stock, NY 12498....*Consumer Reports* rates microwave/convection ovens in its September 1989 issue and includes a short section on the safe use of a microwave oven....In her October 4 *New York Times'* column, microwave cooking specialist Barbara Kafka advises her readers to avoid letting plastic wrap touch food during microwave cooking to prevent the migration of possibly toxic chemicals—at least until FDA staffers have completed their investigations....FDA's Ray Walchle has devised an extremely fast AC power interrupter which permits the testing of a microwave oven's interlock circuitry while it operates. A U.S. patent (No.4,825,330), based on Walchle's invention, has been assigned to FDA's Center for Devices and Radiological Health. For more information, contact Walchle at (301) 443-2536....And, after a five-year effort, Hershey Foods, well-known for their chocolate Kisses, will soon start marketing four types of microwave macaroni, according to the October 5 *Wall Street Journal.*

PEOPLE

Now that he has left EPA, Dr. **Richard Phillips** is working part-time for W/L Associates, based in Frederick, MD. He is reviewing DOE-funded projects and helping to assemble an international data base on ELF bioeffects studies for a number of W/L clients. Phillips plans to move to the Pacific Northwest as soon as he can sell his house in North Carolina....**Laurie Geissinger** has left Seattle City Light (SCL), where she was the coordinator of SCL's task force on EMFs and health, to join the city's water department as a water resource planner....**Edwin Bronaugh** has resigned as the technical director of Electro-Metrics to join the Electro-Mechanics Co. (EMCO) in Austin, TX. Bronaugh will continue to serve as a consultant to Electro-Metrics.

STANDARDS

CISPR and ANSI Actions...CISPR has recently published three amendments to its standards: (1) *Organization, Rules and Procedures of the CISPR*, Amendment 3, 1989, CISPR 10: 1981; (2) *Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus*, Amendment 2, 1989, CISPR 14: 1985; and (3) *Limits and Methods of Measurement of Radio Interference Characteristics of Fluorescent Lamps and Luminaires*, Amendment 1, 1989, CISPR 15: 1985. Copies are available for $8.00 each from: Sales Department, ANSI, 1430 Broadway, New York, NY 10018....ANSI and Underwriters Laboratories have approved a revision to a 1983 EMI standard. *Electromagnetic Interference Filters*, ANSI/UL 1283-1989 (revision of ANSI/UL 1283-1983), will be available soon from ANSI.

TECHNOLOGY

Sterilizing with Microwaves... Two NIST researchers have come up with a new way to sterilize medical and dental instruments using gas plasmas generated in a conventional microwave oven. Drs. Waldemar de Rijk and John Tesk found that by heating clinical instruments in a low-vacuum glass container inside a microwave oven, a low-pressure ionized gas is created which destroys microorganisms. The gas plasma also prevents arcing from metal objects, which could damage the oven's magnetron energy source. "We are speculating that the microorganisms are being killed by ion bombardment in the plasma, which 'denatures' or destroys their protein," de Rijk said. A key advantage of the microwave plasma procedure is that it only takes about 30 seconds; traditional sterilization processes—dry heat or steam pressure—can take up to two hours. In addition, repeated applications of dry heat and steam pressure can damage rubber seals and gaskets and dull the cutting edges of some metal instruments. In the past, RF-generated gas plasmas have also been used to destroy organic matter on mirror-smooth surfaces. For more information, contact: Dr. Waldemar de Rijk, A143 Polymer Bldg., NIST, Gaithersburg, MD 20899, (301) 975-6803.

MM Waves Market... Military applications for millimeter (MM) wave systems will be a billion dollar market in the U.S. by next year and a $1.8 billion market by 1995, according to a new report by Frost & Sullivan (F&S). Military programs using MM (30-300 GHz) technology include the Milstar satellite, the multiple launch rocket system, the Maverick missile and airborne radar systems. F&S estimates that the U.S. Air Force, the largest purchaser of MM technology, will spend $630 million in 1989, followed by the U.S. Army at $280 million. Copies of the market research study (No. A2149) are available for $2,600 each from: F&S, 106 Fulton St., New York, NY 10038, (212) 233-1080.

ETC...

Saving the Ozone Layer with RF... Dr. Alfred Wong of the University of California, Los Angeles, believes he can stop the breakdown of the ozone layer caused by chlorofluorocarbons (CFCs) with radio waves. Chlorine atoms destroy stratospheric ozone, but chlorine ions do not. According to the September 16 *New Scientist*, Wong wants to beam up 100 MW of power at 1.5 MHz to generate electrons which will then combine to form unreactive chlorine ions. And there's more. Wong then wants to use RF signals modulated at the ion-cyclotron frequency to force the chlorine ions to spiral down out of the atmosphere.

How *Not* To Avoid Jet Lag...Travelers may be able to escape jet lag by shunning bright light in the morning prior to departure and by basking in afternoon light following arrival. In the September 1989 *Condé Nast Traveler*, two Harvard University sleep researchers suggest wearing "ultradark" sunglasses —or preferably, welding goggles—to screen out the unwanted light. But they add a warning: a colleague who flew into London's Heathrow airport wearing the prescribed goggles was hauled in for questioning by airport security.

ABSTRACTS

ELF Fields and Power Lines

Maria J. Azanza, "Steady Magnetic Fields Mimic the Effect of Caffeine on Neurons," *Brain Research, 489,* pp.195-198, 1989.

Azanza, of the University of Zaragoza in Spain, found that 1,160 and 2,600 gauss static magnetic fields inhibited or excited isolated mollusc neurons by mechanisms which appear to be calcium ion dependent.

Carl F. Blackman et al., "Multiple Power-Density Windows and Their Possible Origin," *Bioelectromagnetics, 10,* pp.115-128, 1989.

In this, the latest paper on their calcium ion efflux studies, Blackman and coworkers at EPA raise the possibility that the effect may occur at levels even lower than have already been observed. They speculate that the extremely sensitive nature of the calcium ion phenomenon "could account for the major discrepancy between the energy present in the effective [EMF] and the energy required to produce the observed biochemical changes."

M.A. Chilbert et al., "Fibrillation Induced at Power Line Current Levels," *IEEE Transactions on Biomedical Engineering, 36,* pp.864-869, August 1989.

This team from the Medical College of Wisconsin and the VA Hospital in Milwaukee induced ventricular fibrillation in hogs using high current (1-50 A) for short periods of time (16 msec to 3 sec).

G. d'Ambrosio et al., "Chromosomal Aberrations in Bovine Lymphocytes Exposed to 50 Hz Electric Currents," *Journal of Bioelectricity, 7,* pp.239-245, 1988-89.

A significant increase in chromosomal aberrations in lymphocytes exposed for 45 hours to electric currents of 1 mA/cm^2 was observed, but not in those exposed to 0.1 mA/cm^2. The Italian researchers conclude that electric fields may act directly on the chromosome structure.

Lawrence J. Dlugosz et al., "Ambient 60 Hz Magnetic Flux Density in an Urban Neighborhood," *Bioelectromagnetics, 10,* pp. 187-196, 1989.

A survey of a Buffalo, NY, neighborhood indicates that "power line magnetic field levels at urban residences can be reliably characterized on a onetime site inspection using a hand-held magnetic field meter and a simple wiring classification system." This supports the findings of Wertheimer-Leeper, Tomenius and Savitz, the researchers conclude. They also observe that the magnetic fields on urban sidewalks and street corners indicate that "substantial exposures during childhood may occur outside the house."

Soheir M. El Nahas and Hanaa A. Oraby, "Micronuclei Formation in Somatic Cells of Mice Exposed to 50 Hz Electric Fields," *Environmental and Molecular Mutagenesis, 13,* pp.107-111, 1989.

Mice were exposed to 50 Hz electric fields at 100, 170, 220 or 290 kV/m for 24 hours. The Cairo, Egypt-based researchers found that at 170-290 kV/m, there was a significant, dose-dependent increase in the number of micronucleated polychromatic erythrocytes. The researchers point out that "positive results of the micronucleus test signal clastogenic and/or spindle toxicity effects. Since most carcinogenic agents are clastogens, a positive clastogenic effect of an ELF electric field raises serious concern about the potential adverse effect associated with non-ionizing radiation."

Robert J. Fitzsimmons et al., "Frequency Dependence of Increased Cell Proliferation, *in Vitro,* in Exposures to a Low-Amplitude, Low-Frequency Electric Field: Evidence for Dependence on Increased Mitogen Activity Released into Culture Medium," *Journal of Cellular Physiology, 139,* pp.586-591, 1989.

This study on cell proliferation and mitogen activity provides new support for a frequency-dependent effect, which peaks at 16 Hz. The authors, among them Ross Adey, are from Loma Linda University, CA, and the neighboring VA Hospital.

E. Gubéran et al., "Disability, Mortality, and Incidence of Cancer Among Geneva Painters and Electricians: A Historical Prospective Study," *British Journal of Industrial Medicine, 46,* pp.16-23, January 1989.

This Swiss epidemiological study found no significant excess among electricians for all cancers or for any type of cancer; overall mortality was similar to what was expected. The researchers note, however, that the statistical power to detect leukemia and brain cancer risks was "low." The job category "electrician" included electricity installers and repairmen, telephone installers, linemen and cable jointers and car electricians. Geneva painters, on the other hand, had significant increases in overall mortality, cancer mortality and cancer incidence.

M. Hultengren and G. Rosén, *Health Effects of Work in the Production and Distribution of Electricity, Part 5: Exposure to Chemical Factors,* Investigation Report 1988: 22; 29 pp., National Board of Occupational Safety and Health, Solna, Sweden (in Swedish).

This is part of a larger study of health hazards among workers in the electrical power production and distribution industries. The authors found that, next to asbestos, the most significant chemical exposures are to solvents—these can be above the threshold limit values (TLVs).

Jukka Juutilainen, *Health Effects of Low Frequency Magnetic Fields: Experiments with Chick Embryos and Measurements in the Environment,* Academic Dissertation, 59 pp., 1989.

This paperback volume includes Juutilainen's doctoral thesis and six of his published papers on ELF fields (see, for example, *MWN,* M/J86 and S/O88). A very limited number of copies are available from Juutilainen at the Department of Environmental Sciences, University of Kuopio, PO Box 6, SF-70211, Kuopio, Finland.

Leslie Lamarre, "TLWorkstation: Expert Assistance in Line Design," *EPRI Journal,* pp.32-39, July/August 1989.

An overview of the EPRI software program that can help engineers design transmission lines: the program can calculate EMFs, radio noise and voltage interference, among other tasks.

Robert E. Meyer, Tim E. Aldrich and Clay E. Easterly, "Effects of Noise and Electromagnetic Fields on Reproductive Outcomes," *Environmental Health Perspectives, 81,* pp.193-200, May 1989.

This review of the published data includes discussions of biological mechanisms, exposure assessment and epidemiological research. The authors consider the suspected risks to be "quite low" and to be confounded by chemical exposures such as smoking.

Robert G. Olsen and Mingde Wu, "A Wideband Model for Electromagnetic Interference from Corona on Electric Power Lines," *Radio Science, 24,* pp.340-350, May/June 1989.

This new model from Washington State University in Pullman is the first to agree with experimental data on the frequency range 2-30 MHz, according to the authors. This paper is for the mathematically-inclined.

Michael A. Persinger, "Increased Geomagnetic Activity and the Occurrence of Bereavement Hallucinations: Evidence for Melatonin-Mediated Microseizuring in the Temporal Lobe?" ***Neuroscience Letters, 88,*** **pp.271-274, 1988.**

These results, according to Persinger of Laurentian University in Sudbury, Canada, "suggest that bereavement apparitions are situation-specific hallucinations evoked by microseizures within sensitized temporal lobe structures; the occurrence of these microseizures might be facilitated by suppression in melatonin levels that could accompany sudden increases in geomagnetic activity."

H. Peter Rodemann, Klaus Bayreuther and Gerhard Pfleiderer, "The Differentiation of Normal and Transformed Human Fibroblasts ***in Vitro*** **Is Influenced by Electromagnetic Fields,"** ***Experimental Cell Research, 182,*** **pp.610-621, 1989.**

These Stuttgart, F.R.G., researchers conclude that "the exposure of normal human skin and lung fibroblasts *in vitro* to sinusoidal EMFs [20 Hz, 6 mT] induces the differentiation of mitotic to irreversibly postmitotic fibroblasts. The arising postmitotic fibroblasts are significantly more active with regard to total protein and collagen synthesis than the corresponding mitotic fibroblast populations."

Martin Rosenthal and Günter Obe, "Effects of 50 Hz [EMFs] on Proliferation and on Chromosomal Alterations in Human Peripheral Lymphocytes [HPLs] Untreated or Pretreated with Chemical Mutagens," ***Mutation Research, 210,*** **pp.329-335, 1989.**

The EMFs did not alter the spontaneous frequencies of sister-chromatid exchanges (SCEs) and of chromosomal aberrations in cultured HPLs, but did lead to an enhancement of cell cycle progression. When the cells were pretreated with chemical mutagens, EMFs led to "significantly higher frequencies of SCEs." The authors caution that more studies are needed before firm conclusions can be drawn about the effects of EMFs.

Koichi Shimizu, Hideto Endo and Goro Matsumoto, "Fundamental Study on Measurement of ELF Electric Fields at Biological Body Surfaces," ***IEEE Transactions on Instrumentation and Measurement, 37,*** **pp.779-784, June 1989.**

Three new techniques for accurately measuring electric fields on biological surfaces—especially under power lines—are detailed.

M.A. Stuchly and D.W. Lecuyer, "Exposure to Electromagnetic Fields in Arc Welding," ***Health Physics, 56,*** **pp.297-302, March 1989.**

Most arc welders use 50 or 60 Hz currents to produce a plasma arc. Users of some of these devices can be exposed to "relatively high magnetic fields"; they entail "high occupational exposures," according to this survey by the Canadian Bureau of Radiation and Medical Devices. The electric field is generally less than 50 V/m. An operator's magnetic field exposure ranges from a few μT to hundreds of μT. The welders also produce transient RF fields, which were not measured in this study.

T.S. Tenforde, "Applications, Dosimetry and Biological Interactions of Static and Time-Varying Magnetic Fields," ***ICRU News, 1/89,*** **pp.17-20, June 1989.**

Battelle's Tenforde briefly reviews the bioeffects of NMRI EMFs and the ELF-cancer literature. He classifies the Savitz epidemiological study as one which shows "no clear relationship" between childhood cancer incidence and 60 Hz magnetic fields. Until now, *ICRU News* was published on an irregular schedule; it will now be issued twice a year.

Nancy Wertheimer and Ed Leeper, and Richard K. Severson et al., "Letters to the Editor, Re: 'Acute Nonlymphocytic Leukemia [ANLL] and Residential Exposure to Power Frequency Magnetic Fields,' " ***American Journal of Epidemiology, 130,*** **pp.423-427, 1989.**

Wertheimer and Leeper argue that taking into account magnetic fields from electrically-heated beds affects the results of the New York State-sponsored adult ANLL study (see *MWN*, M/J88). The Battelle team responds.

Jonathan R. Wolpaw et al., "Chronic Exposure of Primates to 60 Hz Electric and Magnetic Fields: I. Exposure System and Measurements of General Health and Performance; II. Neurochemical Effects; III. Neurophysiologic Effects," ***Bioelectromagnetics, 10,*** **pp.277-319, 1989.**

This research, sponsored by the New York Power Lines Project, shows that EMFs can affect the balance of neurotransmitter metabolites in the cerebral spinal fluid of monkeys (see *MWN*, N/D85). Some scientists suggest that this work may explain observed increases in suicide and depression. (See also *MWN*, M/J88.)

John E. Zapotosky, ***ELF Communications System Ecological Monitoring Program: Summary of 1987 Progress,*** **Technical Report E06595-3, Chicago, IL: IIT Research Institute, 78 pp., April 1989.**

The most recent findings from the ongoing program to determine if the U.S. Navy's ELF submarine communications system is having effects on the local ecology in Michigan and in Wisconsin. The report is available from: NTIS, Springfield, VA 22161.

Pulsed Electromagnetic Fields (PEMFs)

A. Cossarizza et al., "[ELF PEMFs] Increase Interleukin-2 (IL-2) Utilization and IL-2 Receptor Expression in Mitogen-Stimulated Human Lymphocytes from Old Subjects," ***Febs Letters, 248,*** **pp.141-144, May 1989; "[ELF PEMFs] Increase Cell Proliferation in Lymphocytes from Young and Aged Subjects,"** ***Biochemical and Biophysical Research Communications, 160,*** **pp. 692-698, April 28, 1989; and "DNA Repair After Gamma Irradiation in Lymphocytes Exposed to Low-Frequency PEMFs,"** ***Radiation Research, 118,*** **pp.161-168, 1989.**

In the first two experiments, these Italian researchers found that PEMFs could affect lymphocyte proliferation. In the third experiment, they found that PEMFs do not "affect DNA repair mechanisms." In all three experiments, they used PEMFs with a pulse duration of 2 msec and a pulse repetition rate of 50 Hz. The peak intensity of the magnetic fields was 2.5 mT, with a time rate of change of 1 T/sec.

W. De Loecker, P.H. Delport and N. Cheng, "Effects of Pulsed Electromagnetic Fields on Rat Skin Metabolism," ***Biochimica et Biophysica Acta, 982,*** **pp.9-14, 1989.**

In this effort to understand the mechanism of PEMF interactions, these Belgian researchers found that the fields affect protein synthesis through changes in transport at the cellular membrane and that these changes can be mimicked by varying the composition of the electrolytes in the incubation medium.

J. Leal et al., "Embryonic Development and Weak Changes of the Geomagnetic Field," ***Journal of Bioelectricity, 7,*** **pp.141-153, 1988-89.**

Leal and coworkers in Madrid, Spain, found that the biological response of chick embryos to PEMFs was "linearly related to slight

changes in the values of the horizontal component of the geomagnetic field, especially during the gastrulation phase of the developing organisms." The vertical component of the earth's field was not a factor. The team notes that their findings could explain why different laboratories get different results. (See also *MWN*, J/F87 and M/A88.)

B.F. Sisken et al., "Stimulation of Rat Sciatic Nerve Regeneration with Pulsed Electromagnetic Fields," *Brain Research, 485*, pp.309-316, 1989.

PEMF treatment proved effective in facilitating the regeneration of the nerve. Interestingly, treatment of the animal *prior* to injury also appeared to be effective: "This experiment shows that PEMFs can affect the intact animal and is not solely effective after the infliction of an injury. Furthermore this demonstrates that PEMFs can affect regeneration indirectly, possibly by stimulating growth processes in general." Sisken is at the University of Kentucky in Lexington.

RF/MW Radiation

P.D.C. Brown-Woodman et al., "Evaluation of Reproductive Function of Female Rats Exposed to Radiofrequency Fields (27.12 MHz) Near a Shortwave Diathermy Device," *Health Physics, 56*, pp.521-525, April 1989.

Female rats exposed to 27.12 MHz RF radiation prior to mating showed signs of reduced fertility, although congenital malformations in subsequent progeny were not observed. The authors, who are at the Cumberland College of Health Sciences in Lidcombe, Australia, warn that their results indicate that female operators of diathermy units—particularly physiotherapists—may experience reduced fertility if they remain close to the consoles for prolonged periods of time.

Jin-Yuan Chen and Om P. Gandhi, "RF Currents Induced in an Anatomically-Based Model of a Human for Plane-Wave Exposures (20-100 MHz)," *Health Physics, 57*, pp.89-98, July 1989.

This is the latest in a series of papers by Gandhi's group at the University of Utah which are forcing a reevaluation of RF health risks and exposure standards (see *MWN*, J/A85 and J/A86). Using a computer model, the researchers found that RF currents of 600-800 mA can be induced "over much of the body" for E-polarized fields on the order of those suggested by the 1982 ANSI safety guidelines.

Robert F. Cleveland, Jr., and T. Whit Athey, "Specific Absorption Rate (SAR) in Models of the Human Head Exposed to Hand-Held UHF Portable Radios," *Bioelectromagnetics, 10*, pp.173-186, 1989.

Using models of the human head composed of materials that simulate bone, muscle and eye tissue, Cleveland, of the FCC, and Athey, of the FDA, calculated SARs induced by hand-held transceivers transmitting in the 800 MHz band. Their results indicate that—in addition to power and frequency—the two significant factors affecting the magnitude and distribution of SARs are "radio and antenna position relative to the head" and the "type of antenna used and location of its feed-point."

Andrew Cutz, "Effects of Microwave Radiation on the Eye: The Occupational Health Perspective," *Lens and Eye Toxicity Research, 6*, pp.379-386, 1989.

Cutz, of the Canadian Centre for Occupational Health and Safety, presents an overview of both thermal and non-thermal effects of MW exposures on the eyes. He notes that the effect of "long-term, low-intensity MW exposure on the human lens is poorly understood." This review, which is part of the proceedings of the *1st Congress of the International Society of Ocular Toxicology*, includes 23 references.

V. Delpizzo, "A Survey of Shortwave and Microwave Diathermy Devices," *Radiation Protection in Australia, 6*, pp.115-117, October 1988.

Delpizzo's survey indicates an absence of MW, as opposed to SW, diathermy units—which conforms to the prevailing view among physiotherapists that MW devices are potentially more hazardous and less effective. He notes that very few doctors use diathermy: "It is doubtful that [they] have adequate understanding of the properties, effects and hazards of SW and MW radiation." A number of users reported "adverse effects." For the most part, the injuries were minor and reversible.

***Christopher J. Gordon*, "Effect of Radiofrequency Radiation Exposure on Thermoregulation," *ISI Atlas of Science: Plants and Animals, 1*, pp.245-250, 1988.**

In this paper, Gordon considers only the potential *thermal* effects of RF radiation exposures. He proposes that, if the results of certain studies of experimental animals can be extrapolated to humans, the SAR for hazardous thermal effects may be much lower than the recommended standard of 0.4 W/Kg. Gordon points out that the data base on the thermoregulatory effects of RF radiation appears to be insufficient to develop totally safe exposure guidelines for the general population and he calls for further research. (See also *MWN*, J/A87.)

Kenneth Joyner, "Possible Adverse Thermal Responses in Operators of Radiofrequency Dielectric Heaters," *Radiation Protection in Australia, 6*, pp.107-114, October 1988.

Using a computer model, Joyner found that operators of unshielded industrial RF equipment who are exposed to whole body SARs of 4 W/Kg may experience increases in core blood temperatures of more than 2°C when the air temperature is greater than 30°C, as well as significantly increased cardiac outputs. These effects could be detrimental to pregnancy outcomes. Joyner also reviews some data from one factory using RF machines. He observes that "there is circumstantial evidence to support the premise that pregnant women or women of childbearing age who operate industrial RF (10-50 MHz) devices may be at risk if those devices emit excessive leakage radiation."

***Kenneth Joyner, Paul Copeland and Ian MacFarlane*, "An Evaluation of a Radiofrequency Protective Suit and Electrically Conductive Fabrics," *IEEE Transactions on Electromagnetic Compatibility, 31*, pp.129-137, May 1989.**

The authors, who are with Telecom Australia Research Labs, describe measurements of the shielding effectiveness of a protective suit in the frequency range 200 kHz to 4 GHz—the suit was originally designed to guard against 50/60 Hz fields. They found that the suit caused a resonant enhancement in the head of the model at 3.5 GHz and that it provided no attenuation for magnetic fields at frequencies below approximately 4 MHz. (For other reports on protective suits, see *MWN*, D81 and N/D87.)

Clifford L. Mitchell et al., "Results of a United States and Soviet Union Joint Project on Nervous System Effects of Microwave Radiation," *Environmental Health Perspectives, 81*, pp.201-209, May 1989.

Reported here are the findings of duplicate experiments conducted at the same time at NIEHS in the U.S. and—by Dr. Mikhael Shandala's group—at the Marzeev Research Institute of General and Communal Health in Kiev, U.S.S.R. (see *MWN*, J/A82 and S83). In both studies, male rats were exposed to 10 mW/cm² 2.45 GHz MWs for seven hours. Behavioral, biochemical and electrophysiol-

ogical measurements were made during or immediately after exposure. Some of the effects observed in one study differed from those observed in the other study.

J. Toler et al., "Long-Term Study of 435 MHz Radiofrequency Radiation on Blood-Borne End Points in Cannulated Rats, Part I: Engineering Considerations; Part II: Methods, Results and Summary," *Journal of Microwave Power and Electromagnetic Energy, 23,* pp.95-104 and pp.105-136, 1988.

