that posture they have the audacity to bemoan the ambiguous nature of the data and call for duplicate studies with an eye to ending research.

In summary, although thermal models for microwave interaction have a practical significance in some occupational and military settings, for the vast majority of people the "microwave problem" is one of long-term, low-level exposures to various waveforms spread over a vast frequency spectrum. The determination of risks and the establishment of health standards upon a foundation broader than mere avoidance of thermal changes requires investigation of just those challenging biological questions ignored in this superficial and misleading article. We are indeed very far from any general need to contemplate the authors' shocking suggestion that "some criteria must be developed for determining when to halt research on a given topic, open questions notwithstanding."

Sincerely,

W. Ross Adey, MD
Assoc. Chief of Staff for R&D

Asher R. Sheppard
Research Physicist

August 19, 1986

"The Microwave Problem" by Kenneth R. Foster and Arthur W. Guy is an interesting and timely summary of a complex subject. I'd like to comment on two points made about Dr. Guy's study of pulsed microwave exposure in rats.

1. Some tests of immune function were different in exposed and control animals at 13 months, but not at 25 months. Since the stated mean survival time of these rats was 688 days for exposed and 663 days for controls, at 25 months (760 days), these animals were very old. Immune function declines in very old animals, so the failure to detect a difference in immune status at 25 months in no way compromises the difference found at 13 months.

2. The difference in malignant tumor incidence (18 in exposed v. 5 in controls) is downplayed because, "No single type of tumor predominated...." In fact, among the 18 malignant tumors in the exposed animals, there were 3 adrenal cortical carcinomas, 2 pituitary carcinomas, and 2 thyroid carcinomas. One of the 5 malignant tumors in the control animals was an adrenal carcinoma. This makes a total of 7 malignant endocrine tumors in the exposed animals v. 1 in the controls. Additionally, benign adrenal pheochromocytomas were found in 7 of the exposed animals v. 1 of the controls.

I think that these findings are so suggestive of potential microwave effects that the portions of Dr. Guy's study dealing with immune status and neoplasia should, at a minimum, be replicated.

The "mice" on page 38, line 9, should be "rats."

Sincerely,

Samuel Milham, Jr., MD
Olympia, WA

UPDATES

BIOLOGICAL EFFECTS

EPRI's ELF Teratology Plans Change Again... Following the release of the study results on the multi-generation effects of ELF fields on the growth and development of miniature swine and rats, EPRI announced that it would fund two replication efforts using rats, one at Battelle Pacific Northwest Labs, where the original experiment was carried out, and one at the IIT Research Institute (IITRI) in Chicago (see *MWN*, March/April 1986). Those plans have now been changed. EPRI has cancelled the IITRI experiment and has simplified the protocol for the Battelle replication effort. EPRI's Dr. Bob Patterson told *Microwave News* that research priorities and budget constraints forced the cancellation of the IITRI study. The Battelle rat study has been redesigned, but will still evaluate the effects of ELF fields on three generations of animals. The change will save EPRI about $600,000 -- the total cost of the multi-generation rat study will be approximately $1.2 million. In an interview at the DOE-EPRI contractors meeting in Denver in November, Dr. Larry Anderson of Battelle said that he is "pleased with the new design" and that it "still addresses the questions raised by the pig study."

COMMUNICATIONS

Honolulu Restricts New Broadcast Towers... The Honolulu, HI, City Council has prohibited the construction of new broadcast towers in residential and business districts. The move follows several years of concern about health and interference effects from existing transmitters, which, up to now, have been sited in the city because zoning codes banned them from the surrounding hills to preserve the area's scenic beauty (see *MWN*, April 1984 and July/August 1985). A land-use ordinance, approved in July, limits new towers to industrial, agricultural and preservation districts and requires FM and television transmitters to be at least 2,500 feet from the nearest dwelling; AM broadcast towers must be 500 feet away from residences. The ordinance will not affect existing facilities. A 1984 survey by the Environmental Protection Agency and the Federal Communications Commission found that radiation levels measured in downtown Honolulu were the highest ever measured in a U.S. urban area (see *MWN*, January/February 1985). City Council Chairwoman Marilyn Bornhorst, who has long been concerned about potential radiation risks, sponsored the new ordinance. According to her aide, Richard Melton, residents of high-

rises near broadcast towers continue to complain about health problems, and workers in Honolulu's business district continue to report various types of interference effects.

Hawaii H-3/Omega Developments... The Hawaii congressional delegation has forced a measure through Congress permitting construction of the long-delayed, controversial H-3 highway near an Omega Coast Guard station where navigational communication transmitters operate in the VLF range (see *MWN*, July/August 1982). The Coast Guard has expressed concern that occupants of cars traveling on the planned highway will be exposed to potentially hazardous levels of VLF radiation -- of particular concern are people whose pacemakers may be affected by the fields. In a letter to Senator Robert Stafford (R-VT), chairman of the Committee on Environment and Public Works, Coast Guard Commandant P.A. Yost said he would not object to H-3, "provided the state of Hawaii determines that no harmful radiation or shock hazards exist and provided the proper use and quality of the navigational signal...is not diminished." He added that the state must accept "full liability" for possible health and/or interference problems that occur as a result of the highway's proximity to the Omega facility. The state's secretary of transportation, Wayne Yamasaki, agreed to these conditions in a letter he sent to Stafford, but several experts are less willing to let H-3 construction proceed. Dr. Mark Hagmann, an electrical engineer who has specialized in bioelectromagnetics and who works at NIH, advised Stafford's committee, "I believe that serious hazards would be present during both the construction and use of the proposed H-3 due to the strong electromagnetic fields." (Hagmann said his views were his own and not necessarily those of NIH.) Paul Lane, the Hawaii representative for Medtronic, Inc., the largest maker of cardiac pacemakers in the world, also cautioned Stafford on permitting construction of H-3: "We are concerned that, due to the type and strength of the signal generated in the immediate area of the antenna, people who wear pacemakers may have the pacemakers turned off [due to interference] during transit in the area of the Omega antenna." These and other warnings played only a minor role, however, in determining whether H-3 should be allowed, according to a congressional staffer. The major obstacle was a federal law prohibiting the construction of a highway that might adversely affect parks or other protected lands. Congress overcame that restriction by passing a provision that simply exempts H-3 from that law.

CIA Rebuffed in Virginia... All over the country, citizen groups are fighting the siting of microwave relay towers in their backyards. Even the CIA is not immune to these troubles. According to an item in the October 30 *Washington Post*, the agency was forced to back off from a plan to build a 197-foot-tall, 27-foot-wide tower to transfer signals for the Foreign Broadcast Information Service. As one member of the local planning commission told the *Post*, "Let's be honest....It was an eyesore."

COMPATIBILITY & INTERFERENCE

ARRL Petition Denied Again... The FCC continues to shy away from mandatory labeling of home electronic equipment for susceptibility to RFI. On October 29, the commission rejected a petition from the American Radio Relay League (ARRL) to reconsider its earlier refusal to set enforceable standards (see *MWN*, March/April and July/August 1986). The FCC argued that official action is "premature" because the ad hoc group of the American National Standards Committee C63 is "moving in the desired direction" (see *MWN*, January/February 1986). The FCC left the door open for possible future action, however: "If it is found that voluntary efforts are not yielding an adequate degree of RFI susceptibility control within a reasonable time frame, the commission may then consider mandatory standards and a means of enforcing such standards."

Video Guide to FCC Rules... Vencompass, Inc., has issued the first of three training videos on the FCC's RFI rules. The 65-minute video, which covers limits for radiated and conducted RFI, test methods and FCC enforcement procedures, was prepared by four EMC experts from Spectrum Control, Inc. *Understanding the FCC Rules and Regulations on RFI -- Part 15, Subpart J* costs $99.95; an 8-minute executive overview is available for $14.95. Vencompass plans to release two additional cassettes in the near future: *Understanding and Interpreting FCC Test Data* and *Solutions to FCC RFI, Including Filters, Gaskets, Shielding and Grounding*. For more information, contact: Pamela Venable, President, Vencompass, Inc., 155 W. Eighth St., Erie, PA 16501, (800) 458-4114, or (800) 352-2112 in Pennsylvania.

Bull Market for EMC... Frost & Sullivan, Inc. (F&S), the market research firm, predicts that the EMC market will grow to $1.5 billion in 1990 from $1 billion in 1984. It estimates that military and aerospace companies, which are currently the largest users of EMC products and services, accounting for 35% of sales, will maintain that lead through 1990. According to *Electromagnetic Compatibility Market in the U.S.* (No.1667), the four largest EMC companies, ranked by total 1986 sales, are: Keene Corp. ($70 million), Chomerics, Inc. ($50 million), Sprague Electric ($30 million) and Belden Cable ($30 million). Among the report's conclusions are that the trend towards replacement of metal by coated or filled plastics will continue to have a major impact on the EMC marketplace and that consulting and testing services are becoming larger and larger markets. Overall, F&S found that "EMC is a growing, technologically vibrant industry" which is highly

dependent on FCC regulations and that the industry is "ripe for acquisition and merger activity." The report is available for $1,775 from F&S, 106 Fulton St., New York, NY 10038, (212) 233-1080. Earlier this year, F&S issued a report projecting that the EMI-RFI test equipment market will grow to nearly $320 million by 1989 (see *MWN*, May/June 1986)....And in another recent report, F&S projects that the market for *Power Conditioning Equipment for Mini- and Microcomputers* (including surge suppressors, voltage regulators, uninterruptible power supplies and power line disturbance monitors) will grow to $1.0-1.2 billion by 1990. This report (No.1576) costs $1,750.

GOVERNMENT

EPA Guidance... Action on EPA's four options for the federal RF/MW radiation standard (see *MWN*, July/August and September/October 1986) has been delayed again. The deadline for comments was extended until December 15, at the request of the federal NTIA, as well as EEPA and NAB, among others. According to EPA's Norbert Hankin, about 80 sets of comments had been submitted to the agency by early December, and "they are still coming in."

INTERNATIONAL

Sparks Fly in Saudi Arabia...*The builders of the* Riyadh International Stadium are learning about the problems of locating a large metal structure near a high-power radio station, according to an item in the November 13 *New Scientist*. The stadium's 1,000-foot-diameter roof, which is supported by 24 steel masts and miles of wire, has been acting like a giant antenna. Construction workers have been plagued with electrical burns and shocks caused by a nearby radio transmitter operating at 585 kHz with a power output of 1.2 megawatts. The riggers sensed something was amiss when fluorescent lights began to flicker in rhythm with the radio station's music. A British consulting firm was brought in to ground water pipes and ventilation ducts and to shield the wiring of the stadium's public address system and electronic scoreboard. Cables for TV cameras to broadcast sports events and those for surveillance are too sensitive and have been replaced with fiber optic lines. Though the radiation hazards and EMI problems are reported to have been overcome, they may surface again when the radio station starts to broadcast at full power, double the present output.