Toler and colleagues at the Georgia Institute of Technology and at Emory University, both in Atlanta, exposed 100 adult male rats to a 1 mW/cm^2 pulsed 435 MHz field (1 μsec pulse width, 1 kHz pulse repetition rate) for 22 hours a day, seven days a week over six months—the whole-body SAR varied from 0.04 to 0.4 W/Kg, with a mean of 0.3-0.35 W/Kg. A large number of hormonal, hematological and cardiovascular end points were monitored. The authors conclude that, "Chronic exposure to the low-level, pulsed field resulted in no adverse effects on animal health, as measured by the spectrum of blood-borne end points," and that there was no evidence that the RF environment is "a source of subtle environmental stress." These results are consistent with those from Dr. Bill Guy's lab at the University of Washington in Seattle. Like Guy's study, Toler's was supported by the U.S. Air Force. Toler has now begun a new study to investigate the possible RF-cancer link raised by Guy's study (see *MWN*, J/A84 and Mr85).

VDTs

Kari Jokela, Juha Aaltonen and Ari Lukkarinen, "Measurements of Electromagnetic Emissions from Video Display Terminals at the Frequency Range from 30 Hz to 1 MHz," *Health Physics, 57,* pp.79-88, July 1989.

This group from the Finnish Centre for Radiation and Nuclear Safety in Helsinki measured the ELF and VLF fields from Amstrad, Digital VT, IBM AT and Salora VDTs. The ELF fields were greater than the VLF emissions: at 30 cm, the Amstrad had a field of 7.2 mG (0.72 μT) and the IBM color monitor had a field of 5.3 mG. The IBM unit had the highest VLF field—1.4 mG. (All are rms values.) The authors note that the fields decrease by a factor of 2.5-3.5 at 50 cm, which they call "a more realistic distance when considering actual working conditions."

J.G. Llaurado, "Spontaneous Abortion and Visual Display Terminals (VDTs)," Commentary, *International Journal of Biomedical Computing, 24,* pp.73-78, 1989.

A review of the latest developments in the VDT-pregnancy effects debate.

General Interest

E.C. Field, Jr., et al., "An Aerostat-Supported ELF/VLF Transmitter," *Radio Science, 24,* pp.235-246, March/April 1989.

Kaichi Maeda and Joseph M. Grebowsky, "VLF Emission Bursts in the Terrestrial and Venusian Nightside Troughs," *Nature, 341,* pp.219-221, September 21, 1989.

Walter Olson, "The Case Against Expert Witnesses," *Fortune,* pp.133-138, September 25, 1989.

Howard Rasmussen, "The Cycling of Calcium as an Intracellular Messenger," *Scientific American, 261,* pp.66-73, October 1989.

Letters to the Editor

To the Editor:

I would like to add a note to the ongoing discussion of 60 cycle magnetic fields present around household equipment. The small (six-inch) personal fans, which are commonly used on desks or bedside stands, project considerable AC magnetic fields. These magnetic fields range from several gauss at the fan motor housing to several milligauss at distances of two to three feet away from the fan. My son was using one of these fans on his bedside stand, and I measured an rms 60 cycle magnetic field of 5 mG on his pillow. The measurements were made with an rms milli-gaussmeter manufactured by my company.

Dr. Roger Hastings
Electro-Magnetics Design, Inc.
Burnsville, MN
September 5, 1989

To the Editor:

With regard to your article on "Australians Take Cancer Risks Seriously" [see *MWN*, M/J89], I feel that I have been misinterpreted in the headline "Call for a 15-30 mG Magnetic Field Limit." The discussion I presented was not a call for a 15-30 mG limit for ELF magnetic fields but rather was what I thought was a reasonable approach to the siting of high voltage power lines.

I would very much appreciate you reproducing the relevant paragraph so readers can draw their own conclusions:

> Epidemiological studies by themselves do not prove a case—epidemiological data must be consistent with experimental data and it must be stressed that no cause-effect relationship has been established between ELF magnetic fields and cancer. However, whilst the research work is continuing, an approach to deal with the dilemma which could be adopted embraces the principle of equipartition of risk. That is, no group in the community should be exposed to environmental levels of ELF magnetic fields significantly in excess (<2) of those already experienced by other groups in the community. Basically what this means is that as the ELF magnetic field levels from existing installations are from 15 to 30 mG then no new installations should increase this level significantly. In addition, siting criteria for high voltage transmission lines and building development should take into account the numbers of people that will be exposed and attempt to minimize that number.

Dr. Ken Joyner
Head, Electromagnetic Compatibility Section
Telecom Australia—Research Laboratories
Clayton, Victoria
September 4, 1989

FM Radiation-Leukemia Link Alleged

In September, the widow of an FM radio technician who died of leukemia settled with Collins Radio Co. for what Stuart Lemle, one of her attorneys, called a "substantial" amount. In her suit, Marie Lafferty claimed that Collins had failed to protect her husband from, or warn him against, the health risks associated with exposures to RF radiation (see *MWN*, M/J86).

Lemle, who is with the Washington, DC, firm of Land, Lemle & Arnold, refused to disclose the precise terms, but described the settlement as "considerably more than nuisance value." Mrs. Lafferty was also represented by C.V. Reynolds of Prestonsburg, KY. Reynolds handled Mrs. Lafferty's workers' compensation claim, which was settled at the same time.

Linda Hopgood of Clark, Ward & Hopgood in Lexington, KY, who represented the defendants, refused to comment on the case.

William Lafferty worked as a radio technician at Prestonsburg's WQHY-FM for 22 years, maintaining and repairing transmission equipment, which was manufactured by Collins Radio Co., then a subsidiary of Continental Electronics Manufacturing Co., Inc.—both in Dallas, TX. Collins was later bought by Rockwell International, which, in June 1988, was brought into the suit. Continental settled separately with Mrs. Lafferty in 1988 for an undisclosed amount.

In 1983, Mr. Lafferty began to complain of health problems, including a "burning or boiling sensation internally and on the surface of his skin," Mrs. Lafferty told *Microwave News*. In July of that year, he was diagnosed as having acute myelomonocytic leukemia. He died a month later at the age of 41.

On May 1, 1986, Mrs. Lafferty filed a civil suit against Collins and Continental in Kentucky's Floyd Circuit Court, alleging that WQHY's antenna and transmitter did not have "adequate safeguards to protect persons situated in close proximity from exposure to high levels of [RF] radiation."

A radio engineer familiar with the operation of the station gave a deposition stating that the RF generator at the base of the radio tower was leaking RF radiation, due to ineffective shielding on the door, according to Lemle. The engineer also claimed that safety devices could have been installed.

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Among the expert witnesses were Dr. Arthur Frank of the University of Kentucky in Lexington for Mrs. Lafferty, and Jules Cohen and Richard Tell, consultants based, respectively, in Las Vegas, NV, and Washington, DC, for the defendants.

AM Station's Neighbor Settles Suit

Another wrongful death suit was settled in August by Thomas DiLuzio, a Spokane, WA, widower who claimed that his wife's death had been caused by chronic overexposure to RF radiation from a nearby AM radio transmitter station operated by KGA-AM (see *MWN*, S/O86).

As in the Lafferty case, the terms of this settlement are confidential, according to Robert Greer, one of DiLuzio's attorneys—though there is some disagreement as to who requested that the records be kept secret. Greer, who is with the Spokane law firm of Feltman, Gebhardt, Eymann & Jones, said that KGA's attorneys requested a confidential settlement, but KGA General Manager Steve Cody maintained that it was DiLuzio's request. KGA's attorney, Richard Kuhling of Pain, Hamblen, Coffin, Brooke & Miller in Spokane commented that the question of which party called for secrecy is "water under the bridge."

Janice DiLuzio was 39 in 1982 when she was diagnosed as having multiple myeloma. She died three years later. Multiple myeloma—cancer of the plasma cells—is extremely rare among people under 40: in court papers, DeLuzio's attorneys stated that this was "one of the, if not the, earliest reported case" in the U.S.

In 1972, the DiLuzios and their two children moved into a house approximately 600 feet northwest of KGA's 50 kW AM radio transmitter tower. Their home was in the path of the transmitter's 1,510 kHz directional signal used at night, according to the complaint.

The DiLuzios and others in the neighborhood experienced significant interference with TVs, radios, telephones and other household appliances. In fact, the signal in the community was reportedly so strong that chain-link fences and metal objects inside homes could act as radio receivers.

Mr. DiLuzio filed a wrongful death claim against KGA in July 1986 in the Superior Court for Spokane County, charging the radio station with failing to warn his family and other residents in the neighborhood of the dangers of chronic RF exposure. He also claimed that his children were being exposed at their elementary school, which was located less than 200 feet from the tower on land originally owned by KGA.

KGA's Cody told *Microwave News* that the day he learned of the lawsuit, he hired a consultant to measure the RF fields. "We were well below the ANSI standard," he said, referring to the 1982 guidelines adopted by the American National Standards Institute (ANSI). "If we had been over the ANSI limits, I would have pulled the plug immediately," he added.

Although the DiLuzio case has been settled, the community's problems with KGA continue. A neighborhood commit-

tee which was organized to force the radio station to move to a less populated area is now circulating a petition which states that KGA's broadcast towers may pose a "significant long-term health hazard" to the children at the nearby elementary school and to residents in the surrounding area. The petition also requests the Federal Communications Commission (FCC) to refuse to renew KGA's license until it relocates. According to Cody, relocation is "not a viable option at this time."

In 1988, a team from the Environmental Protection Agency (EPA) and the FCC reported that RF radiation levels from a number of AM stations near the school were far below those specified by ANSI—though it acknowledged that "levels far below the ANSI guide can cause annoying RF shock/burns" (see *MWN*, J/A88).

FM Radio-Cancer Suit Readied for Trial

Beryl and Maelma Main, who own a square dance camp next to the former site of an FM radio transmitter, are suing the owner of KYGO for compensatory and punitive damages, claiming that its "extremely high and unreasonably dangerous levels of RF radiation" caused Beryl to develop non-Hodgkin's lymphoma. A trial date has not yet been set.

In an August 1988 complaint filed in U.S. District Court in Colorado, the Mains are seeking damages from Jefferson-Pilot Broadcasting, Inc., the owner and operator of KYGO. Before the station moved in 1987, KYGO's transmitter was located on Lookout Mountain above Denver, CO.

"We have a very strong case," Bruce DeBoskey, the Mains's attorney, told *Microwave News*. "No risk factors other than RF radiation are involved." DeBoskey is a partner with Silver & DeBoskey in Denver.

Jefferson-Pilot is represented by Geoffrey Race of the Denver law firm of Weller, Friedrich, Ward & Andrew. Race did not respond to a call for comment.

For four months each summer since 1977, the Mains have run the square dance camp on Lookout Mountain within 100 feet of KYGO's tower. In February 1986, when he was in his mid-50s, Mr. Main was diagnosed with cancer. Later that year, an EPA-FCC survey identified RF hot spots up to 10.35 mW/cm^2 in publicly accessible areas near the base of KYGO's tower and up to 300 $\mu W/cm^2$ on the camp's patio/deck (see *MWN*, M/A87).

Following the release of the survey data, KYGO agreed to reduce its power output from 100 kW to 1 kW and to limit radiation levels to 10 $\mu W/cm^2$ on camp property (see *MWN*, M/J87). KYGO subsequently moved its antenna and transmitter.

Drs. Robert Becker of Lowville, NY, and Andy Marino of LSU Medical Center in Shreveport, LA, are expert witnesses for the Mains. Jules Cohen of Washington, DC, Dr. Don Justesen of the VA Hospital in Kansas City, MO, Dr. Carl Sutton of the VA Hospital in Milwaukee, WI, and Dr. Paul Tyler of Potomac, MD, are testifying for Jefferson-Pilot.

Family Sues Nearby FM Radio Station

In November, a Santa Rosa, CA, family will go to court to try to recoup expenses incurred in a successful fight to force KVRE-FM's radio antenna to be moved from a site within 200 feet of their home. Sue and Jack Kantor, who filed suit in September 1987, are also seeking $500,000 in damages from KVRE and the city of Santa Rosa—which issued KVRE's permit. The Kantors claim that KVRE transmissions caused health problems for their son and potential health hazards for the rest of the family.

"It was a real nightmare for two years, but we finally got the station to leave," Sue Kantor told *Microwave News*. "I'm just hoping that we'll get our money back." She estimates their overall expenses at more than $128,500. John Flitner of the Santa Rosa law firm of Monroe, Flitner & Nellessen is representing the Kantors.

In 1985, the city of Santa Rosa issued KVRE a permit for a 3 kW FM radio transmitter and a lease for a site adjoining the Kantor's property. At that time, the Kantors had been living in their home for ten years. Soon thereafter, the Kantors' son John, who was then 11 years old and wearing a metal orthodontic device at night, began to experience "severe headaches" on a daily basis.

KVRE's start-up also caused significant TV and radio interference for the Kantors and many of their neighbors. "For years we experienced good TV reception and overnight it disappeared," Sue Kantor said. Like the DiLuzios, the Kantors suffered significant EMI with their household appliances.

In March 1986, KVRE Manager John Detz told the *Press Democrat*, a local newspaper, that the station met "all government regulations" and that the station had tried to solve the community's problems by "installing filters on TV sets and making other improvements."

The land leased to KVRE by the city was actually located in an unincorporated part of Sonoma County. The Kantors argued that the city did not have jurisdiction over the land, had disregarded local zoning rules and had failed to hold public hearings. The Sonoma County zoning board agreed and ordered KVRE to remove its antenna by April 1987. KVRE went off the air in the summer of 1987, according to David Beach of Senneff, Bernheim, Emery & Kelly, who represents the original owners of the radio station. But he said that "KVRE stopped transmitting from the location for reasons unrelated to the litigation."

Despite repeated calls, the Santa Rosa city attorney could not be reached for comment.

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CONFERENCES

New Listings

1990

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

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

April 1-5: **74th Annual Meeting of the Federation of American Societies for Experimental Biology (FASEB),** Washington, DC. Contact: FASEB Office of Scientific Meetings, 9650 Rockville Pike, Bethesda, MD 20814 (see p.8).

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

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

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

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

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

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

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

August 28-31: **7th International Conference on Electromagnetic Compatibility,** University of York, U.K. Contact: Institute of Electrical Engineers, Savoy Place, London WC2R 0BL, U.K., (01) 240-1871, ext. 222.

September 18-21: **3rd Asia-Pacific Microwave Conference,** Sunshine City Convention Center, Tokyo, Japan. Contact: Prof. Yoshiyuki Naito, Chairperson, Technical Program Committee, c/o Business Center for Academic Societies Japan, 3-23-1 Hongo, Bukyo-ku, Tokyo, 113 Japan, (81) 3-817-5831.

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MICRO WAVE NEWS

Vol. X No. 5 A Report on Non-Ionizing Radiation September/October 1990

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Boeing Pays $500,000 To Settle Strom EMP-Leukemia Suit

Medical Program for EMP Workers

In the largest settlement for an electromagnetic field (EMF) injury ever recorded, the Boeing Co. of Seattle, WA, has agreed to pay more than $500,000 to Robert Strom, who claims that he developed leukemia from on-the-job exposures to electromagnetic pulse (EMP) radiation.

In addition, the out-of-court agreement provides for a comprehensive medical program for the approximately 700 Boeing employees who have worked with EMP since testing began in the 1960s. The settlement became final on September 21.

"The total value of the settlement could be well over $1.5 million," Michael Withey of Schroeter, Goldmark & Bender in Seattle, WA, told *Microwave News*. Withey is the lead attorney representing Strom and his wife Barbara on behalf of Trial Lawyers for Public Justice (TLPJ), a nonprofit group based in Washington, DC. "This landmark settlement confirms that electromagnetic radiation is hazardous to the public health and creates a mechanism for proving that fact in future cases," he said.

"It was an incredible victory. We got virtually everything we were hoping to get out of this litigation," Arthur Bryant, executive director of TLPJ, said in a telephone interview.

The class action suit, which was filed in June 1988 in King County, WA, Superior Court, charged that Boeing had long known of the health risks associated with EMP exposure, yet never warned workers or took any precautions to protect them (see *MWN*, J/A88). It further alleged that Boeing,

(continued on p.11)

Federal Health Agencies Put EMFs on Their Research Agendas

Under the prodding of Congress, federal agencies charged with protecting public and occupational health are taking a new look at electromagnetic fields (EMFs). Meetings are being scheduled and research agendas are being revised to address growing public concerns.

NTP Plans $6-10 Million Animal Studies

The National Toxicology Program (NTP) is planning a series of major animal studies on the reproductive, developmental and carcinogenic effects of extremely low frequency (ELF) EMFs. The studies will involve as many

(continued on p.12)

ELF NEWS

« Power Line Talk »

A map that appears to show a clustering of cancer cases in **Guilford, CT**, over the past 20 years, has the town in an uproar. State health officials drew up the map in response to allegations made by **Paul Brodeur** in the July 9 *New Yorker* of an abnormal number of brain tumors and other central nervous system cancers among people living near a substation and power lines (see p.9). When the map made a fleeting appearance at an August 20 public meeting, some town residents were struck by the apparent clustering of cases along the route of a Connecticut Light & Power line coming from the substation. After the meeting the health department refused to release the map, claiming it would violate the privacy of the cancer victims. But a few weeks later, local activist **Bob Hemstock** got hold of a copy when, he says, the department included the map in the literature it was distributing in response to public inquiries. Not surprisingly, within a few days the map made headlines in the local newspapers (for instance, in the October 3 *New Haven Register*). The map does indeed show a pattern of cases on Meadow Street near the substation, as well as one along Long Hill Road, on which, according to Hemstock and confirmed by Northeast Utilities, runs a 13.8 kV line. There are also a number of cases in the area where a 115 kV transmission line crosses Long Hill Road. The health department is now releasing a modified version of the map, indicating only the general locations of the cases. And no one is admitting that the cancer rate is abnormally high in the area. There is "no clustering," maintains Dr. Sandy Geschwind of the state Department of Health Services.

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Denver, CO's new international airport is being held hostage to a power line siting dispute. The line in question, a 16-mile segment of a 230 kV line, runs right through the middle of the airport site. Officials in Adams and Aurora Counties want the Public Service Co. of Colorado to consider burying the line, rather than rerouting it around the airport—the utility's current plan—according to the September 11 *Denver Post*. Burying the line would reportedly cost $100 million, while moving it east of the airport would run about $18 million. An August 21 *Post* editorial praised county officials for their concern over potential EMF health hazards, but pointed out that the proposed route would run through largely vacant farmland: "If millions of dollars are to be spent to eliminate any risks posed by high-tension lines, the money should be used first to bury the miles and miles of existing cable that were strung through residential areas before the potential hazards became known."

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It's no longer possible to deny EMF health risks categorically, according to the 1989 congressional OTA report, but some people disagree. National Cancer Advisory Board member Dr. **Roswell Boutwell** recently testified that "...sufficient scientific literature is available to assess whether exposure to power frequency fields results in the initiation, promotion or progression of cancer, and there is no scientific basis for the assertion that such exposure is associated with any of those effects," as reported in the August 5 *Asbury Park Press*, a New Jersey newspaper. Boutwell testified in May on behalf of **Jersey Central Power & Light** (JCP&L) at a hearing on the siting of a 230 kV line in Middletown, NJ (see *MWN*, J/A89). He was last seen as a utility expert witness in the 1988 Marcy-South case, for which he was paid approximately $75,000 (see *MWN*, N/D88). After a long-drawn-out battle with JCP&L, residents and the township appear to have won. On September 25, JCP&L announced that it is deferring construction of the line until the mid-1990s "as a result of a slowdown in economic activities in the state, compounded by uncertainties resulting from the Persian Gulf crisis."

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Schools may become the next major battlefield in the EMF conflict. As parents learn more about EMF health effects, they are demanding measurements and, when necessary, reductions of EMF levels in classrooms and schoolyards. Conflicts over EMFs in schools are not new. A few years ago, a school district in Houston, TX, forced Houston Lighting & Power to remove a high-voltage transmission line from school property at a cost of $8.6 million (see *MWN*, J/A88). Since then, complaints involving EMFs in schools have been heard around the country. In 1988, California adopted guidelines requiring a minimum distance between schools and power line right-of-ways (see *MWN* M/J88). What *is* new is the coverage of this issue in the popular press. In one of the most widely read articles, **Paul Brodeur** describes how parents have challenged school boards and utilities over "unacceptably" high field levels measured in and around schools (the article appears in the September 25 ***Family Circle***). One of the controversies cited by Brodeur is in Montecito, CA, where school officials have opted for a low-cost way to practice "prudent avoidance" by relocating desks and roping off certain "hotspots" to insure that students are not exposed to levels above 2 mG (see p.8). And in Fountain Valley, CA, field levels in schools were found to range from 2 mG to as high as 130 mG. **Southern California Edison** researcher Jack Sahl thinks such readings may warrant an investigation, and he told the *Los Angeles Times* (September 2) that, "My position would be: Let's find out what's going on here."

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Dr. **John Peters**'s childhood leukemia study results won't be ready until the beginning of 1991 (see *MWN*, N/D89)—contrary to reports in the September 7 ***Science*** that Peters would present results at the October EPRI utility meeting. Peters told us that he definitely won't be finished by October, nor will he

EMFs in the Press

Public interest in possible health hazards from electromagnetic fields (EMFs) continues to intensify. Here is our latest listing of recent articles and letters in the press (see *MWN*, N/D89).

American Health: Paul Raeburn, "The Switched-On House: Concerns Grow About [EMFs] and Household Devices," March....***Barron's:*** John Nicholson, "Rays of Gloom?" (letter to the editor), August 13....***Byte:*** Bill McGinnis, "Of Monitors and Emissions," September....***Columbia Journalism Review:*** Louis Slesin, "Uncovering Radiation: VDT Stories That Still Don't Make the News," July/August....***The Economist:*** "Very Debatable Units," September 1....***Family Circle:*** Paul Brodeur, "Danger in the Schoolyard," September 25....***Glamour:*** "Fast Facts About VDT Dangers," August; Cindi Leive, "Why I Can't Stop Thinking About My Computer," October....***IEEE Spectrum:*** Eleanor Adair, "Nurturing Electrophobia"; Karen Fitzgerald, Granger Morgan, Indira Nair, "Special Report—[EMFs]: The Jury's Still Out, Part 1: Biological Effects, Part 2: Societal Reverberations, Part 3: Managing the Risks," August....***Issues in Science and Technology:*** C.A.L. Basset, "Premature Alarm over [EMFs]," Spring; letters in response, Summer....***Journal of the American Medical Association:*** David Savitz, "Electric Current and Health" (a review of Brodeur's *Currents of Death*), August 1....***The Lancet:*** J.B. Sibbison, "USA: Danger from [EMFs]," July 14....***Maclean's:*** Diane Brady, "Tension in the Air," August 6....***Macworld:*** Jerry Borrell, "Is Your Computer Killing You?" (editorial), Paul Brodeur, "The Magnetic Field Menace," July; letters in response, October....***The Nation:*** David Corn, "I'm Typing as Fast as I Can," July 2; Herbert Kohl, "Screen Test" (editorial), August 27/September 3....***Nature:*** Seth Shulman, "Cancer Risks Seen in [EMFs]," June 7; David Lindley, "Risky Arguments over Cause and Effect," August 9; Seth Shulman, "All Aboard the Bandwagon," August 16....***New Scientist:*** Andy Coghlan and Nina Hall, "How Magnetic Fields Could Upset Your Ions," August 4....***New Woman:*** Sue Browder, "Warning: Your Home May Be Hazardous to Your Health," October....***New York Times:*** Peter Lewis, "Worries About Radiation Continue, as Do Studies," July 8; Natalie Angier, "Rising Incidence of Brain Tumors Is Drawing Attention and Concern," July 31; Peter Lewis, "Of Magnetism and Monitors," August 7....***The New Yorker:*** Paul Brodeur, "Annals of Radiation: Calamity on Meadow Street," July 9....***Science:*** Robert Pool, "Is There an EMF-Cancer Connection?" September 7; "[EMFs]: The Biological Evidence," September 21; "Flying Blind: The Making of EMF Policy," October 5....***Science News:*** Janet Raloff, "EPA Suspects ELF Fields Can Cause Cancer," June 30....***Scientific American:*** Granger Morgan, "Exposé Treatment Confounds Understanding of a Serious Public Health Issue" (a review of *Currents of Death*), April; Tim Beardsley, "Shocking Genes: [EMFs] Stimulate Gene Activity," July....***Time:*** "Danger from a Glowing Screen," June 18; Philip Elmer-DeWitt, "Hidden Hazards of the Airwaves," July 30....***USA Today:*** Rae Tyson, "Questions Raised About Power Lines and Health," March 15....***U.S. News & World Report:*** Marjory Roberts, "Computer Waves," September 10....***Wall Street Journal:*** "Everyday Electric Items Are Causing Concern," September 25....***Washington Post:*** Michael Specter, "Can Human Disorders Flow from Waves of Household Current?" May 7....***Whole Earth Review:*** Robert Horvitz, "Inhabiting the Electromagnetic Environment," Fall....***Woman's Day:*** Mary-Lou Weisman, "Should You Be Worried About Electricity?" May 22.

be ready for the DOE contractors review in November. His team at the University of Southern California is "working feverishly" to complete the data by the end of the year, he said. *Science* is running a three-part series by Robert Pool examining the EMF health effects debate. The second part appeared in the September 21 issue and the third in the October 5 issue.

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Dr. **Philip Cole** may have to revise his often-repeated argument that an EMF-cancer link is unlikely because increases in the power grid over the past few decades have not been matched by proportionate increases in cancer rates. A new paper in the August 25 issue of *The Lancet* shows that cancer rates have been soaring over the past two decades among people over 54. A team of international researchers led by Dr. **Devra Lee Davis** of the Mount Sinai Medical Center reports that over the past 20 years the incidences of brain and CNS tumors, breast cancer, multiple myeloma and melanoma have risen steeply in the U.S., Japan and four European countries. "The changes in many types of cancer are so dramatic and rapid that they cannot be ignored," Davis told the August 24 *New York Times*.

Epidemiology Roundup: Three New Links to Cancer

Leukemia Among Finnish Linemen

Finnish workers with "probable" exposures to extremely low frequency (ELF) electromagnetic fields (EMFs) had a statistically significant 90% increased risk of leukemia, according to a new study by Dr. Jukka Juutilainen and coworkers. For central nervous system (CNS) tumors and acute myeloid leukemia (AML), the risks increased by 30% and 50%, respectively.

Workers with "possible" EMF exposures also had increased cancer risks—40% for all leukemia, 40% for AML and 30% for CNS tumors.

"It's one more paper where an increased leukemia and brain cancer risk was identified," Juutilainen told *Microwave News*. Preliminary results of the study were first presented at a 1987 conference (see *MWN*, M/J87). Juutilainen, of the Department of Environmental Sciences at the University of Kuopio in Finland, recently reported that residential ELF exposures could be linked to early pregnancy loss (see p.6).

Among those who worked in jobs with probable exposures, linemen and cable jointers had the highest incidence of leukemia, while telephone installers and repairmen showed the greatest risk for CNS tumors. The team noted that electricians—a group which in past studies has been identified as having a higher incidence of cancer—did not have an elevated leukemia risk.

"I believe our results show that it is less likely that a confounder—other than EMFs—is responsible, since we found increased risks in a variety of different occupations," Juutilainen said.

The team investigated 25-to-64-year-old male industrial workers in Finland between 1971 and 1980 and grouped them into three exposure categories: "probable," "possible" and "no exposure." The probable exposure group included electrical occupations; the possible exposure group covered jobs in which electric motors or welding are commonly involved.

The results appeared in the *International Archives of Occupational and Environmental Health, 62*, pp.289-293, 1990.

Leukemia Risks for Navy Electricians

U.S. Navy electricians were two-and-a-half times more likely to develop leukemia than were other naval personnel, according to a new study by Dr. Frank Garland and colleagues at the Naval Health Research Center in San Diego, CA. The team called the finding "intriguing in the light of several studies showing an excess risk of leukemia associated with exposure to EMFs."

Garland and coworkers surveyed naval personnel on active duty between 1974 and 1984 and identified 102 cases of leukemia. The elevated risk for electrician's mates was the only statistically significant (though borderline) increase for a specific job category. Electrician's mates, like their civilian counterparts (electricians and electric power linemen, for example), are exposed on the job to EMFs.

Machinist's mates—the group most likely to be exposed to leukemogenic agents such as benzene and related compounds and ionizing radiation—did not show an increased risk.

The team used "person-years at risk"—instead of occupational histories—to calculate incidence rates. One knowledgeable source pointed out that the main weakness of this type of study is that it equates "one person working at a job for four years" with "four people working at that job for one year each"—which may not be the same for calculating exposure-related illnesses.

Garland declined to comment on the study.

The paper appeared in the *American Journal of Epidemiology, 132*, pp.293-303, 1990.

Cancer Among Swiss Railway Engineers

A new study from the University of Bern showed that Swiss railway engineers had significantly elevated mortality rates for blood and lymphatic cancers (see *MWN*, N/D89). A team led by Dr. Christoph Minder of the Department of Social and Preventive Medicine found that railway engineers, who are chronically exposed to ELF fields, had a statistically significant 60-70% increased risk compared with technical personnel and a nonsignificant 40% increased risk compared with workers in the metal construction and machine building industries.

"The results obtained are consistent with the findings of many other occupational studies" showing an increased leukemia mortality link, the team concluded.

Minder and Drs. M. Balli-Antunes and D.H. Pfluger looked at mortality data on male railway engineers for the years 1969 to 1983, noting that the average duration of employment was probably more than 30 years. They estimated that the engineers may have been exposed to magnetic field levels up to 10 G, although no direct measurements were taken.

Their paper appeared in the first issue of the new journal *Environmetrics (1*, pp.121-130, 1990), which is published in Canada.

Conflicting Parental Occupational Studies

Two studies in consecutive issues of the *American Journal of Epidemiology* illustrate the conflicting views on parental occupational EMF exposures and their effects on children.

In the June 1990 issue, Drs. J.R. Wilkins and Vickie Hundley reported a 90% increased risk of neuroblastomas among children of men exposed to EMFs at work. Wilkins, of Ohio State University, and Hundley, of the Ohio state Department of Health, both in Columbus, noted that there is an "apparent consistency" between their findings and those of Drs. Christine Johnson and Margaret Spitz, who in 1985 reported an elevated risk of neuroblastomas among children of men who had prolonged on-the-job exposure to EMFs—particularly electronics workers (see *MWN*, J/A85). Spitz and Johnson later reported a statistically significant increased risk of CNS tumors among children of men employed in jobs involving EMF exposures (see *MWN*, M/A90).

In the May 1990 issue, however, Dr. Greta Bunin and coworkers had reported no significant association between parental occupational EMF exposure and neuroblastomas. Bunin, of the Children's Hospital of Philadelphia, PA, did find a four-fold increase in the rate of neuroblastomas among children of electrical and electronic products assemblers, but it was not statistically significant.

The two papers appear in the *American Journal of Epidemiology, 131*, pp.776-780 and pp.995-1008, 1990. In 1988, Dr. Philip Nasca found no consistent association between parental occupation and CNS tumors (see *MWN*, J/F89).

Savitz and Loomis on Electrical Workers

Drs. Dana Loomis and David Savitz have published their paper showing that male electrical workers had a significantly elevated rate of mortality from brain tumors. There was also a slight increase for leukemia among certain occupational groups, but in general, leukemia was not associated with electrical work.

These results "corroborate reports of increased mortality from brain cancer among electrical workers, but give only

limited support to suggestions of excess deaths from leukemia," they concluded.

Loomis and Savitz, both at the University of North Carolina School of Public Health in Chapel Hill, found that "brain cancer was concentrated among men aged 65 or older, whereas leukemia was associated with electrical work only among younger decedents and those with acute lymphocytic leukemia."

The results have been slightly revised since Loomis and Savitz first reported the findings in 1989 (see *MWN*, N/D89). The paper appeared in the *British Journal of Industrial Medicine, 47*, pp.633-638, 1990.

Wertheimer and Leeper on Breast Cancer

In an August 13 memo, Dr. Nancy Wertheimer and Ed Leeper called attention to data from their original adult-EMF cancer study indicating an EMF-female breast cancer link. Wertheimer and Leeper addressed their memo to researchers who are studying the association between EMF exposure and breast cancer (see *MWN*, N/D89 and J/A90).

They pointed out that their 1982 paper showed a statistically significant increased risk of breast cancer among women who lived near high-current power lines (see *MWN*, J/F83) and, in their 1987 follow-up paper, they showed that the strongest association was seen among women diagnosed before they reached the age of 55 (see *MWN*, N/D87).

See Wertheimer and Leeper's papers: *International Journal of Epidemiology, 11*, pp.345-355, 1982, and *Annals of the New York Academy of Sciences, 502*, pp.43-53, 1987.

Around the U.S.: Litigation & Regulation

EMF Wrongful Death Suit Dropped

On September 11 the mother of a teenage leukemia victim dismissed her wrongful death suit against the Clark County, WA, Public Utilities District (PUD). The suit, filed in June 1990, alleged that exposure to electromagnetic fields (EMFs) at home and at school was to blame for the 1987 death of Ariana Hightower, who had been a student at the Crestline Elementary School (see *MWN*, J/A90).

Between 1982 and 1989, there were seven reported cases of cancer among Crestline students (see p.9). An investigation by the Southwest Washington Health District recently concluded that magnetic field levels at Crestline were similar to those at other schools and were probably not to blame for the apparent cluster.

Clark PUD General Counsel Wayne Nelson said that the dismissal "was voluntary...and presumably reflects their findings that electric and magnetic fields at Crestline School were not significant and were not the cause of the girl's leukemia."

NJ Scraps 200 mG Limit, Opts for ALARA

The New Jersey Commission on Radiation Protection has dropped its proposal to set a 200 mG magnetic field limit at the edge of power line right-of-ways (ROWs), according to Dr. Fred Sterzer, the chairman of the commission's Non-Ionizing Radiation Advisory Committee (see *MWN*, J/A90). Instead, Sterzer told *Microwave News*, utilities will be required to demonstrate to the state Department of Environmental Protection (DEP) that field levels from any new transmission line will be "as low as reasonably achievable" (ALARA).

The commission's new proposal will also prohibit the siting of playgrounds under power lines, and will require warnings to be posted at playgrounds that are already located under power lines.

The proposal requires all utilities planning to build new lines to get permits from the DEP, which will consider design, siting and economics when applying the ALARA standard. Sterzer gave the following example: If the line is planned near a playground, the field levels will have to be "very, very low," but if it goes through an unpopulated area, there will be more leeway.

The proposed 200 mG limit had been criticized as too weak by some citizens, who pointed to studies that link adverse health effects with levels as low as 2 mG. The new proposal will probably be addressed at the commission's next meeting on October 18.

NY Sets Interim 200 mG Standard

The New York Public Service Commission (PSC) has formally adopted an interim magnetic field limit of 200 mG at the edge of power line ROWs. The interim standard, which was proposed in March, is based on the concept of prudent avoidance (see *MWN*, M/A90). Originally, the PSC had supported the recommendations of a staff task force which advocated a 100 mG limit (see *MWN*, M/A88). The new 200 mG limit applies at 75 feet from new 345 kV lines, 60 feet from new 230 kV lines and 50 feet from lines operating at lower voltages.

EMF-Prudent Avoidance Meeting

A workshop on *Exploring the EMF Dilemma: Prudent Avoidance & Public Involvement* will be held January 17-18, 1991 at the Dunfey San Mateo Hotel in San Mateo, CA. NewsData Corp., the publisher of *Clearing Up* and *California Energy Markets*, two weekly regional utility and energy industry newsletters, is sponsoring the meeting. For more information, contact: NewsData Corp., ATTN: Conference Coordinator, Box C900928, Queen Anne Station, Seattle, WA 98109, (206) 285-4848.

HIGHLIGHTS

The Talk of Prague

"We are participants in one of the great revolutions in the history of biology," Dr. Ross Adey† of the VA Hospital in Loma Linda, CA, told an overflow crowd at the symposium on the *Interaction of Electromagnetic Fields [EMFs] with Biological Systems*, organized as part of the triennial URSI meeting.* A week of meetings in Prague, Czechoslovakia, during the last week of August indicate that the revolution is thriving in Europe—perhaps more so than in the U.S.

After reviewing the literature linking EMFs to cancer, Poland's Dr. Stanislaw Szmigielski concluded, "My personal opinion is that the cancer risk is significant—but it will take two-to-three years to resolve." Szmigielski is at the Center for Radiobiology and Radiation Safety in Warsaw.

In an interview with *Microwave News*, Szmigielski said that the data collection has been completed for his prospective epidemiological study of Polish servicemen exposed to radiofrequency and microwave (RF/MW) radiation and that the analysis is now under way (see *MWN*, J/F87 and J/A89). Because of the potential military implications of the study, Szmigielski indicated that he is not yet sure how the findings will be announced. "We will need permission to publish the results," he said. "But if it is denied, we will present them at conferences."

In other news, Szmigielski is planning new experiments on the immunological and carcinogenic effects of RF/MW radiation using a new exposure system, designed and built by Dr. Piotr Debicki of the Department of Electronics and Microwave Techniques at the University Technical School in Gdansk, Poland. The system will allow thermal and subthermal exposures at 2450 MHz with sinusoidal modulation.

On the regulatory front, Szmigielski anticipates a major re-evaluation of Polish safety standards for exposures from 50 Hz to 300 GHz. He predicted that, if the effort is funded, work will begin in 1991 directed by Dr. Henrik-Richard Korniewicz, a physicist at the Central Institute of Labor Protection in Warsaw.

Finland's Dr. Jukka Juutilainen, of Kuopio University's Department of Environmental Sciences, reported that, as residential magnetic fields rise above 1.3 mG, women are more likely to suffer early pregnancy loss, as measured by changes in human chorionic gonadotropin (HCG) in their urine—the technique is very sensitive and can indicate clinically unrecognized miscarriages. Women exposed to more than 6.3 mG at home had a rate of early pregnancy loss five times greater than that of those living in homes with low magnetic fields. The trend of increasing risk with higher exposures was statistically significant.

More than half the women who participated in the study lived in apartment buildings and very few used electric heat, Juutilainen said in an interview. He said that it was not at all clear what the sources of the magnetic fields were but he speculated that household wiring may be partially responsible.

Juutilainen cautioned that his study was limited by the small number of cases, but added that, "Together with the experimental findings suggesting effects of extremely low frequency (ELF) magnetic fields on embryonic development, the new results encourage continued investigation of the relationship between ELF magnetic fields and pregnancy." (Juutilainen has also recently published an epidemiological study linking on-the-job exposures to cancer; see p.3.)

Germany's Dr. Ute Boikat, a scientific advisor at the Hamburg Department of Labor, Health and Social Affairs, reported that there is growing concern at the local and national levels over power line EMFs. As a result, last year, Hamburg authorities advised that power lines not be built near homes and that there be a 15-meter right-of-way (ROW) on each side of 110 kV lines.

Also in 1989, the Federal Office of Radiation Protection in Salzgitter recommended an even larger ROW—60 meters on each side of 110 and 380 kV lines. Boikat stressed that this was not a regulation per se, but rather an exercise in "prudent avoidance." She noted that the 60-meter ROW is controversial and that utilities are challenging its scientific basis. "My opinion is that the power companies are concerned over liability for future damages," she said.

Boikat also said that there is continuing German interest in studying the possible pregnancy risks associated with working with video display terminals (VDTs), but that research has been frustrated by the inability to secure funding.

In a poster presentation, Drs. Yuri Dumansky and Mikhail Shandala of the Republican Scientific Hygienic Center in Kiev, U.S.S.R., reported that the recommended exposure levels for 50 Hz electric fields are 0.5 kV/m inside homes and 1.0 kV/m in residential areas—and no one should be allowed in areas where the levels exceed 20 kV/m.

The closing session of the symposium promised details of RF/MW radiation occupational and public health standards in the U.S.S.R. and in China. Unfortunately, Drs. Boris Savin of the Institute of Industrial Hygiene and Occupational Diseases in Moscow, Li Ji-xi of Xidian University in Xi'an and Zongqun Zhao and coworkers of Beijing Medical University were unable to attend and the session was canceled.

France's Dr. Bernard Veyret, of the University of Bordeaux, reported that interest in the European Bioelectromagnetics Association continues to grow and that its first scientific meeting will be held in Brussels, Belgium, in December 1991 (see *MWN*, M/J89 and N/D89).

†Adey's invited paper appears in J. Bach Andersen, ed., *Modern Radio Science 1990*, New York, NY: Oxford University Press, which was distributed at the conference and will be marketed by Oxford in January 1991. As at past conferences, a review of recent research was released in Prague. See G. Hyde, ed., *Review of Radio Science 1987-1989*, Brussels, Belgium: International Union of Radio Science (URSI), 1990. The volume includes a well-referenced chapter on "Biological Effects of Electromagnetic Fields," edited by Dr. Maria Stuchly. It is available for $20.00 (including surface postage) from: URSI, 3 Avenue Circulaire, B-1180 Brussels, Belgium.

**XXIII General Assembly of the International Union of Radio Science* (URSI), Prague, Czechoslovakia, August 28-September 5, 1990.

Sweden Proposes Voluntary ELF Emission Limits for VDTs

On October 4, the Swedish National Board for Measurement and Testing (Statens Mät och Provstyrelse, or MPR) recommended the first guidelines to limit emissions of extremely low frequency (ELF) electromagnetic fields (EMFs) from video display terminals (VDTs). The board called for an ELF magnetic field limit of 2.5 mG at 50 cm from a VDT. The MPR also proposed an ELF electric field limit, as well as revised guidelines for very low frequency (VLF) electric and magnetic fields.

"There is not a complete consensus in Sweden on the limits," Lars-Erik Paulsson, of the Swedish National Institute of Radiation Protection (NIRP), told *Microwave News* in a telephone interview. Paulsson is the chairman of the working group that drafted the measurement and emission guidelines. He said that Swedish unions want a lower ELF limit—to be defined by the minimum level that can be measured by the new protocol.

In announcing the new guidelines, the MPR stressed that the emission limits are voluntary as the board does not have the authority to regulate occupational health risks. Similarly, the testing of VDT emissions is not mandatory. The MPR noted that the recommended limits are based on what is technically feasible to measure and on what is achievable "today or within the near future." MPR's Merih Malmqvist told *Microwave News* that the guidelines are not based on health risks because "there are no proven biological reasons" for limiting VDT EMFs, according to Swedish experts.

The MPR is issuing two different documents: a description of the test methods and a "handbook" to help people interpret the test results. The emission guidelines are in the handbook and apply to all types of displays, not only those with cathode ray tubes.

The draft documents were released on October 8, with comments due by October 31. The final guidelines will be published on December 1. The revised test methods will go into effect on January 1, 1991. Paulsson said that he does not expect many changes in the final version because the key problem, the disagreement over the magnetic field limits, "cannot be resolved."

For both ELF and VLF magnetic fields, the guidelines specify that measurements be taken in three planes: one around the middle of the terminal, one 25 cm above the center and one 25 cm below it. In all, 48 readings are now required (the previous protocol called for 82). Thus, to comply with the guidelines, the proposed magnetic field limits would have to be met around, above and below a VDT.

The limit for VLF magnetic fields is now 0.25 mG (25 nT) average root mean square (rms), rather than the previous limit of 0.5 mG (50 nT) peak. "The two limits are essentially the same," Paulsson explained, since the magnetic field emissions limits are specified by average rms rather than peak levels.

The guidelines recommend an ELF electric field limit of 25 V/m at 50 cm from the front of a terminal and a limit for VLF electric fields of 2.5 V/m at 50 cm from all sides of a VDT.

EPA To Study Maglev EMFs

The Environmental Protection Agency (EPA) will investigate the electromagnetic fields (EMFs) associated with magnetic levitation (maglev) trains for the Federal Railroad Administration.

Under an interagency agreement signed in August, EPA's Office of Radiation Programs will measure the electric and magnetic fields from the German Transrapid system, as well as other maglev technologies.

EPA is also charged with interpreting the measured EMFs in relation to potential adverse health effects and comparing them to U.S., German, Japanese and Swedish exposure standards and to standards set by national and international regulatory groups.

The test protocols now call for measuring the magnetic field (B) rather than the time rate-of-change of the magnetic field (dB/dt). The protocols for electrostatic fields remain the same.

The former Swedish guidelines and testing protocols for VDT EMFs only covered VLF fields from 1 kHz to 400 kHz (see *MWN*, S/O88 and M/J89). Now, two frequency ranges are specified: 5 Hz–2 kHz in the ELF band and 2 kHz-400 kHz in the VLF band.

Meanwhile, in the U.S., the Institute of Electrical and Electronic Engineers' (IEEE) P-1140 Working Group has established an ad hoc committee to develop a standard testing methodology for VDT ELF and VLF EMFs. In 1987, P-1140 was charged with developing testing standards solely for VDT VLF EMFs. In 1989, its authority was extended to all types of electronic equipment (see *MWN*, J/A87, M/A88 and M/J89).

At an August 21 meeting, the group concluded that the strong interest in VDT test methods and the existence of Swedish guidelines justified developing VDT test methods separately, not only for VLF EMFs, but for ELF EMFs as well. The working group does not, however, anticipate recommending emissions limits.

The ad hoc committee, which held its first meeting in Cupertino, CA, on September 20 under the chairmanship of Stan Roberts of Apple Computer, is drafting a standard, which will be discussed at its next meeting on November 8.

Ron Petersen, a cochairman of P-1140, told *Microwave News* that he thinks that the IEEE testing protocols will closely resemble Sweden's. Roberts said that, while the committee is considering adapting the Swedish protocols, it is looking at other testing methods as well.

Copies of the Swedish test methods and the handbook will be available in English on December 1. The test methods will cost approximately 800 Swedish Krona ($145.00) outside Sweden; the price of the handbook has not yet been set but will be approximately 400 Krona ($72.50). Order from: Merih Malmqvist, National Board for Measurement and Testing, Box 878, S-501 15 Borås, Sweden, (033) 16 55 53, Fax: (033) 10 13 92.

SPECIAL REPORT

Cancer Clusters and EMFs: A True Link or an Epidemiologist's Nightmare?

Paul Brodeur's account of cancer and other illnesses among people living near a Guilford, CT, substation in the July 9 *New Yorker* has sparked widespread interest in the question of disease clusters and electromagnetic fields (EMFs).

The issue of EMFs and clusters is not, in fact, new. It continues to be one of topical concern,* not only for power line EMFs, but for radiofrequency and microwave (RF/MW) radiation. Indeed, the study of clusters, which is more often associated with chemicals and nuclear radiation, is a hot topic of debate. An editorial in the September 22 *Lancet* focuses on the split in the scientific community over the desirability of studying clusters: For some, such study is a "keystone of medical progress," providing insight into new diseases; for others, it's an "epidemiologist's nightmare"—the search for an elusive, possibly nonexistent, cause under mounting pressure from an outraged community.

The following is a compilation of reported occupational and residential cancer clusters that have been linked—correctly or incorrectly—to various sources of EMFs. Both cluster reports and epidemiological surveys are included.

*Recent articles and journals covering the cluster debate include: "Guidelines for Investigating Clusters of Health Events," *Morbidity and Mortality Weekly Report*, July 27, 1990; Raymond Neutra, "Reviews and Commentary: Counterpoint from a Cluster Buster," *American Journal of Epidemiology, 132*, pp.1-8, July 1990; Chris Raymond, "Nagging Doubt, Public Opinion Offer Obstacles to Ending 'Cluster' Studies," *Journal of the American Medical Association, 261*, pp.2297-2298, April 28, 1989; Richard Rothenberg, Karen Steinberg and Stephen Thacker, "The Public Health Importance of Clusters: A Note from the Centers for Disease Control," proceedings from a *National Conference on Clustering of Health Events, American Journal of Epidemiology, Supplement, 132*, pp.S3-S5, July 1990.

ELF EMFs

Jacksonville, FL: Ovarian Tumors

Between 1974 and 1978, five girls living near a 69 kV power line in Jacksonville, FL, developed endodermal sinus tumors—an extremely rare type of ovarian cancer (see *MWN*, J/F85). The girls ranged in age from 1.5 to 18 years old. A team led by Dr. Tim Aldrich, now at the North Carolina Department of Health Services, wrote that these malignancies were "so rare that virtually no information has been compiled concerning their etiology" and that this cluster was "too remarkable to go unreported." They proposed that magnetic fields from the power line may have had "a mutagenic or a promoter effect," complementing initiation by lead or polycyclic hydrocarbons from a nearby lead smelter plant and highway. Genetics (all of the girls were black) or some combination of genetic and environmental factors may also have been contributors, suggested the team. See T.E. Aldrich, A. Glorieux and S. Castro, "Florida Cluster of Five Children with Endodermal Sinus Tumors," *Oncology, 41*, pp.233-238, 1984.