MEASUREMENT

New Narda Meter... The Narda Microwave Corp. has introduced a new set of radiation monitors. The Model 8700 series consists of the 8716 meter and a choice of two probes: the 8721, which has a "flat" frequency response, and the 8722, which conforms to the well-shape frequency dependency specified by the 1982 ANSI safety standard. Ed Aslan, the engineering manager for Narda's instrument group, told *Microwave News* that the new meter offers a number of advantages over older models: The 8700 series has a wider frequency range, 300 kHz-40 GHz -- earlier units required two different probes to cover this band. And the unit has a built-in test source to make sure that it is operating correctly. The 8700 was originally developed under a U.S. Navy contract; it is a commercial version of the Navy unit. The meter and one of the probes cost $5,000; an additional probe costs $3,000. For more information, contact: Robert Johnson, Instrument Sales Manager, The Narda Microwave Corp., 435 Moreland Rd., Hauppauge, NY 11788, (516) 231-1700.

Resources...A group from the Italian Public Health Labs in Ivrea offers a solution to the problem of finding an accurate and consistent method of measuring electromagnetic fields from 100 kHz to 990 MHz. Santi Tofani and his coauthors' primary concern is protecting workers and the public from overexposure. See their paper in the July 1986 issue of the *IEEE Transactions on Microwave Theory and Techniques*....In Sweden, a group has compared the calibration of 73 commercial power density meters at 27 and 2450 MHz for levels between 10 and 100 mW/cm^2 . At 27 MHz, only 55% of the meters were accurate within 1 dB, compared to 65% at 2450 MHz. One disturbing finding was that 5% of the probes did not work at all, "although their owners thought they did." See Ralf Bostrom, Kjell Hansson Mild and Georg Nilsson's paper in the June issue of the *IEEE Transactions on Instrumentation and Measurement*....Dr. Kun-Mu Chen and coworkers at Michigan State University in East Lansing and Dr. Elliot Postow of the Naval Medical R&D Command in Bethesda, MD, have developed an X-band microwave system that can detect a human at a distance of 30 meters or behind a cinder block wall. The life detection system consists of a low intensity signal (for example, 100 uW at 10 GHz) that is modulated by heartbeats and breathing. Writing in the July issue of the *IEEE Transactions on Biomedical Engineering*, the team suggests that the system could be used to monitor a patient in a clinic or to detect someone hiding inside a vehicle. In addition, although not specifically cited, it is easy to imagine battlefield applications....NBS has issued a new report on the *Shielding Effectiveness Measurements of Plastics* (NBSIR 85-3035) to help engineers get repeatable testing results. The report reviews five of the most common measurement methods and points out that there are substantial differences among the obtained results. John Adams and Eric Vanzura, of NBS's Electromagnetic Fields Division, show, however, that a flanged coaxial holder can overcome the typical measurement problems above 30 MHz. (They found that the system described in the ASTM Emergency Standard 7-83 is not reliable.) The 31-page

report is available for $9.95 from the National Technical Information Service, Springfield, VA 22161; order No. PB 86-219680. Adams and Vanzura published a shorter version of their report in the September/October issue of *EMC Technology*, a controlled circulation magazine, based in Gainesville, VA....NBS staffers have developed a parallel plate device that creates ion concentrations similar to those found near HVDC power lines. The device can produce a known level of ions, accurate to within 9%, and can be used to calibrate ion counters. The device, as well as details on those factors which can influence the accuracy of ion measurements, is described in *Calibration of Aspirator-Type Ion Counters and Measurement of Unipolar Charge Densities* (TN 1223), which may be ordered from the Government Printing Office, Washington, DC 20402; stock No. 003-003-02732-4; $3.75, prepaid....And NBS has also issued *NBS Calibration Services Users Guide 1986-88* (Special Publication 250), which describes its activities for a wide range of measurements, including DC, AC, RF and microwave applications. (The last edition was published in 1982.) The 183-page volume details NBS's measurement assurance programs. Copies are available from the Office of Physical Measurement Services, B362 Physics Bldg., NBS, Gaithersburg, MD 20899, (301) 921-2805.

MEDICAL APPLICATIONS

Shielding an NMRI... The installation of nuclear magnetic resonance imagers (NMRIs) presents complex problems for hospitals. A team from the Oral Roberts University School of Medicine in Tulsa, OK, along with a radiation safety officer from the University of Oklahoma in Oklahoma City, advises that, after an NMRI has been installed, "*a survey of the actual magnetic field at critical positions is absolutely necessary* [their emphasis] to ascertain whether areas with hitherto unrestricted access are actually safe for general use. Areas of access into the immediate vicinity of a [N]MRI magnet and at the 0.5 mT (5 G) level must be posted for patient safety." The NMRI specialists advise that shielding may be needed to reduce fringe fields but caution that the 8-mm-thick steel screens may weigh several tons -- five-ten times as much as the lead sheets commonly used to shield X-ray rooms. Their paper, "Ferromagnetic Screening Around a Superconducting Magnetic Resonance Imager," appears in the October issue of *Health Physics*.

Hyperthermia at VLF Frequencies... Drs. Ichiro Kimura of Saga University and Takeshi Katsuki of Saga Medical School, both in Saga, Japan, have developed an induction heating system, operating at 20-30 kHz, to treat malignant tumors. After testing a number of different materials, they found that copper braided wires, placed in magnetic fields of up to 4,000 A/m, were the most efficient medium for generating uniform heating. Treatment of two oral cancer patients with VLF hyperthermia, in conjunction with chemo- and radiotherapy, was successful. Kimura and Katsuki argue that their new system is not only safe and effective, but is also cheaper than hyperthermia at microwave frequencies. See their paper in the November issue of the *IEEE Transactions on Magnetics*.

MEETINGS

EMC Conferences... The proceedings of a number of EMC meetings are now available. The *1986 IEEE International Symposium on Electromagnetic Compatibility* was held in San Diego, CA, September 16-18. Among the papers presented at the meeting were: "RFI and EMC Survey of Hospitals" by W.H. McGinnis and D.L. Williams, of the Southwest Research Institute; "Assessment of Communication System Susceptibility to the PAVE PAWS Radar" by E.E. Donaldson of Georgia Tech and R.P. Burdett of Georgia Power; "Projected Susceptibilities of VHSIC/VLSIC Devices to the Year 2000 Electromagnetic Environment" by H.W. Denny, also of Georgia Tech; "Vertical Site Attenuation --A Necessity!" by Don Heirman of AT&T Information Systems; "The New British Standards on RF Ignition and Detonation Hazards -- A Review" by P.S. Excell of the University of Bradford in England, and a series of status reports on the seven CISPR subcommittees. A copy of the 524-page proceedings can be ordered for $30.00 (IEEE members) or $60.00 (non-members) from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854, (201) 981-0060. Order No. 86CH2294-7....The three-volume collection of papers presented at last June's *8th International Wroclaw Symposium on EMC*, held in Poland, presents the best opportunity to learn what is happening in Eastern European countries and in the U.S.S.R. Many of the papers are in Russian, but each has an abstract in English. Of special interest are a series of four papers on "EM Emissions Related to Earthquakes" and a session on "EMC and Biological Risks" organized by Professor Henryk Mikolajczyk of the Institute of Occupational Medicine in Lodz, Poland. In addition, K.H. Fagiewicz of the Technical University of Gdansk, Poland, describes "Electrical Equipment as Sources of Radio Interference in Ships' Power Lines," and T.V. Ivanova and D.N. Shapiro, both from Leningrad, present an analytical model of RFI from vehicular traffic. For more information on ordering the symposium record, contact W. Moron, EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland....The proceedings of the colloquium sponsored by the Santa Clara Valley chapter of the IEEE-EMC Society are available for $20.00 in the U.S. ($25.00 overseas) from Ghery Pettit, Tandem Computers, Inc., 2550 Walsh Avenue, Santa Clara, CA 95051....And the preliminary program for next year's *7th International Zurich Symposium & Technical Exhibition on EMC* has been released. 124 papers are scheduled to be delivered in

Switzerland March 3-5; there will also be a number of tutorials, one of which will cover theoretical and practical aspects of protection against nuclear EMP threats. For more information, contact: Dr. T. Dvorak, ETH Zentrum-IKT, 8092 Zurich, Switzerland, (1) 256-2790.

MILITARY SYSTEMS

GWEN EIS... The Air Force announced in early September that it will prepare a full environmental impact statement for its proposed nationwide Ground Wave Emergency Network (GWEN), which is designed to survive the EMP from a nuclear explosion. Just two weeks earlier, a Portland, OR, court had ruled that an EIS is not required for a GWEN-related transmission tower, rejecting a suit brought by the No GWEN Alliance of Lane County, OR, a local group that wants to block construction of a GWEN tower in its community. That decision is now being appealed but the outcome is moot given the Air Force's decision to prepare an EIS. The Air Force held a public meeting on September 25 in Washington, DC, to discuss the scope of the EIS. According to an item in *Defense News* (September 29), opponents of GWEN argued that the towers will be likely targets in the event of a nuclear attack and that the environmental effects of a nuclear war should be included in the EIS. The Air Force said that the assessment will concentrate on RF radiation -- it has already set a 50 V/m general population exposure limit for GWEN (see *MWN*, January/February 1986) -- as well as copper leaching from ground planes used for the towers and risks to sensitive habitats. The full GWEN network will include more than 130 communications relay towers operating at 150-175 kHz. GWEN also has been the target of attack from another direction: Congressman Silvio Conte (R-MA), who last year opposed construction of a communications complex in his district (see *MWN*, July/August 1985), tried but failed to eliminate all funding for GWEN for fiscal year 1987; the House of Representatives' Appropriations Committee did cut GWEN support from the $97 million the Air Force had requested to $51 million. For more information about the GWEN EIS, contact the Office of Public Affairs, Electronic Systems Division, Air Force Systems Command, Hanscom AFB, MA 01731, (617) 377-4064.

STANDARDS

Slow Going for ANS C95.IV... The chairmen of the working groups of subcommittee IV of the Accredited National Standards (ANS) Committee C95 on Non-Ionizing Radiation Hazards are meeting December 1-2 in Las Vegas, NV, to draft a revised version of the exposure standard presented in Madison, WI, last June. At that time, there was considerable apprehension about discussing the substance of the proposed "strawman" draft revision of the 1982 ANSI standard because the literature review was largely incomplete (see *MWN*, July/August 1986). According to a November 13 status report by EPA's Dave Janes, who is chairing the C95.IV group on risk assessment, little progress has been made toward evaluating the more than 300 papers that have been selected for review. About 200 of these have been judged to have acceptable dosimetry, but *only 32* have been reviewed by the biological validation subcommittee -- and of these, 20 have been found to be "relevant for setting standards." (Two of the 20 failed the dosimetry test, however.) Undeterred by the absence of data, the drafting committee is preparing a second version of the strawman standard, which is scheduled to come to a vote next June at a two-day session before the annual meeting of the Bioelectromagnetics Society in Portland, OR.

CISPR and IEC... In our July/August issue, we described CISPR's new standard, *Radio Interference Characteristics of Overhead Power Lines and High Voltage Equipment. Part 2: Methods of Measurement and Procedure for Determining Limits* (No.18-2). The standard has now been released and is available from ANSI for $60.00, plus $6.00 for postage and handling (prepaid). Order from Sales Dept., ANSI, 1430 Broadway, New York, NY 10018, (212) 642-4900.