Milltown, NJ: Brain Tumors

For the past 42 years, Irene Pardun has lived in a house in Milltown, NJ, along the right-of-way of a 230 kV and a 138 kV power line. Pardun said that when she moved in, there was also a substation within 100 feet of her back door—the substation was dismantled in 1976. In 1981, Pardun was diagnosed with a nonmalignant brain tumor, which was surgically removed. Since that time, she has noticed the high incidence of cancers and tumors in her neighborhood. Pardun gave the following information to *Microwave News:* Two doors down from her home, a 14-year-old girl died of a brain tumor in 1961, and in 1989, the girl's mother was diagnosed with a brain tumor. An eight-year-old girl who had previously lived there died of cancer in 1960. Two houses down the street in the other direction, a man died of a cancer in the mid-1980s; his daughter, who currently lives next door, was recently diagnosed with cancer. In a four-family house directly across the street, a three-year-old boy died of cancer in 1957, and a woman died of a brain tumor in 1989. In addition to her brain tumor, Pardun has suffered from recurring cysts, some requiring surgery. Her daughter was diagnosed with myasthenia gravis—a progressive muscular disease—when she was 12. Magnetic field levels in Pardun's backyard on a weekend morning this March were 12-15 mG; inside the house, they were above 10 mG.

Monroe County, NY: Brain Tumors

An investigation of a cluster of childhood brain tumors by the Monroe County (NY) Health Department concluded "...beyond a reasonable doubt that a common source for these cases of childhood brain cancer does not exist." Dr. Mark Merkens, the former deputy director of the department, told *Microwave News*, "I found nothing that tied my patients together in any way." In 1986, a local pediatric oncologist reported seeing four children ages five through nine with brain tumors within an 18-month period. Among these were three girls who attended the same school. Eight cases of childhood brain tumors and three of adult brain tumors were eventually identified in the area. Rochester Gas & Electric measured EMFs in six of the children's homes and found that, in most instances, the levels were under 2 mG except near appliances. None of the homes was located near high-voltage power lines or substations, according to a parent of one of the children. See Mark J. Merkens, *Investigation of Childhood Brain Cancer Cluster Irondequoit and Webster—Census Tracts 110 and 113*, Final Report, Monroe County Health Department, Rochester, NY, May 11, 1989.

Montecito, CA: Leukemia at a School

Between 1981 and 1989, six children in Montecito, CA, were diagnosed with leukemia or lymphoma—five times the expected rate. Of these, four attended the Montecito Union Elementary School, which is located next to a 66 kV overhead power line, three lower-voltage underground lines and a substation. State health officials investigating the cluster stated in a February 1990 report that they "found nothing that would increase cancer risk in the area." A recent survey showed average field levels of 5-30 mG along the north side of the school and approximately 1 mG in most classrooms (the exception was the computer room, with an average of 4-10 mG) and a hotspot of 920 mG next to a pad-mounted transformer in the parking lot; levels of 12 mG and 17 mG were measured at 36 inches and 6 inches, respectively, from the ground above the buried lines (see *MWN*, M/A90). In March, the school board voted unanimously to limit the students' exposures to less than 2 mG by relocating playgrounds and marking off areas with EMF hotspots. There was also an unexplained childhood leukemia cluster in Montecito in the 1950s. See *Investigation of the Montecito Leukemia and Lymphoma Cluster*, Final Report, California Department of Health Services, February 1990; *Montecito Union School Magnetic Field Survey*, Draft Report, California De-

partment of Health Services, May 1990; and Melinda Burns, "Pathologist Suggests Montecito Had Cancer Cluster in 1950s," *Santa Barbara News-Press*, June 14, 1990.

Guilford, CT: Cancer on Meadow Street

A number of residents of Meadow Street in Guilford, CT, have been afflicted with tumors (four brain tumors among them), birth defects, cysts or severe headaches, according to Paul Brodeur in the July 9 *New Yorker*. Meadow Street, which has only ten houses, is the site of a high-voltage substation and power lines. At an August 20 public meeting, state Department of Health Services (DHS) officials briefly displayed a residential map of all Guilford residents who developed brain tumors between 1968 and 1988, which, they said, showed no clustering around the substation. When the map was made public, however, it did indicate an apparent clustering of cancers along the route of a power line running north from the substation (see p.2). DHS epidemiologist Dr. Sandy Geschwind told *Microwave News* that the number of cases is too small to show a true cancer excess. In 1989, George Corrigan of Northeast Utilities took measurements at 48 Meadow Street, the house directly across the street from the substation, and found background levels of 1 mG inside the house and 5 mG beside the substation. Measurements of the whole street were taken in July 1990 revealing field levels of 3-36 mG in front of the houses (the high reading was found next to a riser on a pole) and 7-16 mG in front of the substation, Corrigan told *Microwave News*. See Paul Brodeur, "Annals of Radiation: Calamity on Meadow Street," *The New Yorker*, pp.38-72, July 9, 1990, and Jonathan Brinkman, "Map Raises Doubts of Power Line Safety," *New Haven Register* (CT), pp.15,21, October 3, 1990.

Darrington, WA: Neighbor's Cluster Concern

In a Darrington, WA, neighborhood there have been at least 12 cases of cancer in 19 homes located near two 230 kV power lines, according to Betsy Diedrick, a local resident—in the four houses closest to the lines there were cases of leukemia, lymphomas and brain tumors. An investigation by Dr. Samuel Milham Jr. of the Washington state Department of Health did not reveal any systematic increase of cancer incidence in the area. "It doesn't look like there's anything suspicious," he told *Microwave News*, noting that there were various types of cancer, with no one type predominating. However, Diedrick's survey did generate enough concern among other residents to compel the Snohomish Public Utilities District to relocate a planned substation to an unpopulated area. See Bill Dietrich, "Of Current Concern," *Pacific* (magazine in the Sunday *Seattle Times and Post-Intelligencer*), April 8, 1990; the cover story features Diedrick's map of the cluster.

Vancouver, WA: Crestline School

Between 1982 and 1989, there were seven cases of cancer reported among students who attended the Crestline Elementary School in Vancouver, WA, according to Dr. Karen Steingart of the Southwest Washington Health District. Adjacent to the school's property are a 12.5 kV distribution line and a 115 kV transmission line. Steingart's investigation failed to uncover a cause for the cluster. She told *Microwave News* that measurements taken by the Clark County Public Utilities District (PUD) showed that Crestline does not have significantly elevated EMF levels compared with other schools in the area. She also noted that there were four different types of cancer among the seven children, and four of the seven had lived in the area for less than one year prior to diagnosis. Last June, the mother of a former Crestline student who died of leukemia in 1987 filed a "wrongful death" suit against the PUD, claiming that exposure to EMFs from power lines at home and at school and from a substation near her home caused her daughter's cancer. The suit has since been dropped (see p.5).

RF/MW Radiation

Griffiss AFB, NY: Childhood Leukemia

In a letter to the editor in the November 23, 1963 issue of *The Lancet*, Dr. Samuel Milham Jr. documented a cluster of acute leukemia deaths between 1948 and 1960 among children in Rome, NY. Milham, who is now with the Washington state Department of Health, was unable to identify a common factor, although he "was convinced there was a huge excess," he recently told *Microwave News*. Milham first began to consider a possible connection with RF/MW exposures after reading two studies by Drs. John Lester and Dennis Moore in the *Journal of Bioelectricity (1*, pp.59-76 and pp.77-82, 1982), which showed higher rates of cancer among, respectively, people living on hills in the path of radar signals and people living in counties with an air force base. "I said 'Aha!' when I read them," Milham continued—he recalled seeing a big strategic air command base with "huge radars...looming over" the town: "I could see the radars around the town when I was visiting people." Milham said, however, that, at this point, a link between the cluster and the radars is "pure conjecture."

Rutherford, NJ: Childhood Cancer

In early 1978, a cluster of leukemia and Hodgkin's disease was identified among children living in Rutherford, NJ—many of whom attended the Pierrepont School. Of the potential causes considered, two were RF radiation emitters: the ITT RF/MW test facility in nearby Nutley and Clifton, and the many commercial radio broadcast antennas in the area. The then National Bureau of Standards (NBS) measured the RF levels at the school in May 1979 and the Environmental Protection Agency (EPA) measured them again in July and August 1980. The cause of the cluster was never discovered. See letter of NBS's C.K.S. Miller to New Jersey Department of Environmental Protection, July 17, 1979; EPA's David Hawkins's letter to Congressman Andrew Maguire, February 6, 1980; and Jill Jonnes and Michael Hoyt, "One Stone Left Unturned in Rutherford Cancer Inquiry," *New Jersey Monthly*, pp.38-39, March 1979.

Beaver Falls, NY: RF Sealers

In 1980, the National Institute for Occupational Safety and Health (NIOSH) investigated an alleged cluster of six cases of cancer—including breast and ovarian cancers and lymphoma—among 20 female RF heat sealer operators at the Beaverite Products plant in Beaver Falls, NY (see *MWN*, N81). NIOSH's Terry Leet, the principal investigator, terminated the project, stating that, "There is no convincing evidence in the scientific literature to indicate that RF radiation causes cancer in humans and animals." A NIOSH RF survey of the plant found electric and magnetic field levels as high as 896 V/m and 1.41 A/m, respectively (see also *MWN*, J/F82). Indeed, members of the survey team reported experiencing "heating sensation in the forearms and legs," indicating that "exposed personnel are absorbing significant amounts of RF energy."

Ragerville, OH: AT&T Workers

In 1981, NIOSH could not identify a link between a cluster of five cases of cancer among seven AT&T long lines workers and one cleaning woman employed at a site in Ragerville, OH, and exposure

to MW radiation (see *MWN*, F81). The NIOSH team measured maximum levels of 0.1 mW/cm^2 at the site, but there was some uncertainty as to the actual exposures to RF/MW radiation. James Cole of the Communications Workers of America Local No.4354, who called for the investigation, maintained that the cause of the cluster was associated with the site: "I suspect there could still be a hazard, but we aren't sophisticated enough to measure it or find it."

Portland, OR: Cancer Excess

In the early 1980s, Drs. William Morton and David Phillips of the Oregon Health Sciences University in Portland reported a significant association between certain types of cancer (including leukemia and breast cancer) and RF/MW radiation. They observed the strongest link with the VHF bands—54-88 MHz and 176-216 MHz. See Morton and Phillips, *Radioemission Density and Cancer Epidemiology in the Portland Metropolitan Area*, a report to EPA, June 1983. For another Portland area cluster report, see Michael Daley et al., "Community Fear of Non-Ionizing Radiation: A Field Investigation," *IEEE Transactions on Biomedical Engineering*, 32, pp.246-248, March 1985. (See also *MWN*, J/F82 and My82.)

Lualualei, HI: Cancer and Navy Towers

Between 1979 and 1985, children living within five miles of the U.S. Navy communications complex in Lualualei on Oahu, HI, developed leukemia at four times the expected rate (see *MWN*, M/J87). The Navy measured the RF/MW levels inside the Radio Transmitter Facility (RTF) and at its border. On the basis of those measurements, the Navy concluded that, "There is *no* reason to believe" that people living outside the RTF boundary are suffering any adverse biological effects from electromagnetic radiation (Navy's emphasis). In 1982, when the measurements were taken, the RTF had one VLF antenna, one LF antenna and several HF antennas. There were also a number of MW towers. Concern over the cluster continues to this day: the issue was raised at a state hearing in June 1990.

Honolulu, HI: Excess near Broadcast Towers

In 1987, the Hawaii Department of Health reported that people living near radio and TV broadcast antennas in Honolulu had "significantly higher" cancer rates than those living in other parts of the city (see *MWN*, M/J87). In the past, towers were sited in downtown residential areas to preserve the scenic beauty of the surrounding hills, but in 1986, the Honolulu City Council adopted a zoning regulation barring new broadcast towers in residential and business districts (see *MWN*, N/D86). A 1984 radiation survey of Honolulu by EPA and the Federal Communications Commission found the highest levels of RF radiation ever measured in an urban area (see *MWN*, J/F85).

Giants Stadium, NJ: Football Players

Between 1980 and 1986, four New York Giants football players were diagnosed with cancer. The Giants play in the New Jersey Meadowlands Sports Complex in East Rutherford, where RF radiation residential exposures from 15 AM radio broadcast antennas within eight miles of the complex are among the highest in the country (see *MWN*, N/D88). An epidemiological study of stadium workers (non-players) failed to support a link to RF, though a formal report has yet to be released. See memorandum from Dr. Philip Landrigan, *Meadowlands Sports Complex Cancer Investigation: Executive Summary*, Mount Sinai School of Medicine, New York, NY, July 1989, and Eve Markowitz, "Music Not Only Thing in the Air," *The Record* (NJ), May 6, 1990.

Thurso, Scotland: Leukemia near Dounreay

A cluster of leukemia among children living on hills in the small town of Thurso on the northern coast of Scotland eludes explanation. In a 1988 report, the U.K. Committee on Medical Aspects of Radiation in the Environment (COMARE) was unable to link the cluster to radioactive emissions from the Dounreay nuclear complex, less than ten miles from Thurso. Halfway between Thurso and Dounreay is a U.S. Navy communications complex at Forss—similar to the one in Lualualei, HI (at left). Despite calls for an investigation of the possible link between the cluster and the Forss station, COMARE has not pursued this lead. A new analysis is expected soon. See COMARE, *Investigation of the Possible Increased Incidence of Leukaemia in Young People near the Dounreay Nuclear Establishment, Caithness, Scotland, 1988*, and Louis Slesin, "Thurso & McFarland: A Second Look at Two Childhood Cancer Clusters," *SCRAM* (Edinburgh, Scotland), pp.13-16, February/March 1989.

McFarland, CA: Childhood Cancer

In McFarland, CA, 13 children have developed cancer since 1975, but state health officials have been unable to determine why. Investigations into pesticides as the potential cause of the cluster have not identified anything to distinguish this agricultural community from other towns in the area (see *MWN*, J/F88). Indeed, a report released on May 10, 1990 by the state Department of Health Services concluded that the childhood cancer rates in Kern county—in which McFarland is located—and in three neighboring counties "are not statistically different than rates seen elsewhere in California or in other parts of the United States." What may set McFarland apart is a high-power Voice of America (VOA) shortwave transmitter—located in nearby Delano—with nearly two million watts in total output, which broadcasts at 9 and 11 MHz. A number of experts and McFarland residents believe that the VOA station may play a role in the etiology of the cluster; the possibility of a synergy between toxic chemicals and RF radiation is also being considered. In 1989, EPA measured RF levels in McFarland and found nothing unusual (see *MWN*, M/A89 and J/F90).

Mount Sutro, CA: Childhood Cancer

Between 1973 and 1985, children under the age of 15 in San Francisco's Noe and Eureka valleys developed cancer at twice the expected rate (*MWN*, M/A89). The search for a cause has centered on Mount Sutro tower, a radio and TV tower, and on radioactive and toxic chemical emissions from a nearby hospital. There are five VHF and four UHF TV stations and four FM radio stations transmitting from Mount Sutro tower. In December 1988, engineers from Hammett & Edison, a San Francisco consulting firm, found levels in the range of 3-10 $\mu W/cm^2$ near the base of the tower and 0.5 $\mu W/cm^2$ with a maximum of 2.6 $\mu W/cm^2$ in Noe and Eureka valleys. A recent survey by Dr. Steve Selvin at the University of California, Berkeley, indicated an unusual number of cancer cases in the area around the tower. "This is just a hint of a possible clustering, and not a very good hint," Selvin cautioned in an October 1990 interview with *Microwave News*. The state Department of Health Services will look into the cluster.

Upper Cape Cod, MA: High Cancer Rates

Elevated rates of cancer—particularly lung cancer and leukemia—have been documented among residents of five upper Cape Cod towns, according to an exploratory survey by the Massachusetts Department of Public Health (see *MWN*, M/J88). Researchers at the Boston University (BU) School of Public Health are nearing the end

of a $500,000, two-year investigation of a potential link between the high cancer incidence and such environmental factors as high- and low-frequency radiation from the nearby PAVE PAWS radar and from power lines. BU's Dr. Ann Aschengrau, one of the lead investigators, told *Microwave News* that they expect to issue their report this December.

University of Rochester, NY: NHL

There have been at least 12 cases of non-Hodgkin's lymphomas (NHLs) among employees and students who worked or still work at the University of Rochester's River Campus. Five of the cases are among people who worked at Lattimore Hall. No cause for the cluster has been identified, although some have pointed to the campus's 1,000-watt FM radio antenna located 100 feet from Lattimore Hall (see *MWN*, J/A90). Dr. James Melius of the New York Department of Health told *Microwave News* that, "It's a striking cluster," and that RF radiation is a "legitimate concern." A June 9, 1990 RF survey of Lattimore Hall and nearby buildings found no detectable levels, but the meter used in the survey—Holaday Industries' HI-3002—was not sensitive enough to detect levels in the microwatt range. For more on the cluster, see Mary Ellin Arch, "Mystery of Lattimore Hall," *Times-Union* (Rochester, NY), May 21, 1990, and "Still Puzzling over Cancer 'Cluster,' " April 10, 1990.

EMP-Leukemia Lawsuit Settled *(continued from p.1)*

along with codefendant Lovelace Biomedical and Environmental Research Institute in Albuquerque, NM, used Strom and the other Boeing EMP workers as research subjects without their knowledge or consent. The case against a third codefendant, EG&G, was dismissed.

Unlike many previous EMF settlements, the Boeing agreement is a matter of public record. Part of the settlement with Lovelace remains confidential, however.

Boeing does not admit any liability. "Neither the suit nor the settlement has anything to do with Mr. Strom's leukemia," Russ Young, a Boeing spokesman, told *Microwave News*. "We haven't seen any conclusive scientific evidence that EMP poses a health hazard, but we continue to treat it with great care." However, he added that, "We readily acknowledge that there are still questions about EMP health risks."

Indeed, the leukemia causation issue would not have been directly addressed had the case gone to trial because of the 1988 denial of Strom's workers' compensation claim that EMP radiation caused his leukemia. Although the claim was being appealed, the superior court judge ruled that the parties had to abide by the workers' compensation decision and could not introduce the issue. (Strom ultimately dropped the claim as part of the settlement.)

Medical Program

The Boeing medical program will provide up to ten years of free medical examinations for the 700 EMP workers. Participation will be voluntary, although Young said that all EMP workers exposed to 5 kV/m or more are currently required to undergo medical screening. In addition, Boeing and Lovelace will contribute over $200,000 to a medical fund to be used by an independent medical administrator to evaluate the examinations and assist workers with any EMP-related concerns.

All Boeing EMP workers, except for Strom, can still seek compensation for any illness or injury due to on-the-job EMP exposures.

Strom, a Boeing employee for the past 29 years, worked with EMP from 1983 through 1985, testing its effects on the electrical and electronic components of the MX "Peacekeeper" missile. He worked inside a shielded room containing the EMP power supply and pulsers which, he said, were fired hundreds of times a day. In 1985, at the age of 45, Strom was diagnosed with chronic myelogenous leukemia. He continues to work for Boeing in its commercial avionics division.

"I feel vindicated," Strom told *Microwave News*, but added that he feels "somewhat bittersweet" about the settlement: "It would have been good to go to court and argue the health issues." If the suit had gone to trial, some of the country's leading EMF experts would have testified (see *MWN*, J/A90). Strom acknowledged that the trial might have taken years.

With at least $100,000 of the settlement money, Strom and his wife Barbara plan to establish the Robert Carl Strom Foundation to "ensure that the public continues to learn about the terrible hazards of electromagnetic radiation." The foundation will provide information to the general public through schools, unions and other organizations, sponsor symposia on EMFs and support legislation and EMF-related litigation. An inaugural reception honoring the Stroms will be held in Seattle on November 8. It will be open to the public.

The settlement paves the way for a host of future EMF-health effects lawsuits, according to Withey. "We have amassed significant medical and scientific evidence that EMFs, from power lines near our schools and in our neighborhoods and from

Terms of the Settlement

Listed below are the major points of both the Strom and the class action settlements.

- Boeing pays Robert Strom $500,000 in cash and in an annuity for his family.
- Boeing sponsors a comprehensive medical program for the class of approximately 700 Boeing EMP workers that includes:
  1) Ten years of medical examinations—participation by workers is voluntary;
  2) A $200,000 fund from Boeing and Lovelace to cover expenses associated with the medical exams;
  3) The appointment of a medical administrator, approved by both parties, to oversee the program.
- Strom releases Boeing from all claims, including his workers' compensation claim.
- All of the other class members retain their right to seek compensation for injuries and illnesses related to occupational EMP exposures.

electrical and electronic products like electric blankets and VDTs, do cause biological effects, including leukemia, lymphomas and brain tumors." Withey predicted that, "There is going to be massive litigation." Bryant agreed, adding that, "This case is only the beginning of our efforts to protect the public from these dangers."

The Lovelace Connection

During the discovery phase of the case, the Stroms' legal team turned up a number of documents that revealed that both Boeing and Lovelace had long been aware of the potential health hazards of EMP exposures. For instance, in 1979, Dr. William Morgan, Boeing's chief of radiation health protection, circulated a memo stating that there were indications that EMP radiation disturbs "the whole chemical balance within the body" (see *MWN*, S/O88).

Lovelace researchers working on an EMP bioeffects survey were informed by Boeing in the early 1970s of three cases of leukemia and lymphomas—and instances of other blood abnormalities—among approximately 200 Boeing EMP technicians working at a Montana test site between 1968 and 1972. Yet in its February 1977 report, *Review of Occupational Safety and Health Aspects of EMP Exposure*, Lovelace concluded that "...no adverse health effects of [EMP] exposure have been determined from either the repeated physical examinations performed or the personal observations of the nearly 600 individuals covered in this review." In 1988, Dr. Samuel Milham Jr. of the Washington state Department of Health called for a national study of EMP workers after reviewing the same data (see *MWN*, N/D88).

Strom charged in court documents filed in 1990 that Lovelace's "manipulation, suppression and cover-up of the cancer incidence and potential adverse health effects of EMP exposure..." led to Boeing's relaxation of its in-house EMP exposure standard. The standard was first set at 0.4 kV/m in 1970, but rose to 1 kV/m and then to 5 kV/m over the next seven years. In 1977, the year of the Lovelace report's release, Boeing raised the standard to 50 kV/m (see *MWN*, J/A87).

Over the past two years, the case has captured the attention of the national media. On March 5, 1989, CBS-TV's *60 Minutes* broadcast a segment with Mike Wallace on the Stroms' claims (see *MWN*, N/D88 and M/J89). An update aired on September 2, 1990. Although Wallace did not make the leap from EMP to other EMF-related health risks, some have. For example, an editorial in the August 19, 1990 *Seattle Post-Intelligencer* declared that: "In addition to improving the lot of workers in Boeing plants, this case has helped focus public attention on a potential health hazard that as yet is little understood by scientists and the medical profession—the effect of exposure to electromagnetic fields on the human body. Disturbing—if as yet not definitive—findings in numerous studies suggest that much more is to be learned about [EMFs] before anyone can say with certainty that they do not harm humans."

For information on the Strom Foundation and the inaugural reception, contact: Michael Withey, Schroeter, Goldmark & Bender, 810 Third Ave., Suite 500, Seattle, WA 98104, (206) 622-8000.

Federal Agencies on EMFs *(continued from p.1)*

as 2,000 animals and cost as much as $6-10 million, according to Dr. Gary Boorman of the National Institute of Environmental Health Sciences (NIEHS).

The NTP initiative is the largest government effort to date to investigate EMF health effects. As one observer put it, "The new attitude at NIEHS is entirely appropriate. They have woken up and smelled the coffee." The NTP coordinates research for the Department of Health and Human Services (of which NIEHS is a part), the Food and Drug Administration (FDA) and the National Institute for Occupational Safety and Health (NIOSH).

The draft protocol for the cancer study calls for exposing mice and rats of both sexes to magnetic fields of 20 mG, 200 mG, 2 G or 10 G over a period of two years. Boorman is also considering exposing one group of animals to fields that are switched on and off to gauge the impact of intermittent exposures.

The first draft of the protocol had called for exposures at 2 mG, but, at a September 19 public meeting in Research Triangle Park, NC, a number of experts argued that 2 mG was too close to background levels. The discussion also convinced the NTP to double the number of animals per dose group from 50 to 100. The final protocol is still under review, because, as Boorman pointed out in a telephone interview, "No one really knows what is best." The NTP anticipates issuing a request for proposals by the end of January 1991, and the studies are expected to begin by next fall.

Boorman said that the NTP studies are being coordinated with the two ongoing major animal studies—one at the University of California at Los Angeles, sponsored by the Electric Power Research Institute (EPRI), and one at the University of Quebec, sponsored by Health and Welfare Canada, Hydro Quebec and Ontario Hydro (see *MWN*, J/A89 and M/J90). Health and Welfare Canada also has a smaller, in-house animal study under way.

NIEHS is also planning to fund studies on mechanisms of EMF interactions. Dr. Chris Schonwalder of NIEHS's Division

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of Extramural Research and Training told *Microwave News* that he plans to issue a "program announcement" by the end of this winter. But, he added, "We are ready to entertain applications now." Schonwalder said that NIEHS could fund three or four grants, each in the $120,000-150,000 range.

For more information, contact: Dr. Gary Boorman, Chief, Chemical Carcinogenicity Branch, NIEHS, PO Box 12233, Research Triangle Park, NC 27709, (919) 541-3440; Dr. Chris Schonwalder, Chief, Scientific Programs Branch at NIEHS, (919) 541-7634.

EPA's Cancer Assessment and Research Agenda

The second review draft of the Environmental Protection Agency's (EPA) *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields* is now scheduled to be released in early November (see *MWN*, M/J90). EPA's Science Advisory Board (SAB) is assembling an expert panel to review the document—a meeting is tentatively scheduled for mid-January 1991. Dr. Genevieve Matanoski of Johns Hopkins University's school of public health in Baltimore, MD, will chair the SAB panel.

On June 28, EPA gathered a panel of experts from outside the agency to review the cancer report. To date, the agency has refused to release the panel's written comments, submitted after the meeting. Dr. Robert McGaughy of EPA's Office of Health and Environmental Assessment (OHEA), the project manager for the report, told *Microwave News* that the comments will be released with the second review draft. This external review draft, which will be available to the public, will incorporate the advice of the peer review panel.

EPA is planning to release a *National Research Agenda for Human Exposures to EMFs* as a companion report to the cancer assessment. It will address exposure assessments, biological effects and control technologies for EMFs in the 0-500 kHz frequency band.

EPA's Dr. Joe Elder, who is in charge of writing the agenda, told *Microwave News* that it will not be limited to cancer but will also cover reproductive, developmental, immunological and nervous system effects. Elder stressed that the agenda will address research needs for all government agencies, not just EPA, as well as for private sector organizations, such as EPRI.

For more information, contact: Dr. Robert McGaughy, OHEA (RD-689), EPA, 401 M St., SW, Washington, DC 20460, (202) 382-5898; Kathleen Conway, Science Advisory Board (A-101F), EPA, 401 M St., SW, Washington, DC 20460, (202) 382-2552; Dr. Joe Elder, Office of Health Research (MD-51), EPA, Research Triangle Park, NC 27711, (919) 541-2542.

FDA and Electric Blankets

On the morning of November 14, staffers from the FDA's Center for Devices and Radiological Health (CDRH) will host a seminar on ELF health risks with a special emphasis on electric blankets.

The FDA's interest in electric blankets—a marked change from last year, when the agency dismissed such concerns (see *MWN*, M/J89)—was prompted by 18 members of Congress. In a June 26 letter, first addressed to the U.S. Consumer Product Safety Commission and later to the FDA, they urged immediate action to require a warning label on all electric blankets to discourage their use by children and pregnant women and a public service advertising campaign to publicize the possible hazards. The FDA has the legal authority to regulate "electronic products" such as video display terminals (VDTs) and electric blankets. The members of the House of Representatives wrote that the federal government "has a moral obligation" to warn the public.

Among those signing the letter were Rep. George Miller (D-CA) and Rep. Peter Kostmayer (D-PA), each of whom has held congressional hearings on power line EMFs (see *MWN*, N/D87 and M/A90, respectively).

The seminar will be followed by a meeting of the CDRH's Technical Electronic Product Radiation Safety Standards Committee (TEPRSSC). The safety of electric blankets is on TEPRSSC's agenda for the afternoon of November 15, according to the committee's executive secretary, Arlene Underdonk. A number of ionizing and ultraviolet radiation issues will also be discussed.

For more information, contact: Arlene Underdonk, Office of Standards and Regulations (HFZ-83), CDRH, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-3426.

NIOSH Workshop for a National Research Strategy

NIOSH will hold a scientific workshop in Cincinnati, OH, on January 30-31, 1991 "to develop a national research strategy on the health effects of electromagnetic radiation on workers." At the meeting, the available data will be reviewed, gaps in knowledge will be identified and a research agenda will be discussed. The workshop, which will cover EMFs below 1 kHz, will be open to the public, but attendance will be limited to 250.

Philip Bierbaum, the director of NIOSH's Division of Physical Science and Engineering, who is organizing the workshop, told *Microwave News* that NIOSH Director Dr. Donald Millar had called for the meeting. "Dr. Millar wants to understand what NIOSH should be doing in this area," he said. There are indications that Millar was prompted to study EMFs after a number of congressional inquiries were directed at NIOSH.

For more information, contact: Philip Bierbaum (R-2), Electromagnetic Radiation Workshop, NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226, (513) 841-4321.

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UPDATES

BIOLOGICAL EFFECTS

Now in Print... Two key papers, already much discussed in policy debates, have now been published in *Bioelectromagnetics, Vol.11*, No.2, 1990: (1) The results of the Henhouse Project on the effects of weak PMFs on developing chick embryos—they were first presented in June 1988 (see *MWN*, M/A88), and (2) The findings of Dr. Kurt Salzinger and coworkers on the altered behavior of adult rats exposed perinatally to ELF fields—this study was part of the New York State Power Lines Project; in its report, the project's scientific advisory panel called Salzinger's results "dramatic" (see *MWN*, J/A87)....The results of a 1988 study by Dr. W.Q. Sturner and colleagues which found babies who died of sudden infant death syndrome (SIDS) to have depressed melatonin levels (see *MWN*, S/O88) were published in *Forensic Science International, 45, pp. 171-180*, 1990. Sturner, the chief medical examiner for Rhode Island, along with Dr. Richard Wurtman and other researchers from the Massachusetts Institute of Technology in Cambridge, found that mean melatonin concentrations in cerebrospinal fluid were significantly lower in SIDS infants than in infants who had died of other causes. Though possible reasons for the depressed melatonin levels were not discussed, the paper comes at a time when more and more research is pointing to a connection between exposure to EMFs and altered pineal-melatonin rhythms (see *MWN*, M/J88 and J/A90). Sturner declined to comment on a possible link between SIDS and EMFs, noting that, "We don't work in that area."

EMP

Army Says No to Health Effects Study... The U.S. Army does not plan to study the health of personnel who worked at its EMP test facility in Woodbridge, VA, according to the August 31 *Potomac News*, a Prince William County, VA, newspaper. This comes despite preliminary findings by Dr. Samuel Milham Jr. of the Washington state Department of Health that Boeing employees who worked with EMP suffered leukemia and lymphomas at ten times the expected rate (see p.1 and *MWN*, N/D88). The Army has also declined to look into potential effects on residents in the surrounding area—denying requests from state and county officials—claiming that the responsibility lies with the state health department. However, one state health official said that he does not have the necessary staff for such a study. In April, the *Potomac News* featured a five-part investigative series on the Army's record on EMP safety at the Woodbridge facility (see *MWN*, M/J90). The Army shut down the Woodbridge EMP simulators in 1988—as part of a legal settlement—after 17 years of operation (see *MWN*, M/J88).

LITIGATION

Some Legal Advice..."Injuries from NIER are classic examples of the results of a love affair carried on in ignorance of the risks," writes Bruce DeBoskey in the August 1990 issue of *Trial*, the magazine of the Association of Trial Lawyers of America; he goes on to suggest that, "Creative plaintiffs' lawyers can help remedy this alarming situation by representing the victims of the electronic age." DeBoskey, of Silver & DeBoskey in Denver, CO, recently won an undisclosed sum in settling a case of RF radiation exposure. DeBoskey's two clients claimed that living next to an FM radio tower had caused one to develop non-Hodgkin's lymphoma and had exposed the other to an increased risk of cancer (see *MWN*, S/O89 and M/J90). DeBoskey believes that industry faces "serious punitive damage problems" from its long-standing knowledge of the potential hazards of NIER. Moreover, for those industries that have been "funding research designed to show the absence of harm to workers or....[that] have taken affirmative steps to prevent the institution and enforcement of exposure limits....potential liability is even greater."...An article in the *Columbia Journal of Environmental Law, 15*, No.2, pp.359-388, 1990, warns that the EMF health effects issue is here to stay. "As water and air pollution were to the 1970s, and hazardous waste and toxic chemicals to the 1980s, electromagnetic fields will be an environmental issue of the 1990s," writes law student John Weiss.

MEDICAL APPLICATIONS

MRI Safety... Drs. Emanuel Kanal and Frank Shellock, two physicians who have long been concerned with the possible risks associated with magnetic resonance imaging (MRI), together with Dr. Lalith Talagala have published a detailed review, "Safety Considerations in MR Imaging," in the September 1990 issue of *Radiology* (*176*, pp.593-606). Kanal and Talagala are at the Pittsburgh (PA) NMR Institute; Shellock is at the Cedars-Sinai Medical Center in Los Angeles, CA. Their paper includes 155 references. The last major review was by Dr. Jerome Beers in *Magnetic Resonance Imaging, 7*, pp.309-331, 1989 (see *MWN*, J/A89)....Shellock also published a review last year: "Biological Effects and Safety Aspects of Magnetic Resonance Imaging," *Magnetic Resonance Quarterly, 5*, pp.243-261, 1989. See also his recent study, with two associates at Cedars-Sinai, "Heating of the Scrotum by High-Field Strength MR Imaging," *American Journal of Roentgenology, 154*, pp.1229-1232, June 1990....The FDA's Dr. Whit Athey has also been doing research on MRI; see "A Model of the Temperature Rise in the Head Due to Magnetic Resonance Imaging Procedures," *Magnetic Resonance in Medicine, 9*, pp.174-184, 1989. During the summer, the FDA released a report it commissioned from Dr. J. Patrick Reilly on *Peripheral Nerve and Cardiac Excitation by Time-Varying Magnetic Fields: A Comparison of Thresholds* (No.MT90-100). Specifically, Reilly was asked to investigate the potential health risks from the on-and-off switching of the magnetic fields used in MRIs. Single copies are available from Athey at: Office of Science and Technology (HFZ-133), CDRH, 5600 Fishers Lane, Rockville, MD 20857, (301) 443-3840....Dr. Jeffrey Gold and coworkers at the Cornell Medical Center in New York City have published "Safety of Metallic Surgical Clips in Patients Undergoing High-Field Strength Magnetic Resonance Imaging" in *Annals of Thoracic*

Surgery, 48, pp.643-645, 1989....And a group at Baylor College of Medicine in Houston, TX, led by Dr. Naresh Prasad, has found that "immune response may be enhanced following MRI exposure." See their abstract, "Delayed Tumor Onset Following MR Imaging Exposure," presented at the *9th Annual Scientific Meeting of the Society of Magnetic Resonance in Medicine*, held in New York City, August 18-24, 1990.

Hyperthermia Consensus... In May 1989, an *International Consensus Meeting on Hyperthermia* was held in Trento, Italy, to assess the current status of hyperthermia for the treatment of cancer. The consensus statement, complete with copious references, appears in the *International Journal of Hyperthermia, 6*, pp.837-877, September/October 1990.

PEOPLE

Dr. **Howard Wachtel** has taken a one-year sabbatical from the University of Colorado in Boulder to be a visiting scientist at EPRI. Wachtel will be investigating the neurological effects of EMFs....Dr. **Dan Lyle** has joined Dr. **Mays Swicord**'s lab at the FDA's Center for Devices and Radiological Health. He will be continuing his studies on the effects of EMFs on calcium metabolism, which he was working on when he was a member of Dr. **Ross Adey**'s research group at the VA Hospital in Loma Linda, CA. Swicord told *Microwave News* that Lyle's appointment "indicates a growing emphasis on ELF issues at the center."...Dr. **Jerome Beers** has joined the Radiology Department at Columbia-Presbyterian Hospital in New York City.

VDTs

FDA To Test VDT EMFs... The FDA's Center for Devices and Radiological Health has announced that it will measure emissions of X-rays, ultrasound, VLF and ELF EMFs from television sets and VDTs at its Winchester, MA, lab—the first comprehensive government testing program since 1981 (see *MWN*, Mr81 and My81). The FDA began devising test protocols on October 1 and expects measurements to be completed within 18 months. The agency plans to evaluate more than 100 TVs and VDTs....With concern over possible health effects mounting, several magazines have attempted to do their own tests of ELF EMFs from VDTs—with conflicting results. For example, in the December 12, 1989 *PC Magazine*, Winn Rosch reported fields of more than 60 mG 24 inches in front of an NEC monitor—a much higher level than expected. Rosch next told readers of the February 1990 *MacUser* that they could expect similarly high EMFs from a Macintosh Plus. In contrast, *Macworld* reported much lower levels in its own measurements of ten Macintosh-compatible monitors as part of its July 1990 special report on VDT EMFs. *Macworld* nevertheless called these levels "worrisome." *U.S. News & World Report* published readings taken from 30 different monitors in its September 10, 1990 issue. The magazine averaged the results among three different categories: VDTs, black-and-white PCs and color PCs (the distinction between a VDT and a PC is not clear), and though the levels were similar to those reported in *Macworld*, *U.S. News* concluded that they gave a "message of comfort." *Infoworld* is reportedly planning its own tests.

U.S. Air Force Dismisses VDT EMFs...VDT radiation poses no health hazard, according to a new report from the USAF. The report concludes that, "While research continues on low level ELF effects, results of studies so far have proven no link between ELF and detrimental effects on humans....no reassignment of pregnant VDT workers is warranted," and that, "No basis exists for recommending radiation control measures for VDTs." A copy of *Ergonomics and Radiation Effects from Video Display Terminals and Workstations* (AFOEHL Report 90-043EH00542DXX) is available from: Occupational and Environmental Health Laboratory, Human Systems Division, Brooks AFB, TX 78235.

ETC...

Microwave Month... October is "International Microwave Month," according to the Campbell Microwave Institute in Camden, NJ. The institute reports that its research shows that 86% of children 6-17 years old use MW ovens and that "only" 10% of children under the age of six use them. As for their mothers, most said that their kids liked using MW ovens "a lot" and that "only 10% indicated that they were 'very concerned.'"

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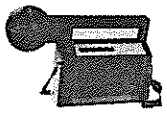
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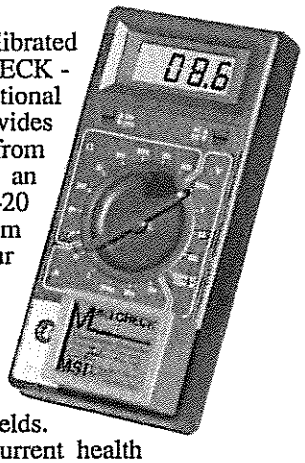
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Microwaves Cause Persistent Eye Damage Below 4 W/Kg

U.S.–U.S.S.R. Epi Study Planned

Low-level, pulsed microwave radiation can cause persistent injury to the eye. Laboratory experiments with monkeys and clinical studies of accidentally exposed workers show that the eye's cone photoreceptors can be damaged by weak radiation, according to Henry Kues of the Johns Hopkins University (JHU) Applied Physics Laboratory (APL) in Laurel, MD, and Jack Monahan of the Food and Drug Administration's (FDA) Center for Devices and Radiological Health in Rockville, MD.

"This is the first time we have primate research data that parallel human exposure data," Kues told *Microwave News*. "It is highly unlikely that the changes in cone vision are artifacts." Kues and Monahan are now setting up an epidemiological study of selected microwave-exposed military and civilian personnel in the Soviet Union to further test their findings.

This summer, Kues and Monahan, accompanied by APL's Terry Pfenning, spent three weeks in the U.S.S.R. meeting with Soviet scientists. "The negotiations look very promising," Monahan said on his return in late September. It is likely that researchers in Kiev, Odessa and St. Petersburg will work with the JHU–FDA team.

"We arrived in Leningrad but it was St. Petersburg by the time we left," Monahan said, noting that the coup and its aftermath had not hampered their

(continued on p.13)

Congress Picks DOE To Lead Federal EMF Research

The U.S. Congress has assigned the coordination of federal electromagnetic field (EMF) health research to the Department of Energy (DOE) so that "duplication of research efforts [will] be avoided."

The DOE has scheduled a meeting for October 10-11 in Washington, DC, to draft contingency plans for a comprehensive EMF research effort covering basic science, mitigation and public education, according to Dr. Imre Gyuk, who heads DOE's EMF research program.

For fiscal year 1992 (FY92), DOE's EMF budget is $5 million (see *MWN*, J/F91). As we go to press, Washington is abuzz with rumors that the DOE will soon have a substantially larger research budget.

DOE's mandate is contained in Conference Report 102-177, which accompanied the FY92 appropriations bill for energy and water development, dated July 30. The bill was signed into law by President Bush on August 17.

« Power Line Talk »

The steering committee of the National EMF Research Program (**NERP**) postponed its September 12 meeting until October 16-17 (see *MWN*, J/A91). Three new members have joined the committee: **James DuShaw** of the International Brotherhood of Electrical Workers, Dr. **Mark Cooper** of the Consumer Federation of America and Dr. **Molly Coye**, commissioner of the California Department of Health Services. With the addition of Coye, California now has two representatives on the panel—Dr. **Charles Imbrecht**, who chairs the state's Energy Commission, is already a member....The NERP staff has identified three more groups as prospective research administrators. **Health Research, Inc.**, of Albany, NY, an independent organization that ran the New York Power Lines Project, the **Public Health Foundation** of Washington, DC, which was set up by the Association of State and Territorial Health Officers of McLean, VA, and the **Southwest Research Institute** of San Antonio, TX, are scheduled to make presentations at the October meeting.

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"The future looks promising for a major breakthrough" in our understanding of EMFs and cancer, concluded Dr. **Gilles Thériault** of McGill University in Montreal, Canada, in an address to the ***8th International Symposium on Epidemiology in Occupational Health***, held in Paris, France, on September 10-12. Thériault called the spate of recent male breast cancer studies "most intriguing" and asked, "What about breast cancer in women?" In another presentation, Dr. **Tore Tynes** of the Cancer Registry of Norway in Oslo reported a statistically significant 45% increase in leukemia among electrical workers who had been on the job at least ten years. There was essentially no excess of brain tumors among these workers, however. Tynes previously found an excess of male breast cancer among EMF-exposed workers (see *MWN*, J/F91), but, in Paris, he noted that railway and tram drivers, who had the largest increase in breast cancer—a fourfold excess—are known to be shift workers, and therefore may have abnormal melatonin cycles. This could be part of the problem, he said. Tynes told *Microwave News* that he is also working on epidemiological studies of residentially and occupationally exposed Norwegians.

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University of Maryland Professor **Robert Park**'s op-ed article, "With Alarming Frequency," which appeared in the September 1 *New York Times*—and in the September 12 *Evening Sun* of Baltimore, MD, under the title "America's Hysteria Over Health Risks"—contends that it is a "scientist's obligation to try to put the [EMF] risk in proper perspective for the public." Park then writes that people concerned about EMFs should know that "from 1930 to 1980 the per capita consumption of electric power in the U.S. increased tenfold—yet the incidence of childhood leukemia...showed no change." The article prompted *The New Yorker*'s **Paul Brodeur** to challenge Park's claims in a letter to the *Times*. Brodeur cites National Cancer Institute statistics, detailed in a June 26 *Times* article, that show nearly an 11% increase in acute lymphocytic leukemia (ALL) and more than a 30% rise in brain cancer rates from 1973 to 1988 (see *MWN*, J/F91 and J/A91). ALL and brain cancer are, respectively, the first and second most common types of childhood cancer, Brodeur notes. In an angry letter to the *Evening Sun*, Baltimore attorney **Kieron Quinn** also objects to Park's piece, charging that he and other physicists who share his view are "intellectual successors to the physicists who established to their own satisfaction that the sun revolves around the earth." Quinn is a member of EMRCET—a group of lawyers working on EMF cases (see *MWN*, M/A91). Neither response was published.

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Rhode Island's **Narragansett Electric Co.** has indefinitely postponed construction of a new 44-mile, 345 kV transmission line. The decision had nothing to do with widespread concern over potential EMF health effects from the line, or with last year's **East Greenwich** town council move to block the project by placing a three-year moratorium on new lines above 60 kV, company spokesman Bud Moran told *Microwave News*. Appealing the East Greenwich action last October, Narragansett Electric argued that the new 345 kV line "is needed to provide reliable electric service," and that without it, western Rhode Island "will be at risk of significant service interruptions" (see *MWN*, N/D90). The company now contends that the line will probably not be necessary for at least another decade. Meanwhile, the fate of two 115 kV lines still slated to run through East Greenwich rests with the state Supreme Court, which is scheduled to rule on the legality of the moratorium sometime this winter. The nearby towns of Coventry and Foster followed East Greenwich's lead by passing moratoriums of their own, and a statewide ban on high voltage power lines was proposed during the 1991 legislative session (see *MWN*, J/F91 and M/J91). Governor Bruce Sundlun subsequently appointed an EMF task force to evaluate the proposed ban (see *MWN*, J/A91).

At EPRI: Sussman Replaces Sagan, Research Budget Up

Dr. Leonard Sagan has turned over the management of the Electric Power Research Institute's (EPRI) EMF health studies program to Dr. Stan Sussman. Sagan is now a senior medical scientist in EPRI's environment division.

"I will now be free to do things I like better, such as writing and speaking—people need information on EMFs," Sagan told *Microwave News*. "This is not a sign of a change in my involvement with EMFs," he added. "I'm still heavily involved."

EPRI's EMF budget will grow by $3 million to $10 million in 1992, Sagan said. The new budget figure includes the costs of administering the program, however.

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Consumers Union (CU) has tested **electric blankets** made by Sunbeam-Home Comfort, which claims that it has now reduced their EMFs by approximately 95%. (Sunbeam also makes electric blankets for Montgomery Ward, J.C. Penney and Sears, among others.) In the October issue of *Consumer Reports*, CU confirms that the magnetic fields have indeed been reduced—no word about the electric fields, however. Nevertheless, CU still advises that "children and pregnant women avoid sleeping with electric blankets and heating pads." CU first issued this recommendation in November 1989 (see *MWN*, N/D89 and M/J90).

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Yet another **cancer cluster** has been reported (see *MWN*, S/O90 and M/J91). In the village of Dalmally, **Scotland, U.K.**, at least eight people have died of cancer in the last five years, according to reports in the British newspapers *The Observer* (July 21) and *The Guardian* (August 9). All the victims lived on two streets in the 36-home community, which is divided by a 275 kV transmission line. In addition, there reportedly have been at least two nonfatal cases of breast cancer and three deaths from motor neuron disease. Local residents are fearful. Scottish Power, which owns the line, "insists that no link between power lines and ill health has been substantiated," *The Observer* reported.

Breast Cancer and EMFs: Recent Papers

No Consistent Link with Electric Blanket Use

Postmenopausal women who used electric blankets through the night on a regular basis for ten years had a slightly increased chance of developing breast cancer, according to a new study by Dr. John Vena and colleagues at the State University of New York (SUNY), Buffalo. The 25-36% increase was not statistically significant, however, and the researchers observed neither an increased risk from general long-term electric blanket use nor a dose–response trend with years of blanket use.

"These findings do not support the hypothesis that electric blanket use is associated with an increased risk for breast cancer," the researchers concluded, but added that, "The slightly elevated estimate of risk for the most frequent electric blanket users and the potential public health significance of electromagnetic field [EMF] exposure suggest that further inquiries be undertaken."

"Our study was prompted by Dr. Richard Stevens's theory that the high rates of female breast cancer in industrialized countries are due to light-at-night or EMFs," Vena told *Microwave News*. Stevens, of Battelle Pacific Northwest Lab in Richland, WA, was the first to suggest that breast cancer may be linked to the effects of light and EMFs on the pineal gland's production of melatonin (see *MWN*, J/F87, M/J88 and J/A90).

In an interview, Stevens said that the Vena study was not a good test of his hypothesis because the pineal gland's exposure to EMFs from electric blankets is slight. And according to Dr. Keith Florig of Resources for the Future in Washington, DC, "The field levels in the head when the current is on range from 1 to 4 mG—depending on how far the blanket is pulled up."

The exposure of different parts of the body is a "critical issue that has to be resolved," Vena acknowledged, pointing out that the pineal effect is only one of a number of potential mechanisms, including direct cancer promotion in breast tissue.

In their paper, the SUNY researchers noted that the study was limited because of its focus on postmenopausal women, who experience relatively small variations in estrogen levels. "Premenopausal women might be a better test of what is actually happening," Vena said in an interview, adding, "We plan to investigate that group." The researchers also wrote that the study had low "power" and could only detect a significant effect above a 2.1-fold risk.

The SUNY study included 382 women diagnosed with breast cancer between 1987 and 1989 and 439 controls. See John Vena et al., "Use of Electric Blankets and Risk of Postmenopausal Breast Cancer," *American Journal of Epidemiology, 134*, pp.180-185, 1991.