NEW PUBLICATION

Biological Effects of Electropollution Brain Tumors and Experimental Models

Edited by Sisir K. Dutta and Richard M. Millis

The prevalence of nonionizing electromagnetic fields and their increase in the ambient, occupational, and therapeutic environments have heightened concern about possible health hazards resulting from electric power, radio-frequency, and microwave radiation exposure. This book presents a timely review of the latest research in the field of electromagnetic bioeffects and includes the latest developments in epidemiological surveys, *in vitro* tests, and experimental models. Contributors include researchers from EPA, FDA, NIH, the State of Maryland, industry, and leading universities. An overview of the electropollution literature with informative abstracts from 168 recent publications is included.

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ELF Epi Study (continued from p.1)

paper, which first revealed the cancer risk due to exposure to very weak alternating magnetic fields, Wertheimer and Leeper's work met with a great deal of skepticism. This attitude undoubtedly will now change. As Savitz told *Microwave News* in an interview, "This has gone from a flaky issue into the mainstream of environmental epidemiological research."

External Field Sources Most Important

The new study indicates that the primary determinants of childhood cancer are the external sources of magnetic fields and not those inside the house, such as electrical appliances. Wertheimer and Leeper took the bold step of estimating magnetic field exposures by classifying houses according to the types of electrical wiring in their vicinity.

At last summer's Bioelectromagnetics Society meeting, Barnes and Wachtel reported that Wertheimer and Leeper's wire coding scheme was a reliable indicator of the external sources of magnetic fields. Bill Kaune of Battelle Pacific Northwest Labs, who worked on a companion study of adult leukemia, agreed that the wire coding scheme correlates with residential magnetic fields (see *MWN*, July/August 1986 and story on opposite page).

In Denver, Savitz argued that the wire codes are the best historical predictor of a child's exposure to magnetic fields at home -- better than actual measurements inside the house because ambient fields can change considerably over time. "If you had to predict what the exposure was ten years ago, use wire codes," Savitz said. Indeed, he noted that the measured fields showed only a "modest" association with childhood cancer.

Savitz found a 30%, non-statistically significant increase in childhood cancer among those living in homes with *measured* magnetic fields over 2.5 milligauss (mG) from external sources, compared to those living in homes with measured ambient magnetic fields of less than 0.65 mG. For childhood leukemia, Savitz observed a stronger association -- more than a doubling of the cancer risk among those exposed to fields in excess of 2.5 mG.

Savitz's case control study is the second to confirm the Wertheimer-Leeper finding. Earlier this year, Dr. Lennart Tomenius published a paper showing that childhood cancer in Stockholm, Sweden, is also associated with weak magnetic fields (see *MWN*, November 1982 and May/June 1986). The Swedish electrical distribution system operates at 50 Hz -- in contrast to 60 Hz in North America.

Given the three supporting studies, "there is now enough credibility to justify more work," Savitz said. Yet there are few sources of money to continue the research effort. As one leading researcher, who requested anonymity, told *Microwave News*, "The credibility keeps growing, but the money keeps shrinking."

A second epidemiological study presented at the Denver meeting indicated no association between adult risks of developing acute non-lymphocytic leukemia and exposure to residential ELF fields (see story on opposite page). Both the childhood and adult cancer studies were paid for by the New York State Power Line Project. The total cost of both studies was approximately $750,000.

A Causal Relationship: Pro and Con

Savitz presented arguments for and against a causal link between magnetic field exposure and cancer incidence. On the causal side are: (1) the new findings are consistent with previous reports in the published literature; (2) the exposure indices from the wire codes are stable over time; (3) random errors would tend to dilute the positive finding and favor a finding denying a link; and (4) the absence of confounding variables.

Factors that argue against a causal link are: (1) the measured fields inside the houses are not related to cancer incidence; (2) the results are somewhat imprecise; (3) the questionable comparability of cases and controls; and (4) the low rate of response among some of the controls.

What's Next? (continued from p.1)

In a paper published earlier this year, Wertheimer and Leeper reported that pregnancies among couples who use electric blankets are more likely to end in miscarriages than those among couples who do not heat their beds electrically (see *Bioelectromagnetics*, 7, pp.13-22, 1986, and *MWN*, May/June 1986).

New EPRI Epi Study

Meanwhile, the Electric Power Research Institute (EPRI) has funded another epidemiological study to further test the Wertheimer-Leeper finding. Under a two-year, $350,000 contract, Dr. John Peters, an epidemiologist at the University of Southern California (USC) in Los Angeles, will investigate the link between all types of childhood leukemia and power line fields.

According to USC's Dr. Joseph Bowman, who is collaborating with Peters, the study will use a data base, compiled for the National Institutes of Health, that includes information on parents' occupations and chemical exposures.

Bowman told *Microwave News* that a decision on how to estimate exposures to electromagnetic fields has not yet been made. Dan Bracken, Bill Kaune, Ed Leeper and Howard Wachtel are scheduled to meet with the USC researchers December 8-9 to review possible coding protocols. Bowman said that the Los Angeles electrical distribution system may not allow the use of the Wertheimer-Leeper coding scheme.

Peters was one of the authors of a letter published in *The Lancet* (November 20, 1982) that supported a trend towards an increased risk of leukemia among workers exposed to electromagnetic fields (see *MWN*, December 1982).

Epidemiology Workshop

Immediately after the Denver power line meeting, a special workshop was held to review the latest ELF epidemiological results. The meeting was closed to the press, but a consensus statement from the participants will be issued.

Dr. Clay Easterly of Oak Ridge National Lab, who organized the workshop with Dr. Bill Wisecup of W/L Associates, told *Microwave News* that, while the ELF effect may be small, if real at all, the problem is a "pervasive" one. "We at Oak Ridge are recommending a multi-centered approach to this problem," he said.

Texas Supreme Court Refuses To Let HL&P Turn on Power Line

The Texas Supreme Court has refused to allow the Houston Lighting & Power Co. (HL&P) to activate a power line that crosses school property. The utility had sought permission to use the line while the Texas Court of Appeals decided whether to overturn a lower court ruling that HL&P had acted with "reckless disregard" of children's health in siting a 345 kV line through school land. A jury awarded the school district $25 million in punitive damages (see *MWN*, November/December 1985).

A three-judge Court of Appeals panel reversed the trial court's injunction against using the line, but, on November 26, state Supreme Court Justice Ted Robertson agreed with the original ruling and forbade HL&P from turning it on.

The $25 million award was based in large part on expert testimony that power line fields can have adverse health effects and may promote cancer. Attorney H. Dixon Montague of Vinson & Elkins in Houston, who is representing the school district, told *Microwave News* that the state Supreme Court is sending a signal that the health effects issue is an important one and cannot be dismissed.

Meanwhile, oral arguments in the appeal of the jury decision were heard on November 13. Ironically, the three-judge panel that will rule on the appeal is the same one which was reversed by the state Supreme Court.

A spokeswoman for HL&P told *Microwave News* that the utility is asking the state Public Utility Commission for permission to relocate the line. When asked what the cost of the rerouting would be, she replied that she did not have a firm number, but that it would be "substantial."

Adult Leukemia: No Link to Residential ELF Fields

An epidemiological study has found no link between acute non-lymphocytic leukemia (ANLL) among adults and their exposure to ELF electric and magnetic fields at home. According to Dr. Richard Stevens of Battelle Pacific Northwest Labs in Richland, WA, the results showed "no pattern at all."

Like the Colorado childhood study, the adult study, which surveyed Washington state residents, confirmed the correlation between residential magnetic fields and wiring codes developed by Dr. Nancy Wertheimer and Ed Leeper (see *MWN*, July/August 1986). There was no association between the codes and the incidence of ANLL, however.

In an interview with *Microwave News*, Stevens said that the study had "very low power" -- partly because 50 out of the 164 eligible ANLL cases did not participate. Stevens explained that many doctors refused to allow anyone to contact the next of kin.

Stevens's study was prompted by a number of epidemiological surveys that suggested that workers exposed to electromagnetic fields had abnormally higher rates of acute leukemia. Unlike the Colorado study, the Washington study was not designed as an attempted replication of the Wertheimer-Leeper cancer findings (see story on p.1).

Canadian Unions Press for Research on ELF Radiation Risks

A working group of representatives from unions, utilities, academia and the federal and provincial governments is being set up in Canada to address research priorities for studies on the health risks associated with exposure to ELF radiation from power lines.

The new initiative comes in response to a written appeal for action from the Communications Workers of Canada (CWC) and the Canadian Union of Public Employees (CUPE) to Jake Epp, the minister of Health and Welfare.

As a result of the CWC-CUPE letter, a meeting was held in Toronto on October 29, chaired by the director general of Health and Welfare, Dr. E. Somers. Following the meeting, Dr. Maria Stuchly of the Radiation Protection Bureau, which is within Health and Welfare's Health Protection Branch, was charged with setting up the working group.

The members of the group have not yet been named, but it is likely that Stuchly will chair it. According to Stuchly, the mission of the working group is to establish the most productive research plan to fill gaps in the U.S. work and to promote and stimulate research in academia. Stuchly said that the group has not been charged with

proposing or setting ELF safety standards.

In a telephone interview, Dr. Sol Sax, Ontario Hydro's chief physician, said, "I'm glad that the government is taking some interest in this area and, hopefully, it will free up some funds for more research."

Gary Cwitco of the CWC in Toronto told *Microwave News* that the Canadian government should fund more research on ELF risks because, given its investment in generation and transmission technology, it is not supporting its fair share of 60 Hz research. Cwitco added that he would like to see more coordination in Ontario Hydro's and Hydro Quebec's research efforts.

According to Stuchly, no increase in research monies has been approved and the "funding problem is still unresolved." Nevertheless, Stuchly said that she is pleased to have the understanding of senior officials that something should be done.

In addition to Stuchly and Sax, Drs. Michel Plante of Hydro Quebec and Gilles Theriault of McGill University in Montreal spoke at the October 29 meeting. Plante and Theriault are planning a large-scale epidemiological study of workers exposed to power line fields (see *MWN*, May/June 1986). Drs. Richard Phillips of the U.S. Environmental Protection Agency and Ken Klein of the U.S. Department of Energy also spoke at the meeting.

Other Developments

EPRI may soon no longer be the only source of utility funds for ELF research. Representatives of the 20 member utilities of the Western Energy Supply and Transmission (WEST) Associates will meet in Phoenix, AZ, in January to discuss priorities for future bioeffects research. One of the major conclusions of a report prepared for WEST Associates was that, "Stable, long-term funding will be necessary to resolve the human health issues associated with exposure to 60 Hz E- and H-fields." According to Jack Sahl, a research scientist with Southern California Edison, a decision on funding should be reached within the next three months. A limited number of copies of the WEST report, *A Critical Review of the Scientific Literature on Low Frequency Electric and Magnetic Fields: Assessment of Possible Effects on Human Health and Recommendations for Research,* are available from Sahl at Southern California Edison R&D, 2244 Walnut Grove Ave., Rosemead, CA 91770, (818) 302-1261.... Drs. Nancy Wertheimer and David Savitz are scheduled to review the latest epidemiological ELF research at the State of Florida's Electric and Magnetic Fields Advisory Panel meeting on December 12 in Tallahassee....Ontario Hydro has issued a "Corporate Strategy" to address the "Health and Biological Effects of Electric and Magnetic Fields." Among the utility's objectives is to "keep risks to Ontario Hydro employees and the public at a level as low as reasonably achievable." For a copy of the one-page strategy, contact John O'Grady at Ontario Hydro's Transmission Effects Unit, 700 University Ave., Suite H8D4 Toronto, Ont. M5G 1X6, Canada, (416) 592-3395....The Western Area Power Administration and the Transmission Agency of Northern California have issued draft environmental impact statements for two 500 kV lines -- The California-Oregon Transmission Project and the Los Banos-Gates Transmission Project. For more information, contact the CA-OR project, PO Box 660970, Sacramento, CA 95866, (916) 924-3995....Dr. Bob Patterson will soon be leaving EPRI to become an associate professor of environmental health engineering at Temple University in Philadelphia, PA. Bob Black, a 7-year EPRI veteran, will take over as project manager for EPRI's non-ionizing radiation research program.

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CONFERENCES

1987 Conference Calendar [Part I]

January 11-13: **6th Annual Hyperthermia Conference,** Park City, UT. Contact: Jamie Siglin, BSD Medical Corp., 420 Chipeta Way, Suite 140, Salt Lake City, UT 84108, (801) 582-5550.

January 12-15: **1987 URSI National Radio Science Meeting,** University of Colorado, Boulder, CO. Contact: S.W. Maley, Dept. of Electrical Engineering, University of Colorado, Boulder, CO 80309.

January 22-24: **2nd Dresden Hyperthermia Symposium,** Hotel Bellevue, Dresden, German Democratic Republic (G.D.R.). Contact: Dr. W. Kruger, Research Institute, Manfred von Ardenne, Zeppelinstrasse 7, Dresden-8051, G.D.R.

February 1-6: **1987 IEEE Power Engineering Society Winter Meeting,** Marriott Hotel, New Orleans, LA. Contact: IEEE Society Special Services, 345 E. 47th St., New York, NY 10017, (212) 705-7893.

February 11-13: **RF Technology Expo '87,** Disneyland Hotel, Anaheim, CA. Contact: James MacDonald, RF Design, 6530 S. Yosemite St., Englewood, CO 80111.

February 21-26: **35th Annual Scientific Meeting of the Radiation Research Society (RRS) and 7th Annual Meeting of the North American Hyperthermia Group,** Westin Peachtree Plaza, Atlanta, GA. Contact: RRS, 925 Chestnut St., Philadelphia, PA 19107, (215) 574-3153.

February 28-March 4: **5th Annual Meeting of the Society for Magnetic Resonance Imaging (SMRI),** Hilton-Palacio Del Rio Hotel, San Antonio, TX. Contact: SMRI, 1340 Old Chain Bridge Rd., Suite 300, McLean, VA 22101, (703) 790-1745.

March 3-5: **7th International Zurich Symposium & Technical Exhibition on Electromagnetic Compatibility,** Zurich, Switzerland. Contact: Prof. T. Dvorak, ETH Zentrum-IKT, 8092 Zurich, Switzerland, (1) 256-2790, or Prof. Ralph Showers, Dept. of Electrical Engineering, University of Pennsylvania, Philadelphia, PA 19104, (215) 898-8123.

March 8-12: **2nd International Conference on Anti-carcinogenesis and Radiation Protection,** National Bureau of Standards, Gaithersburg, MD. Contact: Dr. Michael G. Simic, Room C216, Bldg. 245, National Bureau of Standards, Gaithersburg, MD 20899, (301) 921-2374.

March 12-13: **13th Northeast Bioengineering Conference,** University of Pennsylvania, Philadelphia, PA. Contact: Prof. Kenneth R. Foster, Dept. of Bioengineering, University of Pennsylvania, 220 S. 33rd St., Philadelphia, PA 19104, (215) 898-8534.

March 23-25: **Seminar on Human Exposure to Ultraviolet Radiation: Risks and Regulations,** International Congress Centre RAI, Amsterdam, The Netherlands. Contact: Ms. A.M.C. Alkemade, Ministry of Welfare, Health and Cultural Affairs, International Health Affairs Division, PO Box 5406, 2280 HK Rijswijk, The Netherlands.

March 25-27: **1987 European Workshop on Magnetic Resonance in Medicine (MRM),** University College, London, U.K. Contact: Conference Secretariat, MRM 1987, 47 Belgrave Sq., London SW1X 8QX, U.K., (1) 235-6111.

March 28-31: **65th Annual Convention & International Exposition of the National Association of Broadcasters (NAB),** Convention Center, Dallas, TX. Contact: NAB, 1771 N St., NW, Washington, DC 20036, (202) 429-5350.

March 30-April 2: **5th International Conference on Antennas and Propagation,** University of York, U.K. Contact: ICAP '87 Secretariat, Conference Services, IEE, Savoy Place, London WC2R OBL, U.K.

April 1-3: **1st Eastern Clinical Hyperthermia Symposium & Workshop,** Franklin Plaza Hotel, Philadelphia, PA. Contact: Dr. M. Heinrich Seegenschmiedt, Dept. of Radiation Oncology & Nuclear Medicine, Hahnemann University Hospital, Broad & Vine, Philadelphia, PA 19102, (215) 448-8410.

April 2-4: **Hyperthermia Meeting in Memory of Dr. Mildred Scheel,** University of Munich Medical Center, Klinikum Grosshadern, Munich, F.R.G. Contact: Klinikum Grosshadern, Medizinische Klinik III, Dr. Mildred Scheel Meeting, PO Box 701260, D-8000 Munich 70, F.R.G., (89) 7095-4768.

April 2-5: **4th Annual Conference on Magnetic Resonance Imaging,** Sheraton Grande Hotel, Los Angeles, CA. Contact: Patrice Rapalus, Diagnostic Imaging, 500 Howard Street, San Francisco, CA 94105, (415) 397-1881, ext. 202.

April 8-9: **23rd 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 9-10: **Satellite Communications Status '87: Technology, Applications & Markets,** Halloran House, New York, NY. Contact: Susan Smith, Frost & Sullivan, Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080.

April 14-17: **25th International Magnetics Conference,** Keio Plaza Intercontinental Hotel, Tokyo, Japan. Contact: Secretariat of Intermag '87, 2-14-9, Nihombashi, Chuo-ku, Tokyo 103, Japan, (3) 272-7981.

April 21-23: **4th Annual Electrical Overstress Exposition (EOE),** Convention Center, San Jose, CA. Contact: Jim Russell, EOE, 2504 N. Tamiami Trail, Nokomis, FL 33555, (813) 966-9521.

April 27-29: **1987 IEEE Instrumentation/Measurement Technology Conference,** Sheraton Hotel, Boston, MA. Contact: Robert Blaha, 28 Hermaine Ave., Dedham, MA 02026.

May 5-7: **5th International Ionospheric Effects Symposium (IES),** Hilton Hotel, Springfield, VA. Contact: IES Coordinator, Code 4180, Naval Research Lab, Washington, DC 20375.

May 16-20: **22nd Annual Meeting of the Association for the Advancement of Medical Instrumentation (AAMI),** Westin Bonaventure Hotel, Los Angeles, CA. Contact: Debra Shaver, AAMI, 1901 N. Fort Myer Dr., Suite 602, Arlington, VA 22209, (703) 525-4890.

May 18-21: **19th Annual Meeting of Radiation Control Program Directors (CRCPD),** Boise, ID. Contact: CRCPD, 71 Fountain Pl., Frankfort, KY 40601, (502) 227-4543.

May 18-21: **1987 International Geoscience and Remote Sensing Symposium (IGARSS '87),** University of Michigan, Ann Arbor, MI. Contact: Ms. Joan Eadie, University of Michigan Extension Service, Dept. of Conferences and Institutes, 200 Hill St., Ann Arbor, MI 48104.

May 18-22: **The 1987 National Aerospace and Electronics Conference (NAECON '87),** Dayton Convention Center, Dayton, OH. Contact: Cindy Porubcansky, NAECON '87, 210 Southerly Hills, Englewood, OH 45322, (513) 255-4848.

May 19-21: **EMC Expo '87,** Town and Country Hotel, San Diego, CA. Contact: Sandra Hamilton, PO Box D, Gainesville, VA 22065, (703) 347-0030.

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$25 Million Power Line Award Reversed; Health Issue Affirmed

The Texas Court of Appeals has struck down a $25 million award for punitive damages against Houston Lighting & Power (HL&P) for building a power line across school property without receiving proper permission. The court affirmed, however, the remainder of the jury's decision, including its conclusion that there are potential health effects associated with exposure to electromagnetic fields (EMFs) from power lines (see *MWN*, November/December 1985).

In his November 5 opinion, Judge Paul Pressler denied the $25 million award on the legal ground that HL&P was not guilty of trespass and therefore could not be liable for punitive damages. But he overruled HL&P's contention that there was insufficient scientific basis for the jury's finding. Pressler decided that the jury had not erred when it found that there was "clear and convincing evidence" of potential EMF hazards and that HL&P had therefore abused its discretion in siting a 345 kV power line on school property.

Indeed, Pressler wrote of "the ominous implications of recent scientific research" on the health effects of power line EMFs.

Although attorneys for each side agreed with some parts of the decision, they have both filed for a rehearing, the first step towards an appeal to the Texas Supreme Court.

H. Dixon Montague of Vinson & Elkins, who is representing the Klein Independent School District, is confident that the higher court will reinstate the $25 million award. In the interim, he is delighted with the way the court ruled on the health effects issue. "The opinion is devastating to HL&P in its future power line cases," he told *Microwave News* in a

(continued on p.14)

Congressional Hearings on Power Lines: Follow-Up Seen

"We are not going to let the issue die," a spokesman for Congressman George Miller (D-CA) told *Microwave News* following the October 6 House subcommittee on water and power resources hearing on the health effects of power lines. "We are getting calls from all over the country. We have had more follow-up calls on this hearing than on any other in a long time."

After the hearing, Miller sent a number of probing questions to each of the witnesses who had testified (see *MWN*, September/October 1987). The responses will be included in the transcript of the hearing, which will

(continued on p.10)

ELF NEWS

The Talk of Kansas City

The mood was serious at this year's DOE-EPRI review of research on the health effects of power lines in Kansas City, MO.* The meeting was as intense as a cram session before an exam. Gone was the attitude that with just a little more work the health issue would be settled and resistance to new transmission lines would evaporate.

"Everybody is getting the message that the problem needs to be looked at," DOE's Ken Klein said during a coffee break. Another longtime observer, who preferred anonymity, agreed: "They've pulled their heads out from the sand. Savitz has shocked them."

Only a year ago, at the last DOE-EPRI review, Dr. David Savitz had announced support for the proposition that extremely weak 60 Hz magnetic fields increase the risk of cancer among children. Although Dr. Nancy Wertheimer and Ed Leeper's original study was eight years old and had since been reinforced by a second study, Savitz's results somehow tipped the balance and everything changed. This year in Kansas City, some people were even talking about being in the post-Savitz era.

Any hopes that further analysis of his data would lead Savitz to change his conclusions were dashed when he announced that the association was now stronger than he had previously reported and that he could not find any "variable X" which could explain away the results (see p.4).

This new awareness has not translated into increased government support, however. Money is still tight and those researchers who have managed to stay in business up to now are no more optimistic about the future. Indeed, the DOE's 1988 budget is *down* 15% from its 1987 level to $2.2 million – and that's without possible losses due to across-the-budget cutbacks mandated by the Gramm-Rudman law or by some other belt-tightening federal budget compromise. Other sources, such as the U.S. Environmental Protection Agency (EPA) and the New York State Power Lines Project, have completely dried up.