Demers Male Breast Cancer Study Published

Researchers at the University of Washington and at the Fred Hutchinson Cancer Research Center, both in Seattle, have published their study showing that electricians, telephone linemen and electric power workers had six times the expected rate of male breast cancer, a statistically significant finding (see *MWN*, J/A90). For radio and communications workers, the risk was almost tripled; and for workers with presumed EMF exposure, the risk increased 80%, which is of only borderline statistical significance.

"These results lend support to the theory that [EMFs] may be related to breast cancer in men. The hypothesis warrants evaluation in women," concluded Dr. Paul Demers and coworkers. Male and female breast cancer may be the same disease, they noted, but, "The implications of this study for breast cancer in women are uncertain and are dependent upon the carcinogenic mechanisms involved."

They found that the risk was highest—a statistically significant, more-than-threefold increase—among those who were first exposed before age 30 and at least 30 years prior to diagnosis. In certain occupations, the risks were twice as high. The researchers did not observe a significant trend of increasing risk with increasing length of employment.

The team studied 227 workers diagnosed between 1983 and 1987 and 300 controls. Exposures were categorized by occupation. Since Demers first reported his results in June 1990, two other research teams have published findings of an association between EMF occupational exposures and male breast cancer (see *MWN*, J/F91 and M/A91). See Paul Demers et al., "Occupational Exposure to [EMFs] and Breast Cancer in Men," *American Journal of Epidemiology, 134*, pp.340-347, 1991.

Low Breast Cancer Risk Among Blind Women

Dr. Robert Hahn of the Centers for Disease Control (CDC) in Atlanta, GA, has found that profoundly blind women had half the expected rate of breast cancer as compared to controls with at least some vision. The effect diminished substantially with increasing age.

This finding appears to support the important role of light in suppressing melatonin and increasing the risk of breast cancer. See Robert Hahn, "Profound Bilateral Blindness and the Incidence of Breast Cancer," *Epidemiology, 2*, pp.208-210, 1991.

USC EMF–Childhood Leukemia Study Due in November

The University of Southern California (USC) electromagnetic field (EMF)–childhood leukemia study, which supports the findings of the Wertheimer-Leeper and Savitz studies, will appear in the November 1, 1991 issue of the *American Journal of Epidemiology*. The EMF community has been waiting for the paper since USC's Dr. John Peters announced preliminary results last February at an Electric Power Research Institute (EPRI) workshop (see *MWN*, J/F91 and M/A91).

As originally reported, the USC team found a statistically significant 115% increased risk of childhood leukemia associated with high current wire codes, but did not observe a consistently elevated risk with 24-hour or spot magnetic field measurements. There was no cancer risk associated with measured electric fields.

The paper provides more details on the team's findings of statistically significant associations between leukemia and the use of certain household appliances: a 49% increased risk from use of black-and-white TVs (there was no link to color TVs) and a 182% increased risk associated with electric hair dryer use.

Epidemiology in Print

• A team at the University of Southern California, Los Angeles, has published a study showing that men working for more than ten years in jobs involving low frequency EMF exposures had a tenfold increased risk of developing astrocytomas, a statistically significant finding. Drs. Wendy Mack, Susan Preston-Martin and John Peters observed a significant trend of greater tumor risk with longer employment. "Our results confirm the findings of a positive association between employment in jobs involving presumed [EMF] exposure and brain tumor risk....These results indicate that [EMF] exposure may be an important factor in the etiology of astrocytoma," they conclude. Preston-Martin first reported these findings at the November 1990 Department of Energy contractors review (see *MWN*, N/D90). This study was originally part of a larger project on risk factors for brain tumors (see *MWN*, M/A90). See Wendy Mack, Susan Preston-Martin and John Peters, "Astrocytoma Risk Related to Job Exposure to [EMFs]," *Bioelectromagnetics, 12*, pp.57-66, 1991.

• Children of Scottish women who worked at electrical jobs were 50% more likely to be born prematurely and/or with a low birthweight, according to a group of French and U.K. researchers led by Dr. Silvia Sanjose of the ICRF Cancer Epidemiology Unit in Oxford. Among the electrical workers, electronics wirers had the highest risk—a 74% greater chance—of delivering premature babies and/or babies with low birthweights. The other occupational groups at risk were metal and leather workers. The group did not observe a similar risk among the children whose fathers were electrical workers. See Silvia Sanjose, Eve Roman and Valerie Beral, "Low Birthweight and Preterm Delivery, Scotland, 1981-1984: Effect of Parents' Occupation," *The Lancet, 338*, pp.428-431, August 17, 1991.

• Three recent papers by researchers at the U.K.'s National Radiological Protection Board (NRPB) survey the current EMF bioeffects literature. On epidemiological studies of general health and reproduction, Dr. J.A. Dennis and colleagues conclude that "the bulk of the evidence suggests that there are no effects at exposures below the limits advised by NRPB and [the International Radiation Protection Association]." In a second paper on cancer studies, they note that the evidence "is not sufficient to justify an excessive concern about magnetic field levels in the U.K. from domestic wiring, electrical appliances, power lines, etc., but neither, on the other hand, is there any justification for complacency." The third paper is a brief overview of studies of the bioeffects of extremely low frequency EMFs, radiofrequency and microwave radiation and static magnetic fields. Dr. R.D. Saunders and coworkers conclude that, "The possibility of a health risk cannot be ignored and should be further investigated. If there are such effects, then the evidence suggests that they are subtle and may well be masked by normal biological variation." See J.A. Dennis, C.R. Muirhead and J.R. Ennis, "Epidemiological Studies of Exposures to [EMFs]: I. General Health and Birth Outcome; II. Cancer," *Journal of Radiological Protection, 11*, pp.3-12, 13-25, 1991, and R.D. Saunders, Z.J. Sienkiewicz and C.I. Kowalczuk, "Biological Effects of [EMFs] and Radiation," *ibid*, pp.27-42, 1991.

• In a review of residential EMF studies, Dr. Sol Michaelson of the University of Rochester, NY, concludes that, "In general, the reports to date do not support a definite cause/effect relation between exposure of individuals to 60 Hz electric or magnetic fields and the relative risk of contracting leukemia or other forms of cancer." See Sol Michaelson, "Household Magnetic Fields and Childhood Leukemia: A Critical Analysis," *Pediatrics, 88*, pp.630-635, September 1991.

• In a survey of epidemiological EMF–cancer studies, Dr. Gilles Thériault of McGill University in Montreal, Canada, provides new occupational exposure data. Using an IREQ dosimeter, Thériault and coworkers found that: generating station operators had the highest mean exposures to high frequency transients (7.965 parts per million), splicers had the highest mean exposures to magnetic fields (21 mG) and linemen had the highest mean exposures to electric fields (419 V/m). Comparing EMF-exposed utility workers to non-utility workers, Thériault notes that the utility workers had 65 times greater exposure to transients, 8.1 times higher average magnetic field exposures and 7.6 times higher electric field exposures (see *MWN*, M/A89)—all were statistically significant at the $p<0.001$ level. Thériault points out that the availability of the IREQ dosimeter, developed by Hydro-Québec and marketed by Positron Industries (see *MWN*, J/F90), "opens a new field of research to test the hypothesis of a relationship between EMFs and cancer in environmental as well as in occupational settings." See Gilles Thériault, "Cancer Risks Due to Exposure to [EMFs]," *Recent Results in Cancer Research, 120*, pp.166-180, 1990.

There was a 600% increased risk from use of electric blankets, but it was not significant due to the small number of cases.

The finding of an association with wire codes but not with direct measurements "suggests two fundamentally different interpretations," according to the USC team: First, there *is* a true link between EMFs and childhood leukemia which was not observed because of measurement errors or because of the failure to measure the biologically relevant field parameters. Or second, there is *no* true association and the wire code link is spurious.

With regard to the possibility of an unknown confounder being responsible for the wire code association, the USC team noted that the missing variable would have to be "strongly associated with risk or extremely tightly correlated with wiring configuration classification to have produced the odds ratios" in this and other studies.

The team investigated 232 cases of leukemia among children age 10 and under between the years 1980 and 1987 and matched them with an equal number of controls. Further analysis of the data is under way. The researchers plan future papers.

USC's Dr. Stephanie London is the lead author of the study, "Exposure to Residential Electric and Magnetic Fields and Risk of Childhood Leukemia." It was funded by EPRI.

Congress Awards NAS-NRC $600,000 for ELF Health Review

The U.S. Congress has appropriated $600,000 for a National Academy of Sciences (NAS)-National Research Council (NRC) review of the possible health effects from exposure to extremely low frequency (ELF) electromagnetic fields (EMFs). The project is scheduled to begin in early 1992 and is expected to take more than two years to complete.

An NRC panel will initially conduct a short feasibility study to determine whether there is in fact a need for a full-scale effort, Dennis Mahlum, the project officer for NAS-NRC's Board on Radiation Effects Research, told *Microwave News*. In a telephone interview from his office in Washington, DC, Mahlum said that the project will focus on the carcinogenic, reproductive and behavioral effects of ELF EMFs, but will also include research at other frequencies, where appropriate. No panel members have yet been appointed.

The final study plan is still in preparation; when completed, it will be submitted to the Department of Energy (DOE), which will serve as the conduit for the $600,000. The final product is likely to be an ELF EMF research agenda, Mahlum said. In July, the Environmental Protection Agency (EPA) released its own research strategy document (see *MWN*, J/A91).

Congress set aside the funding for the NAS-NRC review in the appropriations bill for energy and water development for fiscal year 1992, Public Law 102-104, which President Bush signed on August 17. In addition, the joint House–Senate conference report accompanying the law designates the DOE as the lead federal agency for EMF research (see p.1).

Rep. Joseph McDade (R-PA), the top-ranking Republican on the House of Representatives' Appropriations Committee, added the NRC project to the bill. His district includes Scranton, PA, where residents fear that a transmission line may be responsible for a cluster of cancer cases (see *MWN*, J/F91 and M/J91).

In a February 21 letter to NAS President Dr. Frank Press, McDade asked the NAS-NRC to undertake "an independent evaluation" of EMFs and health. On March 8, Press responded that the NAS-NRC staff was "enthusiastic" about doing the study. "As now envisioned," Press wrote, "a committee of approximately 15 experts, representing a broad range of expertise, would perform the study." He estimated that the study would take 24-30 months at a cost of approximately $600,000.

Earlier this year, the NRC circulated a proposal among federal agencies for a study of EMFs from video display terminals (VDTs) but was unable to attract support (see *MWN*, M/A91). The NAS-NRC has an ongoing review of the potential health effects of very low frequency (VLF) radiation from the U.S. Air Force's Ground Wave Emergency Network (GWEN) (see *MWN*, M/J90 and N/D90).

There now are four federally supported reviews of EMF health effects in progress. In addition to the two NAS-NRC projects, EPA is continuing its assessment of EMF cancer risks (see p.12) and the Committee on Interagency Radiation Research and Policy Coordination (CIRRPC) is doing its own review in association with the Oak Ridge Associated Universities (see p.12). The Health Effects Institute is conducting a feasibility study, partly with EPA funding, for a possible EMF research program (see *MWN*, M/A91, M/J91, J/A91 and p.8).

On September 11, Rep. Joe Kolter (D-PA) introduced H.R. 3293, which would authorize the NAS to undertake an EMF research review. The bill was moot upon introduction.

Other Congressional Action

• Michigan Senators Donald Riegle and Carl Levin, both Democrats, have jointly introduced a bill which would allot $2 million to study stray voltage from electrical power transmission systems. The Electrical Transmission Research Act of 1991, S.1685, would require the DOE to direct the NAS to conduct an additional two-year investigation into "the sources of, the damages caused by and the possible means of preventing" stray voltage. The bill would start research on stray voltage exposure mitigation "before the biological scientific studies are completed," according to Riegle, who added that, "If we do not begin to solve these problems soon, it will be 15 years before those who live

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near power lines can sleep peacefully knowing they are not suffering any ill health effects from the lines above their heads." The legislation has been assigned to the Senate Committee on Energy and Natural Resources.

- A plan by Senator Frank Lautenberg (D-NJ) to introduce a bill that would provide $45 million over four years for power frequency EMF research, first floated in June, has been put on hold. In August, Lautenberg spokesman Steven Schlein told *Microwave News* that attempts to draft the legislation failed and that there may never be a bill. EMF legislation is not a priority item for the senator, he conceded.
- Rep. Frank Pallone's (D-NJ) legislation to provide $34 million over five years to the DOE for EMF research will not make it out of the House of Representatives' Committee on Science, Space and Technology this year. In May, the committee authorized $2.2 million for EMF research by EPA for fiscal year 1992—$1.5 million of which was to be used to support a joint public–private research initiative (see *MWN*, M/J91). As we go to press, Congress has not yet completed work on the EPA appropriations bill.

Michigan Hearing Spurs Congressman To Oppose Line

Michigan Rep. Howard Wolpe (D) has asked Consumers Power Co. (CPC) of Jackson, MI, to suspend construction of a controversial 115-mile, 345 kV transmission line, citing concerns about electromagnetic field (EMF) exposures. In an August 13 letter, Wolpe urged the utility to "announce a moratorium on this project."

Wolpe is the chairman of the House Committee on Science, Space and Technology's Subcommittee on Investigations and Oversight, which held a hearing on August 6 in Battle Creek, MI, on the power line and EMFs.

"It is clear that exposure to [EMFs] poses a potential risk of adverse health effects," Wolpe wrote to CPC Chairman William McCormick, adding that, "It is incumbent upon [CPC]...to demonstrate that it has taken all prudent actions to avoid unnecessary public exposure" to EMFs. He also wrote that the testimony presented at the hearing "raised serious questions" about the need for the line and he criticized the utility for not considering "cost-effective alternatives."

CPC's McCormick responded in a September 6 letter that the utility has taken numerous steps to ensure that EMFs from the line are not hazardous. "Despite the lack of any definitive evidence of health problems caused by [EMFs], we incorporated a design that would produce an EMF level at the boundary of the transmission line right-of-way that is *ten times* lower than the most rigorous current safety standard adopted by any state in the U.S.," he wrote, though he did not identify specific levels. He added that, should the state of Michigan or the federal government set stricter standards, CPC will comply with them. McCormick also said that continuing growth in electricity demand makes the line necessary.

In his letter to CPC, Wolpe also paraphrased Dr. Leonard Sagan of the Electric Power Research Institute (EPRI), a witness at the hearing, as "begrudgingly" agreeing that "it would be prudent to avoid potential health risks" associated with new lines if electricity demand could otherwise be met at a lower cost. Sagan responded angrily in an interview with *The Energy Daily* (August 22), a Washington, DC, newsletter, stating that, "My scientific reputation is being used to further someone's political aim." He said that he does not know the specifics of the proposed line and that Wolpe had misrepresented his comments. He told the panel that "the evidence [on EMFs and health] is inconclusive, but deserves further research."

In addition to Sagan, others testifying at the hearing included: Dr. William Farland of the Environmental Protection Agency (EPA); Dr. Abraham Liboff of Oakland University, Rochester, MI; Michael Morris of CPC; State Reps. Michael Nye and Glenn Oxender, both Republicans; and Cathy Smith of Michigan Residents Against Giant Electric (Michigan RAGE).

Liboff summarized his research on EMF effects and told the subcommittee that he believes that extremely low frequency (ELF) EMFs pose "a hazard to humans." He urged that universities be given a more substantial role in EMF research. "The future of the research on ELF effects on health will be most efficiently accomplished using traditional competitive university science settings—laboratories, graduate students and freedom from political interference," Liboff said in his prepared statement.

CPC's Michael Morris said that the utility routed the 345 kV line using "an ultraconservative approach that is head and shoulders better than all existing [EMF] standards, so that any impact will be minimal."

Cathy Smith testified that there is no need for the line. She and Alan Barak, a Lansing attorney representing Michigan RAGE, argued that CPC falsely contends that the demand for electricity will outgrow current transmission and distribution capacity. The Michigan Municipal Cooperative Group Utilities, made up of municipally owned and cooperative electric utilities, backed RAGE's argument that the line is not needed.

The 345 kV CPC line is slated to run from Battle Creek, MI, to Akron, IN (see *MWN*, M/J91).

California Legislature Approves $7 Million EMF Fund

A bill to establish an electromagnetic field (EMF) research and education fund of up to $7 million has passed both houses of the California legislature and is awaiting Governor Pete Wilson's signature.

The legislation, SB920, was sponsored by Senator Herschel Rosenthal, chairman of the Senate Energy and Public Utilities Committee. On September 12, in a 54-24 vote, the General Assembly sent the bill to the Senate floor, where it was approved 31-0 the next day.

If it becomes law, the measure will require California electric utilities to finance the EMF study fund through a onetime fee; an "urgency" provision will immediately send $4,390,000

to the state Public Utilities Commission (PUC) and the Department of Health Services (DHS) for a two-year EMF initiative; and the rest of the fund will be allocated by the legislature for follow-up research.

The California effort is intended to complement the joint public–private National EMF Research Program (see *MWN*, J/A91 and p.2), and has widespread support among utilities as well as among labor and environmental groups, Michael Shapiro, a Rosenthal aide, told *Microwave News*. "None of the major players among California utilities has voiced opposition to the bill," Jack Sahl of Southern California Edison said in a telephone interview, adding that state utilities do not want "to wait around for other entities" to implement EMF research.

At least 80% of the initial allotment is earmarked for DHS research, which would include cellular and epidemiological studies, investigations of EMF health risks among children attending schools near power lines and the development of possible mitigation techniques. A research status report would have to be submitted to the legislature by December 1, 1993.

The rest of the money would be appropriated to the PUC, which would be required to outline an interim prudent avoidance policy by June 30, 1992. The PUC would also oversee the work of a recently formed, 17-member "consensus" group made up of scientists, government officials, consumers and utility representatives. The group—which will help to identify and develop regulatory measures—will hold its first meeting October 10-11.

The bill also directs state utilities to develop employee education programs, provide EMF measurements to customers upon request and distribute written EMF health risk information at least once a year.

The legislation was prompted by "current EMF uncertainty and controversy," and allows for "the longer-term possibility that we may be faced with a serious EMF health problem," Rosenthal remarked at an American Law Firm Association EMF seminar, *Developing a Corporate Strategy*, on September 26 in Los Angeles, CA. The new effort is a follow-up to a $2 million EMF initiative, also sponsored by Rosenthal, passed in 1988 (see *MWN*, S/O88 and N/D88).

BPA Now Reports No Melatonin Effect in Sheep

Sheep living directly under a high voltage transmission line did not show depressed levels of melatonin, according to researchers from the Bonneville Power Administration (BPA), based in Portland, OR, and from Oregon State University (OSU) in Corvallis.

OSU's Dr. Fred Stormshak reported preliminary results showing a 20-25% reduction in serum melatonin at last November's annual Department of Energy (DOE) EMF meeting (see *MWN*, N/D90). Stormshak will present the updated results at this year's DOE review, to be held November 3-7 in Milwaukee, WI.

The researchers compared a group of ten sheep penned under a 500 kV BPA transmission line with a control group of ten sheep penned away from the line. The sheep under the line were exposed to magnetic fields ranging from 15-60 mG and electric fields of 4.5-7.5 kV/m, while the control group was exposed only to background EMF levels.

Over 6,000 blood samples were taken from the sheep over a ten-month period. Initially, sheep under the line had lowered melatonin levels, but later results showed a great deal of "random variation," with no statistically significant difference between the two groups, Jack Lee, a BPA environmental health specialist, told *Microwave News*.

The study is now being repeated using groups of 15 sheep. The replication, in which larger pens will be used to insure that the sheep do not shield each other from the electric field, as they might have in the first study, will also investigate immunological effects. Some of the sheep have EMDEX meters strapped to their bodies to gauge actual EMF exposures, Lee said in a telephone interview.

Melatonin is a hormone secreted by the pineal gland which regulates biological cycles and inhibits cancer. Other studies have shown lowered melatonin levels in animals exposed to EMFs (see *MWN*, M/J88 and J/A90).

Litigation Update

• On July 15, a jury in the Superior Court of Fulton County, GA, ordered Georgia Power Co. to pay Jimmy and Marilyn Barrett $22,000 for one-third of an acre of property condemned for a transmission line right-of-way (ROW). The Barretts, of Buford, GA, had challenged Georgia Power's initial $4,800 property valuation in a condemnation proceeding, arguing that the utility should compensate them for land beyond the ROW where increased EMF levels are detectable. They also asked for compensation for the loss of use of the property and for loss of privacy. The Barretts sought $207,000. A court-appointed Special Master awarded them $13,821—which included $5,013 for EMF-related "consequential damages"—but the Barretts appealed that ruling, leading to the jury trial. According to the Barretts' attorney, John Blandford of Blandford & Werbin in Chamblee, GA, the Barretts feared EMFs from the line might cause them to develop cancer and claimed that the EMFs "contaminated an area as much as 200 feet" from the line. The attorney for Georgia Power, Donald Janney of Troutman, Sanders, Lockerman & Ashmore in Atlanta, GA, said that the utility had offered to settle with the Barretts for $23,000 one week before the case went to trial.

• In a case filed on July 24 against Georgia Power Co. and Oglethorpe Power Co., Larry and Nancy Jordan and their children of Douglasville, GA, charge that Nancy's non-Hodgkin's lymphoma was due to exposure to EMFs from a power line that crosses their property. They are seeking $5 million for negligence, fraud and punitive damages, among other claims. The suit, filed in the Superior Court for Douglas County, GA, alleges that the utilities failed to disclose the potential health risks of power frequency EMFs. The Jordans are being represented by Eugene Brooks of Middleton & Anderson in Savannah, GA, Bruce DeBoskey of Silver & DeBoskey in Denver, CO, and Paul Carroll of Hine, Carroll & Niedrach in Rome, GA. DeBoskey is a founding member of the Electromagnetic Radiation Case Evaluation Team (EMR-CET), a group of plaintiffs' lawyers involved in EMF litigation (see *MWN*, M/A91).

NCI Weighs an EMF Initiative

The National Cancer Institute (NCI) is considering sponsoring a well-defined project on electromagnetic field (EMF)–cancer research. A two-day NCI workshop, *Molecular Mechanisms of Potential EMF-Induced Transformation*, was held September 12-13 in Bethesda, MD, to assess the need, and justification, for such an initiative.

The EMF workshop was only the first step in a "highly competitive" decision-making process, Dr. Richard Pelroy of NCI's Radiation Effects Branch told *Microwave News*. He stressed that the process was still in its early stages; if approved by internal and external reviewers, a formal decision would be announced in about a year, he said.

"There is enormous political pressure for the NCI to become involved" in the EMF issue, according to a knowledgeable source who has been following developments at the NCI. Last May, three branches of the National Institutes of Health (NIH), led by the National Institute of Environmental Health Sciences (NIEHS), published a joint request for EMF proposals (see *MWN*, M/J91).

The NCI and NIH efforts are "complementary," NIEHS's Dr. Michael Galvin, a participant at the NCI workshop, said in a telephone interview. NIEHS is undertaking a multifaceted approach to EMF research, while NCI is interested in addressing specific questions, Galvin explained. He said that the May call for proposals had prompted a "good response."

Other participants at the workshop included: Drs. James Felton (Chair), Larry Anderson, Roswell Boutwell, Kelly Clifton, Marvin Frazier, Reba Goodman, Robert Liburdy, Martha Linet, Richard Luben, J.R. McLean, Martin Misakian and Thomas Tenforde.

HEI Scales Down Plans for EMF Research Program

The Health Effects Institute (HEI) is scaling down its plans for a public–private electromagnetic field (EMF) research program. At the second meeting of the HEI feasibility study committee on August 26-27 in Cambridge, MA, HEI President Dr. Andrew Sivak asked the committee to consider a smaller research program with a $2.5 million budget, as well as the original $20-30 million effort (see *MWN*, M/A91, M/J91 and J/A91).

HEI's funding sources are uncertain—and have become more so by the recent designation of the Department of Energy (DOE) as the lead agency for EMF research (see p.1).

HEI had requested a three-year funding commitment from the Environmental Protection Agency (EPA), but, according to Sivak, EPA will now have to consult with the DOE before it can commit any money to EMF research from its 1992 budget. "If the money isn't forthcoming, I'm not sure the institute is excited about going ahead with the project," he said.

At the August meeting, the committee members focused on the reduced research effort. Most favored a few simple in vitro experiments that could yield definitive, repeatable results. Sivak told *Microwave News* that HEI could fund about five to ten projects in a few areas of research—for example, effects on calcium ion transport, melatonin production and cell division.

Dr. Richard Setlow of Brookhaven National Lab, the chairman of the feasibility committee, indicated that it is unlikely that HEI will sponsor human studies.