Only EPRI has pledged new money – $3.2 million for 1988, a 15% increase over last year. And, what's more, Dr. Leonard Sagan, EPRI's point man for the utilities, does not feel constrained by his budget. It could grow larger, he said.

Much of this money will support ongoing work, but EPRI has also initiated a new basic science program. And everybody has been waiting to find out who will be among the lucky few to start new research projects; only three of the 16 proposals will be funded. Each will get support for three years – which is a long time these days.

The ability to pursue an interesting result or to follow a hunch is a rare luxury in this field. The audience greeted Dr. Reba Goodman with a roar of approval when she digressed from her talk to remind those with the money that, "It takes two to five years to get results. Two years is not enough. We need long-term funding."

Without a doubt, it will take some time to sort out how such weak fields can cause such dramatic effects. The latest clue – Drs. Craig Byus and Ross Adey's finding that certain types of cellular activity can go into overdrive in a 60 Hz field (see p.3) was much discussed – especially since an AP report on their work was picked up by local newspapers across the country the day before the meeting.

The media are definitely onto the power line story. A reporter from a Houston, TX, television station was filming interviews in the hall outside the meeting room. And a favorite topic of conversation during the breaks centered around the proposed ABC *World News Tonight* segment on the power line controversy. (It was subsequently broadcast on November 9 – see p.6.)

Less clear is how the government will respond to public concern. The October 6 Congressional hearings came too late in Washington's budget cycle to change research agendas. It is highly unlikely that any agency will initiate regulatory action because, as EPA's Dave Janes pointed out, no single agency has been officially charged with addressing the issue. "The responsibility is too diffuse," he said.

Any agency official who musters the courage to tackle the problem will have to decide how to handle the Wertheimer-Leeper and Savitz results, which implicate 60 Hz fields on the order of a few milligauss – this is a daunting prospect for any bureaucrat who is attached to his job. Dr. Barry Wilson of the Battelle Pacific Northwest labs tried to get people to focus on the implications of the epidemiological data. "What would be the response if it turns out that David Savitz's work is true?" he asked. *No one* volunteered an answer.

Wilson's question is still an academic one to some – but not to the regulators in Florida, who in the next few months may set standards for allowable exposures along power line rights-of-ways. Utilities will be watching public reaction to this forthcoming proposal closely, because if Florida citizens demand a strict cancer-based standard, it will spell trouble for the industry as a whole.

*The Department of Energy (DOE) and Electric Power Research Institute (EPRI) *Review of Research on Biological Effects from Electric and Magnetic Fields, Air Ions and Ion Currents Associated with High Voltage Transmission Lines*, Kansas City, MO, November 2-5.

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New and Forthcoming Papers on Bioeffects and Health

Byus & Adey: ODC and Cancer Promotion

Tumor cells exposed to weak electromagnetic fields (EMFs) show a marked increase in the activity of a key enzyme related to cell growth, according to studies by Drs. Craig Byus and Ross Adey. "Our experiments are consistent with the epidemiological data showing increased cancer rates due to exposure to power line fields," Byus told *Microwave News* from his office at the University of California at Riverside. Adey is at the VA hospital in Loma Linda, CA.

In a paper published in the October issue of *Carcinogenesis*, Byus and Adey report that EMFs can stimulate the activity of ornithine decarboxylase (ODC). Because ODC is essential to the growth of cancer (as well as normal) cells, the findings are consistent with the hypothesis that 60 Hz EMFs can promote cancer.

If rapidly growing cells show a burst of ODC activity, this is not necessarily an indication of cancer promotion. Many other factors can stimulate ODC synthesis. Dr. David Carpenter of the New York Department of Health, who served as the executive secretary of the New York State Power Lines Project, explained in an interview with *Microwave News* that the hypothesis is a good one, but to be totally convincing, there must be cancer at the end point, not just ODC activity. He argued that the experiment that needs to be done is one in which a leukemia-prone strain of animals is exposed to EMFs, in order to see if the leukemia rate increases.

Among Byus and Adey's key experimental findings were:

- ODC activity remained elevated up to four hours after EMF exposure stopped before later returning to normal. For one cell line (P3 mouse myeloma cells), there was no EMF effect after a one-hour exposure, but, without any further exposure, ODC activity increased to 175% of that in controls two hours later.
- A "power window" was observed in Reuber H35 hepatoma cells. A 10 mV/cm 60 Hz field induced a nearly 50% increase in ODC activity, but a 5 mV/cm field caused only a very slight increase and a 1 mV/cm exposure had no effect. A 0.1 mV/cm field induced a significant 30% increase, however.
- All cell lines tested responded to the field – though to slightly different degrees.
- H35 cells exposed to 60 Hz EMFs continuously for three hours manifested a see-saw effect in ODC activity. One hour after exposure, ODC activity was up; an hour later, activity returned to baseline levels; and another hour later, it was less than in controls. One possible implication of this finding is that, if EMFs are in fact cancer promoters, intermittent exposure to 60 Hz fields may entail a greater risk than continuous exposure.

In a second paper, submitted to *Cancer Research*, Byus and Adey report a similar increase in ODC activity in H35 cells exposed to "athermal" 450 MHz microwaves, modulated at 16 Hz. Here again, the ODC activity persisted for several hours following a one-hour exposure. Microwaves modulated at 60 or 100 Hz had no effect, however. In addition, cells exposed to the microwaves had an enhanced response to a phorbol-ester tumor-promoting agent.

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; Craig V. Byus, K. Kartun, S. Pieper and W. Ross Adey, "Increased Ornithine Decarboxylase Activity in Cultured Cells Exposed to Low Energy Modulated Microwave Fields and Phorbol-Ester Tumor Promoters," submitted to *Cancer Research*. See also *MWN*, July/August 1983.

Milham: Cancer Among Radio Operators

In a new epidemiological study, Dr. Samuel Milham has found that amateur radio operator licensees have a significant excess mortality due to acute myeloid leukemia (AML), multiple myeloma and perhaps certain types of malignant lymphoma. Milham's results will appear in the January 1988 issue of the *American Journal of Epidemiology*.

Following up his 1985 study of members of the American Radio Relay League (ARRL), published in the *Lancet* as "Silent Keys," Milham matched data from the Federal Communications Commission's licensee files with death certificates in California and Washington state. He identified 2,485 deaths between 1979 and 1984 and observed a statistically significant increase in AML – standard mortality ratio (observed/expected x 100) = 176 – a finding consistent with the pattern observed among electrical workers.

Milham, who is with the Department of Social and Health Services in Olympia, WA, and who was the first to report a link between occupational exposure to EMFs and cancer, notes that the death certificates of 31% of Washington state amateur radio operator licensees list occupations with EMF exposures. Job data were not available for the California deaths.

In a telephone interview, Milham told *Microwave News* that analysis of the same data set by license class indicates that novices, who have a limited history of exposure, showed no excess mortality. This finding will be published in a later paper.

Samuel Milham, Jr., "Increased Mortality in Amateur Radio Operators Due to Lymphatic and Hematopoietic Malignancies, *American Journal of Epidemiology, 127*, January 1988, forthcoming. See also *MWN*, July/August 1982, May and July/August 1985 and March/April 1986.

Perry & Pearl: Depression in High-Rise Apts.

If the magnetic fields from distribution lines are strong enough to explain increases in childhood cancer rates, can fields from power lines in high-rise apartment buildings have any health effects? In the January 1988 issue of *Public Health*,

British researchers Drs. Stephen Perry and Laurence Pearl report finding evidence that people living near main electrical supply lines in tall buildings have higher incidences of some types of heart disease and depression.

In the early 1980s, Perry – in collaboration with Dr. Robert Becker's research group at the Upstate Medical Center in Syracuse, NY – reported a tendency towards suicide among those living near power lines. Perry retired from a career as a general practitioner in 1986, and is now pursuing research on power line health effects.

Perry and Pearl selected the hospital records of those who lived in apartment buildings nine or more stories high in the English town of Wolverhampton and then divided them into two groups – those "near" to and those "distant" from the building's power cable. Among the "near" group, there was significantly more "myocardial infarction, hypertension, ischaemic heart disease" (p=0.056) and "depression" (p=0.03), but significantly less "personality defect, anxiety, agitation, young confused" (p=0.026).

For apartments on the same floor of a building in which the power mains were located on one side or the other, magnetic fields were, on average, 1.54 mG higher in the "near" apartments (3.15 mG) than in the "distant" apartments (1.61 mG). The difference was as high as 2.29 mG between apartments that were the closest (3.77 mG) and those that were the farthest away (1.48 mG) from the building's power line. Contrary to some published reports, Perry and Pearl's measurements indicated that magnetic fields were higher on the upper floors, than on the lower floors.

"The findings are not conclusive," Perry and Pearl argue, "but they clearly indicate a need for further investigation with larger samples."

Stephen Perry and Laurence Pearl, "Power Frequency Magnetic Field and Illness in Multi-Storey Blocks," *Public Health, 102*, January 1988, forthcoming. *Public Health* is the journal of the Society of Community Medicine and is published in the U.K. See also *MWN*, December 1981.

Rivas: Effects on the Second Generation

Mice exposed to 50 Hz pulsed magnetic fields (PMFs) over two successive generations showed significant decreases in body weight in the second generation, but not in the first generation, according to a new study from Dr. Jose Delgado's former laboratory in Madrid, Spain.

Dr. L. Rivas and coworkers report that the second generation mice exposed to either 83 μT or 2,300 μT, 5 millisecond PMFs showed significant decreases in weight. Because the difference in the effect at the two exposure levels was small, the team suggests that the strength of the field is "of relatively little importance." They also found significant changes in blood glucose and triglycerides only in the second generation.

Updated Savitz Study: Cancer Link on Firmer Ground

Additional data collection and analysis by Dr. David Savitz have strengthened his finding of a link between exposures to 60 Hz magnetic fields and childhood cancer. The new results, presented at the Kansas City, MO, review of power line health effects on November 4th, have removed some of the earlier ambiguities: the association is now similar for both estimated and measured magnetic fields. Also, Savitz has checked and rejected other variables that could explain away the cancer-power line link.

In his preliminary results, Savitz reported that the increased rate of childhood cancer was significantly associated only with the index devised by Dr. Nancy Wertheimer and Ed Leeper as a surrogate for long-term exposures. The increased cancer risk was more modest and not statistically significant when correlated with instantaneous measurements of magnetic fields – leading some critics to question the reliability of the findings (see *MWN*, November/December 1986).

After tracking down some of the missing exposure data and updating his analysis, Savitz has narrowed the difference to the point that he is satisfied that it is inconsequential. The association with measured magnetic fields is still not statistically significant – due to the small number of cases. But, as Savitz said in an interview with *Microwave News*, "The discrepancy is no longer worth sorting out."

Savitz found only a weak association between measured magnetic fields and cancer when he used a 2 mG threshold for classifying the 60 Hz exposed group. When he changed the cutoff to 3 mG, the childhood cancer risk became "notably larger," though less precise, again due to the limited sample size.

Some reviewers have suggested that air pollution from vehicular traffic along major arteries which are also routes for high current distribution lines may explain the observed cancer link. In Kansas City, Savitz said that he had now examined this possibility and concluded that traffic density is not a confounding variable.

Savitz also reported that he could discern no evidence of a dose-response relationship between cancer incidence and the length of time lived near a high current power line. Dr. Nancy Wertheimer told *Microwave News* that she is "not especially surprised" by this finding, "because we are probably dealing with cancer enhancement, rather than initiation. Our and Savitz's data are both consistent with the hypothesis that the effects of the fields are fast acting."

Savitz, who is with the University of North Carolina School of Public Health in Chapel Hill, and his coauthors have submitted their results to the *American Journal of Epidemiology*.

No effects were observed on serum proteins and cholesterol.

Rivas concludes that his results are consistent with previous studies by Drs. Andrew Marino and Robert Becker and that, though they may be due to a cumulative PMF effect, they are "more probably" due to a "genetic influence on the exposed animals."

L. Rivas, M.A. Oroza and J.M.R. Delgado, "Influence of Electromagnetic Fields on Body Weight and Serum Chemistry in Second Generation Mice," *Medical Science Research, 15*, pp.1041-1042, 1987. See also *MWN*, March/April 1986.

Recently Published

• Dr. Nancy Wertheimer and Ed Leeper have extended their analysis of cancer incidence among adults living near high current power lines (see *MWN*, January/February 1983). Their paper, "Magnetic Field Exposure Related to Cancer Subtypes," appears in the *Annals of the New York Academy of Sciences, 502*, pp.43-54, 1987.

• The Battelle studies on the developmental and reproductive effects of multi-generational exposure of miniature swine and rats to 60 Hz electric fields are reported in two papers in the most recent issue of *Bioelectromagnetics (8*, pp.229-242 and pp.243-258, 1987, and see *MWN*, March/April 1986).

• Three recent papers on cyclotron resonances of calcium ions by Drs. Bruce McLeod and Keith Cooksey of Montana State University in Bozeman, Dr. Stephen Smith of the University of Kentucky in Lexington and Dr. Abe Liboff of Oakland University in Rochester, MI, have been published: two papers, one on diatoms and one on lymphocytes, in the *Journal of Bioelectricity, 6*, pp.1-12 and pp.13-22, 1987; and another on diatoms in *Bioelectromagnetics, 8*, pp.215-227, 1987.

• Dr. Philip Landrigan of the Mount Sinai School of Medicine in New York, NY, includes a discussion of "Leukemia and Electromagnetic Fields" in his paper on "Occupational Leukemia," appearing in *Occupational Medicine: State of the Art Reviews, 2*, pp.179-188, January-March 1987.

Florida Report Out; Court Ruling Makes Standards Moot

As the Florida Department of Environmental Regulation (DER) entered the final stages of rulemaking for power line electromagnetic fields (EMFs), a state court of appeals ruled that exposure standards are not legally required.

The EMF rules have been under development since early last year, after the Florida Siting Board denied the Florida Power Corp. a permit to build a 500 kV line without exposure standards (see *MWN*, March/April 1986). In 1983, the state legislature ordered EMF standards, but they were stalled by a lack of both funds and expertise within the DER (see *MWN*, July/August 1983 and July/August 1984).

In early October, the Florida EMF Advisory Panel, which was set up to guide the DER, recommended maximum EMFs at the edge of a right-of-way of 1-2 kV/m and 50-100 mG for the electric and magnetic fields, respectively. The panel noted that the DER set only "interim" standards – to be reevaluated in no more than three years. (The full text of the panel's recommendations is reprinted below.)

Then, on October 8th, the Florida Court of Appeal (First District) reversed the decision by the state Siting Board – the governor and his cabinet make up the board. In *Florida Power Corp. vs. State of Florida et al.*, the three-judge panel ruled that power lines can be approved without statewide EMF exposure standards, as long as each line is evaluated on a case-

Florida EMF Panel: Recommendations

1. It would be prudent to keep the long-term exposure to the population to low values, by so far as possible routing transmission lines outside of residential areas, and where this is not possible, to limit the magnetic and electric field strengths at the edge of the right-of-way (ROW).
2. There should be an interim standard regulating electric *and* magnetic fields (EMFs). The interim should be for no more than three years. The maximum electric field at the edge of the ROW should be from 1-2 kV/m. The maximum electric field within the ROW should not exceed 8 kV/m. The magnetic field standard for maximum load conditions should not exceed 100 milligauss (mG) at the edge of the ROW while the limit for normal loads should be about 50 mG at the edge of the ROW.
3. It is strongly recommended that the federal government should: (1) adopt standards for electric and magnetic fields so utilities would have consistent standards nationwide, and (2) substantially increase financial support and promote research into the potential health effects of electric and magnetic fields from 60 Hz sources and encourage research into mechanisms for reducing exposures to EMFs.
4. Any state rule adopted should require utilities to design new lines for possible retrofitting of engineered controls to reduce EMFs if research should confirm adverse health effects.
5. Any rule should consider the fact that it is more important to know the effects on humans of fields from transmission lines than the true magnitude of the electric field within the human body. The magnitude of the electric field within a body may be useful in understanding any effects on that body.
6. The potential problem of EMF effects from existing distribution lines and substations should be considered after standards for new facilities are adopted and after scientific knowledge demonstrates a clear health hazard. Placement of distribution lines on clear, dedicated ROWs would allow for better protection of the public, if needed.
7. There appears to be some merit in adopting both electric field standards and magnetic field standards. Electric field standards can reduce the perception effects, shock, tingling or hair vibration, to a tolerable level and keep contact shocks to short-circuit currents to less than 5 mA. Since much research into health effects seems to be concentrated on magnetic fields, a magnetic field standard appears appropriate.
8. Little evidence has been found to indicate any synergistic effects between electric and magnetic fields.
9. The noise of transmission lines as well as mild, nuisance shocks induced by EMFs should be addressed in a rule to protect the public welfare.

ABC News Covers Power Lines

Excerpted below is ABC Television's November 9th World News Tonight *report on the health effects of power lines.*

ABC News:...New York state has spent six years on 16 studies to determine the effect of magnetic fields on human health. The official report concludes up to 15 percent of all childhood cancer could be the result of exposure to magnetic fields. It is the most solid evidence to date according to a top New York state health official.
Dr. David Carpenter: This may be as significant an understanding of the origin of cancer in man in the 20th century as anything that's happened since the understanding that smoking causes cancer.
ABC News: A recent study in Denver found that children who live in homes with higher magnetic fields are twice as likely to develop cancer as those who do not. Dr. David Savitz did the research.
Dr. David Savitz: We looked at the parents' smoking habits and medication use and the family income and we adjusted for a number of those factors and still it didn't explain away the association we saw.
ABC News: Scientists are now trying to pin down exactly what magnetic fields do to the human body. In San Antonio, Dr. Jerry Phillips subjects human leukemia cells to magnetic fields. He says it makes these cancer cells grow faster.
Dr. Jerry Phillips: In our studies we've seen increases in growth anywhere from 2 to 24 fold.
ABC News: So far there is no proven effect on normal cells. But all of this research has the electric power industry scrambling for answers.
Dr. Leonard Sagan: I think there is sufficient reason to conduct research and we're doing so.
ABC News: So is the federal government. Uncle Sam is paying for research at this lab in Kansas City where human volunteers are exposed to the same kind of magnetic fields you find right under power lines. The results show magnetic fields cause the heart to slow down and reduce mental concentration. But the experts disagree over whether enough is known to take action.
Dr. Leonard Sagan: Based on the evidence that exists there is no cause for concern or panic among members of the public.
Dr. David Carpenter: We cannot afford to sit on our duff for another five or ten years waiting for additional research projects to be done without taking some action on this issue.

by-case basis.

The DER's Buck Oven, who is in charge of writing the EMF rules, told *Microwave News* that the decision on whether to issue the rules is now up to the DER's Rule Review Committee, which is made up of the department's senior management. The committee will take up the issue at a meeting in mid-December.

Oven added that the legislature is still on record as desiring EMF standards and that local utilities do want rules adopted.

For a copy of the panel's report, contact: Buck Oven, DER, 2600 Blair Stone Rd., Tallahassee, FL 32301, (904) 487-2522.

EPRI News

The Electric Power Research Institute (EPRI) has produced four videotapes on power line electromagnetic fields (EMFs) and the institute's radiation program: (1) *Electric & Magnetic Fields and Human Health,* 15 minutes, narrated by Dr. Leonard Sagan; (2) *Electric & Magnetic Field Epidemiologic Studies,* 15 minutes, narrated by Robert Black; (3) *Measuring Electric & Magnetic Fields,* 7 minutes, and (4) *Using the EMDEX,* 9 minutes, both narrated by Dr. Stanley Sussman. (EMDEX stands for electric and magnetic field digital exposure – it is a portable dosimetry system.) Copies of the tapes are $50.00 each; tapes 3 and 4 are on the same reel. Order from: Susan Rapone, EPRI, PO Box 10412, Palo Alto, CA 94303.

The cover story in the October/November issue of the *EPRI Journal* is "EMF and Human Health." The same issue also features an editorial by George Hildy, EPRI vice president in the environment division, titled "Field Effects – A Call for Research."

Sagan, who is the manager of EPRI's radiation studies program, is also the author of a new book: *The Health of Nations: True Causes of Sickness and Well-Being,* New York, NY: Basic Books, 233 pp., $19.95.

Utility Survey: ROWs Are No.1

In a recent survey, EPRI member utilities predicted that the siting of transmission line right-of-ways (ROWs) would be their number one environmental issue after 1995. For 1986 through 1995, the utilities ranked ROWs fifth after PCBs, acid rain, hazardous waste disposal and leaking underground storage tanks. When asked to rate environmental R&D concerns, the utilities ranked biological effects of electric and magnetic fields second only to acid rain. These results are cited in the *Ninth EPRI Member Utility Survey Results* (EPRI P-5160-SR), July 1987.

Advisory Subcommittees

EPRI has set up three subcommittees for advice on its radiation studies program. Listed below are the members of

the subcommittees, all of whom serve on the overall radiation studies program advisory committee under the chairmanship of Dr. Gilbert Omenn, the dean of the University of Washington School of Public Health in Seattle.

Basic Sciences Radiation Studies Program: Dr. Martin Blank, Columbia University, New York, NY; Dr. Kenneth Foster, University of Pennsylvania, Philadelphia; Dr. Marvin Goldman (co-chairman), Laboratory for Energy-Related Health Research, University of California, Davis; Dr. Arthur W. Guy, Bioelectromagnetics Research Lab, School of Medicine, University of Washington, Seattle; Dr. Alice Martin, Department of Obstetrics and Gynecology, Northwestern University Medical School, Chicago, IL; John McFeters (utility liaison), Division of Occupational Health and Safety, Tennessee Valley Authority, Muscle Shoals, AL; Dr. Thomas Tenforde (co-chairman), Lawrence Berkeley Laboratory, Berkeley, CA.

Epidemiologic Studies: Dr. A.A. Afifi, School of Public Health, University of California, Los Angeles; Dr. Patricia Buffler (chairwoman), School of Public Health, University of Texas, Houston; Dr. Philip Cole, School of Public Health, University of Alabama, Birmingham; Dr. Robert Hardy, School of Public Health, University of Texas, Houston; Betty Jensen (utility liaison), Public Service Electric and Gas, Newark, NJ; Dr. Carl M. Shy, School of Public Health, University of North Carolina, Chapel Hill.