Although some committee members want HEI to address public education, EPA's Dr. Doreen Hill, an invited observer, said that she was not sure that risk information is "appropriate" for HEI. Dr. David Savitz of the University of North Carolina, Chapel Hill, agreed: "I see HEI as having a unique niche: It should take advantage of [its] well-established tradition in elegant, biologically-driven lab research."

The committee heard presentations from Dr. Joseph Bowman of the National Institute for Occupational Safety and Health (NIOSH) in Cincinnati, OH, on the University of Southern California EMF–childhood leukemia study (see p.4) and from Dr. Walter Rogers of the Southwest Research Institute in San Antonio, TX, on melatonin studies of baboons exposed to fields of 30 kV/m and 1.0 G (see *MWN*, N/D90).

Sivak, Setlow and Dr. Peter Valberg of Gradient Corp.—which is coordinating the feasibility study for HEI—have drafted a research plan incorporating the committee's suggestions. Sivak said, "We're going to present several areas of research that are not completely constrained by money." The committee will meet again on October 11 to review the plan before Sivak presents it to the HEI board on October 24. If the board gives its approval, Sivak hopes to issue a request for proposals by early 1992 and to sign contracts by May or June.

HEI's Asbestos Record

At the August meeeting, Dr. Asher Sheppard of the VA Hospital in Loma Linda, CA, asked Dr. Andrew Sivak how he would answer the charges that HEI's credibility had been undermined by its work on asbestos. Sheppard, a member of the EMF feasibility committee, cited a resolution by the National Association of Attorneys General (NAAG) which expressed a "deep concern" about HEI-AR's—HEI's project on asbestos research—ability to produce unbiased results (see *MWN*, M/J91 and J/A91).

Sivak responded that HEI had earned a great deal of credibility during 11 years of administering research and that there is nothing that HEI can do to satisfy certain factions of the EMF community.

In an interview with *Microwave News*, Sheppard said that Sivak's response was "unsatisfactory—he totally skimmed over the issue. I'd be surprised if HEI got any more money until Sivak can assure a credible EMF program."

The HEI-AR final report on asbestos was released on September 25 and is available at no cost from: HEI-AR, 141 Portland St., Suite 7100, Cambridge, MA 02139, (617) 225-0866.

NEMA Review Cautious on EMF–Cancer Link

Current scientific data are "insufficient" to confirm an electromagnetic field (EMF)–cancer link, and regulating EMF exposures would be "premature," according to an analysis sponsored by the National Electrical Manufacturers Association (NEMA), a trade group based in Washington, DC.

The 125-page literature review, *Extremely Low Frequency Electromagnetic Fields and Cancer: Focus on Tumor Initiation, Promotion and Cancer*, was written by biochemist Dr. Earl F. Walborg Jr., who, together with well-known cancer researcher Dr. Thomas Slaga of the University of Texas, founded Dermigen, Inc., a Smithville, TX-based consulting firm, in 1988.

Though epidemiological studies "have produced evidence suggesting an association between residential [EMF] exposure" and childhood cancer, Walborg argues that the data do not confirm a causal link and stresses the need to determine critical parameters of exposure. Most animal studies have not demonstrated an EMF–cancer relationship, he writes, acknowledging that "an appropriate animal model may not have been utilized." In vitro research has "shown that power frequency [EMFs] can modulate several biological processes" that may be involved in tumor development, including DNA synthesis, RNA transcription, cell proliferation, immune response, enzymatic reactions and pineal gland function, Walborg states.

On November 12, NEMA will sponsor a workshop titled *EMF: Science, Regulation and Law* as part of its annual meeting. NEMA also has published a short brochure, *Biological Effects of Electric and Magnetic Fields*, which presents nontechnical answers to EMF health effects questions. Earlier this year NEMA endorsed the National Electromagnetic Research Program (NERP), a joint public–private research project (see *MWN*, J/A91). The report and the brochure are available at no cost from: NEMA Public Affairs, 2101 L St., NW, Washington, DC 20037, (202) 457-8455.

FROM THE FIELD

Seattle's Concerns Over ANSI 1991 RF/MW Safety Standard

Excerpted below is a letter from Sue Donaldson, a member of the Seattle, WA, City Council to Dr. Tom Budinger of the Lawrence Berkeley Lab in Berkeley, CA, the chairman of the IEEE's Standards Coordinating Committee (SCC) 28, which is responsible for revising the 1982 American National Standards Institute's (ANSI) safety limits for occupational and public exposures to radiofrequency and microwave (RF/MW) radiation. For many years, the city of Seattle has been developing an RF/MW exposure standard (see MWN, *J/A88, J/A89 and S/O89). *In addition, King County, WA, which includes Seattle, is considering adopting its own RF/MW standard.*

In mid-September, Dr. Don Justesen, a member of SCC-28, sent a "provisional response" to Donaldson on behalf of Budinger. In a telephone interview, Budinger told Microwave News *that he and the cochairs of the subcommittee that revised the standard—Drs. Eleanor Adair of the John Pierce Foundation in New Haven, CT, and Om Gandhi of the University of Utah, Salt Lake City—will prepare a written response prior to SCC-28's next meeting on November 2.*

August 12, 1991

Dear Dr. Budinger:

The city of Seattle has been following the progress of SCC-28 in developing guidance for protecting humans from non-ionizing radiation hazards. Revision of the American National Standards Institute (ANSI) C95.1 guidance pertaining to safety levels for human exposure to radiofrequency [RF] electromagnetic fields of 3 kHz to 300 GHz is extremely important to local agencies that have responsibility for issuance of land use permits for telecommunications facilities. This is especially true in light of the absence of federally promulgated standards.

With the inclusion of safety guidance for "uncontrolled environments" as presented in the final draft of ANSI C95.1-1991, the standard is directly applicable to public exposure to non-ionizing electromagnetic radiation (NIER). For this reason, and in consideration of concerns about RF fields expressed by citizens residing in the city of Seattle, we look to you for further explanation of the content of C95.1-1991 and the rationale by which SCC-28 accepted particular guidance levels, safety factors, measures and exclusions. This is very important to us in determining what, if any, local actions are appropriate to enforce the ANSI guidance, and/or further address health concerns in Seattle.

I chair the Seattle City Council Land Use Committee and also an advisory committee concerned with telecommunications facilities in Seattle. On behalf of the Seattle Telecommunications Facilities Advisory Committee, I ask for your response to a number of questions that have come up in reviewing the ANSI C95.1-1991 final draft and the biological literature....

We have five general areas of concern:

- Selection of 4 W/Kg as the level for adverse effects on the basis of data on altered animal behavior, and use of 4 W/Kg as the platform upon which all subsequent components of the standards are set;
- Inadequate explanations of the rationales for a two-tiered standard (other than for induced currents considerations), and the particular safety factors selected;
- Dismissal of non-thermal effects as stated in the conclusion that, "Research on the effects of chronic exposure and speculations on the biological significance of non-thermal interactions have not yet resulted in *any meaningful basis* for alteration of the standard" (emphasis added);
- Lack of the justification for exclusion of portable devices operating at 7 watts and below; and
- Broad assurances provided in the recommended guidelines about avoidance of risk convey the impression that all health issues have been thoroughly and completely addressed, yet there is no acknowledgment of legitimate concerns about cancer which still need thorough investigation.

Questions pertaining to these areas of concern follow:

A. *4 W/Kg Threshold and Biological Endpoint:* What justification is there for disregarding the evidence indicating the existence of health effects below 4 W/Kg, when within the body of scientific studies available to SCC-28, there is evidence supporting the existence of deleterious effects occurring below 4 W/Kg?

The Environmental Protection Agency's (EPA) 1984 review of the literature reached the conclusion that: "...biological effects occur

at an SAR of about 1 W/Kg; some of them may be significant under certain environmental conditions." EPA's publication in the *Federal Register* (July 30, 1986) regarding federal radiation protection guidance states: ..."The evidence indicates that exposure of human beings at frequencies in the resonant region at an SAR of approximately 1 W/Kg produces significant changes in body temperature under some environmental conditions." I understand this conclusion is based in part upon the results of modeling analyses showing whole-body average SARs of 1-4 W/Kg for relatively short durations (1 hour) produce significant increases of about 1°C in human body temperature at ambient temperatures of 25-30°C (77-86°F). The EPA *Federal Register* notice advises that a 1°C rise in the core temperature of humans exposed to RF radiation should be considered hazardous to relatively healthy individuals. In addition, it seems reasonable to conclude that increases in body temperature are likely to occur at SARs lower than 1-4 W/Kg if exposures occur under more thermally stressful conditions, e.g., higher ambient temperature and/or higher relative humidity.

Why did the committee reject the scientific evidence indicating death will occur in some laboratory animals at a dose rate of 4 W/Kg? Why is behavioral disruption identified as the critical biological endpoint in the final draft guideline when it has been demonstrated that prolonged exposures at 4 W/Kg may cause death?...

The final draft of the revised C95.1 guideline indicates (pp.6-1–6-2): "The literature review was followed by extensive deliberations of a Working Group on Risk Assessment that was charged to reach agreement on an SAR at which potentially deleterious health effects *are likely* to occur in human beings" (emphasis added). What precisely does the committee mean by "are likely"? What probability factor and dose–response function are being conveyed here, i.e., are we to assume a 1% probability; or, say 50% or 90%? Is there evidence for the shape of a curve representing the probability of deleterious effects as a function of SAR and thereby evidence for the setting of such probabilities? Is there a quantitative basis for the slope of such a curve in the range near 4 W/Kg?

Use of 4 W/Kg as a threshold suggests it is entirely unlikely that any deleterious effects will occur under 4 W/Kg and conversely, at 4 W/Kg and above, chronic exposure may constitute a health hazard. Is such a sharp distinction, i.e., threshold, realistic on the basis of data for deleterious effects as a function of SAR?

B. *Rationale for the Two-Tiered Standard and Specific Safety Factors:* In the interest of reaching an understanding of the degree of conservatism present in C95.1-1991, we need more specific information related to the rationale for the two-tiered standard and the specific safety factors applied to each tier....

What exactly does the committee mean by "safety factor"? What model is being employed—a probabilistic model where the standards are based on an extrapolation process to determine a level of exposure at which there is a low probability of effect, or a threshold model for which significant effects occur only above a specific threshold value? What is the basis for the specific numerical values (10 and 50) selected by SCC-28 as safety factors?

C. *Relevancy of Non-Thermal Interactions to Modification of the Standard:* The final draft ANSI C95.1-1991 document states on p.6-4: "Research on the effects of chronic exposure and speculation on the biological significance of non-thermal interactions have not yet resulted *in any meaningful* basis for alteration of the standard" (emphasis added) and on p.6-11: "Studies such as those indicating effects, in vitro, on cell function were considered transient and reversible with no detrimental health effects."

Since 1986, a number of research articles have been published concerning thermal or low-level exposures and effects on tissues on the eye (Kues et al., 1987, 1989), effects on cholinergic activity of rat brains (Lai et al., 1987), effects suggesting microwave action on endogenous brain opiods (Lai et al., 1986a, 1986b), effects of short pulses on integrity of the blood–brain barrier (Neubauer et al., 1990), effects on fetal development (Tofani et al., 1986) and effects on the incidence of tumors in chronically exposed rats (Kunz et al., 1985). In addition, a number of in vitro areas have been investigated, including cancer-promoting changes in cultured cells (Balcer-Kubiczek and Harrison, 1986, 1989, 1991). Of the topics on animal exposures, only experimental data on the blood–brain barrier were considered by SCC-28 as a result of the time window set for the literature reviewed.

These recent research results emphasize the existence of biological effects at exposures below 4 W/Kg that may result in deleterious health effects. The recent findings together with older work demonstrating nonbehavioral effects at thermal levels of exposure further weaken the arguments that establish the standard on a behaviorally determined threshold of 4 W/Kg, and the premise that the standard is based upon a conservative view of the existing data.

In light of the work cited above, is there not a biological basis for reexamination of the basic premise that established the standard on a behaviorally determined threshold of 4 W/Kg?

Even if it were more firmly established that in vitro effects referred to in the statement from p.6-11 are indeed "transient and reversible," how can it be assumed that no future health impact may result? Given modern concepts of cell biology and the latency for onset of some diseases, this seems questionable.

D. *Exclusion Clause for Portable Devices:* The exclusion for low-power devices runs contrary to the whole philosophy of the rest of the standard. What is the detailed basis for the exclusion? Are there biological data that support the inherent assumption that if the input power of the radiating device is 7 watts or less, or 1.4 watts or less, the energy deposited in the body is harmless regardless of proximity to the body or duration of exposure? What consideration has been given to hot spots and different kinds of antennas? The recently revised language of C95.1-1991 that indicates the exclusion "...does not apply to devices with the radiating structures maintained within 2.5 cm of the body" needs clarification. What is meant by "maintained"? Also, §4.4, p.4-14 indicates the relaxation of power density limits is allowed for exposure of all parts of the body except for the eyes and testes, yet §4.2.3 and §6 make no mention of the exclusion being disallowed when applied to these parts of the body. How are we to interpret the recommended guidance when hand-held radios may be used with the antenna in close proximity to the eyes?...

E. *Possible Cancer Effects and Definitive Statements of Risk:* A number of statements in the C95.1-1991 final draft suggest an absence of health risks from NIER associated with allowable exposures, yet there has been very little experimentation related to possible elevated risks of cancer.

Would you agree that the issue of cancer and RF exposures has been given far too little attention experimentally for definitive statements about risk of either a positive or negative nature?

I want to thank the SCC-28 committee members for the long hours and intensive efforts undertaken to address this important area. Undoubtedly, the job has been a difficult one. I am not an advocate of the creation of a patchwork of local NIER standards.

I am hopeful that a better understanding of SCC-28's perspective on the above will satisfy the concerns I have presented. Your response is very important to Seattle's decision on whether to embrace the recommended guidance of ANSI C95.1-1991, and as such will be greatly appreciated.

Sincerely,
Sue Donaldson
Councilmember, Seattle City Council

CIRRPC Sharply Critical of EPA EMF–Cancer Report

The Committee on Interagency Radiation Research and Policy Coordination (CIRRPC), which is managed by the White House Office of Science and Technology Policy (OSTP), has urged the Environmental Protection Agency (EPA) to overhaul its draft report on electromagnetic fields (EMFs) and cancer.

In an August 5 letter to EPA Assistant Administrator Erich Bretthauer, CIRRPC Chairman Dr. Alvin Young wrote that the committee believes the report should be "substantially revised, if not rewritten." That conclusion echoes the recommendation of EPA's Scientific Advisory Board's (SAB) Non-Ionizing EMF Subcommittee that the document has "serious deficiencies and should be rewritten" (see *MWN*, J/A91).

Young cautioned that "the evidence presented...does not provide a scientifically sound basis for linking cancer to exposures to electric and magnetic fields." He called the document's executive summary "unnecessarily alarming" and emphasized the importance of rewriting it. "The interpretation of the data is biased towards accentuating a positive correlation," he argued.

Young's letter was accompanied by comments from seven federal departments and agencies that had been asked to review the EPA draft report (see box below). Of the seven, the National Cancer Institute (NCI) and the Department of Defense (DOD) criticized the document as sharply as CIRRPC, emphasizing many of the same points.

NCI's Dr. John Boice stated that "the conclusions presented remain scientifically unsound and unnecessarily alarming." Robert Barker, assistant secretary of defense, urged that, "This report should not be published. Alternatively, the scope of the report could be expanded to incorporate the volumes of research which document a lack of EMF effects, and its conclusions modified accordingly." Late last year, a U.S. Air Force review was similarly critical (see *MWN*, N/D90).

Dr. Imre Gyuk of the Department of Energy found the report improved over an earlier draft but said that the executive summary "suffers from a severe case of overgeneralizations, speculations and unjustifiable conclusions." Reviewers from the Center for Devices and Radiological Health and from the National Institute of Standards and Technology were generally positive in their comments.

Comments Submitted to CIRRPC on EPA EMF–Cancer Report

Seven federal departments and agencies submitted comments to CIRRPC on EPA's draft review document on EMFs and cancer. Compiled below are excerpts from some of the comments.

• **Department of Defense** (Robert Barker, assistant secretary): "...[T]he document does not support a scientific assessment that [EMFs] are possible carcinogens. The document is inconsistent and seriously deficient in not presenting a balanced and comprehensive review of the literature. In addition, it appears to gloss over or ignore studies showing negative results....The overall weight of the epidemiologic evidence is so slight as to be almost nonexistent—certainly not sufficient to justify the alarmist nature of this document....This report should not be published."

• **Department of Energy** (Dr. Imre Gyuk, program manager for electromagnetic research): "[C]larity and understanding of the important issues are still hampered due to treatment of disparate frequency ranges [ELF and RF] in the same chapters....The document would be less subject to attack if it were simply stated that studies of carcinogenesis in animals exposed to ELF have not been done....[The] Executive Summary suffers from a severe case of overgeneralizations, speculations and unjustifiable conclusions."

• **Department of Energy** (Harry Pettengill, deputy assistant secretary for health): "[The] conclusions regarding the risk of cancer in children and adults seem appropriate. While the risks are low, there does seem to be a consistent trend for certain type-specific cancers. There certainly is the need for continued health research in this area and the development of better indicators of exposure."

• **Department of Transportation** (Dr. Aviva Brecher, project manager, maglev EMF health effects): "The EPA draft report is a useful compendium, and a fairly balanced critique of research results to date. I concur with Dr. Imre Gyuk of DOE that lumping ELF fields effects with those of RF and higher (MW) frequencies [of] electromagnetic radiation is technically incorrect and unwarranted....The incomplete, uncertain and internally inconsistent current state of knowledge on EMF and cancer must be more forcefully stated...."

• **Food and Drug Administration's Center for Devices and Radiological Health** (Walter Gundaker, acting director): "This is a well-researched document which presents a reasonable and balanced examination of the evidence available to date. It prudently refrains from rejecting the large body of evidence out-of-hand because of perceived weaknesses of individual studies, yet acknowledges that the aggregate picture has many questions yet to be answered...."

• **National Cancer Institute** (Dr. John Boice, head of the radiation epidemiology branch): "All [NCI] reviewers agreed that the human epidemiologic data to date did not support the sweeping conclusions made in the EPA document. In our judgment the conclusions presented remain scientifically unsound and unnecessarily alarming....There appeared to be a tendency throughout the report to dismiss negative or inconclusive findings rather than weighing these inconsistencies in the overall interpretation....Missing throughout is a clear statement that we cannot conclude at this time whether [EMFs] pose a cancer hazard."

• **National Institute of Standards and Technology** (Paul Todd, biostatistician): "I see no serious problem with issuing the book as it stands. Experimenters who have been quoted may not feel the same way, but the report treats all of the research fairly, and, if anything, is too noncritical."

• **Occupational Safety and Health Administration** (Sheldon Weiner, director, office of standards analysis and promulgation): "[O]ur reviewer of the epidemiological sections of the report feels that EPA has implied an unsupportable degree of confidence in the positive studies relative to carcinogenesis both in children and adults. On the other hand, our reviewer of the animal and in vitro studies feels that EPA has understated the strength of the evidence supporting a carcinogenic link."

CIRRPC Begins Its Own Health Review

An independent review panel on EMF health effects under the direction of CIRRPC met for the first time on September 5-6 in Washington, DC. CIRRPC initiated the review late last year after the White House Office of Science and Technology Policy opposed release of EPA's draft review of EMFs and cancer.

The panel plans to meet monthly and to complete its work within six months. The review was scheduled to start early this year but was delayed for undisclosed reasons (see *MWN*, N/D90, J/F91 and J/A91).

Oak Ridge Associated Universities (ORAU) of Oak Ridge, TN, and Washington, DC, is coordinating the review under contract to CIRRPC. According to a statement issued by ORAU, the review panel will evaluate reported carcinogenic, reproductive and neurophysiological effects. It will consider both power frequencies (15-180 Hz) and very low frequencies (VLF) (10-30 kHz) from video display terminals (VDTs), though they will be addressed separately.

Dr. Glenn Davis, chairman of ORAU's Medical Sciences Division, is chairman of the review panel. The other ten members are: Drs. William Bennett, Yale University, New Haven, CT; Joseph Brady, Johns Hopkins University School of Medicine, Baltimore, MD; Robert Brent, Jefferson Medical College, Philadelphia, PA; Leon Gordis, Johns Hopkins University School of Medicine; William Gordon, Rice University, Houston, TX; Samuel Greenhouse, George Washington University, Washington, DC; Russel Reiter, University of Texas, San Antonio; Gary Stein, University of Massachusetts Medical Center, Worcester; Charles Susskind, University of California, Berkeley; and Dimitrios Trichopoulos, Harvard University School of Public Health, Boston, MA. (Susskind was originally named to head the panel.)

RAC Approves SAB Report on EPA Cancer Assessment

At a September 20 meeting, the Science Advisory Board's (SAB) Radiation Advisory Committee (RAC) unanimously approved the Non-Ionizing EMF Subcommittee's report on the Environmental Protection Agency (EPA) draft EMF–cancer assessment. Four of the seven RAC members were present at the Washington, DC, meeting.

The subcommittee report asks EPA to rewrite its EMF–cancer assessment, citing "serious deficiencies," and cautions that there are insufficient data to classify EMFs as carcinogenic (see *MWN*, J/F91, M/J91 and J/A91).

The SAB's Executive Committee will now review the subcommittee's report at an October 29-30 meeting. Kathleen Conway, an SAB staff member, told *Microwave News* that she expects the executive committee will also approve it. If so, the report will then be sent to EPA Administrator William Reilly.

Five More Cancer–Police Radar Claims Filed

The number of legal claims alleging that police officers developed cancer as a result of operating speed radar units has increased by five, bringing the total to eight. Three Connecticut officers with cancer have filed workers' compensation claims. And the widow of a Wisconsin state trooper who died of cancer and a California police officer who has cancer have filed lawsuits against radar manufacturers. All five of the officers used radar units manufactured by Kustom Signals, Inc., of Overland Park, KS.

In Connecticut, Thomas Malcolm, 42, of the Windsor Locks Police Department (WLPD), charges that he developed testicular cancer from operating a Kustom radar since 1977. Ricardo Rachele, 33, also of the WLPD, used a Kustom unit since 1979 and has cancer in his shoulder and collarbone. A third officer, Vincent Casertano, 56, of the Shelton Police Department, has thyroid cancer—he began operating a Kustom radar in 1971. All three are represented by attorney Stuart Rothenberg of Rothenberg, Rothenberg & Rothenberg in Manchester, CT.

William Gifford, Windsor Locks' police chief, told the Manchester, CT, *Journal Inquirer* that he will continue using the Kustom radar units but that he plans to investigate whether they can cause cancer. Gifford did not respond to a request for comment from *Microwave News*.

In Wisconsin, Naomi Sudbrink of Augusta is suing Kustom, which manufactured the radar units her late husband Arnold had used for more than three years as a Wisconsin state trooper, and five insurance companies. Arnold Sudbrink died last September from cancer that first developed in his eye. The suit was filed on September 13 in Wisconsin Circuit Court for Eau Claire County, where Arnold Sudbrink lived.

Officer Steven Cottini of the Concord (CA) Police Department and his wife, Christine, are seeking $12.5 million from Kustom and MPD, Inc., of Owensboro, KY, for Steven's testicular cancer. From 1977 to 1979, while working for the San Bruno (CA) Police Department, Cottini used the MPD units. From 1979 to 1987, he used the Kustom radar devices while at the Concord Police Department. The suit was filed September 10 in U.S. District Court for Northern California in San Francisco.

John Sweeney of Agoura Hills, CA, is the attorney for both Sudbrink and the Cottinis. Earlier this year, Sweeney sued Kustom on behalf of three plaintiffs (see *MWN*, M/A91 and J/A91).

William Ruppert, a partner in Kustom, told *Microwave News* in a telephone interview that he had no comment on the claims made against the company.

FDA Police Radar Hot Line

The Food and Drug Administration's (FDA) "Problem Reporting Hot Line" is now responding to inquiries about police radar health effects. Data collected from callers may be used to develop an epidemiological survey, according to agency officials.

The hot line, which is regularly used for problems with medical devices, is referring calls to the television, acoustics and microwaves products branch of the Office of Compliance at the agency's Center for Devices and Radiological Health. The hot line number is: (800) 638-6725.

NIOSH VDT Epi Study Revisited

Two letters published in the September 12 *New England Journal of Medicine* question the conclusions of the National Institute for Occupational Safety and Health (NIOSH) study of VDT workers and spontaneous abortions (see *MWN*, M/A91).

In one letter, Dr. Robert Newcombe and Edward Coles of the University of Wales College of Medicine, U.K., cite "considerable" differences between the study population and the controls in the mean number of pregnancies per woman, cautioning that, "The results presented could conceal a potentially serious hazard associated with the use of VDTs, if the difference in the rates of pregnancy resulted from excess early, undetected fetal loss in the exposed group."