Exposure Assessment: Dr. Dan Bracken (chairman), T. Dan Bracken, Inc., Portland, OR; Louis Hosek (utility liaison), Public Service of Oklahoma, Tulsa; Dr. William Kaune, National Bureau of Standards, Boulder, CO; Dr. Jim Quackenboss, Division of Respiratory Science, University of Arizona, Tucson; Dr. Howard Wachtel, Department of Electrical and Computer Engineering, University of Colorado, Boulder; John Wilson, Consolidated Edison Co., New York, NY.

Assorted Notes

• The Edison Electric Institute (EEI), based in Washington, DC, is reactivating its electromagnetic fields (EMF) task force. Although formed in 1983, the task force was not very active until last summer, when the Savitz study was released by the New York State Power Lines Project. According to Richard Loughery, manager of EEI's environmental program, the institute is now tracking power line developments very closely and is getting information out to its members – investor-owned utilities. Loughery noted that the institute will not be duplicating the work of the Electric Power Research Institute (EPRI): EEI will be keeping companies up-to-date on new research, media coverage and regulatory and legislative developments.

• Citing the risk of miscarriages, the December issue of *Parents* magazine advises pregnant women to avoid using electric blankets. The short item (p.17) notes that, "Even off, electric blankets may threaten pregnancy," and that mothers-to-be should use down comforters or layers of woolly blankets. *Parents* magazine has a press run of more than two million copies.

• Prompted by the release of both the Savitz study and the New York State Power Lines Project report, the lead editorial in the September issue of *IEEE Spectrum* is on "Electromagnetic Hazards." It endorses continued research and observes that, "Undoubtedly the general press will follow the [New York] study panel's findings with tenacity and some enthusiasm, and, one hopes, with a minimum of 'yellow journalism'."

HIGHLIGHTS

EMI Blamed for U.S. Army Helicopter Crashes

Electromagnetic interference (EMI) was responsible for the crashes of five Black Hawk helicopters – and the deaths of 22 servicemen – since 1982, according to a November 9 report by the Knight-Ridder Newspapers.

U.S. Army officials have denied the charge, as have spokesmen for Sikorsky Aircraft, the manufacturer of the $6 million UH-60 Black Hawk.

The Black Hawk's stabilator, a movable rear wing designed to lift the aircraft's heavy tail automatically, is controlled electronically, rather than mechanically. Some Army accident investigators believe that the logic module which controls the stabilator is vulnerable to EMI from microwave antennas, radar equipment and radio transmitters.

Despite official denials of an in-flight EMI threat, the Army is now shielding the Black Hawks, according to the November 23 *Aviation Week*. The magazine reported that the Army acknowledges that the Black Hawk is susceptible to EMI – but only when it is on the ground.

According to a three-month investigation by Knight-Ridder's Mark Thompson:

• In all five Black Hawk crashes, the aircraft were flying at altitudes below 1,000 feet when they suddenly dove into the ground. The Army blamed the first three crashes on mechanical and human error. The last two incidents are still officially unsolved.

• Army investigators have strongly suspected EMI from the outset. After a Black Hawk crashed near a CB transmitter in March 1986, the Army grounded the helicopters while the cause was sought. Investigators implicated three radiation sources – two microwave antennas and a CB transmitter. They also warned that 40 of the Black Hawk's 42 electronic systems are vulnerable to EMI and that there is a 50 percent chance of future accidents. In fact, four members of the accident board concluded that EMI was the possible initiating cause of the crashes. Jerry McVey, a former Army major who led the investigation, told Thompson, "I was shocked at the lack of shielding."

• Seven weeks after the March crash, the Army allowed the

helicopters to resume operation and officially dismissed the possibility of EMI as the cause of the crash. It also deleted all mention of EMI from the accident report released under the Freedom of Information Act.

- An April 1987 incident, in which a Black Hawk suddenly dove 2,500 feet after flying near "a large electronic tower" in West Germany before the pilots regained control, prompted the Army to run extensive EMI tests at the Naval Air Test Center at Patuxent River, MD. The Army concluded that the Black Hawk is "susceptible but not vulnerable" to EMI.
- The U.S. Navy, which uses similar helicopters called Sea Hawks, banned its first 14 helicopters from flying near radio towers and subsequently shielded them to a much greater degree than the Army's Black Hawks.
- The Navy tested its Sea Hawks with multi-source radiofrequencies (RF) while the Army used only a single-source. The Army said that the Navy's methods were too expensive.

The Army is adding a back-up switch to protect the Black Hawk's hydraulic system, prohibiting any electrical devices from use on board, restricting the speed limit for flights at altitudes below 3,000 feet and warning pilots not to fly near RF emitters, according to *Aviation Week* (November 16).

Record OSHA Fine Cites Lax Radar Testing

On November 4, the Occupational Safety and Health Administration (OSHA) proposed a fine of $4.2 million against the Bath Iron Works (BIW) in Maine – the largest fine against a single employer in the agency's history. Among the hundreds of violations cited by OSHA were eight instances of workers being exposed to radar radiation; these citations carry a total fine of $64,000.

BIW has contested the citations. It will take months to settle the disagreement.

In March 1986, 23 workers claimed that they were overexposed to radar radiation from a U.S. Navy frigate while working in the company's Portland shipyard. Although it was raining on the morning in question, the men reported facial burns, red arms and suntans. BIW denied that the workers had been exposed, and OSHA was unable to show that the radar had been turned on and cited the company only for failing to post a radiation warning sign (see *MWN*, July/August 1986).

The November microwave citations were for "willful violations," which are defined as those in which "an employer either knew that a condition constituted a violation or was aware that a hazardous condition existed and made no reasonable effort to correct it." They were not based on radiation measurements, according to John Chavez, regional director for public affairs with the U.S. Department of Labor in Boston, MA. He explained that OSHA charged BIW with failing to observe its own procedures during radar testing.

Jim Mackie, a union official at BIW, told *Microwave News* that during a tour of the BIW yard, OSHA inspectors noticed that the antennas on top of a ship were rotating, and, on checking further, found that the radars were turned on.

Months after the March 1986 incident, BIW officials issued a report which concluded that, "There is no clear-cut cause which we can find to explain the medical findings nor is there a clear-cut event we can seek to prevent from recurring." Though the report acknowledged that "fire control radars appeared to be the most likely source" of electromagnetic energy, the company maintained that none of the radars were radiating at the time of the incident.

The accident report is undated and unsigned and is not on BIW letterhead. Despite repeated requests from *Microwave News*, BIW representatives never released the report. A copy was made available by a union official, who said the company passed it out to BIW workers during a meeting.

One of the 23 workers, Dennis Brillant, who was operating a crane at the time of the incident, continues to suffer from psychological difficulties. He is still out of work – due at least in part to an apparently unrelated health problem. According to his attorney, John Sedgewick of Lewiston, ME, Brillant has been examined by a neurologist and a neuropsychologist, who both concluded that Brillant's condition appears to be related to radiation exposure.

FCC Proposes Major Changes to Part 15 RF Rules

On October 2, the Federal Communications Commission (FCC) issued its long-awaited proposal for a major overhaul of the Part 15 regulations governing the use of non-licensed radiofrequency (RF) devices. If approved, the rules will allow the FCC to replace its current case-by-case approach with uniform technical standards.

The revision covers both intentional (walkie-talkies, cordless telephones, security devices) and unintentional (VDTs, computers, receivers) radiators and proposes both conducted and radiated emission limits.

The FCC is proposing to allow intentional radiators to be "operated without restriction as to bandwidth, duty cycle, modulation technique or application" from 9 kHz to above 960 MHz, if they meet the designated limits (see Table below). Above 30 MHz, the radiated limits are the same for

Emission Limits for Intentional Radiators

Frequency Band (MHz)	Field Strength (μV/m)	Measurement Distance (meters)
0.009-0.490	2400/f(kHz)	300
0.490-1.705	24000/f(kHz)	30
1.705-30	30	30
30-88*	100	3
88-216*	150	3
216-960*	200	3
Above 960*	500	3

*Limits are identical for unintentional radiators.

intentional and unintentional emitters. Unintentional radiators would face no limits below 30 MHz.

The commission would allow fewer restrictions in some new bands in order "to foster entire new categories of Part 15 devices and to provide major benefits to both manufacturers and consumers." New products might include wireless stereo speakers, VCRs and computers. These new bands are primarily those already allocated to industrial, scientific and medical (ISM) equipment. Other bands (e.g., for safety services) would be prohibited.

For conducted emissions, the FCC is proposing a limit of 250 μV in the 450 kHz-30 MHz band for both intentional and unintentional radiators. The commission has asked for comment on the need for conducted limits below 450 kHz and above 30 MHz.

In addition, the FCC plans to propose measurement procedures for all intentional and unintentional emitters. These will be based on the American National Standards Institute (ANSI) C63.2 and C63.4 standards as well as on current FCC procedures.

The proposal is long and complex and many experts preferred not to comment until they had analyzed it. Some argued that, while the revisions were an improvement over the present hodgepodge, the rules were still too complicated. The comment period has been extended until March 7, with reply comments due on May 9.

Robert Horvitz, executive secretary of the Association of North American Radio Clubs, told *Microwave News* that the proposal would encourage the proliferation of new devices, with the possible result that "local interference in urban areas will drown out the reception of many foreign stations."

For more information, contact: John Reed, Room 7122, Technical Standards Branch, FCC, Washington, DC 20554, (202) 653-6288.

RF Lighting: FCC Drops Radiated Limits Below 30 MHz

The Federal Communications Commission (FCC) has abandoned its 1986 proposal to set limits on radiated emissions below 30 MHz from RF lighting devices. In an October 9 decision, the commission concluded that existing regulations are adequate to protect communications services – even highly susceptible ones such as AM broadcasting and amateur radio – from electromagnetic interference (EMI) from RF lighting. As a result, RF lighting devices will continue to be regulated under the FCC's Part 18 rules for industrial, scientific and medical devices.

Last year, responding to pleas from the National Association of Broadcasters (NAB), the FCC proposed radiated emissions limits, though weaker ones than those requested by the NAB (see *MWN*, May/June 1986).

In a report and order released on November 2, the commission stated that it was canceling its proposal because most radiated emissions below 30 MHz stem from power cords and limits on conducted EMI should effectively deal with the problem, and because it did not know of any EMI incidents, other than those caused by defective devices.

Michael Rau, an NAB staff engineer, told *Microwave News* that the NAB has no immediate plans to petition the FCC to reconsider its decision. He said that there are some technical questions related to measuring radiation from RF lighting devices which must still be settled. When these questions are resolved, the NAB might then ask the FCC to take another look at the problem.

Meanwhile, the FCC said that it will continue to monitor the development of RF lighting. For more information, contact: Liliane Volcy in the FCC's Office of Engineering and Technology, (202) 653-7316.

In our last issue some of the division signs in the 1.2-3MHz and 3-30 MHz bands were inadvertently omitted. Below is the corrected chart.

Canadian General Population & Occupational RF/MW Exposure Limits

Frequency	E_{occup} (V/m, rms)	E_{pop} (V/m, rms)	H_{occup} (A/m, rms)	H_{pop} (A/m, rms)
.01-1.2 MHz	600	280	4.0	1.8
1.2-3 MHz	600	280	4.8/[f]	2.1/[f]
3-30 MHz	1800/[f] or 3120/[$f^{1.5}$]*	840/[f] or 1600/[$f^{1.5}$]*	4.8/[f]	2.1/[f]
30-100 MHz	60 or 20*	28 or 10*	0.16	0.07
100-300 MHz†	60 or 0.2[f]*	28 or 0.1[f]*	0.16	0.07
0.3-1.5 GHz	3.45[$f^{0.5}$]	1.61[$f^{0.5}$]	0.0093[$f^{0.5}$]	0.004[$f^{0.5}$]
1.5-300 GHz†	140	60	0.36	0.16

Pop = general population; Occup = occupational; f = frequency in MHz; E=electric field; H=magnetic field.
* The lower limits apply only when the exposed person is less than 0.1 m from electrical ground; in all other cases the higher limits apply.
† For 100-300 MHz, the power density is 1 mW/cm² for occupational exposure and 0.2 mW/cm² for general population exposure. For 1.5-300 GHz, the power density is 5 mW/cm² for occupational exposure and 1 mW/cm² for general population exposure.

be available in six to nine months.

In our last issue, we published the full text of the testimony of Drs. Robert Becker, Jerry Phillips and David Savitz. Reprinted below are the recommendations Dr. Ross Adey made at the hearing. These are adapted from the conclusions of a draft report prepared by a panel chaired by Adey for the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), which was set up by President Reagan's science advisor in 1984 (see *MWN*, November/December 1985). The panel's report has never been issued.

In other testimony:

- Dr. Leonard Sagan of the Electric Power Research Institute (EPRI) said that the National Cancer Institute (NCI) would be an "appropriate sponsor" of a large epidemiological study of childhood cancer. Sagan also emphasized that EPRI places no constraints on the publication rights of those who are funded by the institute.
- Sheldon Meyers, the director of the Office of Radiation Programs at the Environmental Protection Agency (EPA), said that while more research is needed on the health effects of electromagnetic fields, EPA has no plans in that area.
- Donna Fitzpatrick, assistant secretary of the Department of Energy (DOE), said that the DOE is committed to continued funding of research on the health effects of power line fields.

FROM THE FIELD

Congressional Hearings on the Health Effects of Power Lines

Reprinted below are the "Recommendations" made by Dr. Ross Adey of the VA Hospital, Loma Linda, CA, in his testimony before the House subcommittee on water and power resources on October 6.

A. Steps Towards Implementation of Health Safety Standards

1. There is a growing and even urgent need for early establishment of national safety standards that would govern exposures to non-ionizing EM fields in the workplace, in the home and in the general environment.
2. These standards would be regarded as interim at the time of promulgation, since current epidemiological knowledge and experimental evidence remain incomplete in precisely defining mechanisms of EM field interaction with body tissues and in evaluating the exact role of these EM fields in human disease. Although incomplete, current knowledge may be considered adequate for establishment of interim standards.
3. Interim standards should cover exposures to environmental fields from ELF frequencies (below 300 Hz) to millimeter waves at 300 GHz. For radio and microwaves, an early requirement involves consideration of pulse- or amplitude-modulation of the carrier wave, since these low frequency characteristics of the field largely determine modes of tissue interactions at athermal field levels.
4. Beyond establishment of interim standards, a major new effort will be necessary in reviewing current research developments and incorporating new knowledge into more refined and more comprehensive standards.
5. There is need for an interagency coordinating group with cognizance over the whole spectrum of the national research and regulatory effort. In the past, the Electromagnetic Radiation Management Advisory Council (ERMAC) offered much-needed foci for research planning and dissemination of information. This need is now especially acute, in times of small budgets and restricted funding. Lack of communication between federal agencies and other funding bodies hampers research and enhances risks of duplication of effort.

B. Research Program Priorities and Logistics

1. There is now substantive experimental evidence for significant modulation of physiological functions in the mammalian body from exposure to environmental EM fields at levels below those producing significant tissue heating.
2. Much further research will be necessary to establish the physical nature of mechanisms of interaction, which involve non-equilibrium states and long-range interactions in biomolecular systems. The magnitude of the problem, its importance in the context of human health and disease, and the absence of an adequate national research program at this time all emphasize the urgency of implementing such a program in the immediate future.
3. It will be of the highest importance to ensure appropriate long-term funding of this research, to be conducted on a team basis by appropriately skilled scientists. Failure to institute research programs on this basis will prevent formation of these teams, with inevitable consequences for the quality and timeliness of urgently needed research.
4. There will be a mandatory requirement for close interdisciplinary collaboration between physical and biological scientists if future research goals are to be achieved.
5. Specific research goals include studies of EM field effects on fetal development; responses of the immune system with emphasis on compromised functions that may lead to malignant disease; a search for physical and chemical mechanisms underlying these sensitivities, including the molecular biology of intercellular communication disrupted in cancer promotion; interactions between drugs and cancer-promoting chemicals at cell membranes; and EM field effects on responses of hormonal and neuroregulatory substances in brain tissue relating to biological rhythms and stress responses.
6. Special exposure facilities will be required to evaluate effects of long-term, intermittent exposures in a variety of animal models. These facilities are needed for both low-frequency and radio frequency studies. They should be established as national regional centers.
7. Epidemiological studies will elucidate correlates between EM field exposure and increased risks of disease and teratological problems in fetal development. Epidemiological studies will be most effective when conducted with insights into the mechanistic basis of EM field bioeffects, including responses to long-term intermittent exposures. Epidemiological yardsticks derived from studies of ionizing radiation in cancer offer little in the design and conduct of needed studies in non-ionizing radiation.
8. Implementation of a national research program should take account of administrative experience and mission orientation of those federal agencies with previous commitments to bioelectromagnetic research. Successful program management in this research field requires broad experience in interdisciplinary research between the physical and life sciences, and a keen awareness of current developments at the frontiers of electrical and electronic engineering applications. Those federal agencies already experienced in these sensitive areas of creative interdisciplinary research may merit consideration for continuing lead roles. Agencies with missions restricted to the health sciences and without these broader commitments or appropriate previous experience may constrain the timely and effective development of urgently needed new knowledge.

UPDATES

BIOLOGICAL EFFECTS

Magnetic Field Teratology...A research group from the Canadian Bureau of Radiation and Medical Devices in Ottawa and Bio-Research Labs in Senneville, Quebec, has failed to find major effects of sawtooth magnetic fields on developing rat embryos. The team exposed groups of female rats to 18 kHz fields seven hours a day for 15 days before pregnancy and for 22 days during pregnancy, at three intensities: 5.7, 23 and 66 μT. Speaking at the power line health effects review in Kansas City, MO, on November 3, Dr. Maria Stuchly of the radiation bureau said that the team's working hypothesis was that the induced current (dB/dt) is the crucial variable. At the three exposure levels, the time-rates-of-change of the magnetic field were 0.48, 1.82 and 5.65 T/s, respectively. Stuchly said that when the results were analyzed on the basis of litters, there were no significant effects on the weight of the fetuses, the number of malformations or the number of fetuses per litter. In the group subjected to the highest exposure, there was, however, a statistically significant increase in minor skeletal anomalies – reduced ossification of ribs. Stuchly said that while the experiment was prompted by the Swedish and Spanish teratological studies on mice and chick embryos, which suggested pregnancy risks for VDT operators, she had not attempted a replication of those studies. She told *Microwave News* that by exposing the rats only seven hours a day – in contrast to the 24-hour exposures in the previous studies – she was trying to better simulate the "real life" exposure conditions of VDT workers.

RF Teratology... One of the most intriguing findings in recent years is the report by a team of Italian researchers, led by Dr. Santi Tofani at the Public Health Labs in Ivrea, showing RF teratological effects in rats at *extremely* low power levels – SAR= 1.1×10^{-4} W/Kg (see *MWN*, November/December 1986). Now Drs. Shin-Tsu Lu and Sol Michaelson of the University of Rochester, NY, have expressed their "surprise" at the lack of technical details in the paper. Writing in the November issue of *Health Physics*, they concede that the Tofani paper "may prove to be a landmark observation," and then they outline some of the details they would like explained – e.g., the size of the plastic animal cages and the type of absorbing materials used in the exposure chamber. In a reply, after answering these and other specific questions, Tofani and coworkers conclude, "We want to point out that for the vast majority of people, the exposure to RF and MW fields is a long-term, low-level one to various waveforms that spread over a vast frequency of the spectrum and therefore the determinations of potential biological effects due to exposure to RF and MW have to be seen within this frame. The SAR parameter is not adequate for describing all these exposure conditions. Therefore, the thermal hypothesis may be a misleading prejudice."

COMPATIBILITY & INTERFERENCE

Power Lines and TVI... The Canadian Electrical Association (CEA) has issued a new report – its third – on TV interference (TVI). According to a study by Ontario Hydro, the greatest source of interference from distribution lines is gap discharges from loose pole hardware, either capacitively or conductively coupled to the line voltage. The CEA also tested a new TVI measurement method based on noise amplitude distribution, originally proposed by EPRI in an earlier CEA project, but does not recommend it because of the required sophisticated instrumentation. Instead, the report favors the more commonly used CISPR quasi-peak and rms parameters. A copy of the report, *TV Interference Study on Distribution Test Line*, Project 205 D 406, is available for $35.00 (CEA members), $50.00 (non-members), prepaid from CEA, R&D Division, Suite 500, One Westmount Square, Montreal, Quebec H3Z 2P9, Canada, (514) 937-6181. For more information, contact J.A. Roiz, at the same phone number. See also *MWN*, September/October 1986.

Astronomers vs. Broadcasters... The frequencies once reserved for British radio astronomers have been taken over by broadcasters, according to the October 1 *New Scientist*. Under an international agreement, astronomers are allowed to use 26 frequencies between 37.75 MHz and 49 GHz, but have first choice on only 14 of those. The other 12 have, up until now, been left clear by broadcasters as a "favor." But now that the British government wants to start a fifth television network, broadcasters will need extra channel space. Writer Barry Fox notes that the astronomers have no legal recourse. See also Fox's piece, "Corrupt Power Corrupts Computer Data," in the magazine's October 29 issue.

MEETINGS

A Two-Edged Sword... The Engineering Foundation is sponsoring a week-long conference, *Electromagnetic Radiation: A Two-Edged Sword*, scheduled for March 27-April 1 in Santa Barbara, CA. According to Ron Peterson of AT&T Bell Labs, who is co-chairing the meeting with Dr. Paul Tyler, a private consultant formerly with the U.S. Navy, the meeting was prompted by recent research on power line fields – notably the Savitz study – as well as by work on calcium efflux and other frequency-specific effects. The press release announcing the meeting notes that, "There is a concern that a schism may be developing between some users of electromagnetic energy and a part of the scientific community. This conference has been organized to help bridge that gap...." A similar meeting was held in October 1984 (see *MWN*, April 1984). Attendance, which costs $575-$725, depending on whether one is sharing a room, is by invitation or application only. Peterson said that the meeting will be held only if there is enough interest; he estimated that the minimum attendance would be

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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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.