The second letter, written by editors of *Microwave News* and *VDT News*, argues that NIOSH's conclusion—that exposure to VDT electromagnetic fields (EMFs) was not associated with an increased risk of spontaneous abortion—was not justified since both the case and the control groups were equally exposed to extremely low frequency EMFs.

In their response, NIOSH's Dr. Teresa Schnorr and colleagues said that the apparent differences in pregnancies went away when adjustments were made for the women who had worked as both directory assistance operators (the case group) and general operators (the control group) during the study period. With respect to EMFs, they pointed out that the crucial difference between cases and controls was that the VDT operators were exposed to higher very low frequency (VLF) EMFs.

Microwave Eye Damage *(continued from p.1)*

mission.

In a presentation at the June meeting of the Bioelectromagnetics Society (BEMS), Kues described how the eyes of monkeys exposed to 3.5-4 W/Kg of 1.25 GHz radiation (0.5 μsec pulses at 16 Hz) for four hours a day, three times a week for three weeks lost most of their cone function and half of their rod function. One week after exposure, the rod photoreceptors returned to approximately 80% of their pre-exposure level, but the cones remained damaged. Cone damage is manifested by a loss of color discrimination and some decrease in visual acuity, Kues explained. Impaired rods result in reduction in night vision.

Four monkeys were exposed and all suffered similar damage, leading Kues and Monahan to conclude that the threshold for the effect is below 3.5 W/Kg. Examination of the eye tissue confirmed the degeneration of cones and suggested that a specific population of cones is more vulnerable than others—different types of cones are responsible for detecting different colors.

Kues and colleagues at JHU medical school's Wilmer Institute—Kues divides his time between the APL and Wilmer—examined two workers who were accidentally exposed to 6 GHz microwaves while operating an illegal satellite uplink. The 30-watt transmitter exposed their retinas to an estimated 5 mW/cm^2 of continuous wave radiation for two 15-minute periods. Both men suffered a 50% loss in cone response as measured by changes in electroretinograms (ERGs). Seven months later, there was no improvement.

Based on these results, Kues and Monahan recommend diagnostic tests for those occupationally or accidentally exposed to microwaves, including: specular microscopy, retinal and iris fluorescein angiography and ERGs. If referred by an ophthalmologist, the Wilmer Institute will examine anyone who has been accidentally exposed to microwave levels in excess of existing safety guidelines as part of its research program, Kues said.

Researchers at JHU-APL have been investigating the effects of microwave radiation on the eye since the early 1980s. In a series of studies, a team led by Kues and Monahan has shown that low-level, pulsed radiation can injure the endothelial layer of the cornea and cause leakage in the blood–aqueous barrier. The effect occurs at a specific absorption rate (SAR) of 2.6 W/Kg or less (see *MWN*, J/A83, S/O86 and J/A87). In addition, the team found that eyes treated with glaucoma drugs are much more sensitive to microwaves—at levels as low as 0.26 W/Kg (see *MWN*, J/A88).

Both the old and the new results challenge the specifics of the current (1991) revision of the 1982 American National Standards Institute (ANSI) guidelines for human exposure to radiofrequency and microwave radiation. The SCC-28 committee rewriting the standard concluded that "whole-body SARs below 4 W/Kg were not associated with effects that demonstrably constitute a hazard for humans." The SCC-28 committee has been criticized for ignoring the previous Kues-Monahan findings (see p.9).

At the BEMS meeting, Kues was asked why the epidemiological study would be done in the U.S.S.R. instead of in the U.S. He replied that U.S. military officials had been "very reluctant" to provide any data. In an interview, Kues said that the Department of Defense is concerned about privacy issues.

A paper describing both the monkey and human results has been submitted for publication to *Archives of Ophthalmology*.

UPDATES

COMPATIBILITY & INTERFERENCE

Black Hawk Helicopter Accidents...EMI has never caused a Black Hawk helicopter accident, according to Secretary of the Army Michael Stone. In an unpublished, August 6 letter to the *New York Times*, obtained by *Microwave News* through the Freedom of Information Act, Stone contends that reports of seri-

ous EMI problems "wrongly discredit an Army helicopter that has proven itself to be a safe, highly effective piece of equipment." One such report, a November 1987 piece from Knight–Ridder Newspapers, blamed EMI for the crashes of five Black Hawk helicopters and the deaths of 22 servicemen since 1982 (see *MWN*, N/D87). A June 1988 investigation by the DOD concluded that the Black Hawk is indeed susceptible to EMI, and in a September 1988 memo to the DOD Inspector General, Stone, then under secretary of the Army, acknowledged that "EMI does raise safety of flight concerns with respect to the Black Hawk" (see *MWN*, S/O88 and N/D88). In his letter to the *Times*, Stone calls the Black Hawk "one of the safest helicopters in the Army's inventory," and points out that, "Since 1987, the accident rate has fallen by 47%." Stone does not mention that in 1987 the Army issued warnings to Black Hawk pilots to stay away from high-power radio transmitters and instituted a program to shield the helicopter from EMI.

INTERNATIONAL

Trip to China... Study Mission International (SMI), a division of W/L Associates, and the Bioelectromagnetics Society are organizing a 19-day, five-city tour of China for September 1993. Participants will meet with Chinese researchers working on the biological effects of 50 Hz EMFs, RF/MW radiation and millimeter waves, as well as their medical and agricultural applications. Dr. C.K. Chou of the City of Hope National Medical Center in Duarte, CA, who will lead the delegation, told *Microwave News* that the trip will be a "mixture of business and pleasure—we intend to explore bioelectromagnetic research and see the sights." Space is limited to 35 scientists and their spouses at a cost of less than $3,000 per person. For more information, contact: Dr. William Wisecup, W/L Associates, 120 W. Church St., Frederick, MD 21701, (301) 663-1915.

MEDICAL APPLICATIONS

RF for a Racing Heart...RF radiation can be used as an effective treatment for paroxysmal supraventricular tachycardia (PSVT)—a rapid heartbeat condition which afflicts roughly one in every 200 people in the U.S.—according to several recent studies. In the past, drug therapy or surgery was required to prevent natural electrical impulses in the heart from triggering up to 300 beats per minute. Now researchers are using RF radiation to insure that these impulses, typically occurring 60 times per minute, stimulate only one beat each. The June 6 *New England Journal of Medicine* includes two papers on this new treatment: Dr. Warren Jackman and coworkers at the University of Oklahoma Health Sciences Center in Oklahoma City report that the treatment is "highly effective," and a team headed by Dr. Hugh Calkins of the University of Michigan Medical Center in Ann Arbor asserts that the new method is "feasible and practical" and has "a favorable risk–benefit ratio." In an accompanying editorial, Dr. Jeremy Ruskin of the Massachusetts General Hospital in Boston predicts that, if the early data are confirmed, the technique will become the "treatment of choice" for PSVT patients. In a paper published in the June 29 issue of *The Lancet*, German researchers led by Dr. Karl-Heinz Kuck of the University Hospital Eppendorf in Hamburg state that the RF treatment "has none of the disadvantages of direct-current shock therapy," and that initial reports on its use are "promising." Despite these optimistic conclusions, the researchers do note some adverse reactions to the treatment. For a popular account of the new research, see the July 20 issue of *Science News*.

MRI Safety... The safety of magnetic resonance imagers (MRIs) is again being questioned. Participants at a May conference on MRI safety held in Bethesda, MD, heard several reports that the intense static magnetic fields, RF EMFs and gradient EMFs from new high-speed MRIs have occasionally produced biological responses ranging from vertigo to a metallic taste in patients' mouths at strengths as low as 1.5 T, according to the July/August issue of *The Institute*, a publication of the Institute of Electrical and Electronics Engineers. Dr. Jeffrey Weinreb of the New York University Medical Center's MRI Department stated in a presentation at the conference that, "We've been saying [that MRIs are safe] for so long, we almost believe it. We now know there are many potential safety hazards with MRI." *Science* also reported on the meeting, which was sponsored by the New York Academy of Sciences. "For the moment...the main task seems to be to find out what effect these high-tech medical wonders actually have on living tissue," it reported in its May 31 issue.

MEETINGS

T&D on EMFs... Excerpts from presentations at a conference held in February are the heart of a 16-page article, "EMF: How Dangerous?" in the June issue of *Transmission & Distribution* magazine, which sponsored the meeting (see *MWN*, M/A91). Among the speakers were: Paul Brodeur of *The New Yorker;* Arthur Bryant of Trial Lawyers for Public Justice, Washington, DC; Dr. Granger Morgan of Carnegie Mellon University, Pittsburgh, PA; U.S. Rep. Frank Pallone (D-NJ); James Sanford of PSE&G of New Jersey; and Thomas Watson of Crowell & Moring, Washington, DC. A copy of the June issue can be obtained for $5.00 from: Intertech Publications, PO Box 12901, Overland Park, KS 66212, (913) 541-6628.

PEOPLE

Dr. **Alicia Dustira** is the EMF contact in the White House Office of Science and Technology Policy (OSTP), reporting to Dr. **Allan Bromley**, the President's science advisor, who has criticized EPA's draft EMF–cancer assessment (see *MWN*, N/D90 and M/J91)....The IEEE has recognized Dr. **Eleanor Adair** of the John Pierce Foundation in New Haven, CT, and **Richard Harris** of National Public Radio for their "literary contributions furthering public understanding of the engineering profession." At a September 1 awards ceremony, the IEEE's U.S. Activities unit praised Adair for "her scholarly and balanced paper titled *Currents of Death Rectified*," a response to Paul Brodeur's book on EMFs which first appeared as a series of articles in *The New Yorker*. Harris was honored for "his balanced five-part series" on EMFs, which ran April 15-19, 1991. Harris

is continuing to follow the EMF debate; he aired an update on the EPA cancer report on September 17....Dr. **Jan Walleczek** has joined Dr. **Ross Adey**'s laboratory at the VA Hospital in Loma Linda, CA. His work is being supported by a grant from the John Fetzer Institute in Kalamazoo, MI....Dr. **Maria Stuchly**, who will soon leave Health and Welfare Canada for the University of Victoria in British Columbia, has been named chair of the International Union of Radio Science's (URSI) newly formed Commission K on Electromagnetics in Biology and Medicine. Dr. **Paola Bernardi** of the University of Rome is the vice-chair. Commission K was set up at URSI's August 1990 meeting in Prague, Czechoslovakia. Stuchly plans to have the first meeting of the more than 20 members of her committee at the *1st World Congress for Electricity and Magnetism in Biology and Medicine* in Orlando, FL, in June 1992 (see *MWN*, M/A91).

STANDARDS

NRPB Updates MRI Standards... The U.K.'s NRPB's revised standards for exposures to MRI systems, outlined by Dr. R.D. Saunders in the July 1991 *Radiological Protection Bulletin*, are generally two-tiered, with a lower limit which may be exceeded under controlled conditions and an upper limit which should not be exceeded. For *static magnetic fields*, the lower limit is 2.5 T and the maximum is 4 T. For *gradient magnetic fields*, the board specifies a maximum induced current density of 400 mA/m² (or 20 T/s) when the magnetic fields are changing for longer than 120 μsec. This limit can be relaxed for shorter exposures. For RF radiation, the board recommends lower and upper limits for whole body SARs of 1 W/Kg and 2 W/Kg, respectively, for exposures of more than 30 minutes. Progressively higher SARs can be applied for shorter exposures up to maximum limits of 2 W/Kg and 4 W/Kg, respectively, averaged over a 15-minute period. Separate limits are specified for the head, trunk and limbs. The board also advises that women should not have an MRI exam during the first three months of pregnancy. A copy of the "Board Statement on Clinical Magnetic Resonance Diagnostic Procedures," *Documents of the NRPB*, 2, No.1, is available for £5.00 from: Her Majesty's Stationery Office Publications Center, PO Box 276, London SW8 5DT, U.K., (44+071) 873-9090.

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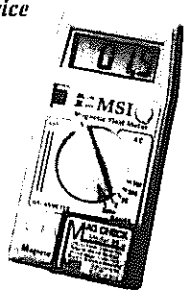
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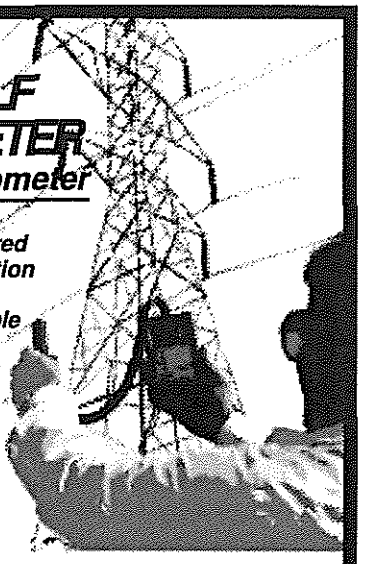
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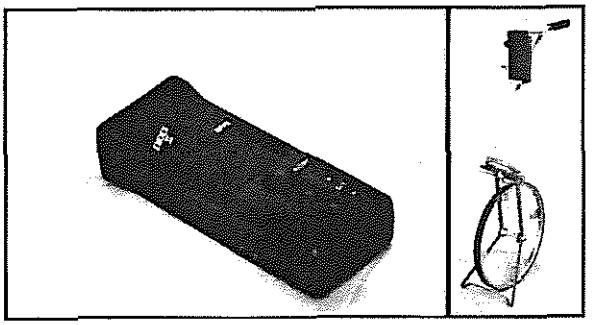


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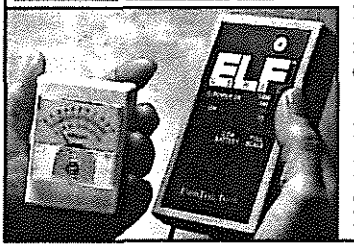
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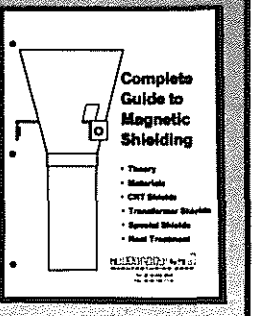
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Swedish Officials Acknowledge EMF–Cancer Connection

New Epi Studies Prompt Policy Shift

Mitigation Strategies Being Adopted

On September 30, Sweden's National Board for Industrial and Technical Development, NUTEK, formally announced that from now on it "will act on the assumption that there is a connection between exposure to power frequency magnetic fields and cancer, in particular childhood cancer."

The new policy was prompted by two major epidemiological studies, released the same day, which add support to the proposition that exposures to weak electromagnetic fields (EMFs) at home and on the job contribute to the development of cancer. This is the first time a national government has recognized the EMF–cancer link.

Jaak Nöu, the director of NUTEK's Department of Electrical Safety, told *Microwave News* that the new policy will apply primarily to children. "We don't yet consider the link proven for adults—this will have to wait for detailed investigations from around the world."

In the residential study, Dr. Anders Ahlbom and Maria Feychting of the Institute of Environmental Medicine at the Karolinska Institute in Stockholm found that children exposed to average fields of 3 mG or more in their homes

U.S. Congress Okays $65 Million EMF Research Plan, see p.2.

had close to four times the expected rate of leukemia. The link to cancer among adults was weaker than for children. "The results provide support for the hypothesis that exposure to magnetic fields increases the risk of cancer," they concluded.

The occupational study by Dr. Birgitta Floderus and coworkers at the Department of Neuromedicine at the National Institute of Occupational Health (NIOH) in Solna, a suburb of Stockholm, showed that men exposed to similar levels of magnetic fields at work had three times the expected incidence of chronic lymphocytic leukemia (CLL).

The studies, which used sophisticated exposure assessments, go a long way toward resolving some of the ambiguities that have prompted doubts about the EMF–cancer link. Most notably, they identify dose–response relationships between cancer and EMF exposure and may explain why previous childhood cancer studies failed to establish a link with measured magnetic fields.

NUTEK will soon begin work on EMF exposure regulations for new homes near power lines and for all new electrical facilities, which Nöu predicted would take about six months to complete. He said that the standard

(continued on p.12)

« Power Line Talk »

The **Health Effects Institute**'s much-delayed EMF research plan will be released by the end of the year, according to Acting President Dr. **Charles Powers**. "HEI is never going to step into a scientific area until its board and its scientific advisers have determined that they have something to contribute," Powers told *Microwave News*, adding that HEI had not promised the plan by a certain date. Dr. Andrew Sivak, who resigned last spring from his position as president of HEI, had originally predicted that the report would be completed by November 1991. After HEI's board reviewed a draft, however, an extensive rewrite was undertaken (see *MWN*, N/D91). "HEI is managing the creation of the report directly now," Powers explained, and Cambridge-based Gradient Corp., which coordinated the work under Sivak, is no longer involved. Dr. **Joe Brain** of Harvard University's School of Public Health now heads the Electric and Magnetic Fields Research Planning Committee; the former chair, Dr. **Richard Setlow** of Brookhaven National Lab, remains a member of the committee. HEI began its work on EMFs in 1991 with funding from **EPA**, which has been considering the creation of a public–private research program (see *MWN*, M/A91, J/A91 and S/O91). The assessment of possible research directions "will be useful irrespective of any additional role HEI may play," Powers said.

«« »»

A 230 kV Philadelphia Electric Co. (**PECO**) power line should not be energized until the Pennsylvania Public Utility Commission (**PUC**) sets EMF exposure standards, PUC administrative law judge **Herbert Smolen** ruled on August 19. Smolen said he made the decision in spite of the fact that "no causal connection between biological effects of EMFs and harm to human health has been scientifically proven or disproven." The PUC had originally approved the utility's plan to upgrade the line from 138 kV in 1990 (see *MWN*, M/J91). Residents and citizens groups later petitioned to have the case reviewed. The PUC has no plans to regulate exposures, according to spokesman John Frazier. On September 14, PECO filed an exception to Smolen's decision—a move that will force the full commission to review and vote on the case, Frazier said. "Smolen couldn't find any adverse health effects, and then he turned around and said the line shouldn't be energized," argued PECO spokesman Bill Jones. "Why endanger service to so many people when we are well within Florida and New York standards?" Jones further criticized Smolen's decision for being "disastrous to economic development" in the state and said that it would set "an extremely dangerous precedent." Even though the commission may decide to reverse Smolen's ruling, nearby residents have claimed a victory. "It's a terrific decision," Dorothy English of Parents Against an Unsafe Environment (**PAUSE**) told *Microwave News*. "We have no EMF exposure standards in Pennsylvania and it's great that the PUC recognizes that maybe it's time for a change." According to Jones, EMFs would measure about 40 mG at the edge of the right-of-way along the 12.8 mile line, which runs between two towns in Bucks and Montgomery Counties. Florida and New York have set right-of-way magnetic field limits for 230 kV lines at 150 mG and 200 mG, respectively (see *MWN*, M/A88, M/A89, J/F90, M/A90 and S/O90). Interestingly, the Florida standard was set after the state's Siting Board denied the Florida Power Corporation a permit to build a 500 kV line, pending the development of magnetic field exposure limits (see *MWN*, M/A86). The Pennsylvania PUC will probably meet to vote on the case at the end of the fall, Frazier said.

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A subsidiary of the **Irish Electricity Supply Board** (ESB) and Dick Roche, a member of the Irish parliament, have engaged in a stinging exchange over whether the subsidiary is fit to investigate a possible EMF–cancer link in North Dublin, since the ESB is involved in long-standing disputes over the siting of its power lines (see *MWN*, S/O87 and M/A89). "There is a well-accepted principle that one cannot be the judge in one's own case," quipped Roche in a July 10 letter to Gerry Breen, managing director of ESBI Engineering Ltd.—a subsidiary of the ESB, Ireland's Dublin-based national utility. Breen had written to Roche saying that he took "grave exception" to remarks Roche had made that appeared in the *Irish Independent*, because they implied that his company lacked "professionalism

Congress Approves $65 Million EMF Research Program

On October 8, Congress passed a far-reaching national energy bill that, among many other provisions, authorizes a $65 million electromagnetic field (EMF) research and public information program. As we went to press, the President was expected to sign the bill.

When the legislation emerged from a House–Senate conference committee, the Department of Energy (DOE) had again been put in charge of the program and been given specific responsibility for engineering research. The National Institute of Environmental Health Sciences (NIEHS) retained responsibility for all health effects research and the communications component of the program. The original version of the legislation gave the entire effort to the DOE, but it was transferred to NIEHS in the bill the House passed last May (see *MWN*, J/F92, M/A92 and M/J92).

The measure provides for $13 million in each of the next five years, of which up to $1 million is for communications. Half of the funds are to come from nonfederal sources.

A full report on the legislation will appear in our next issue.

and ethical standards." He refuted Roche's claim that it would be difficult for an ESB subsidiary to give an "objective appraisal" of its parent company. ESBI Engineering has been asked by a state medical officer to assist in measuring EMFs from power lines in North Dublin. Roche represents County Wicklow, which includes North Dublin, in parliament.

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The **California Energy Commission** (CEC) should take steps to ensure that public exposures to power line EMFs do not grow in the future, according to a report by CEC Staff Toxicologist Dr. Obed Odoemelam—but Odoemelam also recommends that no action be taken to lower EMFs from their present levels. Reducing magnetic fields "would mark a major departure from the existing electric field-based approaches to field control," the report states. Odoemelam reasons that there is not enough scientific evidence to warrant further mitigation policies. "Changes in field control should be instituted only after establishing the cancer-causing effects of magnetic field exposure with a high level of certainty," he writes. The 27-page report provides a brief overview of laboratory, cellular and epidemiological studies on the effects of EMFs and concludes that they are often unreliable or contradictory and permit only "uncertain interpretations." The report is careful to note, however, that the possibility of "significant biological effects cannot be discounted," and recommends that the CEC continue to support related research. The commission has not yet taken a position on the issue, nor has it announced plans to do so, CEC Executive Director B.B. Blevins told *Microwave News*. To order a copy of *High-Voltage Transmission Lines: Summary of Health Effects Studies*, send $2.10 and a self-addressed mailing label to: California Energy Commission, Publication Unit, 1516 Ninth St., MS-13, Sacramento, CA 95814. Refer to publication No. P700-92-002.

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Dr. **Charles Polk** of the University of Rhode Island is organizing a mini-symposium, "Where Are the Thresholds for Biological Effects of Non-Endogenous Low Frequency, Low Intensity EMFs," at the *14th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, to be held in Paris, France, on October 29-November 1. Among the scheduled speakers are Drs. **Friedemann Kaiser, Ken McLeod, Jerry Phillips** and **Bill Pickard**....And Dr. **Morando Soffritti** of the Institute of Oncology in Bologna, Italy, is planning a half-day conference, *ELF EMFs and Cancer: A Priority for Research* on November 23 in Carpi, which is near Bologna. Dr. **Anders Ahlbom**, Dr. **Gary Boorman, Paul Brodeur**, Dr. **Cesare Maltoni** and Dr. **Sam Milham** have been invited to give presentations.

NIEHS Awards IITRI $8 Million for Animal Studies

The National Institute of Environmental Health Sciences (NIEHS) has signed an $8,292,397 contract with the Chicago-based IIT Research Institute (IITRI) for a study of the possible carcinogenic and reproductive effects of 60 Hz magnetic fields on laboratory animals. The effort marks the largest set of studies ever attempted by a health agency in the U.S.

In the cancer study—which will use more than 2,000 rats and mice—animals will be exposed to continuous 20 mG, 2 G or 10 G magnetic fields, or to intermittent 10 G magnetic fields for up to two years. Researchers will use 100 animals in each exposure group, instead of the usual 50, to "give greater sensitivity in detecting marginal effects of exposure," said Dr. Gary Boorman, project officer for the study and chief of NIEHS' pathology branch.

Three generations of animals will be monitored in the reproductive study. Number of litters, number and percent of live pups per litter and mean body weight of live offspring of exposed parents will be checked. The offspring will then be bred, and their offspring will be similarly observed.

The 56-month contract, signed on August 10, will be administered by the National Toxicology Program (NTP), which coordinates research for the Department of Health and Human Services (DHHS); NIEHS is a part of the DHHS. Construction of a $2 million animal exposure system began in September, and the experiments will begin next spring, Boorman said. The National Institute of Standards and Technology (NIST) will confirm that the exposure setup is correct, Boorman said, noting that NIST's validation "will add to the credibility of the study."

For a copy of the *Statement of Work for the Conduct of Studies to Evaluate the Toxic and Carcinogenic Potential of 60 Hz Magnetic Fields in Laboratory Animals for the National Toxicology Program*, contact: Thomas Hardee, NIEHS, Contracts and Procurements Management Branch, PO Box 12874, Research Triangle Park, NC 27709, (919) 541-0429. Refer to contract No. N01-ES-25351. For more on the study, see *MWN*, S/O90.

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